
Ashesi University

# Topic: Determining the Significant Factors Affecting Exchange Rates in Ghana: Application Of Multiple Linear Regression Model

By Group 5

Econometric Final Project

Supervised by: Dr Stephen Armah

16th December 2019

**DECLARATION**

I hereby declare that this thesis is our original work and that no part of it has been presented for another degree in this university or elsewhere.

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Date: 16th December 2019

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## ABSTRACT

The question of what has influenced the exchange rate in Ghana for it to be in constant derail still attracts intense debate. This persistent debate has been given new life due to the recent statement given by His Excellency, the Vice President of Ghana, Dr Mahamudu Bawumia. According to him, the economic structures modified under the underlying factors that affect exchange rate is being controlled; hence the exchange rate will be useful to us (My JoyOnline, 2019). This research investigated the significant factors that affect exchange rate in Ghana.

Focusing on Ghana, data on the exchange rate, inflation rate, GDP per Capita Growth and Monetary Policy Rate were obtained from the World Bank and the website of Bank of Ghana from 1990 to 2018. The multiple regression model was used to establish the exchange rate model in Ghana. Test tools such as Breusch Test, Unit root test, Coefficient Determination, t-statistics, f-statistics and heteroskedasticity were used in conjunction with the multiple regression model to determine the factors that have a significant influence on exchange rate in Ghana.

The result showed that GDP per Capita Growth has a significant influence in determining the exchange rate in Ghana followed by Monetary Policy Rate then Inflation Rate. The result showed a relationship between the exchange rate and the GDP per Capita Growth with an influence rate of approximately 10%. This result proposed that a unit increase in GDP per capita will make the local currency appreciate against the dollar by 10%.

Since the results suggest that GDP per Capita growth has a significant influence on the USD/CEDI exchange rate in Ghana and not inflation rate, it is recommended that the government looks at ways to increase our GDP per capita growth in the country.

Keywords: Exchange rate, inflation rate, currency appreciation, productivity, GDP per Capita growth

## LIST OF ACRONYMS

| **Acronym** | **Meaning** |
|---|---|
| SSA | Sub-Saharan Africa |
| IF | Inflation Rate |
| EXC | USD/CEDI Exchange Rate |
| GDP | Gross Domestic Product |
| CA | Current Account, Balance of Payment |
| MPR | Monetary Policy Rate |

## DEFINITION OF TERMS

**The monetary policy rate** refers to the interest rate set by a central bank as part of its monetary management strategies.

**Inflation Rate** is the rate at which prices increase over time, resulting in a fall in the purchasing value of money.

**Exchange rate** refers to the value of one currency for conversion to another.

**The current account** is a country's trade balance plus net income and direct payments. The trade balance is a country's imports and exports of goods and services. A current account is in equilibrium when the country's residents have enough to fund all purchases in the country.

**Sub-Saharan Africa** is, geographically, the area of the continent of Africa that lies south of the Sahara.

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# CHAPTER ONE

# INTRODUCTION

## Background

The global financial system has gone through two major regimes since the turn of the twentieth century; the Gold standard and the Bretton Woods system. The gold standard was a system adopted by major European countries before the first world war, where they decided to adopt gold as the basis of international payments (GWE, 2018). Thus, gold was permitted to flow across the borders of the countries freely, with there being an agreed-upon price at which the gold can be converted into the local currencies. Thus, the world was effectively operating under a floating exchange rate, with the cost of gold dictating the exchange rate of a country's currency (Igwe, 2018). The gold standard collapsed after the first world war because wartime uncertainties led to many countries taking independent steps to fic their exchange rates, abandoning the gold standard (Igwe, 2018).

The collapse of the gold standard gave way to the birth of the Bretton Woods system in 1944 (Igwe, 2018). This system set out strict rules of conduct aimed at preventing countries from taking unilateral steps, like devaluing their currencies (Igwe, 2018). This system was more like a fixed rate. That is, it provided for an adjustable pegged rate, with a given range, beyond which countries were not allowed to set their exchange rate values. Under this system, currencies were pegged to the US dollar, which was pegged to gold (Igwe, 2018). A significant reason this system failed was that the United States of America, which was supposed to act as the central manager of the system, was unwilling to do so; thus, they put their domestic interest above global ones (Bordo, 1995). The US government pursued policies aimed at benefitting their local economy, to the detriment of the global economy, an example being the imposition of a

worldwide inflation rate in the 1960s (Bordo, 1995). These actions led to the global community to lose faith in the United States, thus leading them to abandon the Bretton Woods system.

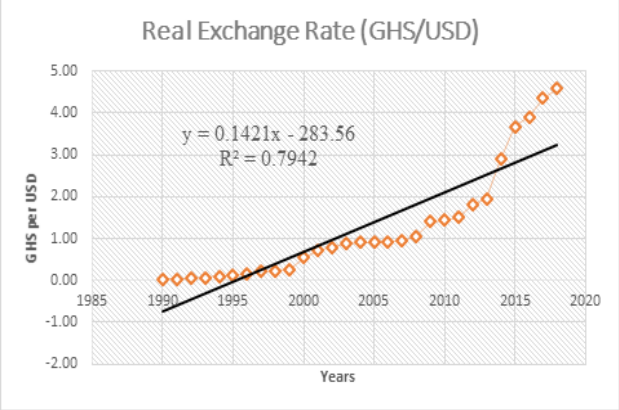
The fall of the Bretton Woods system led to an era where many countries are practising the managed floating rate system. Under this system, exchange rate is left to be determined by market forces, with governments intervening when the need arose (Madura, 2008).

**Exchange Rate Regimes in Ghana**

Like the global economy, Ghana has, since independence, been through two exchange rate regimes, which were the fixed exchange rate regime and the managed floating rate system, which is currently in effect in the country (Nyarko, 2016).

**Trends in Variables of Interest**

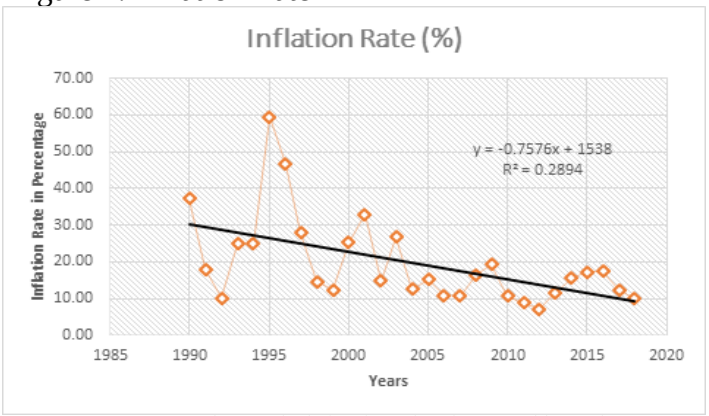
Figure 1:Exchange Rate Movement in Ghana




Source: Author's calculation from data from World Development Indicators. World Bank

Figure 1 above plots the cedi-dollar exchange rate yearly to observe whether any trends exist. From figure 1 above, the Ghanaian cedi is in a depreciation spiral with the currency experiencing net depreciation every year. The depreciation spiral is shown by the trend line, which is positive, implying that the cedi-dollar exchange rate is rising over time. This phenomenon of a yearly depreciating cedi is a cause for concern for import-dependent countries like Ghana because it makes imports more expensive.

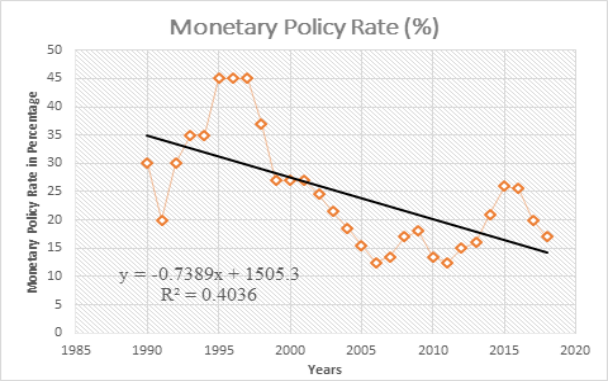
Figure 2: Inflation Rate




Source: Author's calculation from data from World Development Indicators, World Bank.

Figure 2 above shows the movement of Ghana's inflation rate between 1990 and 2018. It can be observed that, unlike the exchange rate, the inflation rate has a downward trend, with a negative slope. The downward trend implies that over the years, the country has tried to maintain a falling inflation rate. A policy of the central bank which makes this possible is the inflation targeting policy, under which a target inflation rate is set, and all effort is placed towards achieving that rate. A falling inflation rate may have many meanings, one of them being that the country is increasing productivity to match its money supply, and so on.

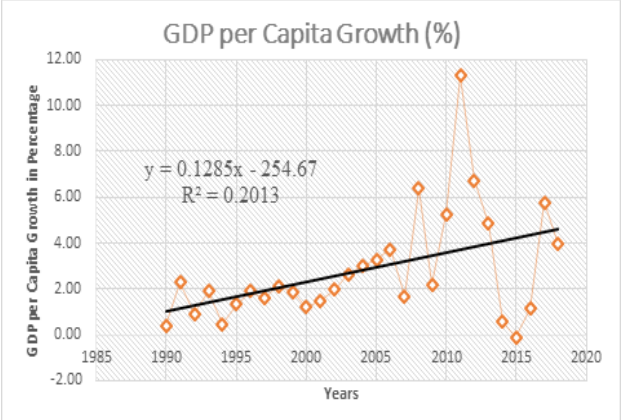
Figure 3:Monetary Policy Rate




Source: Author's calculation from data from the Bank of Ghana

Figure 3 above shows the monetary policy rate for Ghana from 1990 to 2018. From the graph, it can be observed that the benchmark interest rate has a downward trend, implying that it is falling over time. The downward trend may, in part, be attributed to the inflation targeting policy adopted by the Bank of Ghana which leads to lower interest rates. The slope of the trend line is 0.7389, implying that the rate is projected to fall by 0.7389% every year.

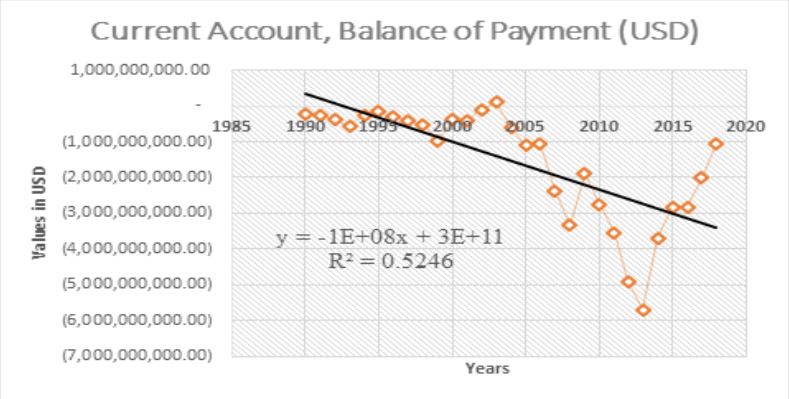
Figure 4:GDP per Capita Growth




Source: Author's calculation from data from World Development Indicators

Figure 4 shows the GDP per capita growth for Ghana from 1990 to 2018. It can be observed that Ghana's GDP per capita growth has a positive trend, meaning that the GDP per capita grows every year. The trend line's slope is 0.1285, implying that the GDP per capita growth changes by 0.1285% every year.

*Figure 5:Current Account; Bop*




Source: Author's calculation from data from World Development Indicators

The current account (Balance of Payment) value measures a country's net imports and exports. It can be observed, from the graph above that after 2005, Ghana's balance of payment has been in a deficit and only started rising after 2010. The graph also has a negative trend line with a slope of -1E+08. The balance of payment deficit has been reducing though, and if the graph above is a good indicator, it is expected to get into the positive after 2020.

**Research question(s)**

1. Which factor has a major influence in determining exchange rate in Ghana?

2. Inflation and Interest rate, which one has a significant impact on the exchange rate?

3. Does GDP growth per capita has a major influence on exchange rate?

4. Does inflation rate have zero relationship with exchange rate in Ghana?

**Objective(s) of the project**

1. To establish a model for estimating the exchange rate in Ghana.

2. To find out if GDP growth per capita has an impact on Exchange Rate

3. To find out the most significant factors affecting exchange rate considering variables such as GDP growth per capita, interest rate and inflation rate.

4. To find practical and workable solutions that would help correct the currency rate depreciation in Ghana.

5. To see if inflation does not influence the exchange rate in Ghana.

**The motivation for the Study**

Ghana, as a developing country, and also import-dependent one cannot afford to have a currency that is in a depreciation spiral because this causes imports to become more expensive. From research, the country is currently under the managed floating rate, meaning that market forces are responsible for setting the exchange rate, with periodic intervention by the governments. The governments can intervene in a variety of ways, targeting factors which influence exchange rate with policies.

The most common method being used by the central bank now is increasing the money supply of USD anytime the cedi is in a deflationary spiral, but that is usually a short-term fix, with the cedi depreciating yearly. The government have not been able to find a solution to keep the country's local currency from depreciating because it has not been able to define a specific and efficient model for exchange rate in the country and the significant factor that affects it. Given this, a study to establish an efficient model and find the most significant factor that affects exchange rate is needed to aid in policymaking.

**Scope of the Study**

The scope of this research is restricted to Ghana in the population of Sub Saharan African (SSA) countries for 28 years. The variables needed to establish the exchange rate model is limited to inflation and inflation rates. Data collected to explore the factors of exchange rate to influence government decisions will be about this country.

From research, it is noted that the inflation rate and interest rate are significant factors affecting exchange rate. Hence, these variables will be used as a study to establish the model for exchange rate in Ghana. Also, Ghana has been experiencing a rampant depreciation in its local

currency when compared to other African Sub Saharan countries (Ghana Statistical Services, 2019). Hence, Ghana will serve as case study country in this research.

**Thesis Organization**

There are five chapters in this study. The first one focuses on the introduction and provides the background of the study, research questions and objectives and the relevance of the study. Chapter two reviews scholarly articles in literature and critiques them to find gaps in previous studies. Chapter three outlines the method to be used in the study. This includes the data source, range and the empirical model to be used. Chapter four presents the findings and analysis of the research and chapter five concludes the study and provides recommendations.

# CHAPTER TWO

# LITERATURE REVIEW

## Introduction

This chapter provides an overview of the concept of exchange rates and the methods with which exchange rate can be modelled as well as a comprehensive analysis of literature work in the field of study.

## Overview of Exchange Rate

According to Amedo and Adjei, Exchange rate is the cost at which a currency is exchanged among countries (2019). Nyarko, also had it that it is the cost one incurs in domestic currency to get an equivalent amount in any foreign currency (2016). The exchange rate is therefore used to determine the relationship of a country's currency with the rest of the world. The exchange rate implies that the currency of a country depreciates if the domestic country would have to exchange more of its currency for one unit of foreign currency.

Many scholars including academicians and policymakers have discussed the topic of exchange rate (Adjei, 2016). The research argues that the managing of exchange rate has been in existence, dominating since there was a crumple of the Gold market price in 1930. Changes in the exchange rate of a country is an essential factor that influences both business and economic performance especially in developing economies where the country is import-dependent. This implies that international traders and investors would always want perfect stability in their domestic exchange rate

## Bilateral, Nominal, and Effective real exchange rate

Bilateral exchange rate from the word bilateral, involves a currency pair whereas an effective exchange rate is the weighted average of a collection of foreign currencies generally used as an overall benchmark for the compactivity of a country. The nominal exchange rate, on

the other hand, shows the number of units of domestic currency that are required to exchange for a unit of a given foreign currency.

**Theoretical framework**

The monetary approach purports that the exchange rate is determined by the interactions of demand and supply of the nation's currency. The supply of money in most countries is assumed to be determined by the monetary authority of these nations which are most of the time the central bank of that country. The monetary approach to exchange rate determination has the view that the devaluation of a country's currency has the potential to improve balance of trade. The implication of the exchange rate determination is because money supply has an impact on exchange rate (Amedo, 2019). Apart from the monetary approach, there are other ones like the purchasing power parity of exchange rate determination, international fishers' theory of exchange rate determination.

**Determinants of exchange rates**

The determinants of exchange rate include inflation, imports and exports, interest rates, Gross domestic product, foreign direct investment, balance of payments, money supply and others.

**Review of other literary work in the same field**

The following empirical researches were reviewed to lead to better understand the factors affecting exchange rate in developing economies.

Amedo, in the paper Determinants of exchange rates in Ghana, used econometric analysis to establish that there is a positive relationship between Gross domestic product and exchange rate movement in Ghana (2019). It was also determined that inflation rate has no significant role in exchange rate movement in Ghana with money supply having a weak influence on exchange rate (2019). It was a multiple linear regression model that was used. Its data was secondary

mainly from the Bank of Ghana with a sample size from 1989 to 2008. The SPSS software, in conjunction with the OLS estimators, was applied in generating and explaining results. The paper tested how these factors affect exchange rate but did not test for the interrelationships between these factors. Also, these results studied a span of 1989 to 2008, but the continuous depreciation of the Ghanaian currency concerning the US calls for an extensive research in recent times to help inform government decisions.

Also, the factors affecting nominal exchange rate for developing countries: A panel data analysis written by Makalesi (2019) was also reviewed. It emerged in his research that GDP, international reserves, and inflation were positive and significant. The interest rate has a significantly low level with money supply being negatively related but with less significance. It was concluded that in developing economies, lower inflation rates contribute to appreciation of the national currency. A panel of 77 developing countries for the period of 2004 to 2016 was used employing the static panel data such as the pooled OLS, fixed effects and random effects. All data were obtained from the world which made the panel data unbalanced thereby the F test been appropriate to be used (Makalesi, 2019).

Moreover, a research paper titled the impact of macroeconomic variables on exchange rate movements in Ghana by Adjei, 2019, was also reviewed. She had her research surrounding the research question: what the effect of interest rate and inflation rate differential on exchange rates in Ghana is? She later assessed which of the variables has the most significant impact on exchange rate. It was discovered that the appreciation or depreciation of a country's currency plays a crucial role in influencing Ghana's trade balance and ultimately its growth. It was also established that there is a positive and statistically significant connection between the exchange rate and net exports. FDI was also found to be having a substantial influence on determinants of

exchange rates with lending interest and GDP having an inverse relationship with exchange rate while inflation is statistically insignificant although there is a positive relationship with exchange rate (Adjei, 2019). The research approach was mainly quantitative with the help of a descriptive research design using eighteen years data; thus from 2000 to 2018.

And finally, the empirical analysis of exchange rates in Ghana by Nyarko (2016) was also reviewed. The paper had a hypothesis of the form: Does public debt, inflation, interest rates, nominal GDP each influence exchange rate and does exchange rate depreciation has a repercussion on the Ghanaian economy. Apart from inflation, the macroeconomic variables at their natural logarithmic level appear to follow a specific trend but became stationary when cointegration was taken. It was also discovered that imports, public debt, nominal GDP and inflation affect exchange rate movement in the Ghanaian economy. It was also discovered that exchange rate depreciation was found to have significant impacts on the economy as it can trigger inflation and worsen the external debt position of government (Nyarko, 2016).

# CHAPTER 3

# METHODOLOGY

## Overview of the Method Section

This research seeks to identify the significant factors that affect the exchange rate in Ghana. Specifically, this study aimed to find out whether GDP per growth is the vital factor influencing the exchange rate and whether inflation rate has no impact on exchange rate in Ghana. According to Amedo and Adjei, Exchange rate is the cost at which a currency is exchanged among countries (2019). Nyarko, also had it that it is the cost one incurs in domestic currency to get an equivalent amount in any foreign currency (2016).

This paper will include data on the exchange rate, inflation rate, GDP per growth and current account balance of payment, and focus specifically on Ghana, a sub-Saharan African country. This chapter is further divided into subsections that discuss the research design, data collection techniques, data analysis procedures and test of significance.

## Research Design

According to Jupp (2011), a research design is one that justifies the reasoning behind the methodology chosen and its relationship with the hypotheses and research questions. Research design is done to ensure that a research will generate credible conclusions from the evidence gathered (Jupp, 2011). Thus, the research design will set out to define the types and sources of data to be used and the framework which will be used to analyse the data.

This research made use of the quantitative methodology. Quantitative research is concerned with the collection and analysis of quantitative data (Jupp, 2011). Thus, it will be an effective methodology in this study due to its ability to establish relationships between quantitative variables. This research method helped us to develop and adopt appropriate

mathematical models, theories and hypotheses in determining the factors that affect Exchange rate in Ghana.

The paper adopted exploratory research for the theoretical part of the work while with the practical aspect, inferential and analytical research method were employed. Secondary data was principally used, but primary data was also indispensable. A sample size of 30 using simple random sample was adopted to obtain the sample. Multiple linear regression and structured interview were used for the quantitative and qualitative aspect respectively.

## Data

### Variables

In this study, we incorporated independent and dependent variables. An independent variable is a variable that is changed or controlled in a scientific experiment to test the effects on the dependent variable. A dependent variable is a variable being tested and measured in a scientific experiment. The independent variables for this study were inflation rates, interest rates, real GDP per capita growth and the current account, Balance of payment. The dependent variable of our study was the real exchange rate.

### Data Sources

Data on the inflation rate and exchange rate for Ghana was obtained from the World Development Indicators index from the world bank. Data on interest rate was obtained from the website of Bank of Ghana. The other independent variables that will be incorporated in this study will be obtained from the World Development Indicators index from the World Bank.

### Sampling Technique and Data Collection Method

The period covered under the study is 1990 to 2018. The period used was the sample size. The sampling technique that was used for this research was convenience sampling. Convenience

sampling is a non-probability sampling technique where subjects are selected because of their convenient accessibility and proximity to the researcher. We chose this sampling technique because it is a non-probability method that is often used during preliminary research efforts to get a gross estimate of the results, without incurring the cost or time required to select a random sample. It also allowed us to get primary data and trends regarding this study without the complications of using a randomised sample. The data collection method adopted in this research was the use of economic statistics on the predetermined variables. This collection method enabled us to get the essential secondary data needed for practical analysis.

**Methods of Empirical Analysis**

The study used a time-series econometric approach to determine the significant factors that affect exchange rate empirically. Specifically, the multiple linear regression model was adopted. In a study, regression is usually done when the variable understudied relies on two or more independent variables. The multiple linear regression model allowed the primary function (exchange rate) to depend on more than one explanatory variable and to have shapes other than straight lines, although it does not allow for arbitrary shapes.

**Justification of Empirical Model**

According to Kaya (2013), the multiple linear regression model helps to eliminate biasedness that are likely to occur in estimating the exact model of an economic problem. Amedo, in the paper Determinants of exchange rates in Ghana used an econometric analysis accurately the multiple linear regression model to establish if there is a relationship between Gross domestic product and exchange rate movement in Ghana (2019). Not only him, but several researchers have also adopted and proven that the multiple linear regression model is the best model needed to determine exchange rates. However, other researchers suggest that the multiple

linear regression model only is not the best. According to them, the variance inflation test, white test and Breusch pagan test in conjunction with the multiple linear regression model is the best approach in predicting exchange rates.

For this study, the multiple linear regression model was used as the primary analysis tool in conjunction with the variance inflation test, unit root and Breusch pagan test. In using the multiple linear regression model, all the assumptions under it must not be violated. Given this, the parameters that were used were evaluated to ensure they are linear in parameters, random and no perfect multi-collinearity among the variables. The multiple linear regression model will be conducted using the Analysis Tool Pack in Microsoft Excel.

The exchange rate would be regressed against the selected macroeconomic variables; these variables are inflation rate, real interest rates, the current account of the balance of payments and real GDP per capita. The general model examining the determinants of these macroeconomic variables that influence exchange rate in Ghana is specified below:

$$\boldsymbol{Exchange\ Rate}\left(\frac{\boldsymbol{cedi}}{\boldsymbol{USD}}\right) = \boldsymbol{\beta_0} + \boldsymbol{\beta_1}(\boldsymbol{inflation\ rate_t}) + \boldsymbol{\beta_2}(\boldsymbol{real\ interest\ rate_t}) + \boldsymbol{\beta_3}(\boldsymbol{real\ GDP\ per\ capita_t}) + \boldsymbol{\beta_4}(\boldsymbol{current\ account, BoP_t}) + \boldsymbol{\varepsilon_t}$$

**Test of Significance**

This study employed the Coefficient of Determination as the test for the fitness of the regression model for exchange rate in Ghana with the data in the research and how close the data fitted in the regression line. Also, the correlation coefficients were used to interpret the effect of the variables on exchange rate in Ghana.

In determining the variable that has a significant effect on exchange rate, the hypothesis testing was conducted. Hypothesis testing is used to infer the result of a hypothesis performed on

sample data from a larger population. The test tells the researcher whether or not the primary hypothesis stated is true (Weinstein, 2019)

Under the hypothesis testing of the three key variables understudied, the following assumptions will be tested;

| HYPOTHESIS | NULL HYPOTHESIS | ALTERNATIVE HYPOTHESIS |
|---|---|---|
| 1 | There is no relationship between the inflation rate and exchange rate. | There is a relationship (positive or negative) between the inflation rate and exchange rate. |
| 2 | GDP per capita growth does not influence exchange rate | GDP per capita growth influences exchange rate |
| 3 | There is no relationship between the interest rate and exchange rate. | There is a relationship (positive or negative) between the interest rate and exchange rate. |

F-test was also conducted to identify the relevant factors that have a significant influence on exchange rate. The t-test of each of the coefficients of the independent variables was compared to the critical values at 5% two-tailed level of significance to determine the variable with the significant influence on exchange rates.

**Validity and Reliability**

Reliability is the degree level to which an assessment tool produces stable and consistent results across various versions of indicators. A validity measure, on the other hand, measures, if the analysis tool adopted, is doing what it is purported to do. Reliability in conjunction with validity measures provides accuracy and legibility to data. The data used in this study was based on a long period of 28 years. The long period of the data helped to increase the validity of the findings derived from our statistical analysis. Also, the data was examined using appropriate econometric models and this will increase the reliability of the study.

# CHAPTER FOUR

# RESULTS

## Introduction

This chapter presents and analyses the results obtained from the study throughout the analysis run. It will focus on the analysis and presentation of results obtained from the data. The data used were secondary which were obtained from the World Bank and many others. The data were analysed based on the appropriate econometric techniques.

The chapter includes descriptive statistics of the data under review as well as some statistics of some variables. To ensure that results are not false and can be modelled using multiple linear regression, multicollinearity test and units root test were undertaken and analysed. The analysis enabled us to answer the research questions as well as achieve the objectives of the study. Thus, this chapter provides results to the following questions stated in the research questions:1. Which factor has a significant influence in determining the exchange rate in Ghana?

2. Inflation and Interest rate, which one has a substantial impact on the exchange rate?

3. Does GDP growth per capita have a significant influence on exchange rate?

4. Does the inflation rate have zero relationships with exchange rate in Ghana?

## Descriptive statistics

Table 1 in the appendix shows the descriptive statistics for the data collected for the variables used in this study. The measures used are the mean, median, standard deviation, the variance, maximum, minimum, kurtosis, skewness and count. The mean used in this study is the arithmetic mean. The arithmetic mean shows the average value of the variable of the years. The mean for Real Exchange Rate, Inflation Rate, Monetary Policy Rate, GDP per Capita Growth and Current Account (Bop) over the period of 28 years in Ghana are 1.26%, 19.70%, 24.50%, 2.82% and - $ 1,533m respectively.

The standard deviation shows how spread the data is from the mean. The standard deviation for Real Exchange Rate, Inflation Rate, Monetary Policy Rate, GDP per Capita Growth and Current Account (Bop) over the period of 28 years in Ghana are 1.36%, 11.99%, 9.90%, 2.44% and $1,567m respectively. The standard deviation for Real exchange rate and the current account (Bop) are very high when compared to the mean which is an indication that the variations in these two variables over the years are high.

The descriptive statistics showed a sample size of 28. The sample size derived is not large enough due to the vast number of missing data in the preceding years of the data size adopted. Because we do not have a large sample size it will be evident to set the level of significance test to 5% other than 1% as stated in the methodology.

This change of significance level or small sample size does not affect our analysis. Because we are working with a MANCOVA (multivariate analysis of covariance) or multiple linear regression and hence it is necessary to remove all data insufficiency or missing data to help provide accurate results. The Results from the descriptive statistics affirm findings in the literature that exchange rates in Ghana over the years have been declining over time.

**Correlational Analysis**

According to Makalesi (2019), Correlation is defined as a bivariate analysis that measures the association and direction of the relationship between two variables. It determines whether the relationship between two variables is strong or weak. In terms of the strength of the relationship, the value of the correlation coefficient varies between +1 and -1. If the value is +1 or close to that, then we say there is a strong positive relationship between the variables but if it is –1 or close to that, then we say there is a strong negative relationship between the variables.

In the methodology, it was stated that the study would look at the relationship between the dependent variables and the independent variables.

The results of the correlation analysis using scatter plot revealed that the coefficient between the dependent variables and the independent variables (inflation rate, monetary policy rate, GDP per Capita Growth and the current account) are -0.0454, -0.0576, 0.1234 and -5E-10. This result shows that there is a weak negative relationship between the dependent variable (exchange rate) and the following independent variables: inflation rate, monetary policy rate and current account. Because the coefficient values are negative and not closer to 1. However, the result showed that there is a weak positive relationship between the exchange rate and GDP per Capita growth since the coefficient value is positive but less than 1.

The result validates the research findings in the literature which says that GDP per Capita growth has a positive relationship with the exchange rate and inflation rate has a negative correlation with exchange rate in Ghana (Adjei, 2019). The vivid description of the relationship between the dependent variable and the independent variable analysis using scatter plot is displayed in the appendix.

**Inferential Statistics**

The main aim of this section is to present the results of the multiple regression analysis. The results obtained will help in determining the factors that have a significant effect on the exchange rate in Ghana. The purpose of this is to examine whether inflation rate has a substantial impact on exchange rate in Ghana, or if interest rate has a significant influence on exchange rate in Ghana. This section also seeks to validate if GDP per capita growth influences the exchange rate in Ghana to the greatest extent as compared to the other variables. Current account (Balance of Payment) served as a proxy for terms of trade while inflation rate, interest rate and GDP per

Capita growth served as the primary variable of interest. The analysis was conducted using the analysis tool pack in Microsoft Excel and E-view.

**Perfect collinearity test**

One of the assumptions underlying multiple regression is that it assumes a no perfect collinearity between the independent variables. Thus, there should be no exact linear relationship among the independent variables used in a study. Given this, the independent variables understudied should not be perfectly related or associated with each other. Research shows that perfect collinearity arises as a result of inaccurate use of dummy variables, the inclusion of a variable which can be computed using other variables in the data set and constant repetition of the same variable. Generally, multicollinearity exists when the independent variables are highly correlated with each other.

To carry out this check, a correlation matrix for the variables was done. The results are shown in Table 2. The correlation matrix was conducted to ensure that there is no issue of multicollinearity. Multicollinearity is a significant problem in an analysis that needs to be addressed because it may lead to biased results and statistical inference may not be made about the data. For there to be multicollinearity, the coefficient value between the independent should be either positively or negatively strong. Thus, the relationship should be close to +1 or –1. If it is not, then perfect collinearity is absent. The correlation matrix revealed that the correlation between the independent variables as observed is less than 1; therefore, the problem of perfect collinearity is not severe, found here or does not exist.

*Table 1:Correlation Matrix for Variables*

| | Exchange Rate (GHS/USD) | Inflation Rate (%) | Monetary Policy Rate (%) | GDP per Capita Growth (%) | Current Account, Bop (USD) |
|---|---|---|---|---|---|
| **Exchange Rate (GHS/USD)** | 1 | | | | |
| **Inflation Rate (%)** | -0.4013 | 1 | | | |
| **Monetary Policy Rate (%)** | -0.4200 | 0.7478 | 1 | | |
| **GDP per Capita Growth (%)** | 0.2217 | -0.4293 | -0.5568 | 1 | |
| **Current Account, Bop (USD)** | -0.5218 | 0.4910 | 0.5538 | -0.5296 | 1 |

**Heteroskedasticity Tests**

In using the ordinary least squares estimates, heteroskedasticity is one of the underlying assumptions. The heteroskedasticity assumes a constant variance of the errors. The heteroskedasticity can be defined mathematically as $Var\ (\varepsilon i)=\sigma 2$. When the variance of the error is not constant, it is known as heteroskedasticity. In testing for heteroskedasticity, the residual plot method was used. The Breusch-Pagan-Godfrey test was used to confirm the test for heteroskedasticity using the residual plot.

The hypothesis tested is:

**Null hypothesis:** There is no heteroskedasticity

**Alternate hypothesis:** There is heteroskedasticity

Using the residual plot test, the plot of the residuals indicates the presence of possible heteroskedasticity by its tendency to fan out as the values of X increase. From the plot, the dispersion (uncertainty) associated with the response of Y decreased as the values of X increased. The result shows that heteroskedasticity is absent.

Using the Breusch-Pagan-Godfrey test, the p-value of the F-statistics for the regression between the residuals and the independent variables was 0.066136. The p-value is greater than the significance level of 5% (0.05). Hence, we fail to reject the null hypothesis that there is no

heteroskedasticity present. Given that there is no presence of heteroskedasticity, we confidently say that the results of the ordinary least square are authentic and reliable for use.

**Unit root tests**

In using time series data, the data used must be stationary. A stationary time series is a type of data series whose statistical properties such as mean, variance, autocorrelation, and so on are all constant over time. Having a stationary time series data is essential because it helps prevent spurious regressions that are likely to occur in a regression analysis. When a time series is not stationary, the results derived from the analysis may indicate a relationship between the variables when such relationship does not exist.

In determining the stationarity of the time-series data used in this study, the unit root test, specifically the Augmented Dickey-Fuller (ADF) test was used to determine if the data was relevant and appropriate for use. The null hypothesis for the unit root test is generally stated as the presence of a unit root and the alternative hypothesis is either stationarity, trend stationarity or explosive root depending on the test used.

The hypothesis tested is:

**Null hypothesis:** There is a unit root

**Alternate hypothesis:** There is no unit root. The series is stationary.

Using Augmented Dickey-Fuller test, the result showed that the data on the inflation rate and GDP per capita growth were stationary at the significance level of 5%. However, exchange rate, monetary policy rate and the current account (Bop) were not stationary at the level of significance at 5%. Monetary policy rate and the current account (Bop) assumed stationarity at the 1st difference except for the exchange rate which became stationary at the $2^{nd}$ difference.

## REGRESSION OUTPUT

### Regression equation

To determine the effects of inflation, GDP, MPR and current Account Balance of payment on exchange rate, the OLS method was used in determining the parameters of the regression equation.

The regression output for the topic understudied is shown below:

*Table 2:Regression Output*

| | Coefficients | t Stat | P-value |
|---|---|---|---|
| **Intercept** | 1.7477<br>(1.0262) | 1.7031 | 0.1015 |
| **Inflation Rate (%)** | -0.0139<br>(0.0289) | -0.4815 | 0.6346 |
| **Monetary Policy Rate (%)** | -0.0230<br>(0.0385) | -0.5966 | 0.5564 |
| **GDP per Capita Growth (%)** | -0.0927<br>(0.1190) | -0.7786 | 0.4439 |
| **Current Account, Bop** | -0.0000<br>(0.0000) | -2.1218 | 0.0444 |

### Coefficient of determination (R-square)

The coefficient of determination is a statistical measure used in determining how good a model is and its level of fitness to the research under study. The R - squared obtained is 32.13%. This implies that the independent variables, which are inflation rate, MPR, GDP per capita growth and current account BOP explain about 32.12% of the variation in exchange rate movement in Ghana.

### Standard error

In measuring the accuracy of the estimates, the standard error serves as a good measure. The standard error is also noted to be the standard deviation of the sample mean. If the standard error has a greater value, then the data is assumed to have more spread. A critical look at the

standard errors for all the variables understudied revealed that all the variables have a small standard error. This provides evidence that the sample used is a good representation of the population.

**Discussion of results**

The results revealed that the inflation rate is statistically insignificant at 5% level, even though there is a negative relationship between inflation rate and exchange rate movement in Ghana when other factors are controlled or held constant. The table above shows that on the average, the coefficient of inflation rate 0.0139 which is greater than zero. The results imply that 1% increase in inflation rate will lead to a 1.39% depreciation of the USD/CEDI exchange rate and vice versa.

This finding confirms the findings of Makalesi (2019), which concluded that in developing economies, lower inflation rates contribute to the appreciation of the national currency. The relationship is valid because when a country is experiencing lower levels of inflation rates, prices are relatively lower leading to the attractiveness of local products, hence increase in exports which then lead to the appreciation of the currency.

Also, the results showed that the monetary policy rate is statistically insignificant at 5% level of significance. The coefficient of the monetary policy rate was –0.023, indicating that there is a negative relationship between the USD/CEDI exchange rate in Ghana. The coefficient shows that monetary policy rate constitutes about 2.3% depreciation of the exchange rate and as such when other variables are controlled, an increase in the monetary policy rate results in the depreciation of the national currency and vice versa. From the result, we can conclude that a 1% increase in monetary policy rate will lead to a 2.3% depreciation of the USD/CEDI exchange rate and vice versa. Given that a higher monetary policy rate would reflect in higher interest rates and

higher interest rates attract foreign capital which causes the USD/CEDI exchange rate to fall since the USD is considered the standard currency for trade thereby depreciating the national currency.

Furthermore, the results revealed that GDP per capita growth is also statistically insignificant at 5% level. It predicts a positive relationship between the growth rate of GDP per capita and the exchange rate in Ghana. This result is valid in most African countries and intuitively makes sense because an increase in GDP signifies a boost in the local economy which tends to increase the level of exports relative to imports. This improves the exchange rate of the domestic country leading to the appreciation of the currency as other factors are controlled.

Lastly, the results also revealed that Current account BOP is statistically significant at 5% significant level, and there is a negative relationship between current account BOP and exchange rate movement in Ghana. According to the results, the relationship between current account BOP and exchange rate is fragile. This implies that current account BOP has a weak influence on exchange rate movement in Ghana

**F – Statistics**

Given that, the individual t-test statistics of the variables showed that almost all the variables are insignificant except for Current Account, the joint f-test was conducted to validate and determine the overall significance of the variables. With an F-test of 2.84, we rejected the null hypothesis that the variables are not significant. This was because the f-test was greater than the critical value of 1.96 at 5% level of significance. The results concluded that the variables used in this study jointly were significant, hence should not be dropped. The different result from the individual t-test statistics is explained to be from the small sample size the data provided on each variable.

**Test for Influence of the variables on the exchange rate model**

As stated in the research objective, this study sought to determine the variable or factor that had a significant influence on the dependent variable. The coefficient of the various variables in the output of the regression was used to define the magnitude of the change that each variable had on the dependent variable.

*Table 3:Magnitude of change of the variables on the dependent variable*

| **FACTORS** | **MAGNITUDE – USE OF COEFFICIENTS OF VARIABLES** | **INFLUENTIAL STATUS** |
|---|---|---|
| Inflation Rate | -1.39% | Influential |
| Monetary Policy Rate | -2.3% | Influential |
| **GDP per Capita Growth** | **-9.3%** | **Highly Influential** |
| Current Account Balance | 0% | Not Influential |

From the table above, it is evident that with a magnitude change of 9.3%, GDP per Capita growth is the variable that has a greater effect on the USD/CEDI exchange rate in Ghana. From this, a one per cent change in GDP per Capita Growth will cause the exchange rate to either increase or decrease. Regarding this study, a one per cent increase in GDP will cause the USD/CEDI exchange rate to reduce by 9.3%. A reduction in the USD/CEDI exchange implies an appreciation of the local currency against the USD.

# CHAPTER FIVE

# CONCLUSION AND RECOMMENDATIONS

## Overview

This is the concluding chapter of the study. It presents a summary of the research problem, the objectives, the methodology, and findings. It also provides some recommendations to policymakers and suggests areas for further studies.

## Conclusion

This study aimed to ascertain the most significant factor which affects exchange rate in Ghana. From research, it was found out that Ghana is currently under the managed floating exchange rate regime, where market forces are allowed to determine the exchange rate. The central authority only comes to intervene when the situation calls for it. This implies that several factors can affect the movement of the USD/CEDI exchange rate. Our study focused on just four of those factors; the monetary policy rate, inflation rate, Current account balance of payment and GDP per Capita growth rate. The factors mentioned above were the study's independent variables, with exchange rate being the dependent variable.

The data was secondary in nature and was collected from the World Bank and the Bank of Ghana websites. The data was collated in Microsoft Excel. The analysis was done both in Excel and Eviews; that is, the multiple regression analysis was done in Excel while the unit root test for stationarity was done in Eviews.

During the regression analysis, the data obtained was tested for usage using the unit root test. Per the results, two of the variables, inflation and GDP per capita were stationary at the level. Monetary Policy Rate and Current Account Balance of Payment had to be differentiated once for them to assume stationarity, and the exchange rate was differentiated twice before it also implied stationarity. From the regression analysis, the following results were obtained:

1. The coefficient of MPR was -0.023 (-2.3%), meaning that a unit increase in MPR will result in a 2.3% appreciation of the Ghanaian cedi against the USD since there will be a fall in the USD/CEDI exchange rate.
2. In the case of the inflation rate, the coefficient obtained at -0.0139 (-1.39%), implying that a unit increase in the inflation rate will lead to a fall in the USD/CEDI exchange rate by 1.39%.
3. The coefficient obtained for Current Account, BOP was -0.000000000396 (-0.0000000396%), implying that a unit increase in current account, BOP, leads to a fall in the USD/CEDI exchange rate by 0.0000000396%. The percentage here is very small hence less influence.
4. The coefficient obtained for GDP per capita was -0.093 (-9.3%), implying that a unit increase in GEP per capita results in a 9.3% appreciation of the Ghanaian cedi against the USD since there is a fall in the USD/GHS exchange rate.

The R-squared value obtained from the regression analysis was 32.13%, implying that the estimated function, Exchange rate = 1.7477 + 0.0139IR – 0.0230MPR – 0.0927GDP - 0.000000000396CA + error, explains only 32.13% of observed behavior. The small r-squared value was explained to be as a result of the small sample size used.

With regards to the hypothesis testing, after the analysis, the first ($H_0$ = There is no relationship between inflation rate and exchange rate) and third ($H_0$ = There is no relationship between interest rate and exchange rate) hypotheses were rejected, because the coefficients of the variables were statistically significant at the 5% level of significance. We fail to reject the second hypothesis ($H_0$ = GDP per capita growth does not influence exchange rate). Further tests carried to test multicollinearity and heteroskedasticity found no evidence of those two.

## Recommendations

The study set out to establish the most significant factor which affects the exchange rate in Ghana. The analysis conducted showed that, among the four factors analysed, GDP per capita growth had the most influence on exchange rate. The effect it had was also negative, implying that as GDP per capita growth rises, the USD/CEDI exchange rate falls, leading to an appreciation in the local currency as against the USD currency.

Given this result, we recommend that policies targeting growths in GDP per capita should be pursued. This implies that the government and other relevant stakeholders must find ways to sustainably grow productivity levels in the country, as that will increase GDP, which will cause GDP per capita to grow. As the GDP per capita grows, the local currency becomes valuable as it appreciates against the USD currency.

## Further Study

This study employed quantitative methods to test the relationships between the exchange rate and some factors which affect it. It did not, however, go into the details behind the behaviour of these factors. That is the study did not employ a qualitative analysis. Given this, further qualitative studies could be used, where primary data from the relevant stakeholders are taken into consideration. This may help give a more unobstructed view of the exchange rate situation.

## Appendix

*Table 4: Descriptive Statistics of Variables used in the research*

| Item | Real Exchange Rate (GHS/USD) | Inflation Rate (%) | Monetary Policy Rate (%) | GDP per Capita Growth (%) | Current Account, Bop (USD) |
|---|---|---|---|---|---|
| **Mean** | 1.26 | 19.70 | 24.50 | 2.82 | (1,533m) |
| **Standard Error** | 0.25 | 2.23 | 1.84 | 0.45 | 290m |
| **Median** | 0.90 | 15.49 | 21.50 | 1.97 | (964m) |
| **Mode** | 0.00 | 0.00 | 45.00 | 0.00 | 0 |
| **Standard Deviation** | 1.36 | 11.99 | 9.90 | 2.44 | 1,567m |
| **Sample Variance** | 1.84 | 143.82 | 98.07 | 5.95 | 2,455B |
| **Kurtosis** | 0.86 | 3.59 | -0.21 | 4.08 | 0.50 |
| **Skewness** | 1.36 | 1.82 | 0.81 | 1.78 | (1.14) |
| **Range** | 4.55 | 52.34 | 32.50 | 11.43 | 5,805m |
| **Minimum** | 0.03 | 7.13 | 12.50 | -0.11 | (5,704m) |
| **Maximum** | 4.59 | 59.46 | 45.00 | 11.32 | 101m |
| **Sum** | 36.41 | 571.40 | 710.50 | 81.86 | (44,476M) |
| **Count** | 28 | 28 | 28 | 28 | 28 |

Collected Data on Variables

*Table 5:Data on Variables*

| Year | Real Exchange Rate (GHS/USD) | Inflation Rate (%) | Monetary Policy Rate (%) | GDP per Capita Growth (%) | Current Account, Balance of Payment (USD) |
|---|---|---|---|---|---|
| **1990** | 0.03 | 37.26 | 30 | 0.39 | (223,200,000.00) |
| **1991** | 0.04 | 18.03 | 20 | 2.28 | (252,052,000.00) |
| **1992** | 0.04 | 10.06 | 30 | 0.92 | (377,000,000.00) |
| **1993** | 0.06 | 24.96 | 35 | 1.90 | (558,800,000.00) |
| **1994** | 0.10 | 24.87 | 35 | 0.46 | (254,600,000.00) |
| **1995** | 0.12 | 59.46 | 45 | 1.34 | (143,700,000.00) |
| **1996** | 0.16 | 46.56 | 45 | 1.92 | (306,850,000.00) |
| **1997** | 0.20 | 27.89 | 45 | 1.60 | (403,464,000.00) |
| **1998** | 0.23 | 14.62 | 37 | 2.14 | (521,730,000.00) |
| **1999** | 0.27 | 12.41 | 27 | 1.87 | (964,300,000.00) |
| **2000** | 0.54 | 25.19 | 27 | 1.19 | (386,417,603.19) |
| **2001** | 0.72 | 32.91 | 27 | 1.48 | (427,467,882.44) |
| **2002** | 0.79 | 14.82 | 24.5 | 1.97 | (105,237,554.61) |
| **2003** | 0.87 | 26.67 | 21.5 | 2.65 | 101,686,603.46 |
| **2004** | 0.90 | 12.62 | 18.5 | 3.01 | (590,188,288.77) |
| **2005** | 0.91 | 15.12 | 15.5 | 3.27 | (1,104,609,520.85) |
| **2006** | 0.92 | 10.92 | 12.5 | 3.72 | (1,056,074,432.76) |
| **2007** | 0.94 | 10.73 | 13.5 | 1.69 | (2,378,784,231.83) |
| **2008** | 1.06 | 16.52 | 17 | 6.37 | (3,327,428,935.89) |
| **2009** | 1.41 | 19.25 | 18 | 2.21 | (1,897,165,484.24) |
| **2010** | 1.43 | 10.71 | 13.5 | 5.25 | (2,747,340,000.00) |
| **2011** | 1.51 | 8.73 | 12.5 | 11.32 | (3,541,315,695.25) |
| **2012** | 1.80 | 7.13 | 15 | 6.73 | (4,911,713,679.07) |
| **2013** | 1.95 | 11.67 | 16 | 4.85 | (5,704,034,549.67) |
| **2014** | 2.90 | 15.49 | 21 | 0.57 | (3,694,575,338.28) |
| **2015** | 3.67 | 17.15 | 26 | -0.11 | (2,823,640,338.08) |
| **2016** | 3.91 | 17.45 | 25.5 | 1.15 | (2,832,047,270.62) |
| **2017** | 4.35 | 12.37 | 20 | 5.77 | (2,002,640,000.00) |
| **2018** | 4.59 | 9.84 | 17 | 3.96 | (1,041,940,000.00) |

# Unit Root Test for the variables used in the study

*Figure 7: Unit Root Test on Inflation*

Null Hypothesis: INFLATION has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=6)

| | | t-Statistic | Prob.* |
|---|---|---|---|
| Augmented Dickey-Fuller test statistic | | -3.017731 | 0.0454 |
| Test critical values: | 1% level | -3.689194 | |
| | 5% level | -2.971853 | |
| | 10% level | -2.625121 | |

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

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(INFLATION)
Method: Least Squares
Date: 12/07/19 Time: 23:52
Sample (adjusted): 1991 2018
Included observations: 28 after adjustments

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|---|---|---|---|---|
| INFLATION(-1) | -0.489315 | 0.162147 | -3.017731 | 0.0056 |
| C | 8.834270 | 3.776524 | 2.339259 | 0.0273 |

| | | | |
|---|---|---|---|
| R-squared | 0.259401 | Mean dependent var | -0.979360 |
| Adjusted R-squared | 0.230916 | S.D. dependent var | 11.58540 |
| S.E. of regression | 10.16010 | Akaike info criterion | 7.543563 |
| Sum squared resid | 2683.919 | Schwarz criterion | 7.638720 |
| Log likelihood | -103.6099 | Hannan-Quinn criter. | 7.572653 |
| F-statistic | 9.106702 | Durbin-Watson stat | 1.711189 |
| Prob(F-statistic) | 0.005637 | | |

Source: Author's calculation from data from World Development Indicator's, World Bank.

*Figure 6:Unit Root Test on GDP per Capita Growth*

Null Hypothesis: GDP has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=6)

| | | t-Statistic | Prob.* |
|---|---|---|---|
| Augmented Dickey-Fuller test statistic | | -3.117874 | 0.0367 |
| Test critical values: | 1% level | -3.689194 | |
| | 5% level | -2.971853 | |
| | 10% level | -2.625121 | |

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

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(GDP)
Method: Least Squares
Date: 12/08/19 Time: 00:28
Sample (adjusted): 1991 2018
Included observations: 28 after adjustments

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|---|---|---|---|---|
| GDP(-1) | -0.529396 | 0.169794 | -3.117874 | 0.0044 |
| C | 1.600221 | 0.627065 | 2.551921 | 0.0169 |

| | | | |
|---|---|---|---|
| R-squared | 0.272140 | Mean dependent var | 0.127376 |
| Adjusted R-squared | 0.244145 | S.D. dependent var | 2.509932 |
| S.E. of regression | 2.182133 | Akaike info criterion | 4.467232 |
| Sum squared resid | 123.8043 | Schwarz criterion | 4.562389 |
| Log likelihood | -60.54124 | Hannan-Quinn criter. | 4.496322 |
| F-statistic | 9.721138 | Durbin-Watson stat | 1.961919 |
| Prob(F-statistic) | 0.004413 | | |

Source: Author's calculation from data from World Development Indicator's, World Bank.

*Figure 9:Unit Root Test on Current Account (1st Difference)*

Null Hypothesis: D(CAA) has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=6)

| | | t-Statistic | Prob.* |
|---|---|---|---|
| Augmented Dickey-Fuller test statistic | | -4.147770 | 0.0034 |
| Test critical values: | 1% level | -3.699871 | |
| | 5% level | -2.976263 | |
| | 10% level | -2.627420 | |

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

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(CAA,2)
Method: Least Squares
Date: 12/08/19 Time: 00:33
Sample (adjusted): 1992 2018
Included observations: 27 after adjustments

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|---|---|---|---|---|
| D(CAA(-1)) | -0.846743 | 0.204144 | -4.147770 | 0.0003 |
| C | -19154675 | 1.56E+08 | -0.123178 | 0.9030 |

| | | | |
|---|---|---|---|
| R-squared | 0.407639 | Mean dependent var | 36650074 |
| Adjusted R-squared | 0.383945 | S.D. dependent var | 1.03E+09 |
| S.E. of regression | 8.05E+08 | Akaike info criterion | 43.92176 |
| Sum squared resid | 1.62E+19 | Schwarz criterion | 44.01775 |
| Log likelihood | -590.9437 | Hannan-Quinn criter. | 43.95030 |
| F-statistic | 17.20400 | Durbin-Watson stat | 1.895448 |
| Prob(F-statistic) | 0.000339 | | |

Source: Author's calculation from data from World Development Indicator's, World Bank.

*Figure 8:Unit Root Test on Current Account*

Null Hypothesis: CAA has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=6)

| | | t-Statistic | Prob.* |
|---|---|---|---|
| Augmented Dickey-Fuller test statistic | | -1.421600 | 0.5574 |
| Test critical values: | 1% level | -3.689194 | |
| | 5% level | -2.971853 | |
| | 10% level | -2.625121 | |

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

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(CAA)
Method: Least Squares
Date: 12/08/19 Time: 00:29
Sample (adjusted): 1991 2018
Included observations: 28 after adjustments

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|---|---|---|---|---|
| CAA(-1) | -0.132062 | 0.092897 | -1.421600 | 0.1670 |
| C | -2.34E+08 | 2.05E+08 | -1.143928 | 0.2631 |

| | | | |
|---|---|---|---|
| R-squared | 0.072123 | Mean dependent var | -29240714 |
| Adjusted R-squared | 0.036435 | S.D. dependent var | 7.83E+08 |
| S.E. of regression | 7.69E+08 | Akaike info criterion | 43.82754 |
| Sum squared resid | 1.54E+19 | Schwarz criterion | 43.92269 |
| Log likelihood | -611.5855 | Hannan-Quinn criter. | 43.85663 |
| F-statistic | 2.020947 | Durbin-Watson stat | 1.572039 |
| Prob(F-statistic) | 0.167027 | | |

Source: Author's calculation from data from World Development Indicator's, World Bank.

*Figure 11:Unit Root Test on Monetary Policy Rate (1st Difference)*

Null Hypothesis: D(MPR) has a unit root
Exogenous: Constant
Lag Length: 1 (Automatic - based on SIC, maxlag=6)

| | | t-Statistic | Prob.* |
|---|---|---|---|
| Augmented Dickey-Fuller test statistic | | -3.264889 | 0.0274 |
| Test critical values: | 1% level | -3.711457 | |
| | 5% level | -2.981038 | |
| | 10% level | -2.629906 | |

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

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(MPR,2)
Method: Least Squares
Date: 12/08/19 Time: 00:33
Sample (adjusted): 1993 2018
Included observations: 26 after adjustments

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|---|---|---|---|---|
| D(MPR(-1)) | -0.703493 | 0.215472 | -3.264889 | 0.0034 |
| D(MPR(-1),2) | 0.111545 | 0.162041 | 0.688377 | 0.4981 |
| C | -0.519306 | 0.782730 | -0.663455 | 0.5136 |

| | | | |
|---|---|---|---|
| R-squared | 0.370217 | Mean dependent var | -0.500000 |
| Adjusted R-squared | 0.315453 | S.D. dependent var | 4.820788 |
| S.E. of regression | 3.988593 | Akaike info criterion | 5.712921 |
| Sum squared resid | 365.9040 | Schwarz criterion | 5.858086 |
| Log likelihood | -71.26797 | Hannan-Quinn criter. | 5.754723 |
| F-statistic | 6.760253 | Durbin-Watson stat | 2.013235 |
| Prob(F-statistic) | 0.004906 | | |

Source: Author's calculation from data from World Development Indicator's, World Bank.

*Figure 10:Unit Root Test on Monetary Policy Rate (1st Difference)*

Null Hypothesis: MPR has a unit root
Exogenous: Constant
Lag Length: 1 (Automatic - based on SIC, maxlag=6)

| | | t-Statistic | Prob.* |
|---|---|---|---|
| Augmented Dickey-Fuller test statistic | | -1.400226 | 0.5672 |
| Test critical values: | 1% level | -3.699871 | |
| | 5% level | -2.976263 | |
| | 10% level | -2.627420 | |

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

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(MPR)
Method: Least Squares
Date: 12/08/19 Time: 00:29
Sample (adjusted): 1992 2018
Included observations: 27 after adjustments

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|---|---|---|---|---|
| MPR(-1) | -0.128119 | 0.091499 | -1.400226 | 0.1742 |
| D(MPR(-1)) | 0.238969 | 0.184961 | 1.291998 | 0.2087 |
| C | 3.125792 | 2.431241 | 1.285678 | 0.2108 |

| | | | |
|---|---|---|---|
| R-squared | 0.108384 | Mean dependent var | -0.111111 |
| Adjusted R-squared | 0.034083 | S.D. dependent var | 4.654058 |
| S.E. of regression | 4.574058 | Akaike info criterion | 5.983118 |
| Sum squared resid | 502.1282 | Schwarz criterion | 6.127100 |
| Log likelihood | -77.77209 | Hannan-Quinn criter. | 6.025931 |
| F-statistic | 1.458714 | Durbin-Watson stat | 1.274259 |
| Prob(F-statistic) | 0.252425 | | |

Source: Author's calculation from data from World Development Indicator's, World Bank.

*Figure 13:Unit Root Test on Exchange Rate*

Null Hypothesis: REAL_EXCHANGE_RATE__GHS_USD_ has a unit root
Exogenous: Constant
Lag Length: 5 (Automatic - based on SIC, maxlag=6)

| | | t-Statistic | Prob.* |
|---|---|---|---|
| Augmented Dickey-Fuller test statistic | | 1,366075 | 0,9981 |
| Test critical values: | 1% level | -3,752946 | |
| | 5% level | -2,998064 | |
| | 10% level | -2,638752 | |

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

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(REAL EXCHANGE RATE GHS USD )
Method: Least Squares
Date: 12/08/19 Time: 00:24
Sample (adjusted): 1996 2018
Included observations: 23 after adjustments

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|---|---|---|---|---|
| REAL EXCHANGE RATE GHS USD ( | 0,161407 | 0,118154 | 1,366075 | 0,1908 |
| D(REAL EXCHANGE RATE GHS USD | 0,396512 | 0,304205 | 1,303436 | 0,2109 |
| D(REAL EXCHANGE RATE GHS USD | -0,512513 | 0,254498 | -2,013819 | 0,0612 |
| D(REAL EXCHANGE RATE GHS USD | 0,062312 | 0,289728 | 0,215071 | 0,8324 |
| D(REAL EXCHANGE RATE GHS USD | -0,813318 | 0,288505 | -2,838761 | 0,0119 |
| D(REAL EXCHANGE RATE GHS USD | 0,991228 | 0,492100 | 2,014282 | 0,0611 |
| C | -0,006338 | 0,059243 | -0,106980 | 0,9161 |

| | | | |
|---|---|---|---|
| R-squared | 0,636931 | Mean dependent var | 0,194148 |
| Adjusted R-squared | 0,500780 | S.D. dependent var | 0,243247 |
| S.E. of regression | 0,171868 | Akaike info criterion | -0,438392 |
| Sum squared resid | 0,472617 | Schwarz criterion | -0,092807 |
| Log likelihood | 12,04151 | Hannan-Quinn criter. | -0,351479 |
| F-statistic | 4,678120 | Durbin-Watson stat | 1,894186 |
| Prob(F-statistic) | 0,006250 | | |

Source: Author's calculation from data from World Development Indicator's, World Bank.

*Figure 12:Unit Root Test on Exchange Rate (2nd Difference)*

Null Hypothesis: D(REAL EXCHANGE RATE GHS USD ,2) has a unit root
Exogenous: Constant
Lag Length: 3 (Automatic - based on SIC, maxlag=6)

| | | t-Statistic | Prob.* |
|---|---|---|---|
| Augmented Dickey-Fuller test statistic | | -5,065872 | 0.0005 |
| Test critical values: | 1% level | -3,752946 | |
| | 5% level | -2,998064 | |
| | 10% level | -2,638752 | |

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

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(REAL EXCHANGE RATE GHS USD ,3)
Method: Least Squares
Date: 12/08/19 Time: 00:34
Sample (adjusted): 1996 2018
Included observations: 23 after adjustments

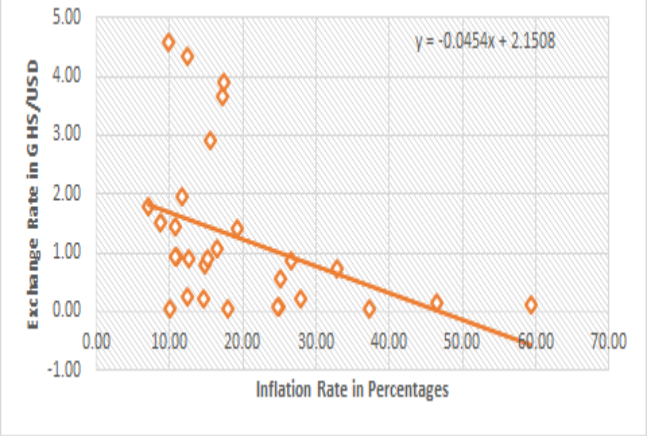
| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|---|---|---|---|---|
| D(REAL EXCHANGE RATE GHS USD | -3,209857 | 0,633624 | -5,065872 | 0,0001 |
| D(REAL EXCHANGE RATE GHS USD | 1,858365 | 0,549011 | 3,384931 | 0,0033 |
| D(REAL EXCHANGE RATE GHS USD | 1,211913 | 0,410023 | 2,955717 | 0,0085 |
| D(REAL_EXCHANGE_RATE__GHS_USD | 0,917178 | 0,233880 | 3,921582 | 0,0010 |
| C | 0,068914 | 0,040979 | 1,681701 | 0,1099 |

| | | | |
|---|---|---|---|
| R-squared | 0,831742 | Mean dependent var | -0,008696 |
| Adjusted R-squared | 0,794351 | S.D. dependent var | 0,391993 |
| S.E. of regression | 0,177763 | Akaike info criterion | -0,427068 |
| Sum squared resid | 0,568796 | Schwarz criterion | -0,180222 |
| Log likelihood | 9,911288 | Hannan-Quinn criter. | -0,364987 |
| F-statistic | 22,24463 | Durbin-Watson stat | 1,838833 |
| Prob(F-statistic) | 0,000001 | | |

Source: Author's calculation from data from World Development Indicator's, World Bank.

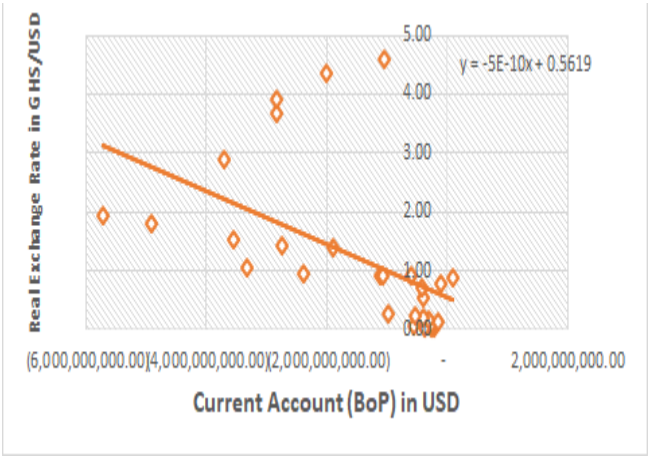
## Relationship between Dependent Variable and Independent Variables

*Figure 15:Relationship between Exchange rate and Inflation*



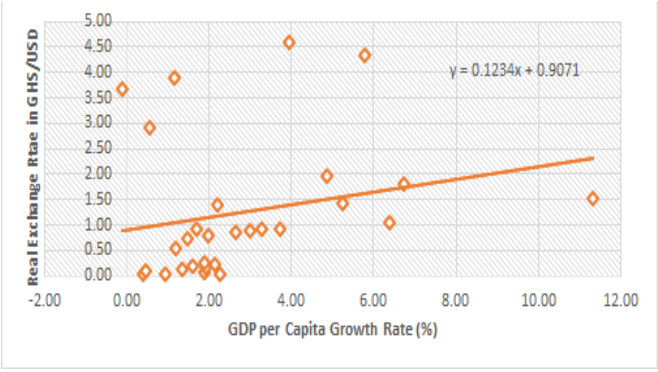

Source: Author's calculation from data from World Development Indicator's, World Bank.

*Figure 14:Relationship between Exchange rate and Current Account*




Source: Author's calculation from data from World Development Indicator's, World Bank.

*Figure 16:Relationship between Exchange rate and Interest Rate*




Source: Author's calculation from data from World Development Indicator's, World Bank.

*Figure 17:Relationship between Exchange rate and Monetary Policy Rate*


Source: Author's calculation from data from World Development Indicator's, World Bank.

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