

KWAME NKRUMAH UNIVERSITY OF SCIENCE AND TECHNOLOGY
COLLEGE OF ARTS AND SOCIAL SCIENCES SCHOOL
OF BUSINESS

AN EMPIRICAL INVESTIGATION INTO THE IMPACT OF REAL EXCHANGE
RATE MISALIGNMENT ON ECONOMIC PERFORMANCE:
THE CASE OF GHANA.

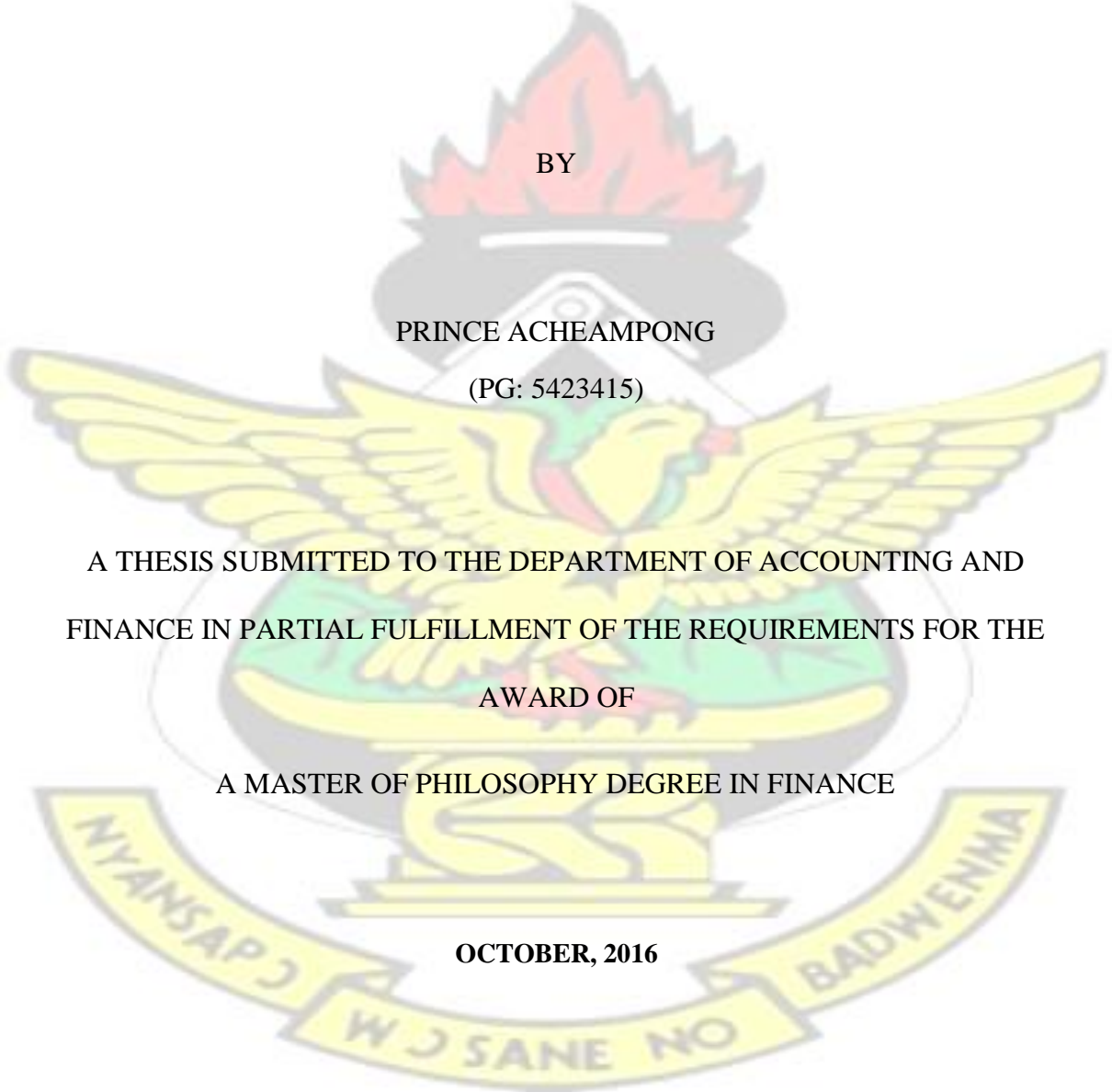
BY

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DECLARATION

I hereby declare that this submission is my work towards the Master of Philosophy Degree and that, to the best of my knowledge, it contains no material previously published by another person nor material which has been accepted for the award of any other degree of the University, except where due acknowledgement has been made in the text.

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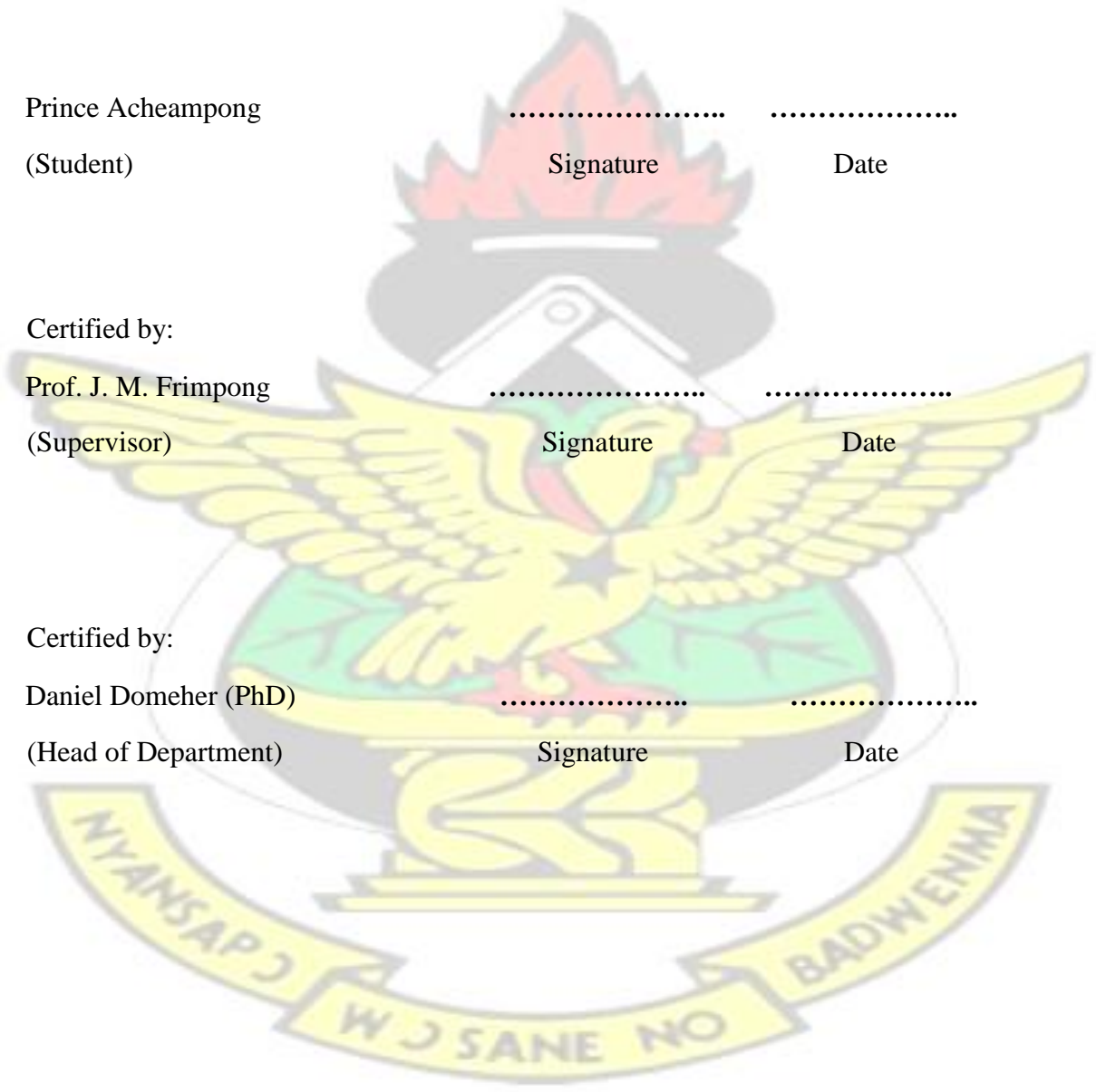
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DEDICATION

To the Almighty God I first and foremost dedicate this work for his guidance, support and protection throughout this work. Furthermore, I dedicate this thesis to my wife, Mrs. Rose Agyapong and my wonderful sons, Joseph Owoahene-Acheampong and Prince OwoaheneAcheampong Jnr. for their unwavering support and care throughout the period of this work. Finally, I dedicate this work to Lucky Edefiam Abiemo for her kindness and support throughout this work.



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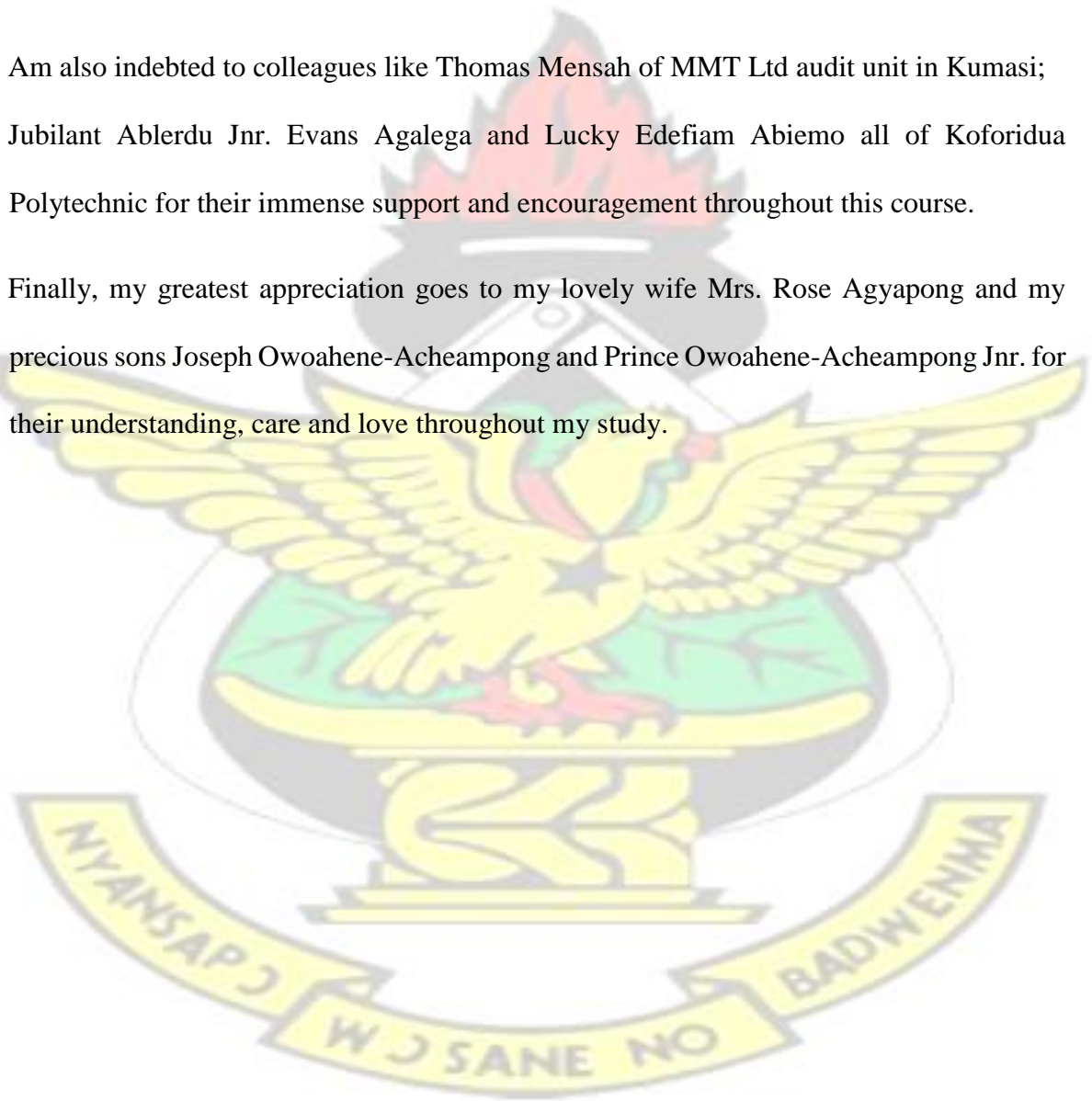


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ABSTRACT

Misalignment of the real exchange rate (RER), whereby the actual RER deviates from its equilibrium value, has important implications on a country's economic performance. This study, thus, investigates the impact of a misalignment in the real exchange rate on the economic performance in Ghana. Annual time series data covering the period from 1980 to 2013 were sourced from the World Bank development indicator CD-room and used in this study. Econometric procedures such as unit root testing, co-integration and the vector error correction models were followed. The single equation method, which is a model based approach for the estimation of the equilibrium exchange rate and hence the misalignment series was adopted for the study. The study reveals that the equilibrium exchange rate is determined by fundamental factors such as productivity, government expenditure, terms of trade, net foreign income and real relative interest rate. The study also shows a substantial misalignment of the real exchange rate over the study period. The real exchange rate was overvalued during the period from 1981 to 1983. The exchange rate was however undervalued over the remainder of the study period. Overall the study indicates a negative impact of the misalignment series on economic performance in Ghana both in the longrun and the short run. It is therefore encouraged, that government's economic policy strategies be focused on strengthening the economic fundamentals such as productivity, terms of trade, better trade policies, attracting more inflows of foreign income etc. with sustained macroeconomic stability and growth being at the center.

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GLOSARY OF ABBREVIATIONS

- ADF Augmented Dicky Fuller
- AREAER Annual Report on Exchange Arrangement and Exchange Restrictions
- ARER Actual Real Exchange Rate
- BEER Behavioral Equilibrium Exchange Rate
- BLUE Best Linear Unbiased Estimate
- BMP Black Market Premium
- BOP Balance of Payment
- CF Capital Flow
- DOLS Dynamic Ordinary Least Squares
- EMIS Exchange Rate Misalignment
- ERER Equilibrium Real Exchange Rate
- EU European Union
- FEER Fundamental Equilibrium Exchange Rate
- GC Government Consumption
- GDP Gross Domestic Product
- GMM Generalized Method of Moment
- GOE Government Consumption Expenditure
- HBS Harrod-Balassa-Samuelson
- IMF International Monetary Fund
- INV Investment
- LQ Liquidity
- ML Maximum Likelihood
- NCF Net Capital Flow

- NER Nominal Exchange Rate
- NFI Net Foreign Income
- OPEN Trade Openness
- OSL Ordinary Least Squares
- PPP Purchasing Power Parity
- REER Real Effective Exchange Rate
- RER - Real Exchange Rate
- SAP Structural Adjustment Programme
- SDR Special Drawing Right
- SIC Standard Industrial Classifications
- TOT Terms of Trade
- TR Total Reserve
- U. S United State
- UNCTAD United Nations Conference on Trade and Development.
- VAR Vector Autoregressive
- VECM Vector Error Correction Model
- WACB West African Currency Board



CHAPTER ONE

GENERAL INTRODUCTION

1.1 Study Background

Studies on forex rate misalignment is becoming a critical issue in recent macroeconomic studies, especially in this modern era of global imbalances. The mid 1990s actually saw a number of emerging countries being ushered into the global imbalance menace. The hastening of financial integration processes worldwide also contributed to an increasing interruption in the RER variability – growth nexus (Béreau et al, 2009). Thus, in the presence of growing financial inclusion and worldwide instability, it is prudent to pay attention to how misalignment in a currency affects the economic fortunes of a nation. This is because, consistent misalignment in the equilibrium exchange rate may have growth implications on an economy.

Ghana, like other middle income countries has operated different exchange rate regimes ranging from fixed exchange to floating regimes. The overall aim is to improve the external balance and also to achieve economic stability. Having been under a forex regime that is fixed prior to independence, the West African Currency Board (WACB) was brought into effect in 1912 by the British to regulate the flow of currency within the countries they colonized. In this way, forex rate of the West African Pound relative to the sterling was fixed (Uche, 1996).

In 1963, the WACB forex system was relegated to the background and in 1965, Ghana adopted the cedi as her legal tender. This was necessitated by the fact that the Ghana government could not observe the rules associated with the operation of the WACB system of exchange regime. The fixed exchange regime does not allow countries to have free

capital movement, independence in interest rate and inflation policies and forex rate stability concurrently. This phenomenon is termed the “Triffin Trilemma” otherwise known as “Impossible Trinity”. The fixed exchange regime failed in Ghana largely due to the breakdown in fiscal and monetary discipline. As a result, there was high inflation, shortage of foreign currency and thus, exchange controls were imposed (Bawumia, 2014).

In 1983, a market influenced forex regime was adopted in Ghana. This was seen as part of the arrangements under the Structural Adjustment Programme (SAP). The SAP allowed for a steady liberalization of the foreign exchange market. This was done to close the gap that existed between unofficial and the formal forex trading centers. Hence forex intermediaries gained acceptance and became part of the system in 1988. This essentially resulted in the gradual absorption of the black market. The value of the cedi in relation to other currencies were thus, influenced by the quantity of the cedi that consumers are willing and able to buy as against the quantity of the cedi available on the market for consumers to patronize. The Ghana cedi becomes expensive when there is an upsurge in the quantity of the cedi that is required for trading as against the available quantity. The cedi will be said to have appreciated in this regard. On the other hand, where the quantity of the cedi available on the forex market is in excess of what consumers actually require for trading the price of the cedi falls, *ceteris paribus*. The cedi will be thought of as experiencing a depreciation.

Over the years, the currency has been depreciating at an increasing rate against the major foreign currencies. This fueled inflation, eroded national income and undermined confidence in the economy (Bawumia, 2014).

Managing real exchange rate (RER) has become an issue of great concern for researchers all over the world in recent times. Stability in the forex is understood to be an important condition that can help improve aggregate economic growth in a country. The forex value of a currency is defined to be the amount of the currency that one has to surrender for a unit of another currency. The exchange rate is said to be nominal when the effect of inflation is incorporated in it. On the other hand, when the effect of inflation is not included in the forex rate, it is termed real exchange rate (RER) (Lothian & Taylor, 1997).

In the literature, a currency is said to be overvalued when it appreciates over its equilibrium level. On the other hand, a currency is said to be undervalued when it depreciates under its equilibrium level. In both situations exchange rate misalignment is said to have occurred. Misalignment, thus, refers to the situation whereby the actual forex rate deviates from its expected stable state. Misalignment, resulting from overvaluation of a currency, for example, has been observed to have damaging effect a country's economic performance. Overvaluation is said to hinder growth in all sectors of an economy (Gylfason, 2002). According to Rodrik (2008), an overvalued currency could be injurious to the economy as it can result in the shortage of supplies in foreign currencies, a large deficit in the BOP, particularly the current portion of the account as well as rapid macroeconomic cycles. Currency undervaluation, is also noted to cause distortions in price signals and adversely impact aggregate demand by raising the cost of imported goods and thus, discouraging both domestic and foreign investment (Bahmani-Oskooee & Miteza, 2003).

1.2 Statement of the Research Problem

The Ghana cedi has been under immense pressure in recent years as a result of rising demand for foreign goods, speculations in the forex market in addition to the increasing dollarisation of the domestic economy. For instance, in 2013, there was a depreciation of 14.5 percent, 16.7 percentage points and 20.1 percent against the US currency, the British pound and the euro respectively according to figures from the interbank market. The performance of the cedi in the forex bureaux market was not that different from that of the interbank market over the same period. The cedi went down by 16.3 percent, 17.5 percentage points and 19.3 percent against the US dollar, the British pound sterling and the euro respectively (BOG, 2014). Despite the continued depreciation of the Ghana cedi, the extent of misalignment may not be known. Furthermore, empirical research on currency misalignment and economic growth has been limited to the developed economies with very few research conducted in developing countries. Musyoki et. al. (2012) derived an exchange rate misalignment for Kenya. They first empirically estimated an equilibrium forex values to analyze any deviation in real forex rate from the expected stable rate as estimated. However, they did not empirically check for any effect of this misalignment on the economy of Kenya. Atsushi, (2006) also conducted a similar study to model an equilibrium exchange rate equation for Botswana and also determined the extent of misalignment but failed to model the effect of this misalignment on economic performance. In Ghana, similar studies have been identified. Kwakye, (2012), used annual data from 1980 to 2010 and the BEER approach to predict a stable forex rate equation for Ghana. He also analysed trends in misalignment in the Ghana cedi. However, Kwakye ended it there without providing insight into the effect that the misalignment could have on the Ghanaian economy. Even though a misaligned currency is thought to have potential damaging effects on an economy, empirical evidence supporting this claim or otherwise is very rare and mostly non-existing

in developing countries and especially in Ghana. There exist, therefore, a huge research gap to be filled. Thus, an attempt is being made here to make available, evidence of any connection between forex rate misalignment and performance of an economy using Ghana as a case study. This study is very crucial to Ghana because if the potential impact of a misaligned currency on the economy is not investigated, it could be very detrimental to the economic fortunes of the country.

1.3 Research Objectives

Following from the discussions above, this study has the general objective of investigating into the effect that currency misalignment has on the Ghanaian economy. Specifically, this study is conducted to achieve the following:

1. to determine factors that affect equilibrium values of real forex rate (ERER) in Ghana.
2. to estimate the stable values of forex rate and the nature of deviations in the forex rate in Ghana.
3. to analyze any possible effect that misalignment in forex rate has on GDP growth rate in Ghana

1.4 Research Questions

Following from the above, the analyses is conducted to answer:

1. which fundamental variables determine the equilibrium values of forex rate in Ghana?
2. what is the nature of deviations between real forex rate and estimated stable forex values in Ghana?
3. what is the effect that misalignment has on the Ghanaian economy?

1.5 Significance of the Study

The importance of the exchange rate between a country's currency and that of its trading partners cannot be overemphasized. How a country performs on the international commodities markets as well as the global financial markets partially depends on the strength of its national currency relative to other major currencies. Thus, a study into how misalignment of a country's currency could impact on the economic performance of that country is very essential.

Such a study will offer the managers of the Ghanaian economy and other policy makers the opportunity to have a purely scientific and objective view of how exchange rate movements actually impacts the economy of Ghana and therefore be able to device appropriate exchange rate policies to encourage growth.

Furthermore, economists as well as financial analysts will find the results of this study a very useful guide in carrying out their own independent reviews.

In addition, academicians and researchers who are very interested in macroeconomic and econometric studies will find the results of this study a useful material in carrying out their own research.

Moreover, the outcome will expand the wealth of literature which has already been accumulated on this subject matter, and in respect of Ghana, provide a useful base for further research into the effect of misalignment on the economic performance of Ghana.

1.6 Scope of the Study

This work is design primarily to study the impact of misalignment of the Ghana cedi on the economic performance of Ghana. Specifically, the study identifies the fundamental factors that affect equilibrium forex rate, estimates stable forex rates based on an adopted model in addition to examining possible effect of the misalignment on the economic success of Ghana. Yearly series from 1980-2013 and drawn mainly from World Bank Development indicators CD-room were used for this study. Thus only secondary sources of data were employed in this study. Furthermore, the period of the study signifies the end of the fixed exchange rate regime and the commencement of the floating rate regime. This was the period where the structural adjusted programme was initiated.

1.7 Study Organization

This work is categorized into five (5) main sections. General introduction which comprises of subsections like; the study background, research problem, objectives as well as research questions etc. are captured in the first chapter it forms the basis on which the empirical tests are conducted. In chapter two detailed review of relevant concepts as well as research finding relevant for this current subject matter is presented. Chapter three covers the methods and procedures by which the work is conducted. The results from the various models are captured in the fourth chapter. Finally, summaries of the major finding, conclusions, in addition to recommendations are presented in chapter five.

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CHAPTER TWO
REVIEW OF LITERATURE

2.0 Introduction

Extensive discussion on both existing theories and previous research finding related the subject matter is done. This chapter begins with definitions and explanations of some theoretical concepts and follows up with empirical research findings on the subject under study.

2.1 Theoretical Concepts on Real Forex Rate, Equilibrium (Stable) Forex Rate and Exchange Rate Misalignment

2.1.1 Real Forex Rate

Theoretical literature provides diverse investigative contexts within which actual values of the forex can be estimated. These include both outward and internal concepts. The external concept refers to the forex value to be cost of overseas commodities as related with local commodities, and the costs stated in one currency. Thus, forex rate under this concept is where the inflation- inclusive forex value is altered to account for local prices in relation to overseas prices for commodities. The relation is as shown:

$$\text{RER} = \varepsilon \left(\frac{P_f}{P_l} \right) \dots\dots\dots (1)$$

where; “RER” refers to actual forex price, “ε” represents inflation-inclusive forex rate, given to be the local currency per overseas currency, where the effect of inflation is captured, “Pf” is overseas cost index and “Pl” is local cost index.

While the application of this concept appears to be simple and intuitively appealing, Edwards, (1989) opines that there are two common deficiencies associated with the PPP approach. Firstly, he noted that defining the RER involves price indices instead of a single price. Edwards, (1989) opines that many commodities are available worldwide. Thus, several forex values in real terms may possibly result when the PPP method is applied since there exist numerous price indices. Therefore, if different price indices are used in the estimation, different figures could be obtained in respect of the real forex rate. A question will therefore arise as to which price index to use. Secondly, he noted that this approach does not incorporate variations that in the relative incentives that somehow influence the distribution of resources amongst traded and non-traded commodity segments (Edwards, 1989).

The internal concept is applied frequently in economic literature when analyzing outward modifications with respect to developing countries. This concept refers to local comparative prices in respect of all categories of commodities (Edwards, 1989). Thus,

$$\begin{aligned}
 &RER \\
 &= \varepsilon \left(\frac{P^* T}{PN} \right) \dots \dots \dots (2)
 \end{aligned}$$

where; RER denotes forex rate in real terms, 'ε' represents the forex rate in nominal terms, P* T and PN are values of traded and non-traded commodities respectively. As opposed to the PPP method, the internal approach captures incentives that influence the distribution of resources amongst the traded and non-traded commodity segments. The rationale stems from the fact that a rise in RER results in increases in the gains from the traded commodities subsector as against the nontraded commodities subsector. Thus, in a situation where there

is worldwide price synchronization, a deterioration in the currency will imply that the international competitiveness of the home country has been enhanced.

For a country like Ghana, the foreign price of tradables appears to exhibit exogenous characteristics contrary to the domestic price of non-tradables that appears to be endogenous barring temporal moments of income or expense inelasticity. Forex rate in real terms in this case appears endogenous and is immune to a predefined inflation-inclusive forex rate. The dynamics of the real forex rate also permits broad assessment of structural, macroeconomic, and sectoral policies and also to evaluate economic performance. The sustainable stable forex rate is said to exist where an economy achieves stability in its internal and external balance for all variables.

Internal equilibrium exists where there is long-term equilibrium for non-traded commodities in the market place, harmonious to the situation where joblessness is at normal degree. This is said to have occurred where trading centers for human effort clears together with nontraded commodities.

It follows the equation:

$$T_n(e) = P_e + g_N = (1 - O)ep + g_n; Y_n < O, \dots\dots\dots$$

(3)

where; T_n is availability of non-tradable commodities where there is complete employment, " P_e " denotes overall private expenditure (ascertained with tradable commodities), " O " represents proportion of expenditure for tradables, whilst " g_N " refers to government expenditure for non-tradables.

The *external equilibrium* is said to occur whenever it becomes possible to fund the current account from long-term sources of capital — and this would be achieved where intertemporal expenditure restrictions are achieved (Edwards, 1989). It is also modeled as:

$$f = b + z + rf(e) = YT(e) - gT - (O + r)c + z + rfY$$

..... (4)

where; “f” connotes overall Net Overseas Properties, “b” represents balance of trade, “z” refers to Balance on Overseas Aid that the government obtained whilst “r” denotes returns on overseas assets when inflation effect is excluded, ascertained from traded commodities.

2.1.2 Equilibrium Exchange Rate

Whiles forex rates in their real terms have observable values, sustainable equilibria forex rate do not have observable values. This represents a huge gap in the literature on forex rate in real terms and any effort directed at filling this gap is subject to model interpretations. The implication is that estimating the sustainable equilibria forex values and for that matter, deviation from the actual forex rate is model dependent. Obtaining sustainable values for the actual forex rate is essential because officialdom sees it necessary so as to correctly set appropriate values for the inflation inclusive rate. The rationale is that if the inflation-inclusive rate is spot-on, then the stable forex rate values so estimated will correspond to the existing forex rates in real terms.

2.1.3 Exchange Rate Misalignment

Forex rate misalignment denotes a deviation in the forex rate in real terms from the estimated long-run sustainable stable path. The degree of the discrepancy comes percentage change of the real forex from the estimated equilibrium. The equation is as below;

$$EMIS = \left(\frac{RER}{ERER} \right) - 1 \dots \dots \dots (5)$$

where; *EMIS* is real exchange rate misalignment, *RER* denotes forex rate that is observable *ERER* presents the unobservable stable rate which is estimated.

2.2 Forex Rate Regimes

Forex rate refers to the currency price of one country in relation to another currency and what links a country's currency to other foreign currencies is overseen using an exchange rate regime. Wolf, (2002) indicates that the history of a country in terms its monetary system, its complexity etc. help to determine the appropriate regime it should – and does – choose. Since the 1990s, many developing countries have experienced a shift restrictive forex regimes to one that appears flexible (floating regime), focusing on inflation-targeting as the main goal. The exchange rate regime adopted at a particular time is linked to the monetary policy in place, as well. The fixed exchange rate dictates that the domestic currency is dependent on other currency/currencies. On the contrary, the floating exchange rate relies on the market that deals with demand and supply of currencies. In between these two extremes, there are intermediate regimes with various deviations of currency pegs. These regimes range from single currency, to crawling currencies, to free-floating currencies – such that the role of the monetary authority ranges from full control, to minimal control, to no control of the exchange rate.

According to a report by IMF, as at 31 December, 2004, the de facto exchange rate arrangements, are as follows: there are forty-one countries in the world with no separate legal tender, of which the African contingent is made up of Equatorial Guinea, Côte d'Ivoire, Guinea-Bissau, Mali, Niger, Senegal, Togo, Cameroon, Central African Republic, Chad, the Republic of Congo, Benin, Gabon and Burkina Faso, Countries with currency board arrangements are seven, of which Djibouti is the only African country. Forty-one countries in the world have other conventional fixed peg arrangements, of which the African countries include Comoros, Eritrea, Botswana, Morocco, Libyan Arab Jamahiriya, Guinea, Lesotho, Namibia, Seychelles and Swaziland.

The pegged exchange rate within horizontal bands and the exchange rates within crawling bands have five countries, and one country respectively that follow this arrangement, of which there are no African countries in these categories. There are six countries worldwide that have crawling pegs, of which Tunisia is one. The managed floats are fifty-one in total, which include Egypt, Ghana, Mauritius, Sudan, Zambia, Ethiopia, Kenya, Mozambique, Rwanda, Algeria, Angola, Burundi, The Gambia, Mauritania and Nigeria; while the independently floating countries in the world are thirty-five, of which Malawi, Madagascar, Sierra Leone, South Africa, the DR Congo, Uganda, Tanzania, Liberia and Somalia are included as the African countries.

2.2.1 Market-determined Forex Regime

Forex regimes affect numerous macro-economic performances in the economy. Maitra (2010), for instance, states that theoretically, the form and path of the relationship existing between forex rate and money supply stems from the forex regime; while Masson (2001) points out that exchange rate regimes are put in place, in accordance with the particular needs of a nation within the period. In this case during a period of hyperinflation, a nation may opt for a peg regime with the view to curbing the situation. Ultimately the peg regime will need to be abandoned, due to a substantial loss of competitiveness – even though inflation has decreased.

Masson, (2001) notes that Policy-makers' changing preferences are seen through transitions between regimes. He opines that a government that purport to have the welfare of the common people at heart might focus on encouraging increases productivity rather than achieving stability in the forex rate. This is achievable when a government is focused on forex rate stability and thus, becomes more conservative.

Frankel, et tal (2001) state that under floating regimes, there is no commitment from officialdom to obey any specific rule regarding the forex rate, because the administration via its central bank may decide to allow the forex rate to follow the market. However, they may also interfere without any specific restriction.

According to Hall, (2008) the only reason why democracies have floating exchange rate regimes is simply because they are democracies. However, a case for flexible forex emanates from the supposed equilibrating role in trade balances and its low inflationary pressures, such that it would free central banks from taking care of external balances, and allow them to direct monetary policy towards maintaining internal balances (Dash and Narasimhan, 2011). Should officialdom decide to operate under a free market forex regime,

it is quite possible that the rates could be excessively volatile, due to speculative bubbles or contagion as noted by (Dubas, 2009).

2.2.2 Fixed Regime

According to Theis and Arce, (2009), a fixed forex rate regime shows the commitment of mitigating inflation; and it is thus seen as a means of gaining credibility by policy makers, yet it should provide stability in the inflation inclusive rate in addition to the real inflation exclusive forex rate, more so for small economies. They also add that the fixed regime plays as a sweetener that is capable of attracting lenders of overseas capital as well as overseas investors while restoring –on short term basis a nations investment environment. They further point out that due to their nature, fixed exchange rates limit flexibility to engage in countercyclical monetary policy.

2.2.3 Intermediate Regimes

Masson (2001), opines that the free floating exchange rate regime is not a practical option for many developing countries. He argues that the non-existence of well-developed and functional financial markets and institutions, make the floating regime not a good option for developing countries. He further noted that due to the rigid constraints associated with the operation of currency board arrangement it is not acceptable to developing countries. The exchange rate regimes therefore swing among various alternative intermediate regimes, subject to the macro-economic policy targets in place. Von Hagen et al., (2007) point out that classifying forex regimes presents major challenges due to high swings of the swings in the forex rate regimes operated by developing countries. He observes that some the

alternative arrangement adopted by these developing countries does not conform to the orthodox fixed-or-flexible dichotomy.

2.3 Theoretical Approaches to Equilibrium Real Exchange Rate Determination

Different approaches to measuring Equilibrium RER and hence the exchange rate misalignment exists in the literature. Discussed below are some of the approaches:

2.3.1. The Purchasing Power Parity (PPP)-based Approach.

This philosophy states that the forex rate involving two nations is simply given by the relative price levels expressed in the same currency (i.e., generalization of the law of one price); and the relative version also asserts that the differential rate of inflation amongst the two nations is equal to but opposite in sign relative to proportional variation in the forex rate between two currencies. Weakly, the PPP hypothesis requires deviations outward PPP real forex rate to die out eventually and the forex rate in its real terms stabilized, exhibiting a stationary or mean reverting property in the long run (Rogoff, 1996; Astorga, 2012). If this is true, the equilibrium forex rate does not change and can therefore be represented by the long-run or PPP real exchange rate.

According to the PPP method, RER misalignment denotes deviations in the actual forex value in relation to uniformity in a pre-defined level of stable exchange. In the literature, several researchers have investigated the PPP method for modeling the stable forex rate and notable among the lots is by (Chinn, 2006).

Despite its simplicity, Aguirre & Calderon, (2006), observe that, the major criticism of the PPP method is that it selects a single equilibrium rate for all periods and could only cater for the monetary sources of exchange rate fluctuations, and is unable to account for the exchange rate fluctuations caused by real factors. For these reasons, most empirical works over the past two decades on this subject have relied on the model-based methods to investigate and analyze forex equilibria rates and the extent of any misalignment in the rates.

2.3.2 Model-Based Measure of RER Equilibrium

The model-based approach to RER misalignments entails the definition of a maintainable forex rate. This stable forex rate explains that effective forex rate (REER) is composed of middle-term external and internal macroeconomic stability. The model-based approach, according to the proponents, appears to overcome the difficulties of the PPP approach. This is due to the fact that the underlying payments of disequilibria method take care of the underlying balance-of-payment positions instead of price level. Several variations of the Model-based approach to equilibrium exchange rate determinations exist and some are reviewed in the subsections below:

2.3.2.1 The Behavioural Equilibrium Exchange Rate (BEER) Approach

This Approach postulates the stable forex rate to be derived by first investigating the connection existing amongst actual forex rate and a vector of fundamentals. This is done in order to identify the possible long-term impact of economic variables on the real forex rate. Proponents of this method of modelling the stable forex rate include Edwards, (1989) and Clark and McDonald, (2000). This approach also involves the decomposition of the

fundamental variables into its transitory and permanent components so as to extract longterm values need for the analysis.

2.3.2.2. Single-equation Approach

The *single-equation methodology* usually develops summarized forms for the EREER from a broad range of theoretical methods are predominantly borrowed from the works of Edwards (1989) and Obstfeld and Rogoff (1996). The long-term association resulting from the theoretical methods normally links the RER with a group of “*fundamentals*” (e.g. terms of trade, government spending, trade policy, etc.). RER misalignments arise when RER deviations from the stable route appears to be insistent. This may be as a result of laughable economic policies at the macro level. This equation method is actually a development from the (BEER) approach and it the approach adopted in the study.

2.4 Empirical Literature relating to equilibrium Forex Rate and Misalignment

Empirical results for possible determinants of the equilibrium have been largely inconsistent and model dependent.

Tashu, (2015) uses three-monthly series covering 1992–2013 for his study on the drivers of Peru’s equilibrium exchange rate. He included variables such as the real commodity price, relative productivity of tradables to non-tradables, net foreign assets, labour mobility as well as Government consumption expenditure in a co-integration analyses to examine the factors that contribute to Peru’s equilibrium real forex values. His findings suggest that export commodity prices do not have a statistically significant effect on Peru’s real effective exchange rate, suggesting that the nuevo sol is not a commodity currency. The findings also provide empirical support to the suggestion that substantial profit repatriation and foreign

exchange interference has effectively insulate Peruvian currency against any possible effect from commodity price shocks. More so, the results indicate that government consumption and productivity chiefly influence movements in the Peruvian currency value.

Hiri, (2014) uses quarterly data from 1980 to 2009; when investigating fundamental movers of the equilibrium forex value in Algeria. Using the single equation approach, He employs variables such as Oil Price (OIL), Government consumption (GC), Liquidity (LQ), Total reserve (TR) (including gold), Net capital flows (NCF), Capital flows (CF), Trade openness (OPEN) and Terms of trade (TOT) for his estimations. The results indicate that variables such as OIL, and LQ, have significantly positive explanatory power for equilibrium forex rate on sustainable basis. His results also indicate a negative and significant relationship between TR, NCF, OPEN, TOT and the equilibrium forex rate in the long run. However, GC influenced positively except for the fact that the effect is not significant to ERER for the long-term analysis. He observes Misalignment episodes in the Algerian economy which was generally undervaluation.

Ebaidalla, (2014), used data covering the period from 1979-2009 to studied the behaviour of equilibrium exchange rate and misalignment in Sudan. He employs the single equation method and includes fundamentals; trade openness, terms of trade, productivity, expenditure by government, non-tradable commodities tax (TAX) and net for overseas income (NFI) for estimation forex rate equilibrium values. Results from his study indicate that trade openness (-ve), government expenditure (-ve), net foreign income (+ve), and taxes revenue (+ve) have statistically significant explanatory ability on forex equilibrium

rates. However, trade terms had a plus sign but insignificant. He concludes that the economy of Sudan experienced currency appreciation over the study period.

Kwakye, (2012) estimated an equilibrium forex rate as well misalignment for Ghana using data covering the period from 1980-2010. He used fundamental variables such as Trade Openness, Real Terms of Trade, Relative Interest Rate, Government Expenditure, Productivity, and External reserves for his study. In addition to this variables, He included budget deficit and domestic credit as nominal macroeconomic variables for his estimations. His Results indicates that Productivity (+ve), trade Openness (-ve), Real Relative Interest Rate (-ve) etc. significantly explain movement in the equilibrium rate. However, budget deficit as well as domestic credit was statistically insignificant. The result also shows the Ghana cedi to be misaligned relative to the estimated equilibrium undervalued/overvalued. That is both overvaluation (Appreciating) and undervaluation (depreciating) were recorded over His study period.

In a related study, Olanrewaju, (2012) adopts the GMM to estimated misalignment for countries including Liberia, Guinea, Gambia, Ghana, Nigeria and Sierra Leone using data from 2000 to 2010. Regressors included in his study are expenditure by government, productivity, trade openness, among other variables. His findings out of the panel estimations reveal that prior year values of the real forex rate have significantly positive association with stable values of the forex rate. The implication is that the previous period's exchange rate has explanatory power on movements in current forex values for the sustainable future. The results from his work also suggest that government expenditure

impacts negatively on the equilibrium value in the zone. The findings suggest that governments of the countries within the zone and included in the study spends more on tradables as against non-tradable goods. He also observes that both productivity and trade openness negatively affect the equilibrium exchange values but the effect is not significant.

In a similar study, Sallenave, (2010) relied on the behavioural approach within a panel framework to compute an equilibrium rate series in order to study trends in misalignment among the G20 countries during the period 1980-2006. His results using from the panel methodology highlights that both net overseas assets and productivity have statistically positive effect on the ERER. He further observes misalignment to be very pronounced among developing nation. Notably he suggests that it takes too much time for the equilibrium rate to converge in the developed countries.

Daboh, (2010) uses the single equation approach when he investigates potential drivers of equilibrium real forex rate (ERER) for Gambia, Ghana, Nigeria and Sierra Leone using aggregate annual data from 1970 to 2006. Fundamental variables included in his model were; barter TOT, Trade liberalization (OPEN), share of expenditure by government to GDP (GEX), technological progress (Yg), investment as a ratio of GDP (I/GDP), and net capital inflow (CAPELO). The results from the study for the four countries' models indicate that fundamentals like GDP growth, investment, TOT, trade liberalization, expenditure by government, capital flows, internal credits, nominal and RER (lagged) have significant impact on the equilibrium exchange rate which corroborates Edwards (1989). On country by country basis, Daboh, (2010) observes that the equilibrium exchange rate for Ghana is significantly affected by trade openness (+ve), Government consumption expenditure

(+ve). Investment had a momentarily negative impact on the equilibrium forex rate for Ghana. He also reports that the TOT has no significant bearing on the equilibrium exchange rate for Ghana. Contrary to the results for Ghana, trade openness and government expenditure have momentarily negative influence on the equilibrium rate (ERER) for Nigeria. Investment momentarily positive explanatory power for Nigeria, which deviates from what was observed for Ghana. Interestingly, the TOT also has no significant impact on the ERER for Nigeria a result consistent with what he obtained for Ghana.

Iossifov and Loukoianova (2007), apply the similar methods when they investigate the trends in the misalignment series in Ghana. Their findings support most of the earlier results discussed above. Particularly, they observe GDP growth in real terms as well as relative interest rate have momentous explanatory power on the equilibrium rate.

Aliyu, (2007) uses three-monthly series from 1986Q1- 2006Q4 for the estimation of exchange rate misalignment for Nigeria employing BEER methods as explained in addition to other methods. He includes fundamental variables such as government fiscal stance, TOT, net foreign assets, crude oil price, net foreign reserve and monetary policy. His findings show net foreign asset to have positive impact and it corroborates with the literature. Therefore, a rise in net foreign asset position will lead to overvaluation of the Naira. It is further noted that when there is a rise in crude oil price volatility, the naira appreciates in value.

De Brock and Stok (2006) adopted a two model procedure (cross-section and annual data series) when they perform similar study for 26 economies in transition with data from 1991

to 1998. For the cross-section analysis, they sampled 10 European Union compliance countries and 16 other conversion economics. The time series data was applied to estimate the BEER model, where productivity, money- to- GDP, trade openness, government consumption, commodity prices and terms of trade were used in the regression model. Their results indicate that, increase in productivity will result in the countries exchange rate appreciating. This clearly conflicts with what Zhang (2001) observed in china.

The above empirical evidence on the estimation of the equilibrium real exchange rate and Misalignment reveals that there is no uniformity as to the regressors used as potential determinants of the equilibrium exchange rate. Thus, any estimation of the equilibrium exchange rate is model dependent and the type of regressors used in the model and this could be a possible source of discrepancy among results from various studies reviewed. Clearly, the estimation of the equilibrium exchange rate is indeed controversial and a challenging procedure. This notwithstanding, one should always be guided by the principle of parsimony when selecting potential drivers of the equilibrium exchange rate.

2.5 Relationship between Misalignment and the performance of an economy

The research in totality, seeks to empirically investigate the relationship between exchange rate misalignment and the performance of an economy. Presented below is a review of some empirical findings relating to the subject matter.

Ebaidalla, (2014), used data covering the period from 1979-2009 and employs cointegration and the error correction model in his study of the link between the estimated misalignment series and economy's performance. His economic growth variable referred

to per capita growth in GDP and it represents the dependent variable. The explanatory variables he employs are derived from the new classical growth model credited to Barro and Lee, (1994). Variables such as Government consumption (*GC*); trade openness (*OPEN*); domestic investment (*INV*); education attainment (*EDU*) to capture human capital investment; population growth (*POP*); are added to the RER misalignment (*EMIS*); which captures the effect of exchange rate policy on economic performance. His results indicate that misalignment has a positive effect on economic performance in Sudan, though the influence is not significant statistically. The other control variables also reveal some interesting results. For instance, his results indicate negative but insignificant relationship between advancement in education and economic growth. Furthermore, government spending, investment and population growth have a plus and statistically significant influence on economic performance. Trade openness has a positive but insignificant impact on economic performance.

Abida, (2011), examines the effect of RER misalignment on long-term economic performance of three Maghreb countries (Tunisia, Algeria and Morocco) during the period 1980-2008 using the System GMM dynamic panel estimation method. He uses a dynamic panel growth model where he included exchange rate misalignment series as one of the regressors together with other fundamentals. Among potential determinants, he considered trade liberalization, spending by officialdom among other variables as control regressors in the model. The results from his study reveals misalignment to negatively impact the economies of the Maghreb countries studied. On the other control variables, he observes that the lag of per capita GDP also negatively impacts those economies, spending by the governments had a deleterious but insignificant effect in the economic fortunes of the three

Maghreb countries. On the contrary, his results show that terms of trade, trade openness and investment all have positive impact on the economic performance but none is significant at 5% level of significance.

Sallenave, (2010) evaluates the economic impact of misalignments among G20 nations of the world. His data covered the period from 1980 to 2006. He estimates a growth system in a panel dynamic framework where he included the misalignment series together with traditional determinants of growth such as output gap, government spending, share of investment, terms of trade, trade openness, population growth among others. His results reveal a substantial negative effect of misalignment on the economic fortunes of the countries studied. On the other regressors included as control variables, he recorded a negative coefficient for the output gap variable however the impact was not statistically significant. His results also indicate substantially positive coefficient for trade liberalization variable over the sample period. The terms of trade is had adverse but insignificant influence. The coefficient estimate for Government spending is also a plus but insignificant.

Aguirre and Calderón, (2005) also studied the economic implications of a misaligned currency and its volatility, drawing data from 60 countries over the period of 1965-2003. Variables used in the growth-misalignment model include GDP per Capita as the regressand and the regressors included human capital, financial depth, trade openness, government spending, CPI, the rate of inflation to represent instability in price levels, terms of trade shocks among others. Their results indicate the existence of an adverse, and statistically significant effect of misalignment on economic performance. This result goes congruence to earlier research findings. They observe similar outcomes respective of the composition

of the variables included in the model for the estimation of the equilibrium values and the misalignment series. Their results corroborate the findings of the World Bank, (1984); Gulhati, et al., (1985).

Furthermore, Razin and Collins, (1999) investigate the relationship between exchange rate misalignment and economic growth for a sample of 93 countries over the period 1975–1992. Their main contribution to the literature is that they developed and adopted an RER misalignment indicator that is based on an IS-LM model of an open economy. Their results indicate that exchange rate misalignment is negatively associated with economic growth, and concluded that very high overvaluation has a negative and significant impact on economic growth, while undervaluation has no significant effect.

Ghura and Grennes, (1993) employ the PPP model, black market-based and endogenous growth model-based to study the relationship between RER and economic performance for a sample of 33 countries in sub-Saharan Africa. They found a negative relationship between RER misalignment and economic performance. They argue that the chronic RER misalignment was the main source of slow growth in Africa.

Evidence from various literature reviewed shows that most of the studies on this subject matter, has largely been done on a panel basis. Thus, country specific studies on the impact of misalignment on growth has been very far and few. Also most of the studies used the per capita GDP as the measure of economic growth. In the case of Ghana, all the studies documented on this subject matter has been estimations of the equilibrium values and the extent of misalignment. Thus, research regarding the effect that misalignment of the Ghana

cedi could have on the economic fortunes of the country is largely non-existing. The study therefore adds to the economic literature on the subject matter by studying the potential effect that a misaligned forex rate with respect to the Ghana cedi could have on the economic fortunes of the country. Also a conscious effort is made in avoiding traditional use of the GDP per capita in measuring economic performance. Here the research adopts the growth rate of gross domestic product as indicator for economic performance.



CHAPTER THREE

RESEARCH METHODOLOGY

3.0 Introduction

The details of the methodology adopted for this study are presented below.

3.1 Data Description and Sources

Predominantly, secondary information is employed in the study. Annual data expanding from 1980 to 2013 are employed in the analysis. The data is sourced from the CD ROM containing World Bank development indicators. The choice for regressors in addition to the duration is necessitated by theoretical, empirical research findings and accessibility of reliable data.

3.2 Estimation of the Determinants of Equilibrium Real Effective Exchange Rate (ERER)

The first step in the estimation procedures is to estimate the long-run co-efficient parameters of the determinants of the equilibrium real effective exchange rate. After extensive review of both theoretical and empirical literature, the variables used in this estimation and their expected signs are detailed below:

3.2.1 Definition of Variables and a Priori Assumptions

3.2.1.1 Real Effective Exchange Rate (Dependent Variable)

Real effective exchange is the currency index of weighted average of a nation's forex selective to pool of convertible currencies when inflation effect is accounted for (Vijayakumar et. al., 2010).

Explanatory Variables:

3.2.1.2 Terms of Trade (TOT)

The index for Terms of trade is computed as the proportional indexes of the unit value export to indexes of the unit value import which is estimated in relation to a base year taken as 2000. Unit value indexes are founded on information from nations who practice democracy and where their democratic systems corroborate with UNCTAD quality controls, supplemented with the aid of UNCTAD's estimates making use of the prior period trading values at the Standard International Trade Classification three-digit level as weights. An increase in the TOT is thought to lead to an increase in national "wealth". If so, then, an increase in the TOT is expected to result in an increase in domestic demand and hence relative prices of non-tradables. In this sense, the effect on real exchange rate is expected to be positive, implying an appreciation of the currency. Thus, the author expects a positive (+) sign for TOT in the long-run. However, short -run deviations could occur.

3.2.1.3 Trade Openness (OPEN)

Trade openness consists of the total imports and exports of commodities and services relative to a percentage of gross domestic product. Increase in liberalization in terms of trade should cause an upsurge in demand for imported commodities and services and reduce relative quantity of non-traded commodities that consumers are willing and able to buy. The effect is a worsening of the current account and a fall in the relative price of nontradables, which will intend result in the depreciation of the real exchange rate. That is a negative (-) effect. Argued another way, openness to trade may cause an increase in competition in the tradables sector and cause the relative price of tradables to fall. This will

result in the appreciation of the real exchange rate. The sign of openness is, therefore, not unambiguously pre-determined. However, the author expects a depreciating (-) effect on the real effective exchange rate of Ghana.

3.2.1.4 Productivity (PROD)

Standard with literature, the productivity indicator is proxied by GDP per capita of Ghana relative to its major trading partners. GDP per capita is gross domestic product divided by mid-year population. Data are in constant local currency. Most theoretical as well as empirical literature postulates a positive association between increase productivity and real exchange rate. Thus, increase domestic productivity is thought to have an appreciating effect on the currency relative to trading partners. The argument is that, increased productivity in a country will raise its relative wage. This will in turn reflect in higher prices of the country's non-tradables and hence cause the real exchange rate to appreciate (positive sign) confirming the so-called Balassa-Samuelson effect. Nonetheless, higher productivity could result in lower relative prices of tradables and thereby triggering the real exchange rate to denigrate (negative sign). Thus, a negative sign for productivity will not be surprising to the author.

3.2.1.5 Government Expenditure (GOE/GDP)

Overall government final consumption disbursement includes all government current expenditures for purchases of goods and services (including compensation for workers). It also entails most disbursements on national defense and security, but excludes government military expenditures that are part of government capital formation. This variable is expressed as a percentage of GDP and used in the model. Where GOE is directed towards non-tradables, its effect on real exchange rate will be positive (i.e. appreciating effect). On

the other hand, if GOE directed more towards tradables, it will impact negatively (depreciating) with respect to the real forex value. The sign of this variable cannot therefore be pre-determined with certainty. In general, however, literature suggests an appreciating effect. But for Ghana a depreciating effect cannot be ruled out.

3.2.1.6 Net Foreign Income (NFI/GDP)

Net income includes the net labor income and net property and entrepreneurial income components of the SNA. Labor income covers compensation of employees paid to nonresident workers. Property and entrepreneurial income covers investment income from the ownership of foreign financial claims (interest, dividends, rent, etc.) and nonfinancial property income (patents, copyrights, etc.). Data are in current local currency and expressed as a percentage of GDP. Increase in NFI in theory is expected to affect real exchange rate positively (appreciating effect). This is because an increase in foreign inflows *ceteris paribus*, creates excess supply of the foreign currency relative to the domestic currency. This in theory leads to a hike in the price of the domestic currency as demand for the domestic currency exceeds the supply. Thus an appreciation of the domestic currency. However, for a country that experiences a net negative NFI balance *ceteris paribus* a depreciating effect on the real exchange rate should be expected.

3.2.1.7 Real Relative Interest Rate (RRIR)

An increase in RRIR relative to trading partners, is expected to draw in capital inflows from abroad which, like foreign reserves, would boost demand in the economy. If such demand is directed towards non-tradables, it will cause an appreciation in the real exchange rate. If however, such increase in demand is directed towards tradables, then a depreciation of the

real exchange rate could result. The authors expect a negative sign (depreciating effect) on this variable.

Following from the above discussion, the functional form of the model and the expected signs of the explanatory variables in the long run equation are as depicted below:

$$\log REER = f(\log TOT^+, \log PROD^\pm, \log OPEN^-, \log GOE^+, \log RRIR^-, NFI^-)$$

3.2.2 Econometric Model Specifications (MODEL 1)

From the above, the mathematical form for the single equation model is developed as:

$$\begin{aligned} \log REER = & \beta_1 + \beta_2 \log TOT + \beta_3 \log PROD + \beta_4 \log OPEN + \beta_5 \log GOE + \beta_6 \log RIR + \\ & \beta_7 NFI \dots\dots\dots \\ & \dots\dots(1) \end{aligned}$$

From the above equation, the econometric model for the determinants of the long-run equilibrium real exchange rates is specified as follows:

$$\begin{aligned} \log REER = & \gamma_1 + \gamma_2 \log TOT + \gamma_3 \log PROD + \gamma_4 \log OPEN + \gamma_5 \log GOE + \gamma_6 \log RIR + \\ & \gamma_7 NFI \dots\dots\dots + \\ & \varepsilon \dots\dots\dots(2) \end{aligned}$$

where, $\gamma_1, \gamma_2, \gamma_3, \gamma_4, \gamma_5, \gamma_6, \gamma_7$ are the long run parameters to be estimated; ε is the random disturbance term (stochastic error term) and log is the log operator.

3.2.3 Empirical Estimation Procedures

Since time series data is employed, the data is first tested to ascertain the stationarity properties of the individual variables included in the model. The various tests performed are detailed below:



3.2.3.1 Unit Root Test

A unit root test is conducted using the Augmented Dickey-fuller (ADF) approach to observe the stationarity properties of all the data set used in this study. This is done to circumvent nonsense estimates that might arise if the variables are not stable. If this is not done, the estimates of the co-efficient parameters could be wrong, leading to wrong interpretation being made. Furthermore, the standard error of the estimates could also be wrongly estimated if the data set are non-stationary and this will affect the reliability of the estimated parameters. Where the data are observed to be non-stationary, the first difference operator is invoked to identify the order of integration in the data set. The ADF test equations are as follows:

For intercept:

$$\delta_0 + \delta_1 \Delta X_{t-1} + \sum_{t=1}^n Y_t \Delta X_{t-i} + \dots \dots \dots (3)$$

For Trend:

$$\Delta X_t = \delta_0 + \delta_1 \Delta X_{t-1} + \delta_2 t + \sum_{t=1}^n Y_t \Delta X_{t-i} + \varepsilon_{it2} \dots \dots \dots (4)$$

For the purpose of this study, equation (4) is used for the unit root testing since the researcher is interested in both the intercept and trend properties of the data. The taustatistic

tests the Null hypothesis of $\delta_1 = 0$, that is, non-stationarity against the alternative that, $\delta_1 < 0$, that is stationarity in the data set. Where the variable is not stationary at levels (i.e. I [0]), it is first differenced d times to ensure stationarity and the order of integration.

Moreover, the unit root test is sensitive to the number of lags used. Thus, the number of lags used is not arbitrarily selected. One way is to allow the system to automatically select the number of lags. However, the number of lags to be chosen for a test for the presence of unit root or otherwise is influenced by the frequency of the data used. For instance, a lag of 1 or 2 is accepted for annual data; a lag number of 12 or 24 is also allowed for monthly data and so on. (Brooks, 2008). Thus, the selection of 4 lags for this study was to improve the robustness of the results.

3.2.3.2 Co-integration Test

After the unit root tests are performed and the stationarity properties determined, a cointegration test to establish whether or not, the data series have any long-run relationship is carried out. That is, to say, whether in the long-run, the data series move together. This test also determines the number of co-integration equations. The Johansen and Juselius (1990) maximum likelihood (ML) procedure is fall upon to examine the number of cointegrating vectors. This also affords inferences to be made on parameter restrictions. The

Johansen Co-integration equation is modeled as follows:

$$\Delta X_T = \sum_{i=1}^{q-i} \varphi_i \Delta X_{t-i} + \varphi_q \Delta X_{t-q} + \mu + v_t \dots \dots \dots (5)$$

where; X_1 is an $n \times 1$ vector of variables, φ_q is an $n \times n$ matrix of rank $r \leq n$, μ is an $n \times 1$ vector of constant term and v is an $n \times 1$ vector of residuals.

The hypothesis is $H_0 = \varphi_q = \alpha\beta'$, where α and β' are $n \times r$ loading matrices and Eigen vectors. The aim of this procedure is to test the number of r co-integrating vectors $\beta_1, \beta_2, \beta_r$ which provide r stationary linear combinations of $\beta'X_t - q$. The linear likelihood ratio (LR) statistics for testing hypothesis $H_0 = \varphi_q = \alpha\beta'$ is a test that there are at most r co-integrating vectors;

$$\Phi_{max} = -T \ln(1 - \lambda_{r+1}) \dots \dots \dots (6)$$

Versus alternative;

$$\Phi_{trace} = -T \sum_{i=1}^r \ln(1 - \lambda_i) \dots \dots \dots (7)$$

The linear restriction (LR) statistic for testing r against $r+1$ co-integrating vectors is given by:

$$-2 \ln(Q) = T \sum_{i=1}^r \ln\left(\frac{1 - \lambda_i}{1 - \lambda_{r+1}}\right) \dots \dots \dots (8)$$

This determines the significant Eigen values and the corresponding number of eigenvector. These procedures are conducted for all the models estimated in this study. If no cointegration is found among the data series after the test, then, the study will adopt the unrestricted Vector Autoregressive (VAR) model in the estimation of the coefficient parameters. However, if the results of the Johansen and Juselius (1990) maximum

likelihood (ML) tests reveals the existence of cointegration relationship among the data series, then the Vector Error Correction (VECM) model will be adopted for the study.

3.2.4 The Vector Autoregressive (VARs) Models

Sims, (1980) popularized the use of VARs in econometrics as a natural generalization of univariate methods. A VAR is a systems regression model (meaning that there is more than one dependent variable) that can be thought of as a kind of crossbreed between a univariate time series models and simultaneous equation models. The simplest case of a VAR is a bivariate VAR. with this, there are only two variables say, y_{1t} and y_{2t} , each of whose current value depend on different combinations of the previous k values of both variables and error terms as;

$$y_{1t} = \beta_{10} + \beta_{11} y_{1t-1} + \dots + \beta_{1k} y_{1t-k} + \alpha_{11} y_{2t-1} + \dots + \alpha_{1k} y_{2t-k} + u_{1t}$$

.....(9)

$$y_{2t} = \beta_{20} + \beta_{21} y_{2t-1} + \dots + \beta_{2k} y_{2t-k} + \alpha_{21} y_{1t-1} + \dots + \alpha_{2k} y_{1t-k} + u_{2t}$$

.....(10)

where u_{it} is a white noise disturbance term with $E(u_{it}) = 0$, ($I = 1, 2$), $E(u_{1t}, u_{2t}) = 0$.

The VAR model is liked by many econometricians for its flexibility and ease of generalization. The model could actually be extended to encompass multivariate versions where more than two variables are involved as is the case in most econometric studies. Another important feature if the VAR is that it allows the value of the variable to depend not only on its own lags or combinations of white noise terms but also the values of other variables and so VAR are more flexible than univariate AR models. Thus, VAR models can

offer a very rich structure, meaning, they may be able to capture more features of the data (Brooks, 2008).

3.2.5 Vector Error Correction Model (VECM)/Equilibrium Correction Model

When long-term associationship is established among the data series, the data series, then the VAR model will not be appropriate. In such a case the VECM will be an appropriate method to be applied. One definition of the long-run that has been adopted for econometric studies suggests that the variables converges upon some long-term value and are no more deviations, thus, $y_t = y_{t-1} = y$; $x_t = x_{t-1} = x$. Therefore, where only first differenced variables are employed, the differenced terms will be zero and no long-run relationship could be estimated. Thus, the model will have not tell anything in respect of an equilibrating associationship between variables, x and y . Therefore, a model that could accommodate this challenge by providing a means to combine first differenced values with prior year's cointegrating variables is needed to overcome such a challenge When we consider the equation;

$$\Delta y_t = \beta_1 \Delta x_t + \beta_2 (y_{t-1} - \gamma x_{t-1}) + u_t \dots\dots\dots(11)$$

We refer to this as the random disturbance correction Model (VECM). The expression $y_{t-1} - \gamma x_{t-1}$ represents the stochastic correction term. If y_t and x_t are cointegrated, with a cointegrating coefficient of γ , then $(y_{t-1} - \gamma x_{t-1})$ will be $I(0)$ even though the constituents are $I(1)$. Therefore, it will be valid to use OLS and standard procedures for statistical inferences. This also means that where the data series is made up of a combination of $I(0)$ and $I(1)$ the co-integration relationship could be validly established. (Brooks, 2008). The

VECM, is said to be a complete expertized maximum possibility approximation model. This mannequin produces extra efficient parameters of co-integrating vectors advance of competing methods. VECM enables the researcher to check for co-integration in a complete scheme of equation in one step without necessitating that specific are normalized. An extra benefit of VECM is that it does not need a priori assumption of endogeneity or exogeneity of the variables to be made. Furthermore, VECM gives the opportunity to test for Granger-causality. The random disturbance term is assessed by the t-test and the first difference of the lagged variables is examined by *F*-test. This model also permits the prediction of the speed with which any disequilibrium between the long-run and short run estimates of the determinants of the equilibrium real exchange rate is corrected for.

3.3 Estimation of the Equilibrium Real Exchange Rate and the Exchange Rate

Misalignment

After estimating equation (2) and determining the long-run determinants of equilibrium real exchange rate (ERER), the equilibrium exchange rate is determined. The equilibrium RER is derived from the multiplication of the long-run estimated coefficients in equation (2) by the permanent values of the RER fundamentals. The actual fundamental variables is not used due to the fact that they may show a significant level of temporary 'noise', but the sustainable values will not have such problem. (Baffes *et al.*, 1997). Therefore, the Hodrick-Prescott (HP) filter is applied to smoothen out the predicted equilibrium RER. The

HP filter allows us to obtain the 'long-run', 'permanent' or 'sustainable' values of the economic fundamentals by decomposing the time series into a trend and stationary

component (Baffes *et al.*, 1997). Hence, the equilibrium RER equation can be depicted through the following model:

$$\ln e_t^* = \beta F_t^P \dots \dots \dots (9)$$

where e^* is the equilibrium exchange rate F , is the vector of permanent or sustainable values of fundamentals obtained using the HP filter, and β is the vector of long-run parameters of equation (2). Therefore, the RER misalignment (EMIS series) will be obtained as the percentage difference between the actual RER and equilibrium RERs, as follows:

$$EMIS = \left(\frac{RER}{ERER} \right) - 1 \dots \dots \dots (10)$$

3.4 Impact of Exchange Rate Misalignment on Gross Domestic Product (GDP) Growth Rate.

The general objective of this study is to investigate the impact of exchange rate misalignment on the economic performance of Ghana. The measure of economic performance chosen for this study is the Gross Domestic Product (GDP) growth rate. After extensive review of relevant literature, the variables included in the model and the a priori assumptions are discussed below:

3.4.1 Definition of Variables and a priori Assumptions

3.4.1.1 GDP Growth Rate (The Regressand)

GDP is the sum of gross value added by all resident producers in the economy plus any product taxes and minus any subsidies not incorporated in the value of the products. It is computed inclusive of lost in the values associated with fabricated assets or for depletion and degradation of natural resources. This variable is the Annual percentage growth rate of GDP at market prices based on constant local currency. The aggregates are founded on constant 2005 U.S. dollars. The study investigates the impact of misalignment in the real effective exchange rate on this variable.

REGRESSORS

3.4.1.2 Exchange Rate Misalignment (EMIS).

Misalignment of the RER, refers to the deviation of the actual real effective exchange rate (RER) from its equilibrium (ERER). Both theoretical and empirical research findings have suggested that misalignment in the exchange rate has important implications on a country's economic performance. This is the main variable of interest to the author in this study. The author expects an overvaluation of the cedi to impact positively on GDP growth and undervaluation, a negative and significant impact on the GDP growth rate in Ghana.

Control Variables:

Even though the main regressor variable of interest in this study is the exchange rate misalignment, other variables were included in the model as control variable to avoid omitted variable bias. The selection of the control variables is based on theoretical literature, empirical findings and availability of consistent data over the study period. The control variables and the a priori assumptions are discussed below:

3.4.1.3 Terms of Trade (TOT)

The definition of this variable is the same as described in the first model. From theoretical as well as empirical literature reviewed, the author expects a positive relationship between GDP growth rate and TOT. Thus, a better terms of trade, *ceteris paribus*, should have a positive impact on the GDP growth rate in Ghana.

3.4.1.4 Government Expenditure (GOE)

The definition of this variable is also as explained in the first model. Theoretically, government expenditure should impact positively on the economy. Theory expects that when the government spends, it goes into productive sectors of the economy to boost GDP growth. However, where the expenditures incurred by a government are directed toward unproductive sectors or such expenditures are not informed by proper economic analysis, it may end up impacting negatively on the growth of the economy. Thus, a negative sign on this variable cannot be ruled out. Nonetheless, a positive sign is expected in this study.

3.4.1.5 Trade Openness (OPEN).

Even though the relationship between openness and economic growth rate has not been unambiguously established by theory, some research findings support the view that increasing openness has a positive impact on productivity and hence GDP growth. Other research findings also support the view of a deteriorating effect of openness on economic growth. The preponderance of the literature suggests a positive long run impact of openness on economic growth. The author thus, expect a positive sign for the long-run estimate but the short-run implication can go either way.

3.4.1.6 Foreign Direct Investment (FDI).

Foreign direct investment are the net inflows of investment to acquire a lasting management interest (10 percent or more of voting stock) in an enterprise operating in an economy other than that of the investor. It is the sum of equity capital, reinvestment of earnings, other long-term capital, and short-term capital. This series shows net inflows (new investment inflows less disinvestment) in the reporting economy from foreign investors, and is divided by GDP. Theoretical literature is ambiguous about the impact of FDI on economic growth. Whereas some theories support the view of a positive impact, other theories predict a negative impact. Empirical results on the relationship between FDI and economic growth have been largely inconsistent. In line with existing literature, the impact of this variable cannot be unambiguously determined.

3.4.1.7 Inflation (INFL).

This variable is defined using the consumer price index and it reveals the annual percentage adjustment in the charge to the average consumer for purchasing a basket of commodities and services that might be static or variable at constant intervals, which may be monthly. Economic theories reach a variety of conclusion about the responsiveness of economic growth to inflation. Whereas some theories predict a positive relationship, other theories suggest a negative impact. Thus, the sign of this variable cannot be unambiguously determined.

Following from the above discussions, the functional form of GDP Growth-Misalignment model and the expected signs is as expressed below:

$$GDP = f(\log TOT^+, \log OPEN^+, \log GOE^+, \log FDI^+, \log INFL^-, EMIS^-)$$

Hence, the econometric model is:

$$\begin{aligned}GDP &= \pi_1 + \pi_2 \log TOT + \pi_3 \log GOE + \pi_4 \log OPEN + \pi_5 \log FDI + \pi_6 \log INFL \\ &+ \pi_7 EMIS \\ &+ it \dots \dots \dots (11)\end{aligned}$$

where, $\pi_1, \pi_2, \pi_3, \pi_4, \pi_5, \pi_6, \pi_7$ the co-efficient parameters to be estimated, it is the stochastic error term and log is the logarithm operator.

3.4.2 Estimation Procedure.

The standard procedure of unit root testing is carried out using the Augmented Dicky Fuller (ADF) test. The co-integration test was also carried out as explained in the earlier model.

After determining the order of integration, the study also used the VECM approach to estimate the long-run and short-run co-efficient parameters.

3.5 Model Adequacy Diagnostic Tests

The adequacy of the models employed in the study as well as their efficiency is diagnosed by testing for heteroskedasticity, autocorrelation Correlation and Normalcy in the residuals.

The procedures adopted for these tests are explained in the subsections below

3.5.1 Test for Autocorrelation/Serial Correlation

In checking for autocorrelation, the study employs the Breusch-Godfrey autocorrelation LM Test. It involves testing a null hypothesis (H_0) of no autocorrelation in the residuals against the alternative (H_1) of the existence of autocorrelation in the residuals. The decision criterion is that if the p-value of the observed R square is greater than 5% (i.e. P-value >5%) the null hypothesis (H_0) cannot be rejected and it would be said that there is no autocorrelation in the residuals. The opposite is also true.

3.5.2 Test for Normality (Jarque-Bera Test)

The study employs the Jarque-Bera test to perform the Normality Test. This test is to ascertain if the residuals are normally distributed or not. Again a null hypothesis (H_0) of normally distributed residuals is tested against an alternative (H_1) which states no normality in the residuals. The null (H_0) is not rejected if the P-value of the Jarque-Bera statistic is above 5% (i.e. P-value >5%).

3.5.3 Heteroskedasticity test: Breusch-Pagan-Godfrey test

Finally, a check is conducted to verify the existence or otherwise of heteroskedasticity in the residuals. Here, the study adopted the Breusch-Pagan-Godfrey statistic. This involves testing, a null hypothesis (H_0) of homoscedasticity in the residuals against the alternative (H_1) of heteroskedasticity. Do not reject null (H_0) if the P-value of the observed R-square is above 5% (i.e. P-value >5%).

3.5.4 Pairwise Causality Tests

The Granger causality test is a statistical hypothesis test for determining whether one-time series is useful in forecasting another time series. Granger, (1969) opines that ordinary regressions reflect “mere” correlation. He opines that causal relationships might be checked via the measurement of predictive power of prior values of a series on the future values of another time series. A time series X is said to Granger-cause another series Y if it can be shown, usually through a series of T-tests and F-tests on lagged values of X (and with lagged values of Y also included) that those X values provide statistically significant information about future values of Y. We say that a variable X that evolves over time Granger-cause another evolving variable Y if predictions of the values of Y based on its own past values and on the past values of X are better than predictions of Y based only on its own past values.

A pairwise Granger causality test is conducted on the time series variables included in the models.

A null (H_0) hypothesis of no causality is tested against the alternative (H_1). Thus, give two variables say, X and Y; the null (H_0) hypotheses are that X does not Granger-cause Y; Y does not Granger-cause X. In each case, if the probability value (P-Value) of the F-statistic is less than or equal to 0.05 ($P\text{-Value} \leq 0.05$) at the 5% confidence level we reject the null (H_0). If the null in both cases are rejected, then, there is evidence of bi-directional causality between X and Y. Where only one of the null hypothesis in the pairwise Granger causality test is rejected, then, the data suggests a uni-directional causality.

CHAPTER FOUR

PRESENTATION OF RESULTS, ANALYSES AND DISCUSSIONS

4.0 Introduction

In this chapter, details of the empirical results obtained from the various models ran are presented. The econometric software package used for this study is the E-views application software 16. Results from the unit root testing, Co-integration as well as the results from the VECM are presented, analysed and discussed below.

4.1 Results of stationarity test

Initially the stochastic characteristics of the variables included in the study before any other test is done. The unit root testing procedure is sensitive to the number of lags used, and therefore the study employed the Schwarz Info Criterion (SIC) and selected a maximum lag of 4, whereas the lag lengths are automatically selected. The results obtained from the unit root testing procedures are shown below.

Table 4.1 Unit Root Testing Results.

Variables	ADF TEST		Order of	I(D)/ Order of integration
	Levels	First Difference	Lag	
GDP	(-3.685284) -3.552973* [0.0376]		4	1(0)
REER	(-2.690069) -3.557759* [0.2470]	(-4.884435) -3.562882* (0.0023)	4	1(1)
TOT	(-2.968885) -3.557759* [0.1561]	(-7.114173) -3.568379* (0.0000)	4	1(1)
PROD	(1.693783) -3.562882* [1.0000]	(-3.579219) -3.557759* [0.0478]	4	1(1)
OPEN	(-1.710498) -3.552973* [0.7239]	(-5.215581) -3.562882* [0.0010]	4	1(1)
GOE	(-3.883352) -3.557759* [0.0247]		4	1(0)
RRIR	(-9.585172) -3.552973* [0.0000]		4	1(0)
NFI	(-5.650622) -3.557759* [0.0003]		4	1(0)
EMIS	(0.166001) -2.963972* [0.9656]	(-3.750490) -3.580623* [0.0352]	4	1(1)
INFL	(-6.361767) -3.552973* [0.0000]		4	1(0)
FDI	(-2.858220) -3.557759* [0.1886]	(-4.265665) -3.557759* [0.0102]	4	1(1)

* represents critical value at 5% confidence levels, () refers to ADF test statistics, [] MacKinnon (1996) one-sided p-value.

The stationarity test outcome is presented above (table 4.1). It could be inferred from results that some variables are stationary at levels while other variables are not. Specifically, government consumption expenditure (GOE), relative real interest rate (RRIR), net foreign income (NFI) inflation (INFL) and GDP growth rate variables are all stationary at levels. For these variables, the ADF test statistics () **are above the critical values at the 5% confidence levels * in absolute terms at their levels.** Thus, for these variables, the null hypothesis of non stationarity is rejected. On the other hand, variables such as productivity (PROD), real effective exchange rate (REER), terms of trade (TOT), trade openness (OPEN), and foreign direct investment (FDI) are non-stationary at levels and thus, the null hypothesis (H_0) could not be rejected on them. Furthermore, the estimated Exchange rate misalignment series is also not stationary at levels. The ADF test statistic () **are less than the critical values at the 5% confidence levels * in absolute terms at their levels.** The implication of this result is that, spurious regressions could result if the data series are used in their levels to run the regressions. Thus, the estimated co-efficient parameters could be wrong, leading to wrong interpretations being made. In addition, the standard errors could be wrong, thus affecting the reliability of the co-efficient parameters for predictions. After first differencing of the series that are non-stationary at levels, they all become stationary. This indicates that all these variables are integrated to the same order, that is, first order integration $I(1)$ thus, paving the way for the use of Johansen cointegration test procedures.

4.2 Determinants of the Equilibrium Real Effective Exchange Rate (EREER).

From literature, the actual real effective exchange rate is observable while the equilibrium exchange rate is not. Thus, the equilibrium exchange rate has to be empirically estimated.

One of the specific objectives of this study is therefore to identify the fundamental determinants of the equilibrium real effective exchange rate. The single equation approach is used to model the determinants of the equilibrium exchange rate. The results obtained from the empirical procedures are presented in the subsections below:

4.2.1 Co-integration Test Results (MODEL 1)

After identifying the stationarity properties of the data sets employed in this study, the long-run relationship among the variables included in the equilibrium equation model was examined. The results obtained from the co-integration tests on these variables are presented in tables 2 and 3 below.

Series included: REER, TOT, OPEN, GOE, RRIR, and NFI.

Table 4.2: Results of Co-Integration Rank Test (Trace)

Null Hypothesis No. CE(s)	Eigenvalue	Trace Statistic	5% critical Value	Probability Value (P-value)
None*	0.950758	182.9416	125.6154	0.0000
At most 1	0.701934	89.60060	95.75366	0.1230
At most 2	0.514784	52.07697	69.81889	0.5460
At most 3	0.422085	29.65901	47.85613	0.7362
At most 4	0.238517	12.66084	29.79707	0.9064
At most 5	0.124990	4.213735	15.49471	0.8855
At most 6	0.002404	0.074607	3.841466	0.7847

Table 4.3: Results of Co-Integration Rank Test (Maximum Eigenvalue)

Null Hypothesis No. CE(s)	Eigenvalue	Max-Eigen Statistic	5% critical Value	Probability Value (P-value)
None*	0.950758	93.34101	46.23142	0.0000
At most 1	0.701934	37.52363	40.07757	0.0944
At most 2	0.514784	22.41797	33.87687	0.5753
At most 3	0.422085	16.99816	27.58434	0.5801
At most 4	0.238517	8.447108	21.13162	0.8743
At most 5	0.124990	4.139128	14.26460	0.8444
At most 6	0.002404	0.074607	3.841466	0.7847

Presented in the tables above (4.2 and 4.3) depict the outcome of the Co-integration tests conducted for the variables in the single equation model. Outcomes from both tests (i.e. the Trace test and Rank test) show evidence of co-integration equation among the variables. In both cases the null hypothesis of no-existence of co-integration is rejected as indicated by (*) at none. The two tests further corroborate the existence of at most 1 co-integrating vectors among the series because both test fail to reject null of at most 1 co-integration vector. These tests suggest two relevant issues. Firstly, series in this model have long-term associationship and short run noise will be brought back to equilibrium. Secondly, cointegration literally implies at least a unidirectional causality among the data series. This property of the data series affords the researcher the opportunity to determine the appropriate model to be used in estimating the long-run indicators of the equilibrium forex rate.

4.2.2 Long –Run Determinants of the Real Equilibrium Exchange Rate

Table 4.4 Results of Long-run (normalized Co-Integration Co-efficient)

The dependent variable is REER			
Variable	Co-efficient	t-statistic	Standard error
Constant	13.79481		
LogTOT(-1)	-1.204253**	-9.65776	0.12469
LogOPEN(-1)	0.046281	0.87935	0.05263
LogPROD (-1)	-5.160913**	-10.3179	0.50019
LogGOE (-1)	1.691440**	8.62401	0.19613
LogRRIR (-1)	-1.021577**	-13.9376]	0.07330
NFI (-1)	-0.322550**	-32.3350	0.00998

Note ** denotes significance at 5 percent levels.

Findings from the long-term estimates indicate that, GOE, RRIR, and NFI all have their estimated coefficients carrying their expected signs and were statistically significant (see **t-statistic**), corroborating the authors' a priori expectations.

Specifically, a 10% increase in the one period lag of government consumption expenditure lead to a corresponding appreciation of approximately 17% in the average value of equilibrium exchange rate and is significant at 5% significance level. The results corroborate what was observed by (Kwakye, 2012; Daboh, 2010; Aguirre and Calderón, 2005; Sackey, 2002). This result, thus, supports the part of literature that asserts that when government expenditure is directed more towards non-tradables it has an appreciating effective on the real exchange rate. Thus, the results suggest that Ghana government's expenditure has been directed more towards the non-tradables goods sector over the period.

This results is however inconsistent with what Daboh (2010) observed for Ghana. He observed a negative (depreciating) impact of government expenditure on real exchange rate, thus, supporting the alternative view that tradables receive the most part of government expenditure in Ghana.

The results from the long run estimates also indicate a depreciating impact of real relative interest rate on the real exchange rate. That is, a 10 percentage point increase in the one period lag values of the real relative interest rate causes the average value of the real exchange rate to depreciate by 10.02 percentage points. This result corroborates the preponderance of literature that suggests that capital flows resulting from rising real relative interest rate is skewed towards the tradable goods sector. The study of Kwakye (2012) arrives at a similar result. This finding is however contrasted by the work of Iossifov and Loukoianova (2007) who rather observe an appreciating impact of real relative interest rate on real exchange rate and thus, suggesting the opposite possible explanation.

In the case of the net foreign income (NFI), a one-unit upsurge in NFI causes the average value of real forex rate to depreciate by approximately 32 units annually. This results is also in support of the part of the literature which suggests that increases in the net flow of foreign income tends to be directed more towards the tradable goods sector putting more pressure on the domestic currency. In Ghana, most of these commodities classified within the tradables are imported and this increases the demand for foreign currencies. This situation further weakens the domestic currency relative to the major foreign currency and thus, a depreciation of the real exchange rate. This finding is however in contradiction to what Ebaidalla (2014), observed in Sudan.

Furthermore, the TOT (An increase in the relative values of non- traded to tradables) contributes significantly to depreciation of the external real exchange rate. Thus, the so-called conventional Balassa-Samuelson effect appears not to be experienced in Ghana. The results presented in table 4.4 indicate specifically that a 10% improvement in the terms of trade will cause the mean values of the real exchange rate to depreciate by approximately 12% in the long-run. An increase in the TOT is thought to lead to an increase in national “wealth”. If so, then, an increase in the TOT is expected to result in an increase in domestic demand and hence relative prices of non-tradables. However, if the improvement in the terms of trade does not translate into wealth creation in productive sectors of the economy, the opposite effect could result. Furthermore, where the increase in domestic demand as a result of the improvement in the terms of trade is not met by supply from the non-tradable goods sector but rather the demand is shifted towards the tradable goods, a depreciating effect on the real exchange rate would be experienced. This appears to be the case with the results obtained for this study. This finding is largely inconsistent with early studies by Kwakye (2012), Daboh (2010) who carried out similar studies on Ghana but with different estimation periods and variables. However, the findings corroborate the work of Hiri (2014), who did a similar study in Algeria.

Contrary to the a priori expectation, Productivity has a negative and significant impact on the real exchange rate. It could be observed from the results in table 4.4 above that a 10% improvement in productivity will lead to a depreciation in the mean values of the real exchange rate of approximately 51% in the long-run. This finding corroborates the early explanation in the case of the terms of trade that the conventional Balassa-Samuelson effect

appears not be experienced in Ghana. MacDonald and Ricci (2001) opine that increases in productivity and competitiveness of the distribution sector (relative to that of foreign countries) cause RER appreciation (as predicted by Harrod-Balassa-Samuelson). They did not observe a similar trend in the case of the non-traded sector or when this sector served as channel for delivering commodities to the final consumer. There is therefore the possibility that the law of one price is not followed especially in the distribution sector and thus, the effect of productivity on the real exchange rate could be positive or negative. This finding also corroborates the earlier findings of Zhang (2001), who establishes a negative relationship between productivity and real exchange rate for china.

Moreover, trade openness has a positive but insignificant effect on the real exchange rate of the Ghana cedi. The results from this study as depicted in table 4.4 reveals that a 10% increase in the trade openness will result in an approximate appreciation in the mean value of the real exchange rate by 4%. In terms of elasticity, this result indicate that the mean values of the real exchange rate is inelastic to how much our economy is opened. This results is inconsistent with our a priori expectation. However, the results is not without economic explanation. One school of thought in the literature posits that, openness to trade may cause an increase in competition in the tradables sector and cause the relative price of tradables to fall. This will result in the appreciation of the real exchange rate. Whiles the findings from this study is in support of this theory, the impact is not significant confirming the inelastic nature of the relationship between the trade openness and real exchange rate. Thus, even though, this study suggests that opening up our economy to the outside world is likely to results in high levels of competition in the tradable goods sector and that will ultimately help the Ghana cedi to appreciate in value, the effect is not that significant in the

long-run. Ebaidalla, (2014) observes a positive but insignificant relationship between exchange rate misalignment (overvaluation) and economic growth in Sudan. His study indicates that the Sudanese currency was overvalued (appreciation) over the period of his study. Thus, an overvaluation leads to an improvement in the economic performance in the case of Sudan.

4.2.3 Short –run estimates (Error Correction Model)

Table 4.5 Results of the Error Correction Model

The dependent variable is the D(LOGREER)			
Variable	Co-efficient	t-statistic	P-value
Constant	-0.184194	-4.265901	0.0007
Δ LogREER (-1)	0.237868	1.034934	0.3171
Δ LogTOT(-1)	-1.422618***	-3.160857	0.0065
Δ LogOPEN(-1)	-0.341662	-1.162697	0.2631
Δ LogPROD(-1)	-4.170872*	-1.783939	0.0947
Δ LogGOE(-1)	0.029672	0.082295	0.9355
Δ LogRRIR(-1)	-0.245587**	-2.291780	0.0368
Δ NFI(-1)	-0.182346***	-3.587086	0.0027
ERROR TERM	-0.429732***	-3.823620	0.0017
R-Square	0.875709	Adjusted R-Square	0.751418
F-statistic	7.045641		0.000253

Note *, **, * denotes significance at 1%, 5% and 10% levels respectively, Δ is the first difference operator.**

Findings from the error correction model which reveals the short term determining factors of the equilibrium exchange rate are presented in the table above (4.5) above. Even though

the main focus of this study is on the long-run permanent values of the fundamental determinants that impact on the equilibrium exchange rate, important statistical features of the model warrant commenting on. The R-Square value of the overall model is approximately 88% with an adjusted R-square value of 75%. The F-Statistic is **(7.045641)** and its associated P-value is **(0.000253)** indicating that on annual basis, the model predicts over 88% of the total changes in the real effective exchange rate accurately all the time and the model fits the data very well. Further the overall acceptance of the model hinges on the sign of the stochastic correction term and its level of significance. A VECM model is admitted for predictions, if the sign of the co-efficient of the random disturbance term is negative and significant statistically. It could be observed that this condition is satisfied by the results presented in table 4.5. The error term is **(-0.429732)** with a P-value of **(0.00017)**. Finally, the error term shows the rate at which the imbalance between the long-term and the short run estimations can be removed. The findings obtained indicate that approximately 43% of the disequilibrium between the actual effective rate and the estimated equilibrium rate are corrected for annually. This implies that it will take approximately 2 years and four months for all the disequilibrium to be removed.

The short-run analysis depicts results that corroborates the a priori expectations. For instance, GOE, RRIR, NFI as well as OPEN all bear their expected signs in the short run. Interestingly, the short run dynamics show trade openness as well as the government's expenditure on consumption to be statistically insignificant. Also, the co-efficient of one period lag values of the dependent variable has a positive impact on the REER however insignificant. Similarly, the co-efficient estimates of TOT and PROD are negative as in the long-run situation however only TOT is significant at all levels of significance. This results

are largely consistent with the findings of most the empirical studies reviewed in this study. But as said earlier, the focus of this study is on the long-run determinants of the equilibrium real exchange rate as discussed above.

4.2.4 Model Adequacy and efficiency Diagnostic Test Results

To test for the efficiency of the models used in the estimation of the long-run and short run parameters of the determinants of the equilibrium real exchange rate equation, three separate residual diagnostic tests were performed on the residual term. The study tests for the existence or non-existence of **serial Correlation**, **Normality** and **Heteroskedasticity**.

The results are as presented below:

4.2.4.1 Serial Correlation/Autocorrelation Test Results

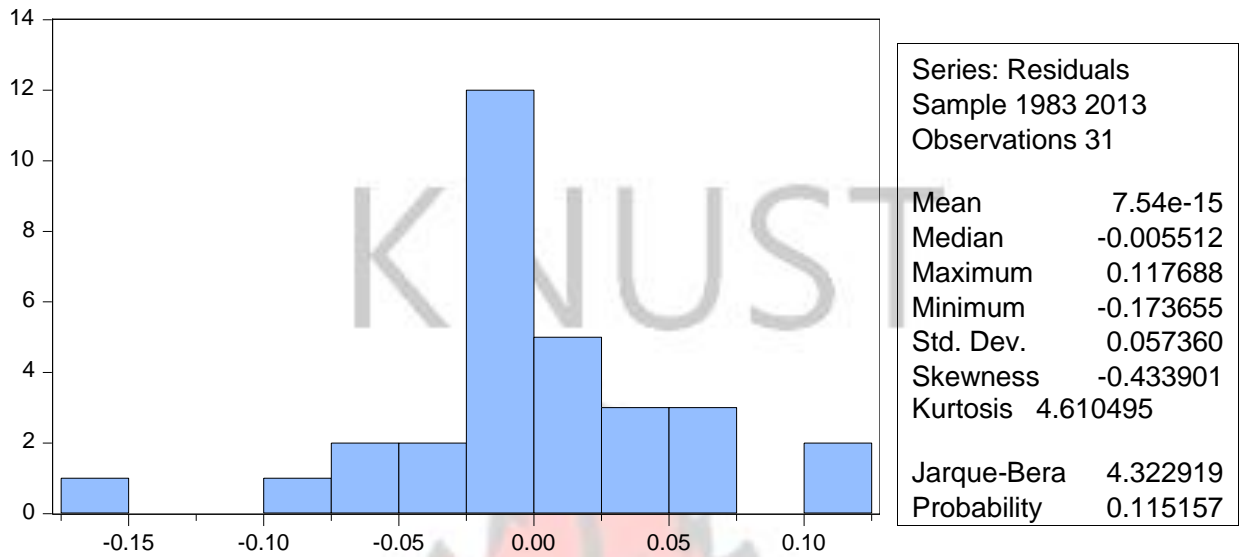
Table 4.6. Breusch-Godfrey serial correlation LM test results

F-statistic	0.060646	Prob. F(2,13)	0.9414
		Prob. Chi-	
Obs*R-squared	0.286561	Square(2)	0.8665

The results presented Table 4.6 indicate that the observed R square of the residuals is **0.286561** with a probability Chi-Square value of **0.8665**, which is more than 5% (i.e. 86.6%). Hence, the null hypothesis (H_0) that the residuals are free from autocorrelation cannot be rejected. It is thus, conclusive enough that data series are not autocorrelated.

4.2.4.2 Normality Test Results

Fig. 1: Normality test Results. Jarque- Bera statistic.



Revealed in the histogram above, is the fact that Jarque-Bera statistic is **4.322919** and the associated p-value is **0.1151574** (i.e. **11.5%**). Since the p-value is above the 5% threshold, the null (H_0) of normally distributed series cannot be rejected. A conclusion can therefore be drawn that the variables admitted in the VECM model are normally distributed.

4.2.4.3 Heteroskedasticity test: Breusch-Pagan-Godfrey Test Results.

Table 4.7: Heteroskedasticity Test results: Breusch-Pagan-Godfrey

F-statistic	1.121213	Prob. F(21,9)	0.4514
Obs*R-squared	22.42738	Prob. Chi-Square(21)	0.3753
Scaled explained SS	9.479261	Prob. Chi-Square(21)	0.9849

The outcome of the heteroskedasticity test depicted above (Table 4.7), suggests a nonrejection of the null (H_0). This indicates that the data series are homoskedastic. The observed R square is **2.42738** and it has a Chi-Square probability value of **0.3753**, which is

greater than 5% (i.e. 37.5%). Altogether, the model adequacy and efficiency tests performed on the residuals verifies that the data series are not autocorrelated, they are normally distributed and also homoskedastic thus suggesting that the model adopted satisfies the “BLUE” quality required of OLS models.

4.2. 5 Pairwise Granger Causality Test Results (MODEL 1)

Table 4.8 Pairwise Granger Causality Tests

Pairwise Granger Causality Tests		
Sample: 1980 2013		
Lags: 2		
Null Hypothesis: Obs	F-Statistic	Prob.
LOGTOT does not Granger Cause LOGREER 32	12.2839	0.0002
LOGREER does not Granger Cause LOGTOT	0.59080	0.5609
LOGPROD does not Granger Cause LOGREER 32	1.82645	0.1803
LOGREER does not Granger Cause LOGPROD	0.04125	0.9597
LOGOPEN does not Granger Cause LOGREER 32	22.5218	2.E-06
LOGREER does not Granger Cause LOGOPEN	0.19468	0.8242
LOGGOE does not Granger Cause LOGREER 32	3.44313	0.0466
LOGREER does not Granger Cause LOGGOE	3.68201	0.0385
LOGRRIR does not Granger Cause LOGREER 32	0.23686	0.7907
LOGREER does not Granger Cause LOGRRIR	0.78012	0.4684
NFI does not Granger Cause LOGREER 32	0.39457	0.6778
LOGREER does not Granger Cause NFI	3.58409	0.0416

The results of the Granger causality test as depicted in the table 4.8 above reveals substantial evidence of causal relationship among some of the variables included in the model.

Specifically, there is a uni-directional causality between the log of terms of trade (LogTOT) and log of real effective exchange rate (LogREER). Given the F-statistic of 12.2839 with the associated P-Value of 0.0002 ($P\text{-value} \leq 5\%$) the null hypothesis that LogTOT does not Granger-cause LogREER is rejected. However, the null hypothesis that LogREER does not Granger-cause LogTOT could not be rejected since the test has an Fstatistic of 0.59080 with a P-value of **0.5609** which is far greater than 5% ($P\text{-value} = 56\%$).

Furthermore, the results indicate non-existence of causal relationship between the log of PROD and the Log of REER in either direction. The F-statistic and the associated P-values are insignificant in the pair and thus, the null hypothesis in both instances could not be rejected.

Also, there is a uni-directional causality between the log of trade openness and the log of real effective exchange rate. The transmission channel is from log of openness to log of real effective exchange rate. Thus, prior values of trade openness together with lagged values of real effective exchange rate helps to predict the future values of the real effective exchange rate better. However, the null hypothesis that log of real exchange rate does not Granger-cause log of openness could not be rejected since the F-statistic and the associated P-value is insignificant at the 5% confidence levels.

Moreover, there is a bi-directional causality between the log of government consumption expenditure and the log of real effective exchange rate. In both tests, the null hypothesis is rejected since the F-statistics and their associated P-values are significant at the 5% confidence levels. Thus, prior values of both government consumption expenditure and real effective exchange rate help in predicting the future values of both variables better when lagged values of both variables are included in the models.

Detailed results of the casual relationship among the other variables are presented in the appendices (see appendix 6).

The results of the pairwise Granger causality tests corroborate the results of the cointegration tests where it is shown that there exists at least a unidirectional causality among the variables included in the models.

4.3 Estimation of Equilibrium Real Effective Exchange Rate (EREER) and Misalignment (EMIS)

Having identified the RER determinants, the equilibrium real effective exchange rate is estimated as in equation (9) and the RER misalignment is determined using equation (10).

The results are as shown in the table 4.6 below:

Table 4.9 Results of equilibrium REER and Misalignment (EMIS)

Year	REER	EREER	EMIS	% EMIS	REMARKS
1980	2.888801	3.039966	-0.04973	-4.973	Undervaluation
1981	3.228367	3.029619	0.065602	6.5602	Overvaluation
1982	3.328278	3.019541	0.102246	10.2246	Overvaluation
1983	3.562842	3.010254	0.183569	18.3569	Overvaluation
1984	2.749637	3.002209	-0.08413	-8.413	Undervaluation
1985	2.60855	2.99563	-0.12921	-12.921	Undervaluation
1986	2.411001	2.990541	-0.19379	-19.379	Undervaluation
1987	2.285216	2.986908	-0.23492	-23.492	Undervaluation
1988	2.240235	2.984675	-0.24942	-24.942	Undervaluation
1989	2.210878	2.983732	-0.25902	-25.902	Undervaluation
1990	2.20774	2.983882	-0.26011	-26.011	Undervaluation
1991	2.21661	2.984819	-0.25737	-25.737	Undervaluation

1992	2.162079	2.986119	-0.27596	-27.596	Undervaluation
1993	2.103567	2.987372	-0.29585	-29.585	Undervaluation
1994	2.012004	2.988297	-0.32671	-32.671	Undervaluation
1995	2.074591	2.988894	-0.3059	-30.59	Undervaluation
1996	2.110674	2.989287	-0.29392	-29.392	Undervaluation
1997	2.135157	2.989597	-0.2858	-28.58	Undervaluation
1998	2.163415	2.989933	-0.27643	-27.643	Undervaluation
1999	2.158043	2.990414	-0.27835	-27.835	Undervaluation
2000	1.973828	2.991057	-0.34009	-34.009	Undervaluation
2001	1.97858	2.991694	-0.33864	-33.864	Undervaluation
2002	1.976774	2.991966	-0.33931	-33.931	Undervaluation
2003	1.977815	2.991519	-0.33886	-33.886	Undervaluation
2004	1.971821	2.989916	-0.34051	-34.051	Undervaluation
2005	2.010258	2.986663	-0.32692	-32.692	Undervaluation
2006	2.032568	2.981214	-0.31821	-31.821	Undervaluation
2007	2.029627	2.973156	-0.31735	-31.735	Undervaluation
2008	2.008267	2.962286	-0.32206	-32.206	Undervaluation
2009	1.972087	2.948763	-0.33122	-33.122	Undervaluation
2010	2	2.932842	-0.31807	-31.807	Undervaluation
2011	1.977708	2.915133	-0.32157	-32.157	Undervaluation
2012	1.948914	2.896313	-0.32711	-32.711	Undervaluation
2013	1.951091	2.876992	-0.32183	-32.183	Undervaluation

The results as presented in the table 4.9 above shows proof of misalignment in the real exchange rate from its equilibrium level. Beginning from a position of undervaluation in 1980, where the Cedi experienced a misalignment of approximately 5% undervaluation, the real value of the cedis was overvalued between 1981 and 1983 against its equilibrium levels.

Specifically, there was overvaluation of approximately 7%, 10% and 18% from 1981 to 1983 respectively. Thus the maximum overvaluation of the cedi for the study period occurred in 1983 while the minimum overvaluation occurred in 1981.

This result is consistent with what Kwakye (2012) also observed for Ghana during the same period. He opines that the period of overvaluation witnessed fixed nominal exchange rate being grossly overvalued due to high inflation, general economic instability, and severe economic distortions as characterized by the general economic hardship the nation endured during that period. From 1984 to the end of the study period, the real exchange rate has been undervalued relative to its equilibrium levels as can be seen from the table above. This is as a result of steps taken by successive government to curtail the severe economic hardship the country experienced in between the period of 1981 and 1983 (Kwakye, 2012)

From 1984 to the end of the study period, the results indicate that the cedi has been undervalued in relation to its equilibrium value as estimated. Starting from an undervaluation of approximately 8% in 1984, the cedi shows a continuous depreciation (undervaluation) at an increasing rate up until 1991 where the percentage misalignment fell from 26% undervaluation in 1990 to 25.7% in 1991. From 1992 where Ghana began her democratic journey, the extent of the misalignment (undervaluation) has been somewhat unstable. From the year 2000 coming, the extent of misalignment has generally been high compared to the previous periods understudied. The minimum undervaluation from the year 2000 to the end of the study period is 31.7% which occurred in the year 2007, a year prior to an election and the highest undervaluation recorded is 34.051 recorded in 2004 which was an election year. Generally, the misalignments recorded for the election years has been

high. This reflects the common phenomena of successive governments spending out of budget during electioneering periods without any regard for macroeconomic prudence and any negative implications on the economy after the elections.

On a whole, the misalignment in the real value of the Ghana cedi has had a depreciating effect on the Ghana cedi over the study period. However, none of the years understudied had a misalignment of up to 40%. This, may mean that the Ghana cedi's under and over valuation has not been that severe.

4.4 The Impact of Real Exchange Rate Misalignment on Gross Domestic Product (GDP) Growth Rate.

The main aim of this study is to empirically examine the impact of real effective exchange rate misalignment on the economic performance of Ghana. Having generated the misalignment series, the growth-misalignment relationship is investigated as in equation (11). The results of the various procedures are depicted as in the subsequent sections below.

4.4.1 Co-integration Test. (MODEL 2)

Since more than one variable is used in this model, a test of the long-run relationship or associationship among the data series is conducted. The Johansen and Juselius (1990) maximum likelihood (ML) test is adopted and the results for this model are presented below.

Series included: GDP LOGTOT LOGFDI LOGGOE LOGOPEN
LOGINFL EMIS

Table 4.10 Co-integration Rank Test (Trace)

Null Hypothesis No. CE(s)	Eigenvalue	Trace Statistic	5% critical Value	Probability Value (P-value)
None*	0.950758	182.9416	125.6154	0.0000
At most 1	0.701934	89.60060	95.75366	0.1230
At most 2	0.514784	52.07697	69.81889	0.5460
At most 3	0.422085	29.65901	47.85613	0.7362
At most 4	0.238517	12.66084	29.79707	0.9064
At most 5	0.124990	4.213735	15.49471	0.8855
At most 6	0.002404	0.074607	3.841466	0.7847

Table 4.11 Co-integration Rank Test (Maximum Eigenvalue)

Null Hypothesis No. CE(s)	Eigenvalue	Max-Eigen Statistic	5% critical Value	Probability Value (P-value)
None*	0.804515	52.23272	46.23142	0.0102
At most 1	0.701821	38.72198	40.07757	0.0705
At most 2	0.569173	26.94555	33.87687	0.2663
At most 3	0.386322	15.62509	27.58434	0.6974
At most 4	0.331252	12.87516	21.13162	0.4638
At most 5	0.206927	7.418865	14.26460	0.4408
At most 6	0.080710	2.692905	3.841466	0.1008

Tables 4.10 and 4.11 shows the results of the Co-integration tests on the variables that are included GDP growth-Misalignment model. It could be seen from tables 10 and 11 that whereas the trace test indicates the existence of 2 co-integration equations among the variables, the rank test indicates one co-integration equation. What is conclusive from these tests is that there exists at most one co-integration equation among the variables in this model. This literally implies that there exist at least a unidirectional causality among the data series.

4.4.2 Impact of Exchange Rate Misalignment on GDP growth rate (long-run and short-run estimates)

The main aim of this study is to empirically investigate the impact of exchange rate misalignment on economic growth in Ghana. The results obtained from the long-run as well as the short run estimates of the relationship between economic growth as measured by the GDP growth rate and the regressors are presented and discussed below.

Table 4.12 Results of Long-run (normalized Co-Integration Co-efficient)

The dependent variable is GDP			
Variable	Co-efficient	t-statistic	Standard error
Constant	-180.3165		
LogTOT(-1)	7.343121	1.34313	5.46717
LogOPEN(-1)	6.872066	1.41606	4.85293
LogINFL (-1)	29.01842**	6.13899	4.72690
LogGOE (-1)	98.91462**	9.31526	10.6186
LogFDI(-1)	-2.909493**	-2.66203	1.09296
EMIS(-1)	-17.42268	-1.26890	13.7305

Note ** denotes significance at 5 percent levels.

The results from table 4.12 depicts the long-run estimates of the relationship between GDP growth rate and its determinants. The results confirm most of the a priori expectations put forward by the author. For instance, Terms of trade, trade openness, government expenditure, and the misalignment all carried their expected signs in the long run. Only inflation and foreign direct investment went contrary to the author's expectations.

The results from table 4.12 indicate that, when the one period lag values of the terms of trade improves by 10%, it will lead to a corresponding increase in the mean values of the GDP growth rate by approximately 73%. Thus, there is an elastic relationship between terms of trade and the GDP growth rate of Ghana. This implies that if the terms of trade between Ghana and its trading partners deteriorates by 10 percentage points, the economic growth rate will slow down by 73 percentage points in the long-run. However, the impact on the economy is not statistically significant (see **t-statistic**). The result corroborates earlier study by Abida (2010) for the three Maghreb countries where, he also finds a positive but insignificant impact of terms of trade on economic performance. A possible explanation could be sort from the economic theory of productivity expansion and technological improvement. It is argued that releasing the balance-of-payments restrictions and the expansion of the production set, improvements in a country's TOT would results in growth in GDP. This means that there is a positive associationship between TOT and GDP. An upsurge in relative price of exported commodities enlarges the possible set for buying larger quantities of production inputs, and for investing in productivity-enhancing events such as adopting more technologically efficient production processes. Ghana over the years has witness significant improvement in our exports through the expansion of the export based. Previously our main export commodities were limited to Gold, Cocoa, and Timber.

However, there has been a surge in the export of non-traditional export commodities in recent years which might have helped in the positive relationship. Furthermore, there has been an improvement in the methods of production in most of the industries and efficiency appears to have improved also. The insignificant nature of this relationship suggests that Ghana still has a lot to do if we are to enjoy the full benefits of better terms of trade with our trading partners. It suggests that our export base is still not large enough to bring significant gains from better terms of trade. Numerous research reports corroborate this hypothesis of a 'positive growth effect' of TOT, and this includes studies by Bleaney and Greenaway, (2001), Deaton, (1999) and Deaton and Miller (1996). This finding is however inconsistent with Sallenave (2010) who conducts a similar study for the G20 countries. He finds a negative but insignificant effect between terms of trade and GDP per capita on the G-20 countries. This result may thus suggest that developing countries stand to benefit more from better terms of trade than their developed partners.

Furthermore, government expenditure has a positive and significant impact on the GDP growth rate. From table 4.12, it is observed that a 1% rise in the government's consumption expenditure in the previous year will lead to an approximate increase in the average values of the GDP growth rate by 99% in the long run. This finding is largely consistent with studies by; Ebaidalla, (2014); Sallenave, (2010); Aguirre and Calderón (2005); Razin and Collins (1997). On the contrary, the findings of Abida (2010) do not support the results of this study. He observed a negative but insignificant relationship between government consumption expenditure and economic growth. The theoretical explanation for such a positive relationship is given by the economic growth equation $GDP = C + I + G + (X-M)$. Where C; represents household consumption expenditure,

I; represents Firms expenditure, G; represents Government consumption expenditure and (X-M) represents net export. Thus, there exist a theoretically positive relationship between Government consumption expenditure and GDP (Bernanke and Robert, 2001). Thus, when government's expenditure is directed towards the productive sectors of the economy, it impacts positively on the GDP growth. For Ghana, our recent engagements with the IMF has put a strand on the government's ability to spend on wasteful and pet projects that does not benefit the economy as a whole. Stringent measures and restrictions imposed on the government by foreign aid partners has also contributed in the recent shift in the government expenditures towards more productive sectors. The recent focus on road construction, improvement in rural electrification, etc. might have contributed to the observed long-term positive relationship between the government expenditure and GDP growth rate.

Moreover, the results from the long run estimates show a positive and significant long-run relationship between inflation and GDP growth rate. Specifically, the results as presented in the table 4.12 indicate that a 1% increase in the one period lag values of inflation will lead to a corresponding increase in the mean value of GDP growth rate by approximately 29% on annual basis. This finding corroborates earlier results by Agalega and Acheampong (2013) who studied the impact of inflation among other policy variables, on GDP growth rate in Ghana. They used data covering the period of 1980 to 2010 to establish a long-run positive relationship between inflation and GDP growth rate. Mallik et al (2001) also arrived at similar conclusion on the impact of inflation on economic growth among four South Asian countries. This finding, thus, support that part of literature which argues that

Inflation and GDP move together. The literature observes that during periods of high inflation, especially, the demand pull, inflation could lead to increase in demand for goods and services; this could lead to increase in productivity and for that matter increasing the GDP consequently. Also, periods of mild inflation or decreased inflation could lead to a fall in the demand for most goods and services and for that matter, a decrease in productivity of factors of production and this could consequently result in a fall in the GDP growth rate.

Again, opening the economy of Ghana up to foreign partners appears to contribute positively to the GDP growth rate of Ghana. The results as presented in table 4.12 suggest that when the economy is opened to our trade partners by 1% it leads to a corresponding increase in the average growth rate of the economy by approximately 7% in the long-run.

However, the impact is not statistically significant. This results is consistent with the works of Sallenave, (2010) and Abida, (2010) who also obtained similar results in their respective studies. Ebaidalla (2014), also observes a positive relationship between trade openness and economic growth in Sudan, but for his study, he observed a significant relationship. The implication of this result is that Ghana stands to lose by closing its economy from its trading partners. Even though Ghana has not significantly benefited from trade relations with other countries, the economy of Ghana is import led, meaning we depend more on the other countries for most of our needs and wants as a country. We have not been able to grow our economy to a level that will enable us to be self-sufficient. Basic commodities which could have been produced locally are imported. This development suggests that Ghana needs the foreign partners more than they do. Hence opening the Ghanaian economy up to the outside world appears to benefit our economy and hence the positive relationship between trade openness and GDP growth rate.

Contrary to the author's a priori expectation, the sign of FDI is negative. This implies that improvement in the inflows of foreign direct investments into the country has not have any positive impact on the economy. Specifically, the results as presented in the table 4.12 suggest that when the inflows of FDI into Ghana improves by a 10 percentage points, it leads to a fall in the mean value of the GDP growth rate significantly by approximately 29% in the long-run. This results is particularly interesting considering the fact that Ghana continues to encourage more foreign investment into the country. However, a closer look at the direction of most of the FDIs into Ghana may support this finding. Firstly, FDI inflows to the country have generally been very minimal probably below the threshold that can generate the needed growth impacts (Frimpong and Oteng, 2006). Secondly, that over 70% of foreign direct investments inflows has been directed toward the mining sector of the Ghanaian economy (Ibrahim, 2005). These mining activities most often than not destroy agricultural lands and other natural resources such as the pollution of water bodies and breeds of pollution related diseases which costs the country huge sums of money to curtail. Meanwhile, the bulk of the profits from these mining sector are repatriated by these foreign companies without being channeled to other efficient seeking sectors of the Ghanaian economy. Considering the economic disposition of the Ghanaian economy coupled with the situation whereby the mining sector has not been able to create the required linkages to propel the growth process, it is expected that much of the inflows have to be refocused to the manufacturing and agricultural sector in order economy to accrue positive benefits from FDI inflows.

Finally, on the main variable of interest, the study shows that misalignment of the Ghanaian cedi, that is, a deviation of the real value of the Ghana cedi from its equilibrium value has

a negative impact on the Ghanaian economy in the long run. The misalignment of the Ghana cedi generally shows undervaluation (depreciation) of the cedi against its major trading foreign currencies. Thus, a deterioration of the Ghana cedi has a long term injurious but insignificant effect on the Ghanaian economy. The results of the long run estimate indicate that a 1 percentage point depreciation of the Ghana cedi could cause a corresponding fall in the mean value of the GDP growth rate by approximately 17 percentage points in the long run. This reveals an elastic and inverse relationship between exchange rate misalignment and GDP growth rate. Sallenave (2010) on his part, observes a negative and significant impact of exchange rate misalignment on economic performance when he evaluates the growth effects of real effective exchange rate misalignments for the G20 countries over the period 1980-2006. Abida (2010), also observes a negative and significant effect of the real exchange rate misalignment and economic growth when he used the GMM dynamic panel estimation method to investigate the long-run growth effect of misalignment on economic performance for the three Maghreb countries (Tunisia, Algeria and Morocco) over the period 1980-2008.

Aguirre and Calderón (2005) also observe a similar association between misalignment and economic growth when they investigate studied the growth effects of real exchange rate (RER) misalignments and their volatility for 60 countries over the period of 1965-2003. Their results indicate the existence of an adverse and significant association between growth and RER misalignment. The results of this study is thus, consistent with most of the existing empirical evidence from other countries. Even though the impact appears not to be statistically significant, the country cannot afford to ignore the negative impact. A closer look at the misalignment series suggests that none of the years understudied had the estimated misalignment series to be more than 35% on annual basis. Thus, the real exchange

rate deviations from its equilibrium has generally fallen below 35%. This might have contributed to the insignificant nature of the impact. However, the depreciation of the Ghana cedi cannot be allowed to continue since a further depreciation in the long term beyond the current threshold of approximately 35% could have a very significant deteriorating impact on the Ghanaian economy.

Table 4.13 Results of the Error Correction Model

The dependent variable is the D(GDP)			
Variable	Co-efficient	t-statistic	P-value
Constant	0.769498	1.765404	0.0978
Δ GDP(-1)	0.050694	0.217234	0.8310
Δ LogTOT(-1)	8.150246	0.713559	0.4865
Δ LogOPEN(-1)	14.94802***	2.101424	0.0529
Δ LogINFL(-1)	4.007872	1.540289	0.1443
Δ LogGOE(-1)	0.029672	0.082295	0.9355
Δ LogFDI(-1)	-2.846289	-1.469084	0.1625
Δ EMIS(1)	-16.42234***	1.731745	0.1038
ERROR CORRECTION TERM		-2.875375	0.0116
	-0.213644**		
R-Square	0.799534	Adjusted RSquare	0.599068
F-statistic	3.988375		0.005523*

Note *, **, * denotes significance at 1%, 5% and 10% levels respectively, Δ is the first difference operator.**

The results from the short run estimates in table 4.13 mimics that of the long run estimates in table 4.12. All the variables are in their first difference since some of the series were non-stationary at levels. All the variables have signs that are consistent with the long run

estimates. For instance, the term of trade has a positive though insignificant effect on the measure of economic performance. A one percentage point improvement in the terms of trade in the short run leads to a corresponding increase in the mean value of the GDP growth rate by approximately 8 percentage points in the short run. Interestingly, opening the Ghanaian economy to the outside world has a positive and statistically significant impact on the economy in the short run. Thus, a one percentage increase in trade openness results in a corresponding increase in the average GDP growth rate by some 15% in the short term. On the main variable of interest, that is, the exchange rate misalignment series, there also exists a negative relationship between the misalignment variable and GDP growth rate. Thus, the depreciation of the Ghana cedi slows down economic growth both in the long term and the short term.



CHAPTER FIVE

SUMMARY OF FINDINGS, CONCLUSION AND RECOMMENDATIONS

5.1 Introduction

The main aim of this study was to investigate the impact of real exchange rate misalignment on economic performance in Ghana. Specifically, the research sort to investigate the longrun determinants of the equilibrium real exchange rate, the nature and extent of the misalignment and finally, the impact of the misalignment on the economic growth rate of Ghana. The major findings from the various econometric procedures adopted for the study are summarized in the subsections below. This is followed by the general conclusion from the study and recommendations for further studies as well as policy implications.

5.2 Summary of findings from the study

The findings from the empirical studies conducted are presented in the line with the specific objective which the study sort to achieve.

Among the several economic variables that could potentially impact on the equilibrium real exchange rate, the study included terms of trade (TOT), trade Openness (OPEN), Productivity (PROD), government consumption expenditure (GOE), relative real interest rate (RRIR) and net foreign income (NFI) in the single equation econometric model to identify the long run determinants of the equilibrium real exchange rate. It was find out that terms of trade, productivity, relative real interest rate and the net foreign income all have a negative and significant impact on the equilibrium exchange rate. On the other hand, government consumption expenditure and trade openness were observed to have a positive impact on the equilibrium real exchange rate but only government expenditure had

significant long run impact. Thus, the equilibrium real exchange rate is determined in the long run by fundamental variables such as the terms of trade, government consumption expenditure, productivity, net foreign income as well as the real relative interest rate except for trade openness which has no significant effect. These findings are largely consistent with those of (Kwakye, 2012; Daboh, 2010; Aguirre and Calderón, 2005; Sackey, 2002 etc.).

The findings from the study indicates that there is a misalignment of the Ghanaian currency over the study period. That is, over the entire period of the study, the actual real effective exchange rate deviates from its equilibrium value. The actual value of Ghanaian currency was overvalued between 1981 and 1983 against its equilibrium levels. A finding also observed by Kwakye, (2012). The study further observed that the Ghanaian currency was undervalued for the majority of the study period. Thus, apart from the period between 1981 and 1983 where the currency was overvalued, the currency was undervalued for the remainder of the study period. The minimum undervaluation from the year 2000 to the end of the study period is 31.7% which occurred in the year 2007, a year prior to an election and the highest undervaluation recorded is 34.051 recorded in 2004 which was an election year. Generally, the misalignments recorded for the election years has been high. This reflects the common phenomena of successive governments spending out of budget during electioneering periods without any regard for macroeconomic prudence and any negative implications on the economy after the elections. On a whole, the misalignment in the real value of the Ghana cedi has had a depreciating effect on the Ghana cedi over the study period. However, none of the years understudied

had a misalignment of up to 40%. This, may mean that the Ghana cedi's under and over valuation has not been that severe on annual basis.

The thrust of this study was to investigate the impact of exchange rate misalignment on economic performance. The indicator for economic performance is the Gross Domestic Product (GDP) growth rate. It is find out that exchange rate misalignment has a negative impact on economic performance in Ghana both in the long-run and the short-run. Even though the impact is not significant for now, the country cannot continue to watch over the cedi's depreciation since a further depreciation beyond the current misalignment of 34% might have a significant impact on the economy.

On the other control variables, an interesting result was obtained for the FDI variable. It was observed that increases in FDI have not had any positive impact on the Ghanaian economy. The results rather indicates an adverse effect of FDI on the economic growth rate in Ghana. It is observed that FDI inflows into the country has not been enough presumably below the level that could stimulate the expected growth impacts (Frimpong and Oteng, 2006). Secondly, that over 70% of foreign direct investments inflows has been directed toward the mining sector of the Ghanaian economy (Ibrahim, 2005) and this might have contributed to the negative impact. The other variables have impacts that are largely consistent with economic theory as discussed.

5.3 Conclusion

This study used fundamental variables to model the impact of exchange rate misalignment on economic performance in Ghana over the period of 1980 to 2013. The study first

identifies the long run determinants of the equilibrium exchange rate based on which the equilibrium exchange rate as well as the misalignment series were estimated empirically. The misalignment series is then modeled within the framework of other control variables to investigate the impact of the misalignment on economic performance. The revealed that the equilibrium real exchange rate in Ghana is determined by the fundamental variables such as, productivity, terms of trade, trade openness, government expenditure, relative real interest rate, and Net Foreign Income. Specifically, all the variables in the model except openness have long run significant impacts on the equilibrium real exchange rate. The study also reveals a substantial misalignment in the real effective exchange rate against its equilibrium level. Apart from 1981 -1983, where there was overvaluation, the remainder of the study period witnessed undervaluation suggesting that the Ghana cedi has been depreciating on annual basis over the study period. The study also point out that the equilibrium real exchange rate has followed a declining path over the period of study. This pattern means that the combined effect of the fundamental factors depreciating the equilibrium exchange rate outweighs the possible effect of any appreciation in the equilibrium exchange by other factors.

Finally, the study has shown that the depreciation of the Ghana cedi has a negative impact on economic performance both in the short run and the long run. It is also evident from this study that, movement in the fundamentals hold the key to explaining the depreciation of the Ghana cedi as over 88% of the variation in the real exchange rate is explained by the fundamental variables included in the single equation model.

5.4 Recommendations

1. This study has shown that fundamental variables such as terms of trade, productivity, real relative interest rate, government expenditure etc. determine the movement of the real exchange rate. The government's economic policy strategies be focused on strengthening the economy's fundamentals such as productivity, terms of trade, better trade policies, attracting more inflows of foreign income etc. with sustained macroeconomic stability and growth being at the center.
2. Ghana is an import led country and for that matter, the depreciation of the Ghana cedi has not yield any economic dividend for the country as shown by the negative impact of the undervaluation on GDP growth rate in this study. Thus, policy measures aimed at reducing significantly, the importation of certain commodities which can be profitably produced in Ghana is encouraged.
3. Furthermore, the estimation of the equilibrium exchange rate and for that matter the misalignment is model dependent. Further studies should be conducted using the PPP as well as approaches other than the single equation method. This will help in ensuring the robustness of various estimation procedures and hence the one to be adopt for Ghana.

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Null Hypothesis: D(TOT) has a unit root

Exogenous: Constant, Linear Trend
Lag Length: 1 (Automatic - based on SIC, max lag=4)

Test critical	1%	4.28458	t-Statistic b.* values:	level	0	Pro
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5%	3.56288	Augmented Dickey -Fuller test	0.00	level 2	statistic -7.114173	00
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Test critical values:	1% level	-4.296729
5% level	-3.568379	-
10% Augmented Dickey-Fuller	5.21558	0.001 level -3.218382 test statistic 1

Test critical values:	1% level	4.28458
	level	0

*MacKinnon (1996) one-sided p-values.

5% level	3.56288
level	2
10% level	7

Null Hypothesis: OPEN has a unit root

Exogenous: Constant, Linear Trend Lag Length: 0 (Automatic - based on SIC, max lag=4)

t - Prob. Statistic *

Augmented Dickey-Fuller test statistic	1.71049	0.723
	8	9

Test critical values:	1% level	4.26273
	level	5

*MacKinnon (1996) on e-sided p values.

5% level	3.55297
level	3
10% level	3.20964
level	2

Null Hypothesis: D(OPEN) has a

unit root

Exogenous: Constant, Linear Trend Lag Length: 1 (Automatic - based on SIC, max lag=4)

*MacKinnon (1996) one-sided p-values.

KNUST

Null Hypothesis: GOE has a unit root

Exogenous: Constant, Linear Trend Lag Length: 1 (Automatic - based on SIC, max lag=4)

	t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic	-3.883352	0.0247
Test critical values:		
1% level	-4.273277	
5% level	-3.557759	
10% level	-3.212361	

*MacKinnon (1996) one-sided p-values.

Null Hypothesis: D(GOE) has a unit root

Exogenous: Constant, Linear Trend

	t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic	-4.83683	0.00
Lag Length: 4 (Automatic - based on SIC, max lag=4)		

Test critical values:	1% level	4.32397	9	10% level	3.21526	7
	5% level	3.58062	3			
	10% level	3.22533	4			

(1996) one-sided p values.
 *MacKinnon (1996) one-sided p values.

Null Hypothesis: D(PROD) has a unit root
 Exogenous: Constant, Linear Trend Lag Length: 0 (Automatic - based on SIC, max lag=4)

Null Hypothesis: PROD has a unit root

Exogenous: Constant, Linear Trend
 Lag Length: 2 (Automatic - based on SIC, max lag=4)

	t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic	1.693783	1.0000

Test critical values:	1% level	4.28458	0
	5% level	3.56288	2

		t-Statistic *	Prob.		
		-			
Augmented Dickey-Fuller test statistic		3.57921	0.0478	Exogenous: Constant, Linear Trend Lag Length: 0 (Automatic - based on SIC, max lag=4)	
Test critical values:		4.27327		t-Statistic *	
1% level		7			
5% level		3.55775			
10% level		3.21236		Augmented Dickey-Fuller test statistic	
*MacKinnon (1996) one sided p values.		-		9.58517	0.0000
				2	0
Test critical values:				4.26273	
1% level				5	

Null Hypothesis: RRIR has a unit root

Null Hypothesis: NFI has a unit root -sided p -

Exogenous: Constant, Linear Trend
Lag Length: 1 (Automatic - based on SIC, max lag=4)

Null Hypothesis: D(EMIS) has a unit root

		t-Statistic	Prob. *	root
		-		Exogenous: Constant, Linear Trend
Augmented Dickey-Fuller test statistic		5.65062	0.0003	max lag=4)

		t-Statistic	Prob. *
Test critical values:		4.27327	
1% level		7	
Augmented Dickey-Fuller test statistic		3.75049	0.035
Lag Length: 4 (Automatic - based on SIC,			

5% level	3.55297	level 3	-	3.67017
10% level	3.20964	level 2	-	2.96397
*MacKinnon (1996) one-sided p-values.			Test critical values:	1% level
				2
				5% level
				2.62100
				7
				10% level

level	9	-	4.32397
10% level	3.21236	level 1	9
*MacKinnon (1996) one-sided p-values.			Test critical values:
			1% level
			3.58062
			3
			5% level
			3.22533
			4
			10% level
Null Hypothesis: EMIS has a unit root			
5%	3.55775	test statistic	0
			2

Exogenous: Constant Lag Length: 3 (Automatic - based on SIC, *MacKinnon (1996) one-sided p-max lag=4) values.

	t -	Prob.	
	Statistic	*	Null Hypothesis: INFL has a unit root
Augmented Dickey -Fuller test	0.1660		Exogenous: Constant, Linear Trend
statistic	0.965	01	Lag Length: 0 (Automatic - based on SIC, max lag=4)

		t-Statistic	Prob.*	5% level	3.55775 9
<hr/>					
				10% level	3.21236 1
<hr/>					
Augmented Dickey-Fuller test statistic		6.36176 7	0.000 0		
<hr/>					
Test critical values:	1% level	4.26273 5			
	5% level	3.55297 3			
	10% level	3.20964 2			

*MacKinnon (1996) one-sided pvalues.

Null Hypothesis: D(FDI) has a unit root
Exogenous: Constant, Linear Trend Lag Length: 0 (Automatic - based on SIC, maxlag=4)

*MacKinnon (1996) one-sided pvalues.

Null Hypothesis: FDI has a unit root

Exogenous: Constant, Linear Trend Lag Length: 1 (Automatic - based on SIC, maxlag=4)

		t-Statistic	Prob.*
<hr/>			
Augmented Dickey-Fuller test statistic		4.26566 5	0.010 2
<hr/>			
Test critical values:	1% level	4.27327 7	
	5% level	3.55775 9	
	10% level	3.21236 1	
<hr/>			
Augmented Dickey-Fuller test statistic		2.85822 0	0.188 6

Test critical values: 1% level 4.27327
7

*MacKinnon (1996) one-sided pvalues.

t- Prob.
Statistic *

Null Hypothesis: GDP has a unit root

-

Exogenous: Constant, Linear Trend
Lag Length: 0 (Automatic - based on SIC
lag=4)

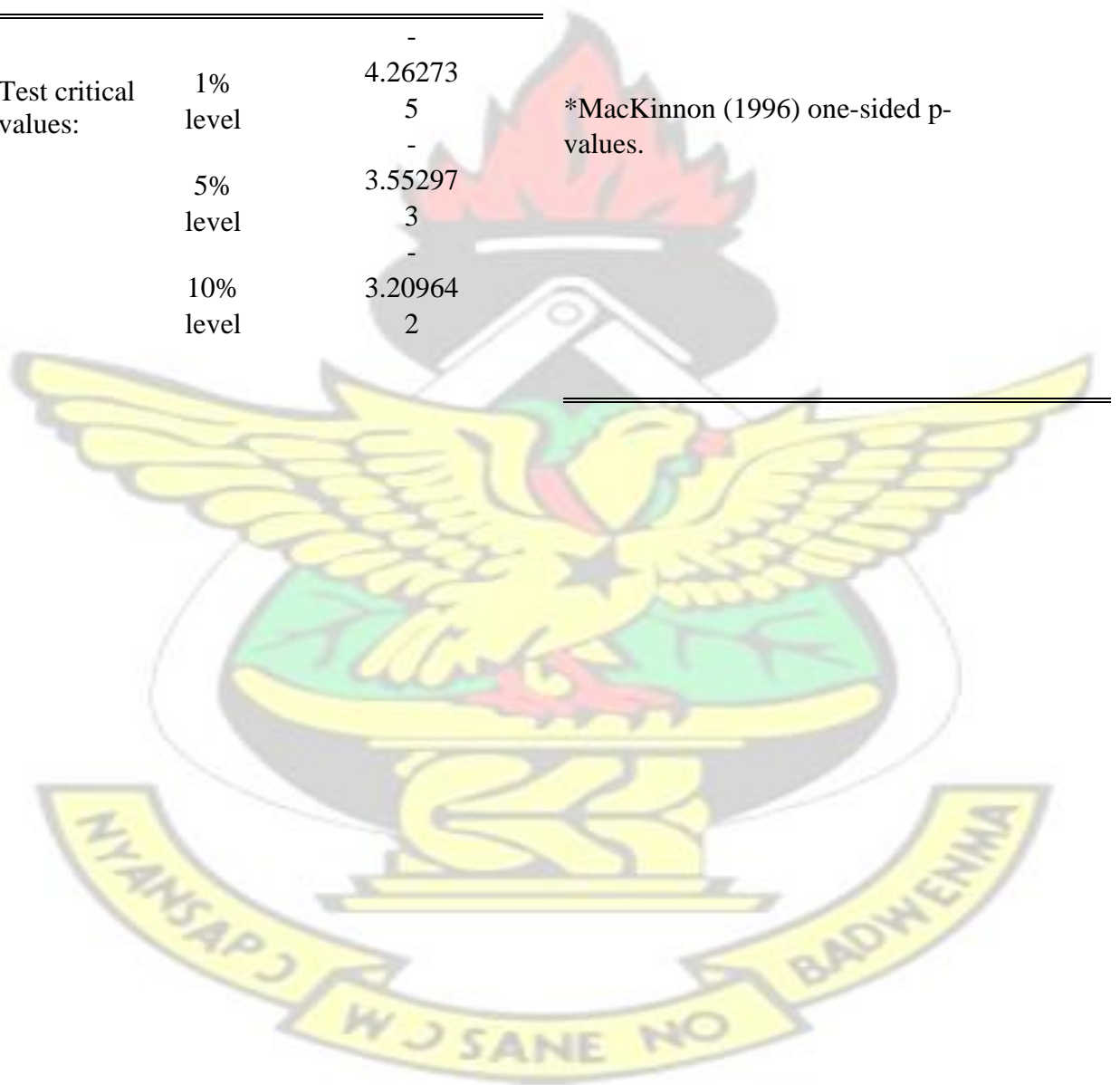
Augmented Dickey-Fuller test 3.68528 0.037
statistic 4 6

Test critical
values:

1%
level
5%
level
10%
level

-
4.26273
5
-
3.55297
3
-
3.20964
2

*MacKinnon (1996) one-sided p-
values.



Appendix 2

CO-INTEGRATION TEST RESULTS (MODEL 1)

Date: 11/12/15 Time: 18:35
 Sample (adjusted): 1982 2012
 Included observations: 31 after adjustments
 Trend assumption: Linear deterministic trend
 Series: REER TOT OPEN PROD GOE
 RRIR NFI
 Lags interval (in first differences): 1 to 1

Unrestricted Co-integration Rank Test (Trace)

Hypothesis		Trace		0.05	
No. of CE(s)	Eigenvalue	Statistic	Critical Value	Prob.**	
None	* 0.950758	182.9416	125.6154	0.0000	
At most 1	0.701934	89.60060	95.75366	0.1230	
At most 2	0.514784	52.07697	69.81889	0.5460	
At most 3	0.422085	29.65901	47.85613	0.7362	
At most 4	0.238517	12.66084	29.79707	0.9064	
At most 5	0.124990	4.213735	15.49471	0.8855	
At most 6	0.002404	0.074607	3.841466	0.7847	

Trace test indicates 1 cointegrating eqn(s) at the 0.05 level

* denotes rejection of the hypothesis at the 0.05 level

**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesis		Max-Trace		Eigen 0.05	
No. of CE(s)	Eigenvalue	Statistic	Critical Value	Prob.**	

None *	0.950758	93.34101	46.23142	0.0000				
At most 1	0.701934	37.52363	40.07757	0.0944			At most 2	0.514784
	22.41797	33.87687	0.5753					
At most 3	0.422085	16.99816	27.58434	0.5801				
At most 4	0.238517	8.447108	21.13162	0.8743				
At most 5	0.124990	4.139128	14.26460	0.8444				
At most 6	0.002404	0.074607	3.841466	0.7847				

Max-eigenvalue test indicates 1 cointegrating eqn(s)
at the 0.05 level

* denotes rejection of the hypothesis at the 0.05 level

**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegrating Coefficients (normalized by b*S11*b=I):

REER	TOT	OPEN	PROD	GOE	RRIR	NFI	
0.002243	-0.012913	0.019905	-0.010751	-0.009498	0.004811	0.686695	0.000659
0.042301	0.047373	-0.001232	0.406459	0.039665	-0.961389		
0.001625	0.004571	-0.020621	0.014513	0.157940	-0.006044	-1.360770	
-1.34E-05	-0.074177	0.026888	0.021897	-0.762118	0.057814	0.235819	
0.000919	-0.028079	0.005498	-0.005592	0.610591	-0.001833	1.765763	
-0.000579	9.79E-05	-0.049095	0.001940	0.128125	0.004280	0.323973	
0.000314	-0.067736	-0.024628	0.020971	-0.187471	0.008007	-2.310720	

Unrestricted Adjustment Coefficients (alpha):

D(REER)	-294.8641	107.8272	-87.74168	89.95639	45.10454	6.430962	-4.203047
D(TOT)	-3.406040	0.325050	3.504571	3.584591	3.747723	-0.291069	-0.099612
D(OPEN)	0.023960	-3.777072	-1.711270	-0.333067	-0.133250	2.576782	0.147017
D(PROD)	-5.885778	-5.102630	5.261989	-3.571938	-0.160309	-2.256982	0.268279
D(GOE)	0.298061	-0.580117	-0.222651	0.413894	-0.292108	-0.078121	0.021930
D(RRIR)	-2.521284	-10.98460	-1.844281	-0.335718	-2.337758	-0.702334	-0.303218
D(NFI)	0.349328	0.023633	-0.332517	-0.102335	0.097609	-0.049129	0.002357

1 Cointegrating Log
Equation(s): likelihood -735.7270

Normalized cointegrating coefficients (standard error
in parentheses)

REER	TOT	OPEN	PROD	GOE	RRIR	NFI
1.000000	-5.756735	8.873699	-4.792705	-4.234418	2.144970	306.1306
	(2.43640)	(1.72318)	(0.77443)	(22.6963)	(1.52893)	(74.3888)

Adjustment coefficients (standard error in
parentheses)

D(REER)	-0.661422
	(0.12779)
D(TOT)	-0.007640
	(0.00521)
D(OPEN)	5.37E-05
	(0.00450)
D(PROD)	-0.013203
	(0.00666)
D(GOE)	0.000669
	(0.00060)
D(RRIR)	-0.005656
	(0.00747)
D(NFI)	0.000784
	(0.00027)

Co -integration tests (GDP -EMIS MODEL)

Date: 12/08/15 Time: 12:49
Sample (adjusted): 1982 2013
Included observations: 32 after adjustments
Trend assumption: Linear deterministic trend
Series: GDP LOGTOT LOGFDI LOGGOE
LOGOPEN LOGINFL EMIS
Lags interval (in first differences): 1 to 1

Unrestricted Co-integration Rank Test
(Trace)

Hypothesized Trace 0.05

No. of CE(s)	Eigenvalue	Statistic	Critical Value	Prob.**
None *	0.804515	156.5123	125.6154	0.0002
At most 1				
*	0.701821	104.2795	95.75366	0.0114
At most 2	0.569173	65.55757	69.81889	0.1043
At most 3	0.386322	38.61202	47.85613	0.2760
At most 4	0.331252	22.98693	29.79707	0.2467
At most 5	0.206927	10.11177	15.49471	0.2722
At most 6	0.080710	2.692905	3.841466	0.1008

Trace test indicates 2 Co-integrating eqn(s) at the 0.05 level
 * denotes rejection of the hypothesis at the 0.05 level
 **MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Co-integration Rank Test (Maximum Eigenvalue)

Hypothesized	Max-Eigen	Prob.**
None *	0.804515	52.23272
At most 1	0.701821	38.72198
At most 2	0.569173	26.94555
At most 3	0.386322	15.62509
At most 4	0.331252	12.87516
At most 5	0.206927	7.418865
At most 6	0.080710	2.692905

Max-eigenvalue test indicates 1 Co-integrating eqn(s) at the 0.05 level
 * denotes rejection of the hypothesis at the 0.05 level
 **MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Co-integrating Coefficients (normalized by b'S11*b=I):

LOGOPE

GDP	LOGTOT	LOGFDI	LOGGOE	N	LOGINFL	EMIS
0.300792	-7.039321	0.535985	-16.10631	2.020510	1.109786	10.95123
-0.026275	-3.365357	-1.029422	0.516689	-3.326067	-8.561953	-5.027126
-0.543359	9.418168	0.062781	-8.548564	-6.552072	3.058321	-37.00576
0.231063	-5.056839	2.598633	-8.895789	-6.306171	-0.797849	-4.867947
0.624434	-1.152647	-0.091559	-10.33168	-1.682698	2.074939	-5.439611
0.269498	-	13.36042	0.609096	5.423587	-5.418760	2.680510
-1.993584		0.252734	-12.26468	0.914014	-6.309917	8.809778
1.799621					21.43042	

Unrestricted Adjustment Coefficients
(alpha):

D(GDP)	0.287049	0.365269	0.621008	0.213955	-0.493799	-0.520335	-0.363897
D(LOGTO							
T)	0.060626	0.040016	0.104099	0.001695	-0.030140	0.024158	0.018236
D(LOGFD							
I)	-0.016238	0.079634	-0.014886	-0.112018	-0.005836	0.021673	-0.032874
D(LOGG							
OE)	0.016558	0.020482	0.007619	0.012917	0.018142	-0.008184	-0.004860
D(LOGOP							
EN)	0.033371	0.017034	-0.001545	0.035362	-0.003360	0.008501	-0.009390
D(LOGIN							
FL)	-0.027901	0.116562	-0.004953	0.036467	-0.075885	-0.002720	0.020553
D(EMIS)	-0.022246	-0.001016	0.008518	0.003027	0.004282	0.003075	0.003644

1 Cointegrating Equation(s):
Log likelihood 137.7343

Normalized cointegrating coefficients (standard error in parentheses)

LOGOPE

GDP	LOGTOT	LOGFDI	LOGGOE	N	LOGINFL	EMIS
1.000000	-23.40261	1.781912	-53.54629	6.717297	3.689542	36.40797

(5.39383) (0.97151) (7.69226) (4.84592) (3.37937) (12.9689)

Adjustment coefficients (standard error in parentheses)

D(GDP) 0.086342
(0.13585)
D(LOGTOT)
T) 0.018236
(0.01120)
D(LOGFDI)
I) -0.004884
(0.01507)
D(LOGGOE)
OE) 0.004980
(0.00332)
D(LOGOPEN)
EN) 0.010038
(0.00461)
D(LOGINF)
FL) -0.008392
(0.01341)
D(EMIS) -0.006691
(0.00146)

APPENDIX 3

VECM RESULTS (MODEL 1)

Dependent Variable: D(LOGREER)

Method: Least Squares (Gauss-Newton / Marquardt steps)

Date: 11/30/15 Time: 13:10

Sample (adjusted): 1983 2013

Included observations: 31 after adjustments

$$D(\text{LOGREER}) = C(1) * (\text{LOGREER}(-1) - 1.20425250131 * \text{LOGTOT}(-1) + 0.0462805064206 * \text{LOGOPEN}(-1) - 5.16091303371 * \text{LOGPROD}(-1) + 1.69144029613 * \text{LOGGOE}(-1) - 1.02157748774 * \text{LOGRRIR}(-1) - 0.322549937726 * \text{NFI}(-1) + 13.7948104292) + C(2) * D(\text{LOGREER}(-1)) + C(3) * D(\text{LOGREER}(-2)) + C(4) * D(\text{LOGTOT}(-1)) + C(5) * D(\text{LOGTOT}(-2))$$

$$+ C(6)*D(LOGOPEN(-1)) + C(7)*D(LOGOPEN(-2)) + C(8)*D(LOGPROD(-1)) + C(9)*D(LOGPROD(-2)) + C(10)*D(LOGGOE(-1)) + C(11)*D(LOGGOE(-2)) + C(12)*D(LOGRRIR(-1)) + C(13)*D(LOGRRIR(-2)) + C(14)*D(NFI(-1)) + C(15)*D(NFI(-2)) + C(16)$$

V	Coefficient	Std. Error	t-Statistic	Prob.
C(1)	-0.429732	0.112389	-3.823620	0.0017
C(2)	0.237868	0.229839	1.034934	0.3171
C(3)	0.786814	0.204067	3.855662	0.0016
C(4)	-1.422618	0.450073	-3.160857	0.0065
C(5)	-0.626228	0.526063	-1.190407	0.2524
C(6)	-0.341662	0.293853	-1.162697	0.2631
C(7)	1.254641	0.388326	3.230900	0.0056
C(8)	-4.170872	2.338012	-1.783939	0.0947
C(9)	11.65594	2.627234	4.436583	0.0005
C(10)	0.029672	0.360558	0.082295	0.9355
C(11)	-0.303034	0.353790	-0.856537	0.4052
C(12)	-0.245587	0.107160	-2.291780	0.0368
C(13)	-0.102317	0.091799	-1.114578	0.2826
C(14)	-0.182346	0.050834	-3.587086	0.0027
C(15)	-0.067122	0.053188	-1.261961	0.2262
C(16)	-0.184194	0.043178	-4.265901	0.0007
R-squared	0.875709	Mean dependent var		-0.044425
Adjusted R-squared	0.751418	S.D. dependent var		0.162701
S.E. of regression	0.081120	Akaike info criterion		-1.879464
Sum squared resid	0.098706	Schwarz criterion		-1.139341
Log likelihood	45.13169	Hannan-Quinn criter.		-1.638202
F-statistic	7.045641	Durbin-Watson stat		1.857217
Prob(F-statistic)	0.000253			

VECM RESULTS (GDP-EMIS MODEL)

Dependent Variable: D(GDP)

Method: Least Squares (Gauss-Newton / Marquardt steps)

Date: 12/08/15 Time: 12:52

Sample (adjusted): 1983 2013

Included observations: 31 after adjustments

D(GDP) = C(1)*(GDP(-1) + 7.34312069179*LOGTOT(-1) - 2.90949319155

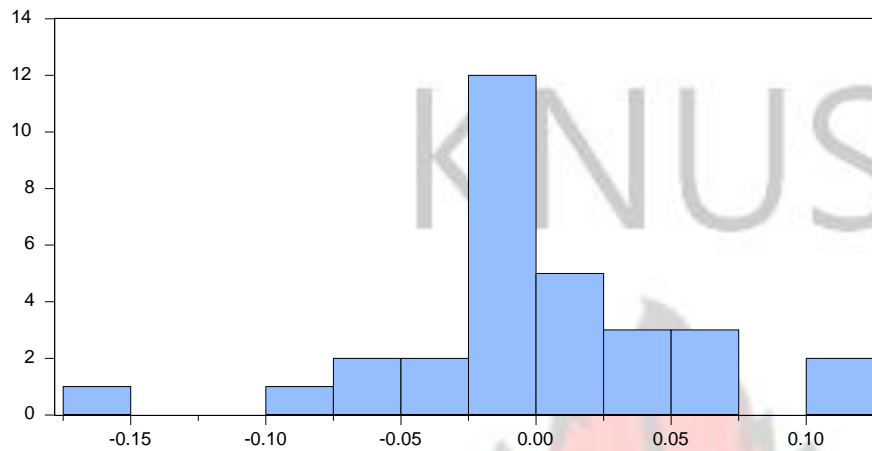
$$\begin{aligned}
& *LOGFDI(-1) + 98.9146174725*LOGGOE(-1) + 6.87206601666 \\
& *LOGOPEN(-1) + 29.0184245416*LOGINFL(-1) - 17.4226772437 \\
& *EMIS(-1) - 180.316502972) + C(2)*D(GDP(-1)) + C(3)*D(GDP(-2)) + \\
& C(4)*D(LOGTOT(-1)) + C(5)*D(LOGTOT(-2)) + C(6)*D(LOGFDI(-1)) + \\
& C(7)*D(LOGFDI(-2)) + C(8)*D(LOGGOE(-1)) + C(9)*D(LOGGOE(-2)) + \\
& C(10)*D(LOGOPEN(-1)) + C(11)*D(LOGOPEN(-2)) + C(12) \\
& *D(LOGINFL(-1)) + C(13)*D(LOGINFL(-2)) + C(14)*D(EMIS(-1)) + C(15) \\
& *D(EMIS(-2)) + C(16)
\end{aligned}$$

	Coefficient	Std. Error	t-Statistic	Prob.
C(1)	-0.213644	0.074301	-2.875375	0.0116
C(2)	0.050694	0.233359	0.217234	0.8310
C(3)	0.044572	0.229919	0.193858	0.8489
C(4)	8.150246	11.42196	0.713559	0.4865
C(5)	17.02027	12.98202	1.311065	0.2096
C(6)	-2.846289	1.937459	-1.469084	0.1625
C(7)	-0.138320	1.968284	-0.070275	0.9449
C(8)	-2.830743	10.41362	-0.271831	0.7895
C(9)	23.28145	11.47844	2.028277	0.0607
C(10)	14.94802	7.113280	2.101424	0.0529
C(11)	-11.58530	8.884266	-1.304024	0.2119
C(12)	4.007872	2.602026	1.540289	0.1443
C(13)	5.575594	2.196658	2.538216	0.0227
C(14)	35.00333	20.21275	1.731745	0.1038
C(15)	-16.42234	13.45560	-1.220484	0.2411
C(16)	0.769498	0.435877	1.765404	0.0978
R-squared	0.799534	Mean dependent var		0.453401
Adjusted R-squared	0.599068	S.D. dependent var		3.332217
S.E. of regression	2.109934	Akaike info criterion		4.637511
Sum squared resid	66.77730	Schwarz criterion		5.377634
Log likelihood	-55.88142	Hannan-Quinn criter.		4.878773
F-statistic	3.988375	Durbin-Watson stat		2.241084
Prob(F-statistic)	0.005523			

Appendix 4

Residual diagnostic tests results

Normality Test: Jarque- Bera



Series: Residuals	
Sample 1983 2013	
Observations 31	
Mean	7.54e-15
Median	-0.005512
Maximum	0.117688
Minimum	-0.173655
Std. Dev.	0.057360
Skewness	-0.433901
Kurtosis	4.610495
Jarque-Bera	4.322919
Probability	0.115157

F-statistic	0.060646	Prob. F (2,13)	0.9414
Obs*R-squared	0.286561	Prob. Chi-Square(2)	0.8665

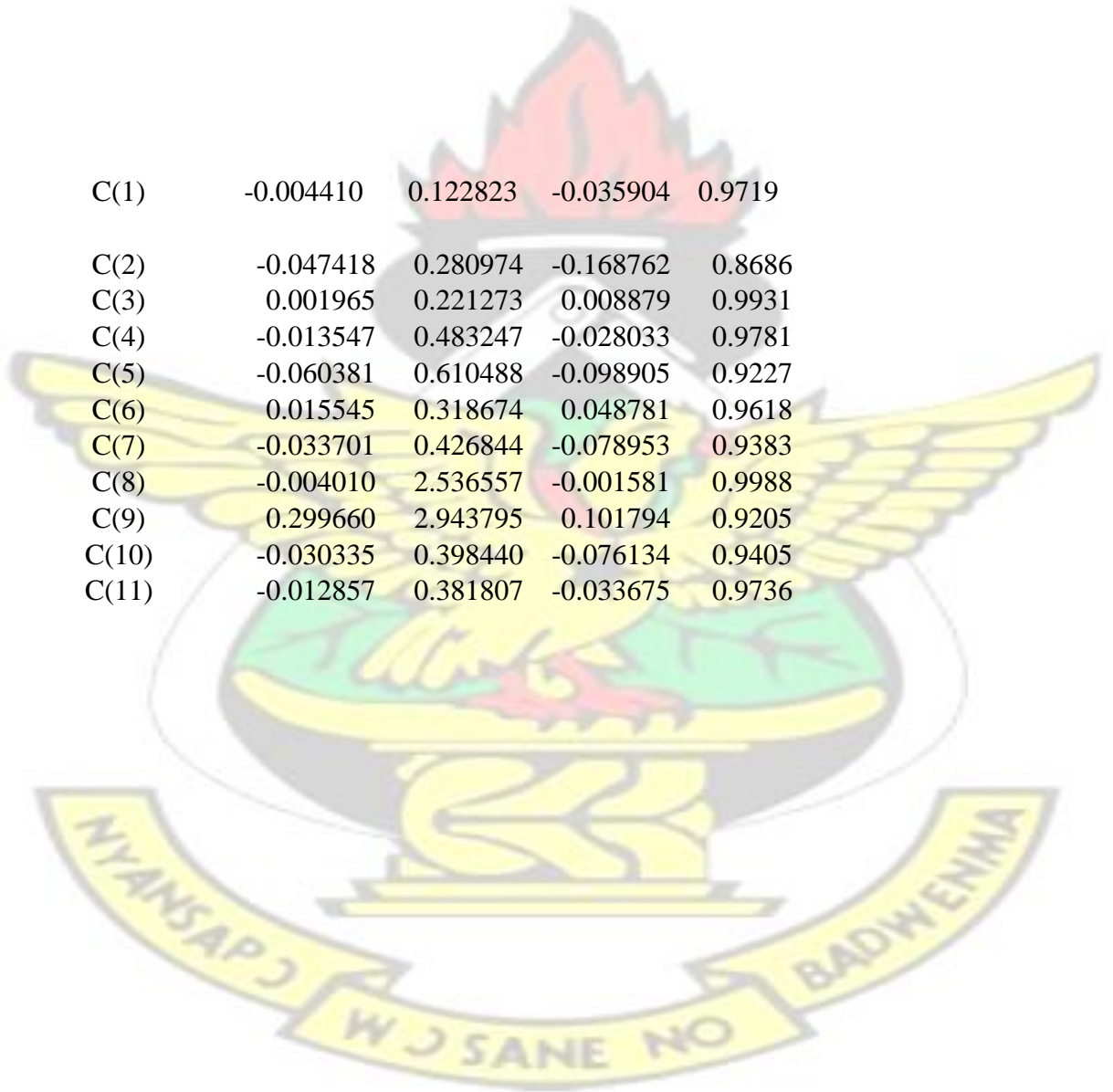
Test Equation:
 Dependent Variable: RESID
 Method: Least Squares
 Date: 11/16/15 Time: 09:56
 Sample: 1983 2013 Included observations: 31
 Presample missing value lagged residuals set to zero.

Variable	Coefficient	Std. Error	t-	Prob.
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Breusch-Godfrey Serial Correlation LM Test:

KNUST

C(1)	-0.004410	0.122823	-0.035904	0.9719
C(2)	-0.047418	0.280974	-0.168762	0.8686
C(3)	0.001965	0.221273	0.008879	0.9931
C(4)	-0.013547	0.483247	-0.028033	0.9781
C(5)	-0.060381	0.610488	-0.098905	0.9227
C(6)	0.015545	0.318674	0.048781	0.9618
C(7)	-0.033701	0.426844	-0.078953	0.9383
C(8)	-0.004010	2.536557	-0.001581	0.9988
C(9)	0.299660	2.943795	0.101794	0.9205
C(10)	-0.030335	0.398440	-0.076134	0.9405
C(11)	-0.012857	0.381807	-0.033675	0.9736



C(12)	-0.008875	0.121090	-0.073294	0.9427
C(13)	-0.001989	0.103783	-0.019166	0.9850
C(14)	-0.005530	0.056869	-0.097236	0.9240
C(15)	0.002470	0.060403	0.040899	0.9680
C(16)	-0.005575	0.050666	-0.110028	0.9141
RESID(-1)	0.135450	0.389267	0.347961	0.7334
RESID(-2)	0.004936	0.343462	0.014370	0.9888

R-squared 0.009244 Mean dependent var 7.54 E-15 Adjusted R-squared -
1.286360 S.D. dependent var 0.057360
S.E. of regression 0.086733 Akaike info criterion -1.759718
Sum squared resid 0.097793 Schwarz criterion -0.927080
Log likelihood 45.27563 Hannan-Quinn criter. -1.488299
F-statistic 0.007135 Durbin-Watson stat 1.990109
Prob(F-statistic) 1.000000

F-statistic	1.121213	Prob. F(21,9)	0.4514
Obs*R-squared	22.42738	Prob. Chi-Square(21)	0.3753
Scaled explained SS	9.479261	Prob. Chi-Square(21)	0.9849

Test Equation:
Dependent Variable: RESID^2
Method: Least Squares
Date: 11/16/15 Time: 09:57
Sample: 1983 2013
Included observations: 31

Variable	Coefficient	Std. Error	t-Statistic	Prob.
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Heteroskedasticity Test: Breusch-Pagan-Godfrey

KNUST



C	1.239682	0.455800	2.719 795	0.0236
LOGREER(-1)	0.006275	0.026841	0.233776	0.8204
LOGTOT(-1)	-0.030969	0.040077	-0.772748	0.4595
LOGOPEN(-1)	-0.037817	0.030786	-1.228379	0.2505
LOGPROD(-1)	-0.210080	0.258561	-0.812496	0.4375
LOGGOE(-1)	0.052817	0.045410	1.163115	0.2747
LOGRRIR(-1)	-0.025787	0.010328	-2.496773	0.0340
NFI(-1)	0.003288	0.003276	1.003892	0.3417
LOGREER(-2)	0.005876	0.024433	0.240472	0.8154
LOGREER(-3)	0.040788	0.020420	1.997419	0.0769
LOGTOT(-2)	0.018346	0.056282	0.325958	0.7519
LOGTOT(-3)	-0.092890	0.045888	-2.024272	0.0736
LOGOPEN(-2)	-0.039871	0.034773	-1.146605	0.2811

LOGOPEN(-3)	0.090764	0.035010	2.592528	0.0291
LOGPROD(-2)	-0.246266	0.355495	-0.692742	0.5060
LOGPROD(-3)	0.025110	0.310855	0.080776	0.9374
LOGGOE(-2)	0.057372	0.037725	1.520809	0.1626
LOGGOE(-3)	0.046398	0.032366	1.433563	0.1855
LOGRRIR(-2)	-0.017946	0.009621	-1.865228	0.0950
LOGRRIR(-3)	-0.020954	0.013613	-1.539277	0.1581
NFI(-2)	-0.009413	0.007019	-1.341032	0.2128
NFI(-3)	0.005211	0.005215	0.999386	0.3437

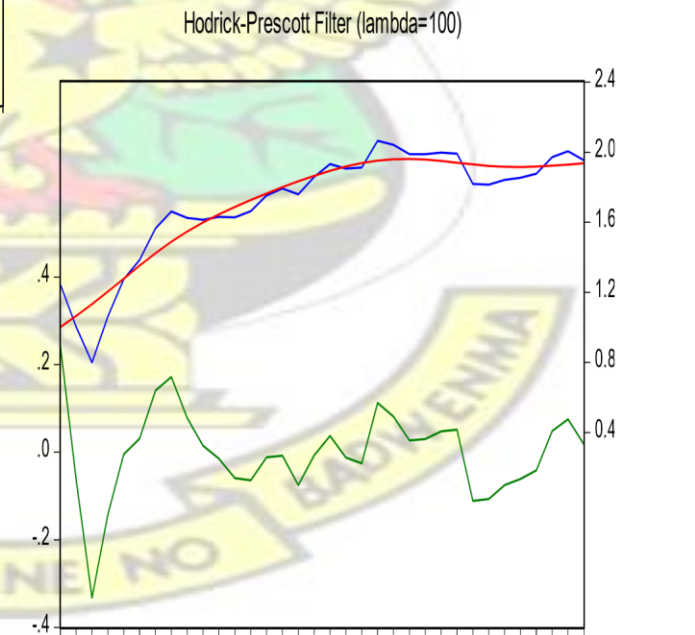
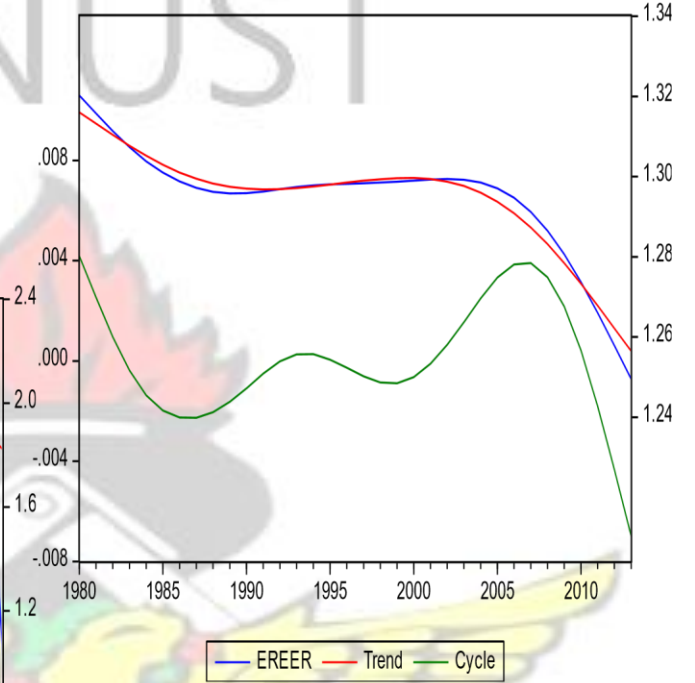
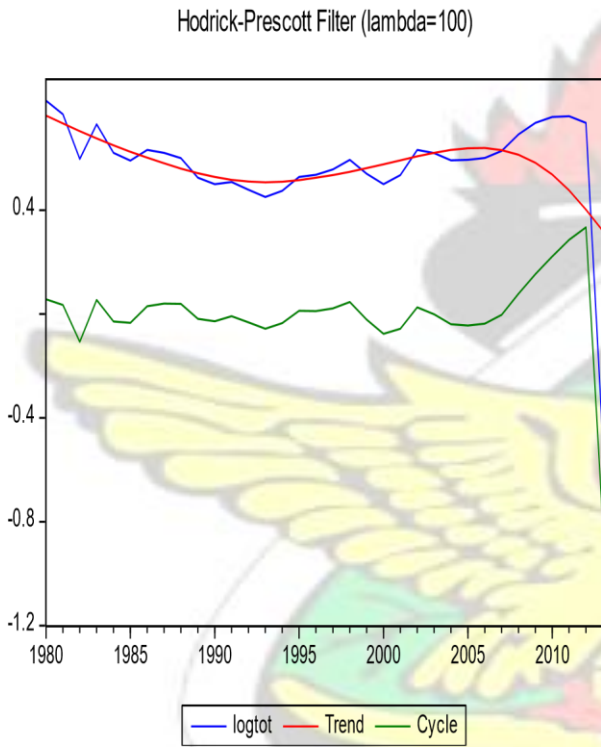
R-squared	0.723464	Mean dependent var	0.003184	Adjusted R-squared	0.078213	S.D.
dependent var	0.006150					
S.E. of regression	0.005905	Akaike info criterion			-7.243535	
Sum squared resid	0.000314	Schwarz criterion			-6.225866	
Log likelihood	134.2748	Hannan-Quinn criter.			-6.911800	
F-statistic	1.121213	Durbin-Watson stat			2.786498	
Prob(F-statistic)	0.451441					



Appendix 5

Graphs of Hodrick-Prescott Filtered Values
(Lambda=100)

Hodrick-Prescott Filter (lambda=100)



0.0

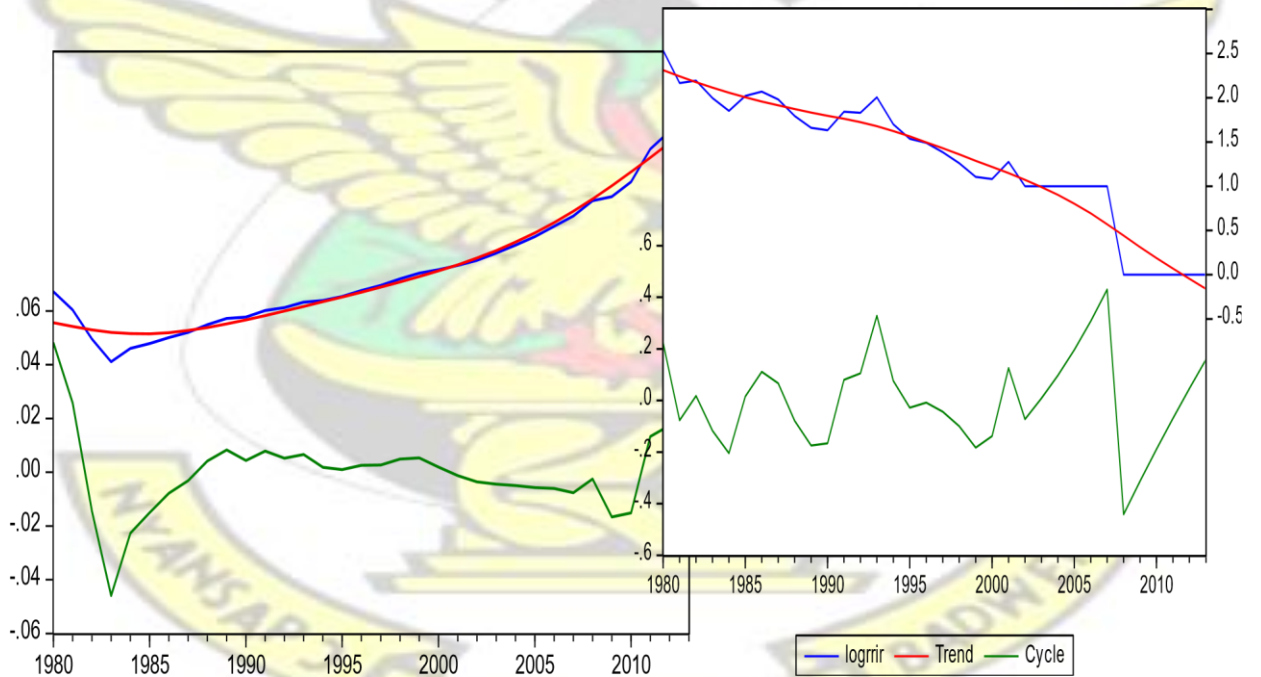
KNUST

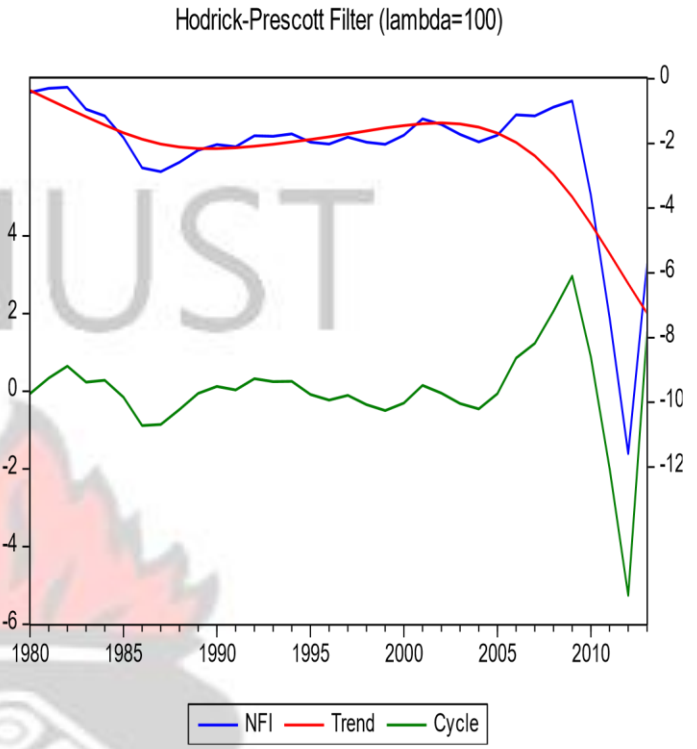
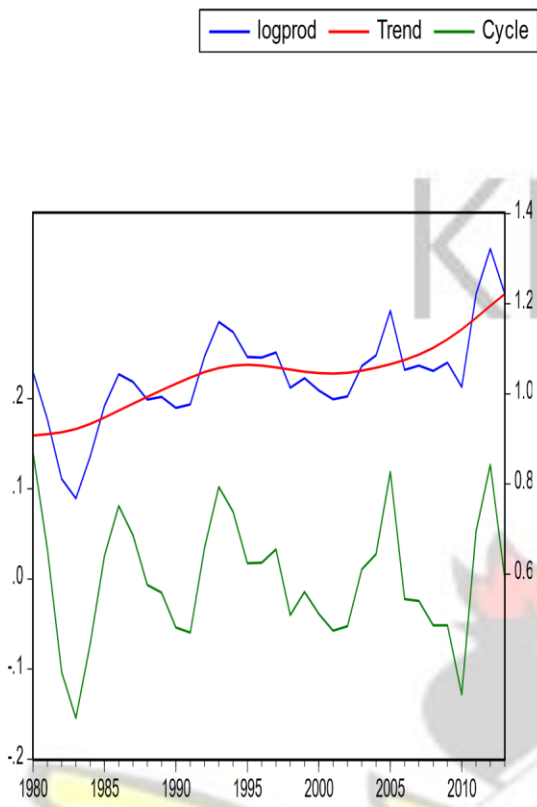
1980 1985 1990 1995 2000 2005 2010

—logopen — Trend — Cycle

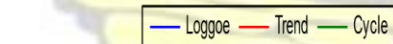
Hodrick-Prescott Filter (lambda=100) Hodrick-Prescott Filter (lambda=100)

3.0





Hodrick-Prescott Filter (lambda=100)



Appendix 6: PAIRWISE GRANGER CAUSALITY TEST RESULTS.

Pairwise Granger Causality Tests (**MODEL 1**)

Sample: 1980 2013

Lags: 2

Table 4.8 Pairwise Granger Causality Tests

Null Hypothesis:	Obs	F-Statistic	Prob.
LOGTOT does not Granger Cause LOGREER	32	12.2839	0.0002
LOGREER does not Granger Cause LOGTOT		0.59080	0.5609
LOGPROD does not Granger Cause LOGREER	32	1.82645	0.1803
LOGREER does not Granger Cause LOGPROD		0.04125	0.9597
LOGOPEN does not Granger Cause LOGREER	32	22.5218	2 .E-06
LOGREER does not Granger Cause LOGOPEN		0.19468	0.8242
LOGGOE does not Granger Cause LOGREER	32	3.44313	0.0466
LOGREER does not Granger Cause LOGGOE		3.68201	0.0385
LOGRRIR does not Granger Cause LOGREER	32	0.23686	0.7907
LOGREER does not Granger Cause LOGRRIR		0.78012	0.4684
NFI does not Granger Cause LOGREER	32	0.39457	0.6778
LOGREER does not Granger Cause NFI		3.58409	0.0416
LOGPROD does not Granger Cause LOGTOT	32	1.22862	0.3085
LOGTOT does not Granger Cause LOGPROD		5.40408	0.0106
LOGOPEN does not Granger Cause LOGTOT	32	1.00148	0.3806
LOGTOT does not Granger Cause LOGOPEN		0.28521	0.7541
LOGGOE does not Granger Cause LOGTOT	32	4.34748	0.0231
LOGTOT does not Granger Cause LOGGOE		1.20871	0.3142
LOGRRIR does not Granger Cause LOGTOT	32	0.58053	0.5664

LOGTOT does not Granger Cause LOGRRIR		0.83836	0.4434
<hr/>			
NFI does not Granger Cause LOGTOT	32	31.0824	1 .E-07
LOGTOT does not Granger Cause NFI		0.18767	0.8300
<hr/>			
LOGOPEN does not Granger Cause LOGPROD	32	7.58952	0.0024
LOGPROD does not Granger Cause LOGOPEN		0.06099	0.9410
<hr/>			
LOGGOE does not Granger Cause LOGPROD	32	0.89412	0.4207
LOGPROD does not Granger Cause LOGGOE	8.41345	0.0014	
<hr/>			
LOGRRIR does not Granger Cause LOGPROD	32	8.33226	0.0015
LOGPROD does not Granger Cause LOGRRIR		2.28772	0.1208
<hr/>			
NFI does not Granger Cause LOGPROD	32	1.60495	0.2195
LOGPROD does not Granger Cause NFI		5.27068	0.0117
<hr/>			
LOGGOE does not Granger Cause LOGOPEN	32	0.96230	0.3947
LOGOPEN does not Granger Cause LOGGOE		2.61654	0.0915
<hr/>			
LOGRRIR does not Granger Cause LOGOPEN	32	1.23577	0.3065
LOGOPEN does not Granger Cause LOGRRIR		0.18965	0.8283
<hr/>			
NFI does not Granger Cause LOGOPEN	32	1.39107	0.2661
LOGOPEN does not Granger Cause NFI		1.74979	0.1929
<hr/>			
LOGRRIR does not Granger Cause LOGGOE	32	3.46544	0.0457
LOGGOE does not Granger Cause LOGRRIR		0.78841	0.4648
<hr/>			
NFI does not Granger Cause LOGGOE	32	3.74804	0.0366
LOGGOE does not Granger Cause NFI		1.52746	0.2353
<hr/>			
NFI does not Granger Cause LOGRRIR	32	0.24611	0.7836

LOGRRIR does not Granger Cause NFI

2.21549

0.1286

Pairwise Granger Causality Test Results (GDP – EMIS MODEL)

Sample: 1980 2013 Lags:

2

Null Hypothesis:	Obs	F-Statistic	Prob.
LOGTOT does not Granger Cause GDP	32	5.75062	0.0083
GDP does not Granger Cause LOGTOT		4.30345	0.0239
LOGFDI does not Granger Cause GDP	32	3.27503	0.0533
GDP does not Granger Cause LOGFDI		4.42190	0.0218
LOGGOE does not Granger Cause GDP	32	0.18059	0.8358
GDP does not Granger Cause LOGGOE		8.30959	0.0015
LOGOPEN does not Granger Cause GDP	32	4.37180	0.0227
GDP does not Granger Cause LOGOPEN		0.09740	0.9075

Pairwise Granger Causality Tests

LOGINFL does not Granger Cause GDP	32	0.97086	0.3916	GDP
does not Granger Cause LOGINFL	4.80034	0.0165		

EMIS does not Granger Cause GDP	32		0.5475
		0.61609	
GDP does not Granger Cause EMIS		1.53125	0.2345
LOGFDI does not Granger Cause LOGTOT	32	0.24029	0.7881
LOGTOT does not Granger Cause LOGFDI		1.36631	0.2721
LOGGOE does not Granger Cause LOGTOT	32	4.34748	0.0231
LOGTOT does not Granger Cause LOGGOE		1.20871	0.3142
LOGOPEN does not Granger Cause LOGTOT	32	1.00148	0.3806
LOGTOT does not Granger Cause LOGOPEN		0.28521	0.7541
LOGINFL does not Granger Cause LOGTOT	32	1.4699 4	0.2478
LOGTOT does not Granger Cause LOGINFL		2.08121	0.1443
EMIS does not Granger Cause LOGTOT	32	0.50450	0.6094
LOGTOT does not Granger Cause EMIS		12.7623	0.0001
LOGGOE does not Granger Cause LOGFDI	32	2.76745	0.0807
LOGFDI does not Granger Cause LOGGOE		1.48172	0.2451
LOGOPEN does not Granger Cause LOGFDI	32	3.58993	0.0414
LOGFDI does not Granger Cause LOGOPEN		0.83481	0.4449
LOGINFL does not Granger Cause LOGFDI	32	1.68357	0.2046
LOGFDI does not Granger Cause LOGINFL		1.11794	0.3416
EMIS does not Granger Cause LOGFDI	32	3.82907	0.0344
LOGFDI does not Granger Cause EMIS		1.57554	0.2253
LOGOPEN does not Granger Cause LOGGOE	32	2.61654	0.0915
LOGGOE does not Granger Cause LOGOPEN		0.96230	0.3947

LOGINFL does not Granger Cause LOGGOE	32	1.48791	0.2438
LOGGOE does not Granger Cause LOGINFL		0.19515	0.8239
EMIS does not Granger Cause LOGGOE	32	3.28544	0.0528
LOGGOE does not Granger Cause EMIS		3.40067	0.0482
LOGINFL does not Granger Cause LOGOPEN	32	1.12622	0.3390
LOGOPEN does not Granger Cause LOGINFL		3.04078	0.0644
EMIS does not Granger Cause LOGOPEN	32	0.15223	0.8595
LOGOPEN does not Granger Cause EMIS		22.1672	2.E-06
EMIS does not Granger Cause LOGINFL	32	2.24304	0.1255
LOGINFL does not Granger Cause EMIS		3.58433	0.0416

