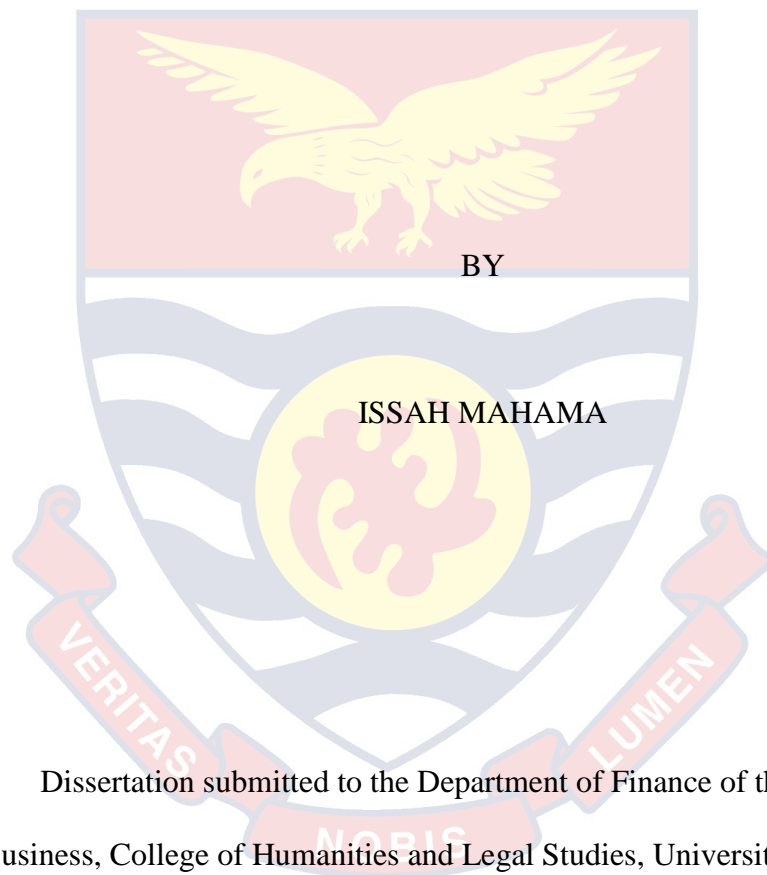


UNIVERSITY OF CAPE COAST

EFFECTS OF INFLATION AND INTEREST RATE ON EXCHANGE  
RATE IN GHANA



Dissertation submitted to the Department of Finance of the School of  
Business, College of Humanities and Legal Studies, University of Cape Coast,  
in partial fulfillment of the requirements for award of Master of Business  
Administration degree in Finance

MAY 2019

## DECLARATION

### Candidate's Declaration

I hereby declare that this dissertation is the result of my own original research work and that no part of it has been presented for another degree in this university or elsewhere.

Candidate Signature ..... Date: .....

Name: Issah Mahama

### Supervisor's Declaration

I hereby declare that the preparation and presentation of the dissertation were supervised in accordance with the guidelines on supervision of dissertation laid down by the University of Cape Coast.

Supervisor's Signature ..... Date: .....

Name: Dr. Camara K. Obeng

## ABSTRACT

The study assessed the effects of inflation and interest rate on exchange rate in Ghana using data from 1991 to 2016. Inflation rate, interest rate, government expenditure, private investment and money supply were used as independent variables whereas exchange rate was taken as dependent variable. Augmented Dickey-Fuller (ADF), Philips-Perron (PP) unit root tests were applied to find the level of integration in the time series. Auto-Regressive Distributive Lag and its error correction model were applied to find long run and short run relationships. The study found the existence of long run and short run relationships in the estimated model. Inflation, interest rate, government expenditure and money supply exerted positive and significant impact on exchange rate both in the short run and long run. Inflation and money supply had higher impacts in the short run compared to the long run. Private investment showed a negative effect on exchange rate in the short run and long run. The Granger causality test results revealed a unidirectional causality from interest rate to exchange rate. However, there was a bi-directional causality between inflation and exchange rate. It was therefore recommended that the Bank of Ghana needs to ensure a stable exchange rate in order to stimulate economic growth in Ghana. Thus, the Bank of Ghana needs to put measures in place to ensure a stable exchange rate for sustained period of time.

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## DEDICATION

To my family and sons Ruhullah and Ikhlas.



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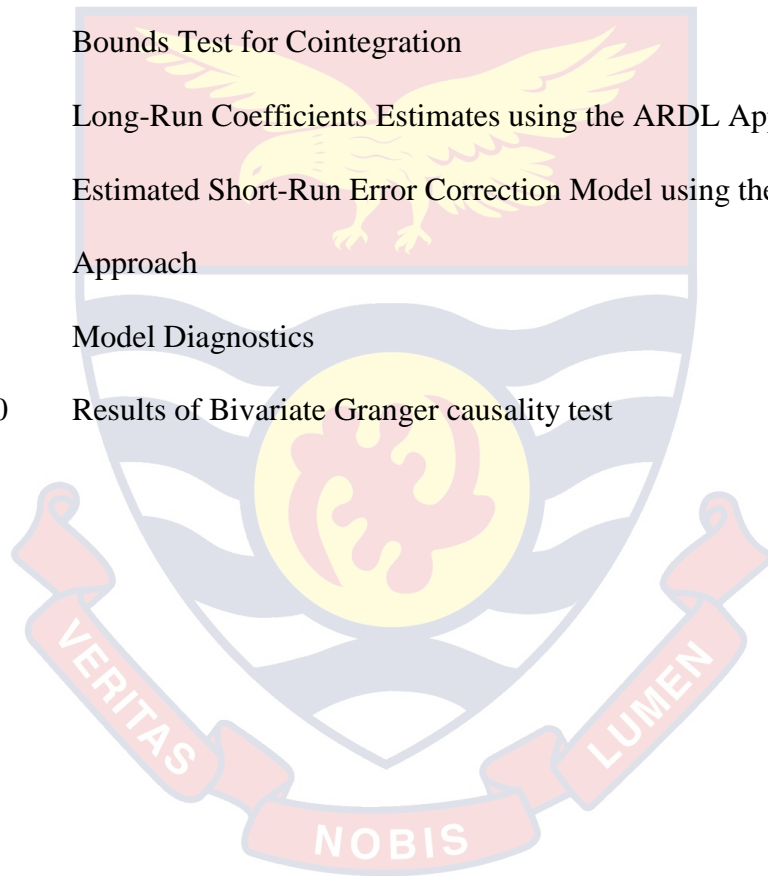
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## LIST OF ACRONYMS

Exchange rate	EXR
Inflation	INF
Interest Rate	INT
Private Sector Investment	PINV
Government Expenditure	GE
Money Supply	MS
Autoregressive Distributed Lag	ADRL
Augmented Dickey Fuller	ADF
Philip-Peron	PP
International Fisher's Effect	IFE
Interest Rate Polarity	IRP
Purchasing Power Parity	PPP
Ordinary Least Square	OLS
Consumer Price Index	CPI
Swartz Information Criterion	SIC
Swartz Bayesian Criterion	SBC

## CHAPTER ONE

### INTRODUCTION

#### Background to the Study

Finance and economic literature are awash with theories and researches linking exchange rate, interest rate and inflation (Ebiringa & Anyaogu, 2014). The International Fisher Effect (IFE), interest rate parity, purchasing power parity and Mundell Fleming models remain critical examples. IFE which suggests that currencies of countries with relatively high interest rates tend to depreciate with increasing nominal interest rate when compared with her trading partners, reflecting the expected rates of inflation. Thus, it connects exchange rate volatility to periodic variations in interest rate and inflation (Ebiringa & Anyaogu, 2014).

Sundavist (2002) maintain that the differences in anticipated inflation that are embedded in the nominal interest rates are affecting the future spot rate of exchange. The IFE in its generalized form models relationships between the interest rate differentials of two countries and their corresponding inflation differentials, to the extent that countries with high rates of inflation would have higher nominal interest rates than those with lower rates of inflation. The purchasing power theory (PPP), on the other hand, states that the normal equilibrium rate of exchange between two inconvertible currencies is determined by the ratios of their purchasing powers; hence the rate of exchange tends to be established at the point of equality between the purchasing powers of the two currencies (Nucu, 2011).

In essence, when a country's inflation rate rises relative to that of another country, it experiences decreases in exports and increases imports,

thereby putting downward pressure on the value of the country's currency. The PPP theory in the views of Shangufta (2011) proposes that changes in exchange rate are caused by inflation rate differentials, while difference in nominal interest rates is attributed to difference in expected rates of inflation given that real interest rates are the same across countries.

In recent years, there has been a special interest in the link between exchange rates inflation and interest rates in both advanced and developing countries. This is understandable, given the important role these variables play in determining developments in the nominal and real sides of the economy, including the behaviour of domestic inflation, real output, exports and imports. Among emerging market economies, this interest is further spurred by the fact that many of them have recently introduced changes in their monetary and exchange rate policies, moving to inflation targeting frameworks which operate occasionally under flexible exchange rate regimes. Exchange rate variability – in itself and vis-à-vis interest rate variability has in recent years risen compared to previous periods characterized by far more rigid exchange rate regimes, even if the extent of such fluctuations is still a matter of debate (Bergen, 2010).

Moreover, the effect of exchange rate shocks on domestic prices and inflation is usually summarized in terms of a phenomenon called exchange rate pass-through, which is the effect that a permanent exchange rate shock of a given magnitude has on prices and inflation over time. Prior to the monetary-approach emphasis of the 1970s, it was common to emphasize international trade flows as primary determinants of exchange rates. This was due, in part, to the fact that governments maintained tight restrictions on international

flows of financial capital. The role of exchange rate changes in eliminating international trade imbalances suggests that we should expect countries with current trade surpluses to have an appreciating currency, whereas countries with trade deficits should have depreciating currencies. Such exchange rate changes would lead to changes in international relative prices that would work to eliminate the trade imbalance (Miller & Benjamin, 2004)

Recent global economic turmoil affected significantly different systems of economy. Exchange rate is not an exception as it is closely aligned to macroeconomic variables. Country with an appreciating home currency will experience its goods become more expensive in international market which may affect the exports and at the same time imports become inexpensive (Sauer & Bohara, 2001). This is a double blow to the home country which will rapidly affect the balance of payments.

The recent Ghanaian economic crisis in 2008 caused by currency depreciation eroded not only market capitalization of companies but also severely strained the national economies (Government of Ghana, 2009). To bailout the distressed companies the governments used tax payers' money in the hope of recovering the amount spent in future once these organizations stabilize. To bridge the gap, the governments increase the tax rates and also bringing new taxes such as service tax and surcharges. These measures bring in some disparity and imbalance in economic alignment which affect the exchange rates ultimately.

This prompted to investigate the role of relative interest rates, inflation rates and a host of economic variables of home and host countries in determining the exchange rates. This study therefore undertakes to empirically

evaluate the interdependencies and significance of the relationships between exchange rate, interest rate and inflation in the short run as well as its sustainability in the long run using Ghana as a case study.

### **Statement of the Problem**

The theoretical as well as empirical relationship between interest rate and exchange rate has been a debatable issue among economists. According to Mundell-Fleming model, an increase in interest rate is necessary to stabilize the exchange rate depreciation and to curb the inflationary pressure and thereby helps to avoid many adverse economic consequences (Mundell, 1963). The high interest rate policy is considered important for several reasons. First, it provides the information to the market about economic management team to resolve not to allow the sharp exchange rate movement that the market expects given the state of the economy and thereby reduce the inflationary expectations and prevent the vicious cycle of inflation and exchange rate depreciation. Secondly, it raises the attractiveness of domestic financial assets as a result of which capital inflow takes place and thereby limiting the exchange rate depreciation. Thirdly, it not only reduces the level of domestic aggregate demand but also improves the balance of payment position by reducing the level of imports.

All forex trading involves the exchange of one currency with another. At any one time, the actual exchange rate is determined by the supply and demand of the corresponding currencies. The demand of a certain currency is directly linked to the supply of another. The link between inflation and interest rates remain eminent though unexplored by authors and scholars to identify their impact on exchange rates. Inflation is a sustained increase in the average

price of all goods and services produced in an economy. Money loses purchasing power during inflationary periods since each unit of currency buys progressively fewer goods. Purchasing power parity theory states that the exchange rate between one currency and another is in equilibrium when their domestic purchasing powers at that rate of exchange are equivalent. On the other hand, changes in domestic interest rates in one of the countries affect the foreign exchange rate as the demand for the currency that has had a change of interest rate will change. This implies an interaction between interest rates and inflation on exchanges rate.

The Cedi touched a historic GHS3.50 low against the dollar in late 2011. This resulted in the Bank of Ghana tripling the prime rate during that time. The effect was an increase in the cost of borrowing, which slowed down uptake of credit and slowed economic growth in 2012. The Cedi strength was sapped by interplay of factors and market fundamentals such as declining exports receipts.

Pattanaik and Mitra (2001) indicate that interest rates, inflation rates and exchange rates are all highly correlated. By manipulating interest rates, central banks exert influence over both inflation and exchange rates, and changing interest rates impact inflation and currency values. The real exchange rate is the actual exchange rate adjusted for inflationary effects in the two countries of concern. In another instance, Ndung'u (1997) states that interest rate differential will widen with real exchange rate appreciation, and this will trigger capital inflows. Kiptoo (2007) found that the real exchange rate is obtained by adjusting the nominal exchange rate with inflation differential between the domestic economy, and foreign trading



partner economies. Sifunjo (2011) further found that the derivation of the real effective rate therefore, requires that the data of the nominal exchange rate, domestic inflation and foreign inflation be obtained. Domestic inflation will rise with exchange rate depreciation, and the influence of foreign inflation will decrease with exchange rate appreciation. However, the recent Ghanaian currency crisis and the failure of high inflation and interest rates policy to stabilize the exchange rate at its desirable level during 1997 even up to date have challenged the credibility of raising interest rates to defend the exchange rate. Critics argue that the high interest rates imperil the ability of the domestic firms and banks to pay back the external debt and thereby reduce the probability of repayment. As a result, high interest rates lead to capital outflows and thereby depreciation of the currency.

Nevertheless, only a few studies have been carried satisfactorily in Ghana to indicate how such relation can affect the exchange rates either positively or negatively. This study therefore, seeks to examine the relationship between interest rates, inflation and exchange rate in Ghana.

### **Purpose of the Study**

The main purpose of this study is to examine the relationship between inflation, interest rate and exchange rate in Ghana using quarterly time series over the period 1991Q1-2016Q4 as a result of data availability.

### **Research Objectives**

Specifically, the study seeks to;

1. Carry out a trend analysis of interest rate, inflation rate and exchange rate.
2. Estimate the effects of interest rate and inflation rate on exchange rate.

3. Determine the direction of causality between inflation, interest rate and exchange rate.

### **Research Hypotheses**

This study tested the following hypotheses based on research objectives

1. Ho: There are no long-run significant effects of interest rate and inflation rate on exchange rate.
2. Ho: There are no short-run significant effects of interest rate and inflation rate on exchange rate.
3. Ho: There is no direction of causality between inflation, interest rate and exchange rate.

### **Significance of the Study**

The main objective of this study is to determine the causal relationship between inflation interest rate and exchange rate, using secondary data from 1991 to 2016. Thus, over the years, Ghana has had problems in managing depreciation of its local currency, and, therefore there is the need to understand the relevant policy variables needed to address this problem. Choosing the optimal tools to cub the situation is the main challenge confronting policymakers and hence it is important to understand the underlying interrelationships between inflation, interest rate and exchange rate in the case of Ghana, which is useful from public policy point of view.

This study contributes to the stock of knowledge on the existing debate on the causal relationship between the above focus variables and also verify existing theories on the link between inflation, interest rates and exchange rate. It is hoped that the findings of this study provides managers of the economy and policy makers with insights to put the appropriate strategies and

measures in place to boost the performance of the Ghanaian economy for a sustained economic growth.

### **Delimitation of the Study**

This study examined the relationship between inflation, interest rate and exchange rate, using quarterly data from 1991 to 2016. The study employed the following control variables based on the literature: government expenditure, private sector investment, and money supply.

### **Limitations of the Study**

One major limitation of this study was the availability of monthly or quarterly data on all variables from the Bank of Ghana and the World Bank. Thus, to produce highly reliable estimates especially with cointegration, variables that have their values already in quarters were needed. As a result, quarterly series were generated through interpolation for the purpose of the estimation. However, there is no advantage in the power of these tests by switching from low frequency to high frequency data and merely increasing the number of observations over a short time period.

### **Organisation of the Study**

The study is organized into five chapters; chapter one presents the introduction comprising the background to the study, statement of the problem, purpose of the study, the research objectives, research hypotheses, significance of the study, delimitations, limitations of the study and organisation of the study. Chapter two reviews the literature of previous study comprising both theoretical and empirical review and chapter three looks at the research methods to carry out the study including research design, specification of the model, definition and measurement of variables,

estimation techniques, sources of the data in the study, and tools for data processing and analysis. Chapter four presents the results and discussion and chapter five present summary, conclusions and policy recommendations as well suggestions for future research.



## CHAPTER TWO

### LITERATURE REVIEW

#### Introduction

This chapter provides a review of theoretical and empirical literature for the study. It essentially consists of two parts; the first part indicates the overview of Ghana's growth experience as well as theoretical review underpinning the study while the second part provides a review of empirical studies conducted to evaluate the relationship that inflation and interest rate have with exchange rate.

#### Theoretical Review

At the heart of modeling the relationship between exchange rate and interest rate and inflation are theories and postulates that underpin volatility in their periodic values, which includes but not limited to:

#### Exchange rate theories

Exchange rate is one of the basic economic tools that are used to correct a number of economic misalignments facing nations. It has been widely applied in most structural adjustment programmes across the world. It has been used as a strategic policy tool for directing the direction of flow of economic resources (skilled labour, Capital, managerial know-how, and foreign exchange) into import and export sectors. However, for this to result to sustainable economic growth and development stability must be maintained in exchange rate regime (Schaling, 2008). A number of theories have been postulated for the determination of exchange rate. They include Purchasing Power Parity (PPP) theory, Interest Rate Parity theory, Demand and Supply theory, Portfolio-balance theory etc.

### **Purchasing power parity (PPP) theory**

The purchasing power theorem as advanced by Kuttner and Posen (2006) assumes that the normal equilibrium rate of exchange existing between two inconvertible currencies is determined by the ratios of their purchasing powers; hence the rate of exchange tends to be established at the point of equality between the purchasing powers of the two currencies. In essence, when one country's inflation rate rises relative to that of another country, decrease exports and increases imports depress the country's currency. The theory attempts to quantify inflation-exchange rate relationship by insisting that changes in exchange rate are caused by the inflation rate differentials (Kara & Nelson, 2002).

In absolute terms, PPP theory states that the exchange rate between the currencies of two countries equals the ratio between the prices of goods in these countries (Ndungu, 1997), implying that exchange rate must change to adjust to the change in the prices of goods in the two countries. However, the expected inflation differential equals the current spot rate and the expected spot rate differential (Kamin, 1997). The PPP in its simplest form asserts that in the long run, changes in exchange rate among countries will tend to reflect changes in relative price level.

Kamin and Klau (2003) are of the view that if exchange rates are floating, the observed movement can be explained entirely in terms of changes in relative purchasing power while if it is fixed, equilibrium can be determined by comparing satisfactory methods thus explaining the observed movements in exchange rates for countries whose rates were floating. Determining equilibrium parity rates for those countries whose surviving rates were out of

line with post war market conditions and assessing the appropriateness of an exchange rate.

Despite criticisms of PPP theory, the theoretical foundation and explanation may sound reasonable and acceptable but its practical application in real situation maybe an illusion, especially in the long run (Grigorian, Khachtryan & Sargsyan, 2004). The pitfalls notwithstanding, PPP theory is generally a sine-quo-non in the exchange rate determination literature, and continues to remain relevant in the determination of exchange rate among countries of the world (Nucu, 2011).

### **Interest rate parity theory**

The interest rate parity characterizes the relationship between interest rate and exchange rate of two countries. It assumes that the exchange rate of two countries will be affected by their interest rate differentials. The interest rate parity tries to relate interest rate of one country to the exchange value of her trading partner (Fadli et al., 2011). In other words, interest rate change in a country is a reflection of the exchange value of the currency of that country and her trading partners(s). Accordingly, the difference in the rate of interest in two countries should be able to explain the exchange value of the currencies of the countries (Alum, 2012). Thus, when interest rates are low, exchange value of the domestic currency in relation to international currencies will be low (devaluation). The reverse is the case if interest rates are high. But where relative interest rates levels exist, an increase in a country's interest rates will lead to a depreciation of its currency (Bergen, 2010). This is same as traditional flow model, which posits that increase in domestic interest rate relative to foreign interest rate causes an appreciation of the exchange rate

through induced capital inflow (Alex & Innes, 2006). Thus, changes in interest rate (interest rate differentials) can cause major changes in the exchange rates (Carrera & Restout, 2008).

### **Interest Rates**

An interest rate is described as the price a borrower pays for the use of money he does not own, and has to return to the lender who receives for deferring his consumption, by lending to the borrower. Interest can also be expressed as a percentage of money taken over the period of one year (Devereux & Yetman, 2002). An interest rate is very well stated as the rate of increase over time of a bank deposit. An Interest, which is charged or paid for the use of money, is often expressed as an annual percentage of the principal. It is calculated by dividing the amount of interest by the amount of principal.

Interest rates often change as a result of the inflation and government policies. The real interest rate shows the nominal interest rate minus inflation. A negative real interest rate means that the nominal interest rate is less than the inflation rate (Gagnon & Ihrig, 2004). Interest rate is the tool used by the central bank of a country to keep a check on any major currency fluctuation. An increase in interest rate is necessary to stabilize the exchange rate depreciation and to curb the inflationary pressure and thereby helps to avoid many adverse economic consequences.

### **Inflation Rates**

Inflation means a sustained increase in the aggregate or general price level in an economy. Inflation means there is an increase in the cost of living. There is widespread agreement that high and volatile inflation can be damaging both to individual businesses and consumers and also to the



economy as a whole. Aside interest rate and inflation, the exchange rate is one of the most important determinants of a country's relative level of economic health. Exchange rates play a vital role in a country's level of trade, which is critical to most free market economy in the world. For this reason, exchange rates are among the most watched and analyzed manipulated economic measure by governments. But exchange rates matter on a smaller scale as well: they impact the real return of an investor's portfolio (Gudmundsson, 2012). Generally, the inflation rate is used to measure the price stability in the economy. A low inflation rate scenario will exhibit a rising currency rate, as the purchasing power of the currency will increase as compared to other currencies.

### **Exchange Rates**

According to Mishkin (2008), the exchange rate of the currency in which a portfolio holds the bulk of its investments determines that portfolio's real return. A declining exchange rate obviously decreases the purchasing power of income and capital gains derived from any returns. Moreover, the exchange rate influences other income factors such as interest rates, inflation and even capital gains from domestic securities. While exchange rates are determined by numerous complex factors that often leave even the most experienced economists confused, investors should still have some understanding of how currency values and exchange rates play an important role in the rate of return on their investments. Exchange rates are prices that are determined by supply and demand. For some countries the exchange rate is the single most important price in the economy because it determines the international balance of payments. (Levich, 2001). There is no general theory

of exchange rate determination, but Eiteman, Stonehill and Moffett (2001) divide the potential exchange rate determinants into five areas: parity conditions, infrastructure, speculation, cross-border foreign direct investment and portfolio investment, and political risks.

### **Relationship between Inflation and Interest rate**

Asgharpur, Kohnehshahri, and Karami (2014) agreed that interest rates have a negative relationship to inflation. It is also supported by Kandel, Ofer and Sarig (1996) which states that interest rates negatively correlated to inflation. Fisher Hypothesis says that interest rates reflect fluctuations in inflation. On the other side of the interest rates can also have a positive relationship as expressed by Mishkin (1988) and Gibson (1982). Ghazali and Ramlee (2003) found that there is no significant relationship between interest rates and inflation.

### **Relationship between Interest rate to Exchange Rate**

Decreasing the amount of money in circulation will result in the increase in value of the currency with lower levels of investment and consumption. So it can be said that interest rates have a negative relationship to the exchange rates (Jordaan, 2013). On the other hand, Hakkio (1986), Berument and Gumay (2003) states that an increase in interest rates could also have an impact on the increase in exchange rates. The movement of interest rates will stimulate the attractiveness of the asset, so the demand for assets will increase and the demand for money will also increase (Hakkio, 1986).

### **Effects of Interest Rate and Inflation on Exchange Rate**

All over the world, changes in interest rates can have both positive and negative effects on the world business markets. Interest rates affect the

economy by influencing stock and bond interest rates, consumer and business spending, inflation, and recessions. However, it is important to understand that there is generally a 12-month lag in the economy, meaning that it will take at least 12 months for the effects of any increase or decrease in interest rates to be felt. By adjusting the federal funds rate, the Fed helps keep the economy in balance over the long term (Pétursson, 2008).

Global Interest Rates are the rates of central banks of respective countries. These rates change periodically, interest rates have a great impact on currency valuation and its relative currency paired value. According to Otuori, (2013) there are many theories about the causes of inflation, but economic predictions based on those theories have not always been substantiated by ensuing developments. There are strong arguments to substantiate the theory that inflation can affect exchange rates.

However, in reality there may be no direct relationship between the two. We know that exchange rates continually fluctuate, but the cost to the consumer is more stable, the supply chain and currency hedging absorbing much of the variations. The liberalization experience in Ghana shows that domestic interest rates have remained high even when inflation has been low and declining. That is, the economy of Ghana has been on inflationary trend though sometimes experienced deflationary for a few blips, and the exchange rate has been volatile.

## **Empirical Review**

### **Inflation, interest rate and exchange rate relationship**

Ali, Mahmood and Bashir (2015) attempted to investigate the impact of inflation, interest rate, and money supply on exchange rate volatility in Pakistan using monthly data for the period ranging from July, 2000 to June, 2009. The authors employed Johansen Cointegration approach and Vector Error Correction Model (VECM) to establish that there exist short run and long run relationships between inflation and exchange rate volatility. The study also indicated that money supply growth and a rise in interest rate raises the general price level which in effect leads to exchange rate volatility.

Madesha, Chidoko and Zivanomoyo (2013) using granger causality test empirically probed the relationship between exchange rate and inflation in Zimbabwe. An annual data for the period 1980 to 2007 was used. The findings of this study indicated that inflation and exchange rate granger-cause each other and thus have a long run relationship. Similarly, to explore exchange rate determinants in Ghana with much emphasis on inflation, Immurana, Iddrisu and Kyei-Brobby (2013) using an Autoregressive Distributed Lag (ARDL) to cointegration model with an annual data series covering the period 1985-2010 maintained that inflation significantly affects exchange rate positively in the long run but affects it negatively in the short run. Exchange rate is a principal indicator of economic growth of a country and its variability has a significant impact on international trade.

Kashif (2011) studied the long run relationship between inflation and exchange rates in Pakistan using Ordinary Least Square (OLS) model and a monthly data from 1970-2009. He considered inflation as the explanatory

variable and the exchange rate as the explained variable per contemporary study. The study maintained that there is a strong negative correlation between inflation and exchange rate. This finding may suggest and render invalid the argument of imported inflation. He also found that a rise or fall in the value of a currency is caused by the macroeconomic variables such as the interest rates, money supply and inflation. In effect, changes in the spot and forward exchange rates are the results of changes in inflation.

Ezirim et al. (2012) investigated the interdependencies between exchange rates and inflation rates behavior in Nigeria. Using autoregressive distributed lag analytical framework, they found that exchange rates movements and inflation spiral are cointegrated, associating both in the short run and in the long run. Thus, indicating that in a regime of inflation targeting, policy aimed at exchange rates manipulation becomes a proper monetary action, and vice versa. The present study includes interest rate as one of the explanatory variables given that it is one of the important monetary phenomena, which is a key driver of exchange rate in an economy.

Nucu (2011) examined the influence of gross domestic product (GDP), inflation rate, money supply, interest rates and balance of payments on exchange rate of Romanian against the most important currencies (EUR, USD) for the period 2000 to 2010 and found an inverse relationship between exchange rate (EUR/RON), GDP, and money supply. On the other hand a direct relationship was found between EUR/RON, Inflation and Interest rate. The validation of the correlation between exchange rate and balance of payment could not be established because it is not significant.

Prasertnukul, Kim and Kakinaka (2010) studied the relationship among exchange rates, price level and targeting inflation by using time series data from 1990 -2007 for the panel of Asian countries. Empirical results showed that due to increase in inflation rate, exchange rate would be depreciated in Philippines, Indonesia, Thailand and South Korea. They found that when inflation accrued in selected countries then exchange rate will be stabilized.

Bergen (2010) asserted that the high interest rate policy doesn't defend currencies against speculative attacks; implying that there is a stinking lack of any systematic association between interest rates and the outcome of speculative attack. However, Utami and Inanga (2009) while examining the influence of interest rate differentials on exchange rate changes based on the IFE theory and the influence of inflation rate and interest rate differentials in Indonesia using quarterly and yearly data for the interest, inflation differentials and changes in exchange rate over a five year period, 2003-2008 used four foreign countries namely: the USA, Japan, Singapore and the UK and Indonesia as the home country, found that interest rate differentials have positive but no significant influence on changes in exchange rate for the USA, Singapore and the UK, relative to that of Indonesia. On the other hand, interest rate differentials have negative significant influence on changes in exchange rate for Japan. Also, the results showed that several inflation rate differentials have significant positive influence on interest rate differentials.

In another study, Alex and Innes (2006) investigated the relationship between expected inflation and nominal interest rates in South Africa and the extent to which the Fisher Effect hypothesis holds using 3months banker's acceptance rate and the 10 year government bond rate to proxy both short and

long term interest rates, found the existence of long term unit proportional relationship between nominal interest rates and expected inflation using Johansen co-integration test.

Mumuni and Owusu-Afriyie (2004) in their study, explored the factors that drive exchange rate in Ghana specifically the cedi/dollar rate. They employed cointegration techniques and error correction model in their analysis. The outcome of the study contended that the dynamics in the cedi/dollar rate are significantly determined by the rate of inflation and the treasury bill rate among others. Bawumia and Abradu-Otoo (2003) in an attempt to ascertain the relationship between money growth, inflation, and exchange rate in Ghana employed an error- correction mechanism and cointegration analysis. Monthly data series covering the period 1983-1999 were used. The results of the study suggested a long run relationship between inflation, money supply growth, cedi depreciation and real income. It was also found that there is a positive correlation between exchange rate, money supply growth and inflation in Ghana but found inflation to be inversely related to real income.

### **Chapter Summary**

From the above review, it is realized that several works have examined the relationship between inflation, interest rate and exchange rate in both the developed and the developing countries including Ghana, most of these works concentrated on the interrelationship between exchange rate and its determinants without necessarily paying much attention to particular areas such as inflation, interest rate and exchange rate linkages where most policies and strategies should be geared towards in order to achieve the desired rate of

growth. This in effect has left some gaps in the exchange rate-determinants literature. In the light of this and many others, this study attempts to examine the relationship between inflation, interest rate and exchange rate in Ghana during the period 1991-2016. Consequently, it attempts to contribute to the limited existing literature by focusing mainly on which particular areas that most policy issues should be geared towards in the Ghanaian economy as far as exchange rate is concerned.





## CHAPTER THREE

### RESEARCH METHODS

#### Introduction

This chapter presents the research methods employed in the study. Specifically, it gives a detailed description of the research design, specification of the model, definition and measurement of variables in the model, estimation technique, sources of data and tools for data processing and analysis.

#### Research Design

The study adopts a quasi-experimental research design to study the relationship among the variables and to meet the expectation of the study. In this design, the study establishes the long term as well as the short term relationships between these variables of interest. The study followed the positivist paradigm within the framework of classical and neoclassical economics. The positivist philosophy favours the use of quantitative approach to research used in this study. Also, this philosophy is suitable for the development of mathematical models to measure relationship between quantitative variables.

#### Research Approach

Quantitative method was used in this study. This calls for a suitable model to be employed to examine the effects of inflation and interest rate on exchange rate in Ghana. In this regard, this study adapts the purchasing power parity theory and fisher's theory to model the relationship among the variables. The fisher's model is modified to include other variables to analyse the relationship between inflation, interest rate and exchange rate as well as other control variables using time series quarterly data from 1991 to 2016 in

Ghana. This is due to the fact that the study is a macro study and involves trends analysis.

### Model Specification

The study adopts the international Fisher effect theory to capture the relationship among the variables as shown in equation (1). Thus, following Madura and Zarruk (1995), Shalishali and Ho (2002), the historical exchange rates and the nominal interest rate differential follow from the assumptions that the effective exchange rate adjusted return on a foreign bank deposit (or any money market security) is:

$$r = (1 + i_f)(1 + e_f) - 1 \quad (1)$$

Where  $i_f$  is the foreign interest rate, and  $e_f$  is the percentage change in the value of the foreign denominating the security. Equation (1) states that the actual or effective return on a foreign money market security depends on foreign interest rate ( $i_f$ ), as well as the percent change in the value of foreign currency ( $e_f$ ) denominating the security. Furthermore, the investors who invest in the money market at the home country is expected to receive the actual rate of return which is simply the interest rate offered on those securities. In accordance with the IFE, the effective return on a home investment ( $i_h$ ) should be on average equal to the effective return on a foreign investment ( $r$ ),  $r = i_h$ .

Substituting equation (1) for  $r$ , the equation becomes:

$$i_h = (1 + i_f)(1 + e_f) - 1 \quad (2)$$

Solving for  $e_f$  becomes:

$$e_f = [(1 + i_h)/(1 + i_f)] - 1 \quad (3)$$

When  $ih > if$ ,  $ef$  will be positive. This means that the foreign currency will appreciate when the home interest rate is greater than the foreign interest rate. Conversely, when  $ih < if$ ,  $ef$  will be negative. That is, the home currency will appreciate when the home interest rate is smaller than the foreign interest rate. It should be recalled that the difference in the nominal interest rate between countries is due to differences in expected inflation rates assuming that the real rate of return is equal across countries. It should also be recalled that the PPP theory suggests that the currency of a country with a higher inflation rate will depreciate by the amount of inflation differential.

Therefore, the country with a higher interest rate will experience depreciation in the value of its currency by the amount of interest rate differential which will consequently negate any gains by investors who invest in the securities of those countries due to a higher interest rate. Eventually, the return on investment in respective countries will be similar. For the purpose of the study and following Ezirim et al. (2012), Madura and Zarruk (1995), Shalishali and Ho (2002), the empirical model in relation to the theoretical model in equation (1) can be written as:

$$EXR_t = \eta(INF_t^{\beta_1} INT_t^{\beta_2} GE_t^{\beta_3} PINV_t^{\beta_4} MS_t^{\beta_5}) e^{\varepsilon} \quad (4)$$

EXR is the exchange rate, INF is the inflation rate, INT is the interest rate GE is the government expenditure, PINV is the private sector investment, MS is the money supply,  $e$  is the error term. It is to be noted that, the variables in equation (4) are in exponential form which represent their elasticities and it is because they will be subsequently converted into logarithm. Foot and Stein (1991) argued that depreciation of the exchange rate stimulate private investment. They advocated that devaluation does not only favour the export

sector but also help foreign firms to acquire local assets at much lower price to increase investment. Real exchange rate depreciates persistently in response to an unexpected exogenous increase in government expenditure (Muller, 2008).

According to McKinnon (2005), sustained exchange rates reflect the monetary policies that a government takes: tight money brings about an appreciation of the currency which leads to deflation; easy money brings depreciation and inflation in the economy. Government expenditure, private sector investment and money supply entered equation (4) based on these empirical evidence. Taking logarithm of the variables in equation (4), the exchange equation becomes:

$$\ln EXR_t = \beta_0 + \beta_1(INF_t) + \beta_2 \ln(INT_t) + \beta_3 \ln(GE_t) + \beta_4 \ln(PINV_t) + \beta_5 \ln(MS_t) + \varepsilon_t \quad (5)$$

Where  $\ln \eta = \beta_0$ ,  $\ln \ell = 1$ ,  $\ln =$  natural logarithm. Equation (5) is subsequently modeled with optimal lags of the variables to depict the ARDL representation.

#### **Expected Sign of the variables**

The coefficients  $\beta_1, \beta_2, \beta_3, \beta_4, \beta_5$  in equation (5) are the various elasticities of the respective variables.  $\beta_0, t$  and  $\varepsilon$  are the drift component, time and error term respectively. The prior signs for the coefficient in equation (5) are  $\beta_1 > 0, \beta_2 > 0, \beta_3 > 0, \beta_4 < 0, \beta_5 > 0$ . The choice of the variables included in the above model is based on the literature, economic theory, data availability and their significance in the model chosen for the study.

#### **Definition and Measurement of Variables**

For the purpose of this study, the following operational definitions and measurements were used for the variables being examined.

### **Exchange rate (EXR)**

Exchange rate (EXR) is the weighted average of a country's currency relative to an index or basket of other major currencies adjusted for the effects of inflation. In this study, the real effective exchange rate was used. This study used real effective exchange rate as a measure of the exchange rate as was used by (Jiménez-Rodríguez & Sánchez, 2005). Exchange rate depreciation may lead to increase in the export of goods and services since goods produced in the economy become relatively cheap. This will have a positive impact on economic growth.

Depreciation of the domestic currency may also result in the reduction of imports. However, the impact of exchange rate depreciation on the economy may depend on the balance of payment position of the country. There are many ways to measure an exchange rate. The most common way is to measure a bilateral exchange rate. A bilateral exchange rate refers to the value of one currency relative to another. Bilateral exchange rates are typically quoted against the US dollar (USD), as it is the most traded currency globally. That is, the value of the Ghanaian Cedi against the US Dollar.

### **Inflation (INF)**

This is the index of prices used to measure the change in the cost of basic goods and services in comparison with a fixed base period. The annual percentage change in the cost to the average consumer of acquiring a fixed basket of goods and services that may be fixed or changed at specified intervals, such as yearly was used to measure inflation. It is a reflection of macroeconomic instability. A high rate of inflation is generally unattractive to foreign investors because it raises the cost of borrowing and thus lowers the

rate of capital investment. Inflation is therefore used as an indicator to capture macroeconomic instability, (Asiedu & Lien, 2004). The study expects a positive relationship between inflation and exchange rate. The study employed Consumer Price Index (CPI) to measure inflation.

### **Interest rate (INT)**

Interest rate is the rate charged by financial institutions/lenders on borrowings (loans). Interest rates were measured using the Bank of Ghana's prime rate. The prime rate is the annualized interest rate the central bank charges commercial, depository banks for loans to meet temporary shortages of funds. The study expects a positive relationship between the country's interest rate and exchange rate.

### **Private Sector Investment (PINV)**

This is the investment made by either foreign or local investors for the purpose of a return. The private investment was measured as a private investment as percentage of GDP. The study expects a negative relationship between private sector investment and exchange rate.

### **Government Expenditure (GE)**

Ratio of government expenditure to GDP variable was used as a measure and it enters the model as a policy variable and also to complete the components of the GDP. Government expenditure, according to the Keynesian proposition is expected to raise exchange rate. It could, however, reduce economic growth because of the crowding out effect on private investment and the inflationary pressures it can lead to (Allen & Ndikumana, 2000). However, given that all things remain constant and following Keynesian

proposition, the study expects a negative relationship between government expenditure and exchange rate.

### **Money Supply (MS)**

Money supply which is also an independent variable was measured using the broad money supply (M2+) as defined by Bank of Ghana. Also, per the simple theoretical monetary model, an increase in money supply is expected to depreciate the cedi.

### **Sources of Data**

This study used secondary data obtained from the World Bank database, and the Bank of Ghana quarterly bulletins and annual reports. This study employed quarterly series of the chosen variables from the period 1991:Q1 – 2016:Q4. Ghana's exchange rate, inflation, interest rate, government expenditure, private sector investment, and money supply were obtained from both the Bank of Ghana website and World Development Indicators. Quarterly series of the variables were generated from annual series using econometric views software 9.0.

### **Estimation Technique**

This study first investigates the time series properties of the data using the Augmented Dickey-Fuller (ADF) and the Philip-Perron (PP) tests. The unit root test will be used to check the stationarity properties of the data. The study then proceeds to test for the long-run and short-run relationships among the variables using the Autoregressive Distributed Lag (ARDL) approach.

### **Unit Root Tests**

Since macroeconomic time series data are usually non-stationary, it is very important to test for the stationarity properties of the data. This testing

requires the test of the order of integration of the data set which is the unit root tests. A stationary series is said to be integrated of order (d) if it achieves stationarity after being differenced (d) times. Many studies have shown that models with non-stationary variables tend to produce spurious regressions and make the usual test statistics (t, F, DW, and  $R^2$ ) unreliable (Al-Yousif, 2002). So, if the non-stationary variables are differenced properly, they become stationary. The appropriate number of differencing is called the order of integration. Therefore, if a time series, for example, Y becomes stationary after being differenced d times, Y is said to be integrated of order d, denoted by  $Y \sim I(d)$ .

In line with empirical literature, the study employed the ADF and PP tests to inspect the stationarity properties of the variables included in the model. These tests actually involve two separate steps. First, they test the model with constant but no linear time trend, and second, with both constant and linear trend in order to determine the degree of integration of the data series. The main reason for conducting these two tests is to be sure that, the series enter the model to be estimated in non-explosive form and also to address the issue of tests with low power. The ADF and PP tests are similar except that they differ with regard to the way they correct for autocorrelation in the residuals.

For instance, the PP (non-parametric) test generalizes the ADF procedure, allowing for less restrictive assumptions for the time series in questions. That is, it relates the assumptions pertaining to autocorrelation and heteroskedasticity. Both ADF and PP tests, test the null hypothesis that the variables under investigation have unit root against the alternative hypothesis



of no unit root. Moreover, in each of these tests, the optimal lag length is chosen using the Swartz Information Criterion (SIC). Here, the sensitivity of the ADF test to lag selection renders the PP test an important and essential additional tool for making inferences about unit roots. The basic formulation of the ADF is given as:

$$\Delta Y_t = \mu + \delta_t + \rho Y_{t-1} + \sum_{i=1}^p \psi_i \Delta Y_{t-i} + \varepsilon_t \dots \dots \dots (6)$$

Where  $Y_t$  denotes the series at time t,  $\Delta$  is the difference operator,  $\mu$ ,  $\delta$ ,  $\rho$ , and  $\psi$  are the parameters to be estimated and  $\varepsilon$  is the stochastic disturbance term.

The hypothesis testing is given as:

$$H_0 : \rho = 0 \text{ (Series contain unit root- non stationary)}$$

$$H_1 : \rho \neq 0 \text{ (Series contain no unit root - stationary)}$$

From the hypothesis test, if the tau ( $\tau$ ) value or test statistic is more negative than the critical values, then, we reject the null hypothesis and conclude that the series is stationary. However, if the tau ( $\tau$ ) value is less negative than the critical value, we fail to reject the null hypothesis and conclude that the series is non-stationary.

**Cointegration Test**

In the face of non-stationary series with unit roots, first differencing appears to provide the appropriate solution to the problems. However, first differencing tends to eliminate all the long- run information which economists are invariably interested in. Thus, such differencing may result in a loss of low frequency information or long-run characteristics of the series data. Nevertheless, Engle and Granger (1987) disclosed that, if there is an

equilibrium relationship between such variables, then for this relationship to have any meaning, a linear combination of these variables, the disequilibrium error should fluctuate around zero (that is, it should be stationary). Thus, two time series integrated of the same order  $d$  are said to be co-integrated if one unique linear combination of these series exists which is integrated in an order inferior to  $(d-b)$  with  $\geq 1$ . After establishing that variables are stationary, it is necessary to determine whether or not there is any long-run relationship between them, and this leads to co-integration testing.

### **The Bounds Testing/ARDL Procedure**

In fact, a number of time series studies have used the Johansen's co-integration technique to determine the long-run relationship between variables of interest. This technique actually remains the choice for many researchers who argue that, this is the most accurate method to apply for  $I(1)$  variables. However, a series of studies by Peseran and Peseran (1997), Peseran and Shin (1999), and Peseran, Shin and Smith (2001) have introduced an alternative co-integration technique known as the Autoregressive Distributed Lag (ARDL) bounds test. This technique has a number of advantages over the Johansen's co-integration technique.

First, the ARDL Approach is the more statistically significant technique to determine the co-integration relations in small samples (Ghatak & Siddiki, 2001), while the Johansen's co-integration technique requires large data samples for validity. Second, while other techniques require all the regressors to be integrated of the same order, the ARDL approach can be applied whether the regressors are  $I(1)$  or  $I(0)$ . This means that, the ARDL approach avoids the pre-testing problems associated with standard co-integration, which

requires that the variables already be classified into I (1) or I (0) (Peseran et al., 2001). In addition, Tang, (2006) stated that, the ARDL approach is also applicable when the explanatory variables are endogenous and is sufficient to simultaneously correct for residual serial correlation.

Bahmani-Oskooee and Kandil (2007) explained that, the first step in any co-integration technique is to determine the degree of integration of each variable in the model but this depends on which unit root test one uses because different unit root tests could lead to contradictory results. For example, applying the conventional unit root tests such as the Augmented Dickey-Fuller and the Philips-Perron tests, one may incorrectly conclude that a unit root is present in a series that is actually stationary around one-time structural break (Perron, 1997).

Thus, the ARDL approach is useful since it avoids all these problems. Another difficulty of the Johansen's co-integration technique which the ARDL approach avoids concerns the large number of choices which must be made including decisions regarding the number of endogenous and exogenous variables to be included in the model, the treatment of deterministic elements, as well as the order of VAR and the optimal number of lags to be used. Finally, with the application of the ARDL approach, it is possible that different variables have different optimal number of lags, while in Johansen's technique, this is not permitted.

According to Peseran and Peseran (1997), the ARDL approach requires the following two steps. In the first step, the existence of any long-run relationship among the variables of interest is determined using an F-test. The second step of the analysis is to estimate the coefficients of the long-run

relationship and determine their values, followed by the estimation of the short-run parameters of the variables with the error correction representation of the ARDL model. By applying the error correction model (ECM) version of ARDL, the speed of adjustment to equilibrium will be determined. In order to apply the bounds test procedure for co-integration, the following restricted (conditional) version of the ARDL models are estimated to test the long-run relationships between exchange rate volatility and economic growth. This framework is implemented by modeling equation (3) as a conditional ARDL as:

$$\Delta \ln \text{EXR}_t = \alpha_0 + \sum_{i=1}^p \lambda_{1i} \Delta \ln \text{EXR}_{t-i} + \sum_{i=1}^p \lambda_{2i} \Delta \ln \text{INF}_{t-i} + \sum_{i=1}^p \lambda_{3i} \Delta \ln \text{INT}_{t-i} + \sum_{i=1}^p \lambda_{4i} \Delta \ln \text{PINV}_{t-i} + \sum_{i=1}^p \lambda_{5i} \Delta \ln \text{GE}_{t-i} + \sum_{i=1}^p \lambda_{6i} \Delta \ln \text{MS}_{t-i} + \eta_1 \ln \text{EXR}_{t-i} + \eta_2 \ln \text{INF}_{t-i} + \eta_3 \ln \text{INT}_{t-i} + \eta_4 \ln \text{PINV}_{t-i} + \eta_5 \ln \text{GE}_{t-i} + \eta_6 \ln \text{MS}_{t-i} + v_t \dots \dots \dots (7)$$

Where  $\Delta$ 's are the first difference operators,  $\eta_1 \dots \dots \dots \eta_6$  are the long run multipliers,  $\lambda$ 's are the short run coefficients to be estimated through the error correction framework in the ARDL models,  $\alpha_0$  is the constant term (drift) and  $v$  is the white noise error term.

The first step in the ARDL approach is to estimate equations (5) by applying OLS. The second step is to test the null hypothesis of no long run relationship among the variables in equation (5) against the alternative hypothesis of the presence of a long run relationship among the variables using F-test denoted by  $F_{EXR}(\text{EXR}|\text{INF}, \text{INT}, \text{PINV}, \text{GE}, \text{MS})$  and it is given by:

$$H_0 : \eta_1 = \eta_2 = \eta_3 = \eta_4 = \eta_5 = \eta_6 = 0$$

$$H_1 : \eta_1 \neq \eta_2 \neq \eta_3 \neq \eta_4 \neq \eta_5 \neq \eta_6 \neq 0$$

Given that the asymptotic distribution of F-statistic is non-standard without considering the independent variables being I(0) or I(1), Peseran et al. (2001) generated and presented the appropriate critical values according to the number of independent variables I the models of presence or absence of constant term or time trend in the models. Therefore, the calculated F-statistic is compared with two sets of critical values developed on the basis that the independent variables are I(d)-where  $0 \leq d \leq 1$ . Here, the lower critical bound assumes that all variables are I(0) whereas the upper critical bound assumes that the variables are I(1).

If the calculated F-statistic exceeds upper critical value, then the null hypothesis of no co-integration is rejected irrespective of whether the variables are I(0) or I(1). This signifies that, there are long-run relationships among the variables. On the other hand, if the F-statistic falls below the lower bound then the null hypothesis of no cointegration cannot be rejected. Additionally, if the F-statistic lies within the lower critical and upper critical bounds, then, the test is inconclusive (Peseran & Peseran, 1997). However, when all the variables are integrated of order zero (i.e. I(0)), then the null hypothesis of no co-integration is rejected implying that there exist long-run relationships among the variables, otherwise they are not co-integrated.

For optimal lag length for each variable, the ARDL methodology estimates  $(m+1)^{k+1}$  number of regressions, where m is the maximum number of lags and k is the number of variables in the equations. The orders of the lags of the ARDL models are chosen using one of the following information criteria: Schwarz-Bayesian Criterion (SBC), Akaike Information Criterion (AIC), the  $\bar{R}^2$  Criterion or the Hannan and Quinn (HQ) Criterion.

### Long-run and Short-run Dynamics

Once co-integration is established, the next step is that, the following ARDL ( $p, q_1, q_2, q_3, q_4, q_5, q_6$ ) models are estimated in order to obtain the long run coefficients (estimates). These are given by:

$$\begin{aligned} \ln EXR_t = & \lambda_0 + \sum_{i=0}^p \eta_1 \ln EXR_{t-i} + \sum_{i=0}^{q_1} \eta_2 \ln INF_{t-i} + \sum_{i=0}^{q_2} \eta_3 \ln INT_{t-i} + \sum_{i=0}^{q_3} \eta_4 \ln PINV_{t-i} + \\ & \sum_{i=0}^{q_4} \eta_5 \ln GE_{t-i} + \sum_{i=0}^{q_5} \eta_6 \ln MS_{t-i} + \mu_t \dots \dots \dots (8) \end{aligned}$$

When there is a long run relationship among the variables, then the unrestricted ARDL error correction representations (short run) are estimated as:

$$\begin{aligned} \Delta \ln EXR_t = & \alpha_0 + \sum_{i=0}^p \lambda_{1i} \Delta \ln EXR_{t-i} + \sum_{i=0}^{q_1} \lambda_{2i} \Delta \ln INF_{t-i} + \sum_{i=0}^{q_2} \lambda_{3i} \Delta \ln INT_{t-i} + \sum_{i=0}^{q_3} \lambda_{4i} \Delta \ln PINV_{t-i} + \\ & \sum_{i=0}^{q_4} \lambda_{5i} \Delta \ln GE_{t-i} + \sum_{i=0}^{q_5} \lambda_{6i} \Delta \ln MS_{t-i} + \phi ECT_{t-i} + \mu_t \dots \dots \dots (9) \end{aligned}$$

From equation (9) the  $\lambda$ 's are the coefficients relating to the short run dynamics of the convergence to equilibrium,  $ECT_{t-i}$  is the error correction term resulting from the estimated long run equilibrium relationship, and  $\phi$  is the coefficient denoting the speed of adjustment to long run equilibrium when there is a shock in the system. Here, the residuals from the co-integration equation, lagged one (1) period is defined as:

$$\begin{aligned} ECT_t = & \ln EXR_t - \alpha_0 - \sum_{i=0}^p \phi_{1i} \Delta \ln EXR_{t-i} - \sum_{i=0}^{q_1} \phi_{2i} \Delta \ln INF_{t-i} - \sum_{i=0}^{q_2} \phi_{3i} \Delta \ln INT_{t-i} - \\ & \sum_{i=0}^{q_3} \phi_{4i} \Delta \ln PINV_{t-i} - \sum_{i=0}^{q_4} \phi_{5i} \Delta \ln GE_{t-i} - \sum_{i=0}^{q_5} \phi_{6i} \Delta \ln MS_{t-i} \dots \dots \dots (10) \end{aligned}$$

Engle and Granger(1987) explained that when variables are cointegrated, their dynamic relationship can be specified by an error correction

representation in which an error correction term (ECT) computed from the long-run equations must be incorporated in order to capture both the short-run and long-run relationships. The error term indicates the speed of adjustment as stressed above to long-run equilibrium in the dynamic models. In other words, its magnitude shows how quick the variables converge to equilibrium when they are being disturbed. It is expected to be statistically significant with a negative sign. The negative sign indicates that any shock that occurs in the short-run will be corrected in the long-run. Therefore, the larger the coefficients of the error correction term in absolute terms, the faster the convergence to equilibrium.

To ensure the goodness of fit of the models, the diagnostic and stability tests are also conducted. The diagnostic test examines the serial correlation, functional form, normality, and heteroskedasticity associated with the selected models. Peseran and Peseran (1997) suggested that conducting stability test is of great importance. This technique is also known as cumulative sum (CUSUM) and cumulative sum of squares (CUSUMSQ). The CUSUM and CUSUMSQ statistics are updated recursively and plotted against the breaks points. If the plots of CUSUM and CUSUMSQ statistics stay within the critical bounds of five percent level of significance, the null hypothesis of stable coefficients in the given regression cannot be rejected (Peseran & Peseran, 1997).

### **Causality Test**

Causality is the measure of the ability of one time series variable to predict the future values of another time series variable. Granger Causality was developed in the 1960s by Engle and Granger (1987) and has been widely

used in economics to date. According to Granger causality, if a variable X “Granger causes” a variable Y, then past values of X should contain information that helps predict variable Y above and beyond the information contained in past values of Y alone. Engle and Granger (1987) postulated that stationary variables X and Y causing each other can be represented in a model form as follows:

$$X = \alpha_0 + \sum_{i=1}^p \gamma_1 X_{t-i} + \sum_{j=1}^p \gamma_2 Y_{t-j} + \varepsilon_t \dots \dots \dots (11)$$

$$Y = \beta_0 + \sum_{i=1}^p \lambda_1 Y_{t-i} + \sum_{j=1}^p \lambda_2 X_{t-j} + \mu_t \dots \dots \dots (12)$$

Based on (11) and (12), it can be proposed that Y Granger cause X if  $\gamma_2$  is statistically significant and also can be concluded that X Granger cause Y if  $\lambda_2$  is statistically significant.

### Chapter Summary

This chapter presented the methodological framework suitable for conducting the study. The study adopted the Purchasing Power Parity and Fisher’s theories to capture the relationship among the variables. The study followed the standard literature of Ezirim et al. (2012), Madura and Zarruk (1995), and Shalishali and Ho (2002) to specify the econometric model for exchange rate. Quarterly time-series data exchange rate, inflation, interest rate, private sector investment, government expenditure and money supply from 1991 to 2016 will be used for the study. Stationarity test will be conducted using Augmented Dickey–Fuller (ADF) and Phillip-Perron (PP). Finally, Autoregressive Distributed Lag (ARDL) econometric methodology was used



to examine the long-run and short-run dynamics among the variables. Granger causality was used to determine the causal effects among the variables.



## CHAPTER FOUR

### RESULTS AND DISCUSSION

#### Introduction

This chapter presents and discusses the estimation results. The results of the descriptive statistics of the variables, both ADF and PP unit root tests, trend analyses of the focus variables, ARDL approach to cointegration and Granger-causality test are presented and discussed in relation to the hypotheses of the study.

#### Descriptive Statistics

Table 1 indicates that, all the variables have positive average values (means). The minimal deviation of the variables from their means as shown by the standard deviation gives indication of slow growth rate (fluctuation) of these variables over the period. Most of the variables were positively skewed implying that the majority of the values are less than their means.

**Table 1: Descriptive Statistics of the Variables**

	EXR	INF	INT	PINV	GE	MS
Mean	5.233	3.170	5.320	1.510	2.798	3.977
Median	5.139	2.762	4.255	1.497	2.623	3.983
Maximum	6.537	1.912	16.939	2.060	5.421	4.708
Minimum	4.025	5.798	1.664	1.104	1.411	2.912
Std. Dev.	0.290	0.908	3.278	0.091	0.834	0.161
Skewness	1.175	-3.125	1.475	-2.270	1.262	1.448
Kurtosis	11.312	19.313	4.988	20.840	4.991	28.517
Sum	481.425	11.682	489.465	156.990	290.947	365.909
Sum Sq. Dev.	7.669	75.093	977.856	0.849	71.667	2.364
Observations	104	104	104	104	104	104

Note: Std. Dev. represents Standard Deviation while Sum Sq. Dev. represents Sum of Squared Deviation.

Source: Field data, Mahama (2019)

It is evident from the Table 1 that, inflation and private sector investment are negatively skewed implying that majority of the values are greater than their means.

## Unit Root Tests

Although the bounds test (ARDL) approach to cointegration does not necessitate the pretesting of the variables for unit roots, it is however vital to perform these tests to verify that the variables are not integrated of an order higher than one. The aim is to ascertain the absence or otherwise of  $I(2)$  variables to free the result from spurious regression. Thus, in order to ensure that some variables are not integrated at higher order, there is the need to complement the estimated process with unit root tests.

As a result, before the adoption of Autoregressive Distributed Lag approach to cointegration and Granger causality test, unit root tests were conducted in order to investigate the stationarity properties of the data. As a result, the Augmented Dickey-Fuller (ADF) and Philips-Perron (PP) tests were applied to all variables in levels and in first difference in order to formally establish their order of integration. In order to be sure of the order of integration of the variables, the test was conducted first with intercept and no time trend, and second with intercept and time trend in the model. The optimal number of lags included in the test was based on automatic selection by Schwarz-Bayesian Criterion (SBC). The study used the P-values in the parenthesis in Tables 2 and 3 to make the unit root decision, (that is, rejection or acceptance of the null hypothesis that the series contain unit root) which arrived at similar conclusion with the critical values.

The results of ADF test and PP test for unit root with constant only in the model for all the variables are presented in Table 2 and Table 3 respectively. The null hypothesis is that the series is non-stationary, or

contains a unit root. The rejection of the null hypothesis for the test is based on the MacKinnon (1991) critical and probability values.

**Table 2: Results of Unit Root Test with constant only: ADF Test**

Levels			First Difference			
Variables	ADF-Statistic	Lag	Variables	ADF-Statistic	Lag	$I(0)$
lnEXR	-3.163[0.256]	1	$\Delta$ lnEXR	-5.001[0.000]***	0	$I(1)$
INF	-1.877 [0.336]	0	$\Delta$ INF	-4.102[0.000]***	2	$I(1)$
INT	-2.825 [0.588]	1	$\Delta$ INT	-6.452[0.000]***	0	$I(1)$
PINV	-0.508 [0.986]	5	$\Delta$ PINV	-4.592[0.000]***	1	$I(1)$
GE	-2.776[0.658]	4	$\Delta$ GE	-7.263[0.000]***	3	$I(1)$
MS	-3.251 [0.205]	5	$\Delta$ MS	-7.551[0.000]***	4	$I(1)$

Note: \*\*\* indicate the rejection of the null hypothesis of non-stationary at 1% level of significance,  $\Delta$  denotes first difference, and  $I(0)$  is the order of integration. The values in parenthesis are the P-values.

Source: Field data, Mahama (2019)

**Table 3: Results of Unit Root Test with constant only: PP Test**

Levels			First Difference			
Variables	PP-Statistic	Bwd	Variables	PP-Statistic	Bwd	$I(0)$
lnEXR	-2.542[0.109]	2	$\Delta$ lnEXR	-5.010[0.000]***	1	$I(1)$
INF	-1.192 [0.321]	1	$\Delta$ INF	-4.093[0.005]***	2	$I(1)$
INT	-2.573[0.102]	4	$\Delta$ INT	-6.485[0.000]***	2	$I(1)$
PINV	-2.444 [0.133]	5	$\Delta$ PINV	-3.791[0.009]***	1	$I(1)$
GE	-1.792 [0.382]	4	$\Delta$ GE	-5.143[0.006]***	1	$I(1)$
MS	-1.658 [0.438]	1	$\Delta$ MS	-4.063[0.005]***	0	$I(1)$

Note: \*\*\* indicate the rejection of the null hypothesis of non-stationary at 1% significance levels,  $\Delta$  denotes first difference, Bwd is the Band Width, and  $I(0)$  is the order of integration. The values in parenthesis are the P-values.

Source: Field data, Mahama (2019).

**Table 4: Results of Unit Root Test with constant and trend: ADF Test**

Levels			First Difference			
Variables	ADF-Statistic	Lag	Variables	ADF-Statistic	Lag	$I(0)$
lnEXR	-2.322[0.137]	1	$\Delta$ lnEXR	-6.144[0.000]***	0	$I(1)$
INF	-2.869[0.178]	1	$\Delta$ INF	-4.713[0.001]***	0	$I(1)$
INT	-2.529[0.313]	1	$\Delta$ INT	-6.589 [0.000]***	0	$I(1)$
PINV	-1.752 [0.719]	1	$\Delta$ PINV	-4.565 [0.002]***	0	$I(1)$
GE	-1.905 [0.641]	5	$\Delta$ GE	-7.133[0.000]***	3	$I(1)$
MS	-2.858 [0.181]	3	$\Delta$ MS	-4.083 [0.000]***	2	$I(1)$

Note: \*\*\* indicate the rejection of the null hypothesis of non-stationary at 1% significance level,  $\Delta$  denotes first difference, and  $I(0)$  is the order of integration. The values in parenthesis are the P-values.

Source: Field data, Mahama (2019)

From the unit root test results in Table 4, it can be seen that all the variables are non-stationary at levels. This is because the P-values of the ADF statistic are not statistically significant. However, when the variables are differenced for the first time they become stationary. This is because the null hypothesis of the presence of unit root (non-stationary) is rejected at 1 percent significant levels. Table 5 presents the unit root test results obtained for the PP test with both constant and trend in the model.

**Table 5: Results of Unit Root Test with constant and trend: PP Test**

Levels			First Difference			
Variables	ADF-Statistic	Lag	Variables	ADF-Statistic	Lag	$I(0)$
lnEXR	-2.269 [0.243]	3	$\Delta$ lnEXR	-6.129 [0.000]***	1	$I(1)$
INF	-1.941 [0.624]	4	$\Delta$ INF	-4.678 [0.002]***	2	$I(1)$
INT	-1.109 [0.921]	5	$\Delta$ INT	-6.471[0.000]***	2	$I(1)$
PINV	-2.047 [0.568]	2	$\Delta$ PINV	-3.156 [0.012]***	1	$I(1)$
GE	-2.809 [0.198]	5	$\Delta$ GE	-	13	$I(1)$
				11.493[0.000]***		
MS	-2.692 [0.242]	6	$\Delta$ MS	-4.566 [0.002]***	2	$I(1)$

Note: \*\*\* indicate the rejection of the null hypothesis of non-stationary at 1% significance level,  $\Delta$  denotes first difference, and  $I(0)$  is the order of integration. The values in parenthesis are the P-values.

Source: Field data, Mahama (2019)

### Bounds Test for Cointegration

It is important to establish the existence of a long run relationship between the variables by employing the bounds testing approach to cointegration (Pesaran et al, 2001). Cointegration test helps to verify the long run and short-run relationships among the variables of interest. The results are presented in Table 6.

**Table 6: Bounds Test for Cointegration**

Critical value Bounds	90% Level		95% Level		99% Level	
	I(0)	I(1)	I(0)	I(1)	I(0)	I(1)
Intercept with no trend	2.141	3.250	2.476	3.646	3.267	4.450
Dependent Variable	lnEXR					
$F_{lnEXR} = F_{lnEXR INF,INT,PINV,GE,MS}$	F-Statistic		4.586			

K is the number of regressors. Note: Critical values were obtained from Pesaran and Pesaran (1997).

Source: Field data, Mahama (2019)

As shown in Table 6, the joint null hypothesis of lagged level variables (that is, variable addition test) of the coefficients being zero (no cointegration) is rejected at 1 percent significance level when the intercept without trend is included in the model. This rejection is necessitated by the fact that the calculated F-statistic value of 4.675 (i. e.  $F_{lnEXR}(\cdot) = 4.586$ ) exceeds the upper bound critical value of 4.450 at 99% level. As a result of the existence of Cointegration among the variables in Table 6, the long run and short run estimates of the ARDL models were estimated to obtain the long and short run coefficients and their standard errors. The estimation was done using Schwarz Bayesian Criterion (SBC).

### Trend Analysis of Inflation, Interest Rate, and Exchange Rate

This section presents the analysis of inflation, interest rate, and exchange rate which answers the study’s first objective. This is presented in Figure 1. From Figure 1, it can be seen that between 1991 first quarter and 1992 second quarter, inflation, interest rate and exchange rate were increasing until 1993 quarter three where all of them fell. This may be partly due to the improvement in the country’s economy and the world economic conditions. Also, this may be as a result of stabilization policies pursued by the government. The up and down behaviour of the variables continued throughout the period, that is, up to 2016 quarter one. It can be concluded that inflation, interest rate, and exchange rate move in the same direction. However, exchange rate remained constant along the line between 1999 quarter four and 2011 quarter one.

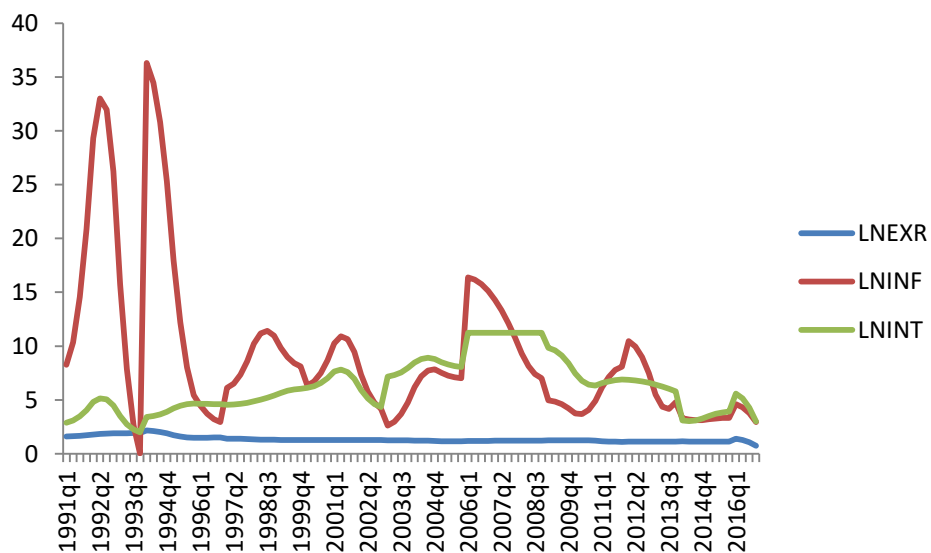


Figure 1: Trend analysis of inflation, interest rate, and exchange rate from 1991-2016.

Source Field data, Mahama (2019)

## Long Run Relationship

This section presents the long-run estimation results which addressed the study's objective of a long-run relationship between inflation, interest rate and exchange rate in Ghana. As shown in Table 7, all the estimated coefficients have their prior expected signs. From the results, the coefficient of inflation rate is statistically significant at 10 percent significance level implying that 1 percent increase in inflation rate will increase exchange rate by approximately 0.02 percent. This result confirms theoretical literature such the Purchasing Power Parity Theory (PPP) and most findings in much empirical literature such as (Ali, Mahmood & Bashir, 2015; Madesha et al, 2013; Immurana et al, 2013; Ezirim et al., 2012). Further, the results indicated that changes in inflation have a potential impact on exchange rate.

The coefficient of interest rate is statistically significant at 1 percent level, indicating that if Ghana were to increase her interest rate by 1 percent, exchange rate will increase by approximately 0.05 percent in the long run. This means that interest rate has the potential to influence economic growth over the period. This negative effect of interest rate on economic growth lends support to the argument that with an import inelastic country like Ghana interest rate hike is likely to hurt economic growth. This result is in line with the findings by (Ali, Mahmood & Bashir, 2015; Madesha et al, 2013; Immurana et al, 2013; Ezirim et al., 2012; Nucu (2011) in Sub-Saharan Africa.

In addition, the coefficient of private sector investment is statistically significant at 10 percent level, indicating that if investment allocated to private sector were to increase by 1 percent, exchange rate will decrease by approximately 0.3 percent in the long run. This means that increased



investment leads to productivity and exports which in causes change in a negative direction. This means that private sector investment negatively affects exchange rate in Ghana. This finding is in line with the findings of Foot and Stein (1991).

Furthermore, the coefficient of government expenditure carried the expected negative sign and is statistically significant at 1 percent significance level. Thus, if the government expenditure increases by 1 percent, exchange rate will increase by approximately 0.04 percent in the long-run. That is, increases in government expenditure have had a significant adverse effect on exchange rate in Ghana. This result is in line with the study by (Muller, 2008).

Finally, the coefficient of money supply had it expected positive sign, and it is statistically significant at 1 percent. This means that if money supply increases by 1 percent, exchange rate will also increase by 0.07 approximately in the long run in Ghana. The result implied that as more money is pump into the economy, aggregate demand increases and in effect increases exchange rate.

**Table 7: Long-Run Coefficients Estimates using the ARDL Approach**

ARDL(2, 0, 2, 2, 2, 0, 2) selected based on SBC Dependent Variable: lnEXR

Regressor	Coefficient	Standard Error	T-Ratio	P-values
Constant	-1.8835	0.7572	-2.4872**	[0.015]
lnINF	0.0163	0.0083	1.9643*	[0.053]
lnINT	0.0454	0.0154	10.467***	[0.000]
lnPINV	-0.2980	0.1541	-1.9333*	[0.057]
lnGE	0.0442	0.0033	-13.314***	[0.000]
lnMS	0.0664	0.1784	0.3723*	[0.068]

Note: \*\*\*, \*\* and \* denote significance levels at 1%, 5% and 10% respectively

Source: Field data, Mahama (2019)

The long-run results indicate that any disequilibrium in the system as a result of a shock can be corrected in the long-run by the error correction term. Hence, the error correction term that estimated the short-run adjustments to equilibrium is generated as follows:

$$\text{ECM} = \ln\text{EXR} + 0.0163*\ln\text{INF} + 0.0454*\ln\text{INT} - 0.2980*\ln\text{PINV} + 0.0442*\ln\text{GE} + 0.0664*\ln\text{MS} + 1.8835*\text{C}$$

### Short Run Relationship

This section also presents the short-run estimation results which addressed the study's objective of a short-run relationship between inflation, interest rate and exchange rate in Ghana. Thus, once the long-run cointegrating model has been estimated, the next step is to model the short-run dynamic relationship among the variables within the ARDL framework. Thus, the lagged value of all level variables (a linear combination is denoted by the error-correction term,  $\text{ECM}_{t-1}$  is retained in the ARDL model. Table 8 presents the results of the estimated error-correction model using the ARDL technique. The model is selected based on the Schwarz Bayesian Criterion.

**Table 8: Estimated Short-Run Error Correction Model using the ARDL Approach**

ARDL(2, 0, 2, 2, 2, 0, 2) selected based on SBC		Dependent Variable: $\Delta \ln \text{EXR}$		
Regressor	Coefficient	Standard Error	T-Ratio	P-values
Constant	-0.5830	0.26166	-2.2283**	[0.029]
$\Delta \ln \text{EXR}(-1)$	0.8117	0.0604	13.4315****	[0.000]
$\Delta \ln \text{INF}$	0.0431	0.0010	4.3100***	[0.000]
$\Delta \ln \text{INT}$	0.0357	0.0025	0.0502****	[0.000]
$\Delta \ln \text{PINV}$	-0.3037	0.0501	-6.0531***	[0.000]
$\Delta \ln \text{GE}$	1.4307	0.1254	6.404***	[0.000]
$\Delta \ln \text{MS}$	0.2939	0.0685	4.2915***	[0.000]
ECM(-1)	-0.1718	0.0289	-5.9432***	[0.000]
R-Squared	0.7248	R-Bar-Squared	0.6309	
S.E. of Regression	0.13835	F-stat. F( 8, 79)	8.1242	[0.000]***
Mean of Dep. Variable	0.0337	S.D. of Dep. Variable	0.1767	
Residual Sum of Squares	1.7473	Equation Log-likelihood	55.0684	
Akaike Info. Criterion	44.068	Schwarz Bayesian Criterion	30.4430	
DW-statistic	2.0072			

Note: \*\*\*\*, \*\*, and \* denote significance level at 1%, 5% and 10% respectively

Source: Field data, Mahama (2019)

The results from the ARDL model as displayed in Table 8 suggest that the ultimate effect of previous period value of exchange rate on current values of exchange rate in the short-run is positive and statistically significant at 1 percent significant level. The implication is that current values of exchange rate are affected by previous quarters' values of exchange rate in Ghana. This is expected in that previous growth and increases in exchange rate where the domestic currency depreciates serves as an indication of instability and may affects the economy which in turn stimulates inflation and interest rates and the subsequent resulting effects on exchange rate leading to economic

instability. This result is in line with findings in the empirical studies by (Ali, Mahmood & Bashir, 2015; Madesha, Chidoko & Zivanomoyo, 2013).

The results also showed the expected negative sign of error correction term lagged one period ( $ECM_{t-1}$ ) and it is highly significant at 1 percent significant level. This confirms the existence of the cointegration relationship among the variables in the model. The ECM stands for the rate of adjustment to restore equilibrium in the dynamic model following a disturbance. The coefficient of the error correction term (ECM) is around  $-0.1718$ . In other words, the significant error correction term suggests that a deviation from the long-run equilibrium subsequent to a short-run shock is corrected by about 17% at the end of each quarter in a year. The rule of thumb is that, the larger the error correction coefficient in absolute terms, the faster the variables equilibrate in the long-run when shocked.

Consistent with the long-run results, the coefficient of inflation rate has the theorized positive impact on exchange rate in the short-run. From the results, a 1 percent increase in inflation rate will increase exchange rate by approximately 0.04 percent in the short-run. It can be realized that inflation rate has a higher impact in the short run compared to the long run. The results are in line with findings by Nucu (2011); Abradu-Otoo and Bawumia (2003); Prasertnukul et al (2010).

Moreover, the coefficient of interest rate has a positive impact on exchange rate in the short-run. The coefficient is statistically significant at 1 percent significant level. The results show that a 1 percent increase in interest rate will increase exchange rate by approximately 0.04 percent in the short-run. This confirms the results in the long run model. This by implication

indicates that, interest rate and exchange rate move in the same direction suggesting that increases in interest rate will potentially affect exchange rate in a positive manner. This result is still in line with the findings by (Ali, Mahmood & Bashir, 2015; Madesha, et al , 2013; Bergen, 2010).

In addition, the coefficient of private sector investment is negative and is statistically significant at 1 percent level, indicating that if private sector investment were to increase by 1 percent, exchange rate will decrease by approximately 0.3 percent in the short run, all other things remaining constant. This also corroborates the long run model results. This finding is in line with the findings of (Foot & Stein, 1991)

Again, the coefficient of government expenditure also maintained its positive sign and is statistically significant at 1 percent significant level which is consistent with the long-run results. The result therefore suggests that if government expenditure goes up by 1 percent, exchange rate will increase by approximately 1.4 percent in the short-run. Thus, the short-run and long-run results indicate that increases in government expenditure particularly on short term consumables goods has been a conduit for exchange rate increases affecting local currency. The positive effect of government expenditure on exchange rate seems more severe in short-run (-1.4) than in the long-run (-0.04). The results indicate how important it is to control increases in government expenditure in Ghana by putting in the appropriate policies. Its impact in both the short and long run appears to be debilitating. This result is consistent with the empirical study by (Muller, 2008).

Finally, consistent with the long-run estimate, the coefficient of money supply also maintained its positive sign and statistically significant at 1

percent significant level. The results indicate that a 1 percentage point increase in money supply will increase exchange rate by about 0.3 percentage points in the short run. The results suggest that money supply is important to be monitored and has a direct relationship with exchange rate in short-run than in the long-run.

The R-Square shows that around 72 percent of the variations in economic growth are explained by the regressors in the model. It can be seen that the R-Square value 0.72 is less than the Durbin DW-statistic value of 2.007 indicating that the results are not spurious.

### **Model Diagnostics and Stability Tests**

In order to check the estimated ARDL model, the significance of the variables and other diagnostic tests such as serial correlation, functional form, normality, heteroskedasticity and structural stability of the model are considered. As shown in Table 9, the model generally passes all diagnostic tests in the first stage. The diagnostic test shows that there is no evidence of autocorrelation and the model passes the normality test indicating that the error is normally distributed. Additionally, the model passes the white test for heteroskedasticity as well as the RESET test for correct specification based on the probability values in parentheses.

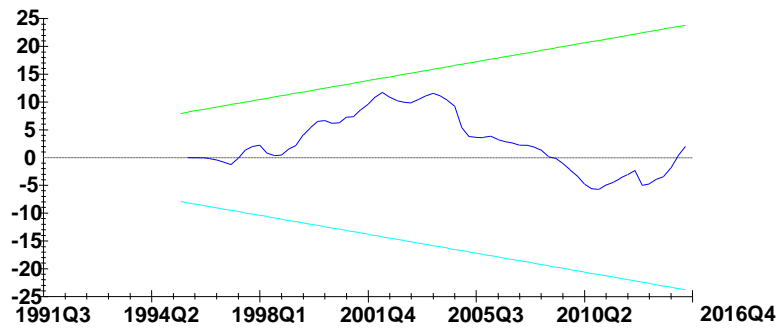
**Table 9: Model Diagnostics**

<b>Diagnostics</b>	<b>LM-Version</b>	<b>F-Version</b>
Serial correlation	$\chi^2_{Auto}(4)$ 2.486 [0.534]	F(4, 68)=1.624[.278]
Functional Form	$\chi^2_{RESET}(1)$ 0.644 [0.365]	F(1,71) =7.019[0.207]
Normality	$\chi^2_{Norm}(2)$ 0.575[0.657]	Not Applicable
Heteroskedasticity	$\chi^2_{White}(1)$ 2.421[.311]	F(1,88)= 2.514[.316]

Source: Field data, Mahama (2019)

Finally, regarding the analysis of the stability of the coefficients, the Cumulative Sum (*CUSUM*) and Cumulative Sum of Squares (*CUSUMQ*) are applied. Following Pesaran and Pesaran (1997), the stability of the regression coefficients is evaluated by stability tests which show whether or not the parameter estimates are stable over time. This stability test is appropriate in time series data, especially when one is uncertain about when structural change might have taken place. The results for *CUSUM* and *CUSUMQ* are shown in Figures 2 and 3.

The null hypothesis is that the coefficient vector is the same in every period and the alternative is that it is not (Bahmani-Oskooee & Nasir, 2004). The *CUSUM* and *CUSUMQ* statistics are plotted against the critical bound of 5 percent significance level. According to Bahmani-Oskooee and Nasir (2004), if the plot of these statistics remains within the critical bound of the 5 percent significance level, the null hypothesis that all coefficients are stable cannot be rejected.

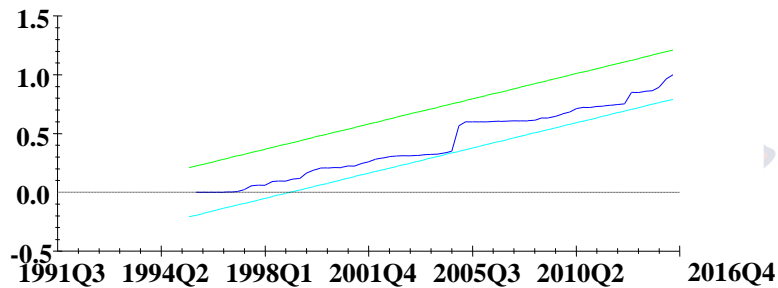


The straight lines represent critical bounds at 5% significance level

Figure 2: Plot of cumulative sum of recursive residuals

Note: The variable on the vertical axis is residuals while the variable on the horizontal axis is years in quarters.

Source: Field data, Mahama (2019)



The straight lines represent critical bounds at 5% significance level

Figure 3: Plot of cumulative sum of squares of recursive residuals

Note: The variable on the vertical axis is the square of the residuals while the variable on the horizontal axis is years in quarters.

Source: Field data, Mahama (2019)

As depicted in Figures 2 and 3 above, the plot of both the *CUSUM* and *CUSUMSQ* residuals are within the 5 percent critical bound (boundaries). That is to say that the stability of the parameters has remained within its critical bounds of parameter stability. It is clear from both graphs in Figures 2 and 3 that both *CUSUM* and *CUSUMQ* tests confirm the stability of the coefficients.



### Granger Causality Test

After establishing cointegration among the variables, Granger causality test was then applied to measure the linear causation between inflation, interest rate and exchange rate. The results of the test are presented in Table 10.

**Table 10: Results of Bivariate Granger causality test**

Null Hypothesis:	F-Statistic	Prob.
INF does not Granger Cause lnEXR	2.95927	0.0351**
lnEXR does not Granger Cause INF	4.23355	0.0173**
INT does not Granger Cause lnEXR	2.61484	0.0625*
lnEXR does not Granger Cause INT	0.27007	0.7639

Note: \*\*, and \* denote significance level at 5% and 10% respectively

Source: Field data, Mahama (2019)

The bivariate Granger causality test results in Table 10 reject the null hypotheses that the inflation and interest rates do not Granger cause exchange rate at 5 percent and 10 per cent levels respectively. The rejection of the null hypotheses indicates that inflation and interest rates cause changes in exchange rate. Also, from the results, the null hypothesis that log of exchange rate does not Granger cause inflation was rejected at 5 percent level indicating that there is a bi-causal relationship between inflation and exchange rate. However, the null hypothesis that log of exchange rate does not Granger cause interest rate cannot be rejected even at the conventional level. The results of Granger causality tests confirm causation from inflation and interest rates to exchange rate.

### Chapter Summary

This chapter has examined the time series properties of the data used for estimation, presented and discussed the results. Unit root test employing

both the ADF and the PP techniques essentially showed that all the series had to be differenced once to achieve stationarity. This implied that all the series are integrated of order one,  $I(1)$ . The presence of non-stationary variables implied the possibility of the presence of a long-run relationship among the variables, which the study verified using ARDL bounds test.

The results of the ARDL (2, 0, 2, 2, 2, 0, 2) model selected based on SBC show the presence of long-run and short-run relationship between inflation, interest rate and exchange rate while controlling for private sector investment, government expenditure and money supply. Whereas inflation, interest rate, government expenditure and money supply exerted positive and statistically significant impact on exchange rate, a negative effect from private sector investment to exchange rate was found. The major finding of the study is that inflation and interest rate increases exchange rate in Ghana. Therefore, policy must be targeted at reducing inflation and interest rate in the country since they can increase exchange rate.

Also, the results of the ARDL (2, 0, 2, 2, 2, 0, 2) model selected based on SBC show that the error correction term ( $ECM_{t-1}$ ) for exchange rate carried the expected negative sign. The significant error correction term suggests that a deviation from the long-run equilibrium subsequent to a short-run shock is corrected by about 17% at the end of each quarter in a year.

The diagnostic and parameter stability tests revealed that the model passes the tests of serial correlation, functional form for misspecification, non-normal errors and heteroskedasticity at conventional levels of significance and the graphs of the CUSUM and CUSUMSQ indicate the absence of any instability of the coefficients because the plots of these graphs are confined

within the 5 percent critical bounds of parameter stability suggesting that all the coefficients of the estimated ARDL model are stable over the study period. The Granger causality test results revealed a unidirectional causality from interest rate to exchange rate. However, there was a bi-directional causality between inflation and exchange rate.



## CHAPTER FIVE

### SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

#### Introduction

The purpose of this chapter is to present the summary, conclusions and recommendations. The summary presents a brief overview of the research problem, objective, research methods and findings. The conclusions capture the overall outcomes regarding the findings of the study in light of the hypotheses. Recommendations also present specific policies to be implemented by policy makers. The chapter also makes suggestions for future research.

#### Summary

As indicated early on, the theoretical as well as empirical relationship between the inflation, interest rate and exchange rate has been a debatable issue among economists. Again, it has been shown that interest rates, inflation rates and exchange rates are all highly correlated. By manipulating interest rates, central banks exert influence over both inflation and exchange rates, and changing interest rates impact inflation and currency values. This study specified an empirical model of exchange rate for Ghana with specific focus on the role of inflation and interest rates. Specifically, the study investigated the long run, short run and the causal relationship between inflation and interest rates and exchange rates while controlling for other exchange rate determinants using quarterly time series data from 1991Q1 to 2016Q4.

In order to investigate the long and short run relationship between inflation, interest rate and exchange rate, the Autoregressive Distributed Lag (ARDL) approach to cointegration and error correction was preferred to other

techniques because of its several advantages over other alternatives. One advantage is that the problem of endogeneity which can occur in studying these macroeconomic variables is solved. From the regression results, there were long run and short run relationships between exchange rate and inflation rate, interest rate, government expenditure, private sector investment and money supply.

Granger-causality test was employed to examine the direction of causality between inflation, interest rate and exchange rate. The results of the Granger-causality test suggest that there is a unidirectional relationship between interest rate and exchange rate with causality running from interest rate to exchange rate. However, there is a bi-directional relationship between inflation rate and exchange rate. The diagnostic tests results show that the model passes the test of serial correlation, functional form misspecification, non-normal errors and heteroskedasticity at conventional levels of significance. The graphs of the cumulative sum of recursive residuals (CUSUM) and the cumulative sum of squares of recursive residuals (CUSUMSQ) show that there is stability of the parameters.

### **Conclusions**

The following conclusions were drawn from the study.

First, the study in line with the empirical literature has shown trend analyses involving the behaviour of inflation, interest rate, and exchange rate. Second, in relation to the empirical studies, the study has indicated that there exist a long-run and short-run relationship between inflation and interest rates and exchange rate with both inflation and interest rates positively influencing exchange rate.

Third, the results presented in this study imply that private sector investment, government expenditure and money supply are statistically important determinants of exchange rate. Fourth, the study found a unidirectional causality between interest rates and exchange rate and bidirectional causality between inflation rate and exchange rate. This means that inflation and interest rates lead to changes in exchange rate in Ghana.

### **Recommendations**

Taking into consideration the findings from the study, the following recommendations are proposed.

Government and Bank of Ghana need to create an enabling environment for investors in order to boost investment in the private sector. Thus, cost of doing business should be reduced to encourage both foreign and local investors. This can be done partly through partnership with other stakeholders to attract investment into the sector which will in effect improve productivity and reduce the downwards pressure on local currency.

Moreover, financial institutions in Ghana need to also consider reducing their interest rate to attract borrowing from the private sector so as to boost development in the financial sector leading to more growth in the economy and also reducing exchange rate.

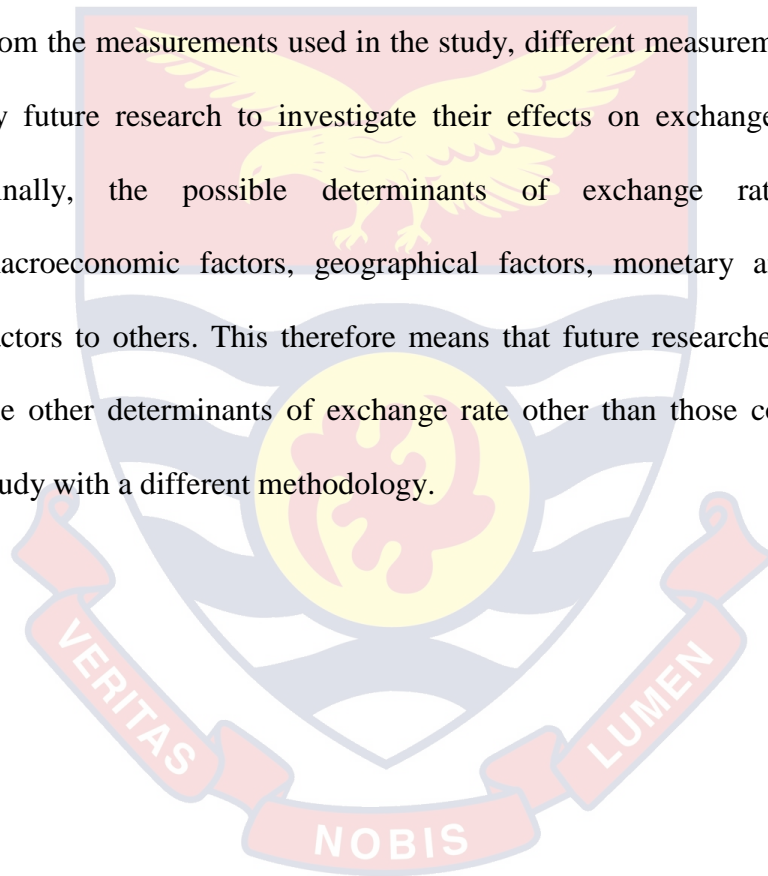
Bank of Ghana needs to ensure a stable exchange rate in order to stimulate economic growth in Ghana. Thus, the Bank of Ghana needs to put concrete and adequate measures to ensure a stable exchange rate for sustained period of time.

Also, the findings that government expenditure and money supply positively impact on exchange rate shows how important it is for the

government and Bank of Ghana to decrease government expenditure and excess money supply in the Ghanaian economy. Thus, to stabilize exchange rate government must ensure that further increases in both government expenditure and money supply are curbed.

### **Suggestions for Future Research**

Since inflation and interest rate are important policy variables that influence the performance of the economy and have many measurements apart from the measurements used in the study, different measurements can be used by future research to investigate their effects on exchange rate in Ghana. Finally, the possible determinants of exchange rate range from macroeconomic factors, geographical factors, monetary and fiscal policy factors to others. This therefore means that future researchers could explore the other determinants of exchange rate other than those considered in this study with a different methodology.



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