UNIVERSITY OF EDUCATION, WINNEBA

INFLATION TARGETING POLICY, REAL EXCHANGE RATE, EXPORTS AND IMPORTS NEXUS IN GHANA (1984 – 2019)

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DECLARATION

Student's Declaration

I, ERASMUS OFORI FARRON hereby declare that this thesis is the result of my own original work and effort towards the Master of Philosophy Degree in Economics. To the best of my knowledge, it neither contains material published by another person or material which has been accepted for the award of any other degree of the University, except where due acknowledgements have been made in the text.

Signature …….....……

Date ….....…….....…

Supervisors' 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 Education, Winneba.

Supervisor's Name: Dr. Gershon Yao Dake

Signature …….....……

Date ….....…….....…

DEDICATION

I dedicate this work to my dear wife, Felicia, my father, Mr. Stephen Ofori Farron and my mother, Madam Florence Annan - Takyi for their support.

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LIST OF ABBREVIATIONS

AIC	Akaike Information Criterion
ADF	Augmented Dickey-Fuller
AR	Autoregressive
ARDL	Auto Regressive Distributed Lag
BoG	Bank of Ghana
BOP	Balance of Payment
COICOP	Classification of individual Consumption According to Purpose
CPI	Consumer Price Index
CUSUM	Cumulative Sum
CUSUMQ	Cumulative Sum of Squares
ECM	Error Correction Model
ERP	Economic Recovery Program
FFIT	Full – Fledged Inflation Targeting
GDP	Gross Domestic Product
GLSS	Ghana Living Standard Surveys
GSS	Ghana Statistical Service
IMF	International Monetary Fund
IT	Inflation Targeting
LM	Lagrange Multiplier
LSM	Least Square Method
MPC	Monetary Policy Committee
MPR	Monetary Policy Rate
OECD	Organization for Economic Co – operation and Development
OLS	Ordinary Least Square
OMO	Open Market Operations
PNDC	Provisional National Defence Council

PP	Phillip-Perron
PPP	Purchasing Power Parity
PR	Policy Rate
PSBR	Public Sector Borrowing Requirement
SBIC	Schwarz Bayesian Information Criterion
TGARCH	Threshold Generalized Autoregressive Conditional Heteroscedasticity
VAR	Vector Auto Regression
WAMU	West African Monetary Union
WDI	World Development Indicators
WPI	Wholesale Price Index

ABSTRACT

Inflation Targeting (IT) Strategy has been adopted widely by both developing and developed countries as a tool of monetary policy. Bank of Ghana (BoG) formally adopted Inflation targeting Policy in 2007, making Ghana the second sub Saharan African country to do so. This study sought to analyze empirically the effectiveness of IT policy on Exchange Rate, Exports and Imports by employing annual time series data from 1984 - 2019. The dataset was divided into periods before the adoption of IT (1984 – 2006) and after Inflation Targeting (2007 – 2019) in order to analyze the effect of IT on the selected variables. A dummy variable capturing the periods before and after the adoption of IT was employed. This study used Vector Autoregressive model to analyze the time series data on Exchange Rate, Exports and Imports. The results indicate that IT has a negative and statistically significant effect on Exchange rate. Also, the results show that Inflation Targeting has a positive but statistically insignificant effect on export in Ghana. Finally, the results revealed that Inflation Targeting has a negative but statistically insignificant effect on imports. The study therefore recommends that Bank of Ghana adopts policy measures towards stabilization of the exchange rates so that level of imports can be controlled and exports encouraged. Also, the study recommends that government implement policies that are directed towards the patronization of locally produced goods so as to improve our trade balance.

CHAPTER ONE

INTRODUCTION

1.0 Background to the study

Economists generally agree that monetary policy should primarily be concerned with the pursuit of price stability. However, they still differ on how this objective can be achieved most effectively. Though this debate remains unresolved, many countries have adopted Inflation Targeting as their monetary policy framework with the aim of ensuring price stability. This is because when prices are stable, they impact positively on key macroeconomic variables such as exchange rate, exports and imports. Both inflation and exchange rate are essential for the macroeconomic objective of price stability. Exchange rates have effects on the volume of exports and imports as well as balance of payments position of a country (Hossain, 2002). Aliyu (2009) noted that when exchange rate appreciates, it results in decreased exports and increased imports while depreciation improves exports and discourages imports. The depreciation of exchange rate is likely to cause a shift from foreign goods to local goods. When exchange rate changes, particularly depreciation, it passes through to consumer prices resulting in inflation. Exports will no longer become competitive due to high prices, Ito and Sato (2008). This is because, the high inflation erodes export competitiveness that would have resulted from the depreciation in the exchange rate; as a result, exchange rate does not become effective in correcting deficit in the balance of payment and relieving debt burden. According to Stonebraker (2013) currency appreciation would lead to decrease in the price of import products and increase the price of export products, hence the competitiveness of a country's export product can be weakened in the international trade market. In theory, a change in domestic prices will results in a

change in the exchange rate which eventually will raise or lower the cost of foreign goods, thereby reducing or increasing demand for imports. All other things being equal, if the volume of imported goods and services rise above its exports, the terms of trade worsen. This leads to depreciation of the country's currency as pressure would be mounted on foreign currencies (increase in demand). However, if the rise in imports is lower than the increase in exports, this would bring about favorable terms of trade and appreciation of the currency (cedi). There is an inverse relationship between inflation and export. Inflation makes local goods and services more expensive on the international market. Export of goods and services will only increase if demand for domestic export in foreign countries is inelastic (Fleming, 1962; Mundell, 1963). Therefore, inflation affects export primarily through their influence on exchange rate.

The real exchange rate is very essential in economic activities for at least two reasons. Firstly, changes in the real exchange rate (real depreciation and appreciation) have a strong influence on the direction of trade. If a country's real exchange rate appreciates, then the country's goods and services become expensive, leading to a surge in her imports (Salehi-Isfahani, 1989). On the contrary, if a country's real exchange rate experiences depreciation, all other things being equal, her goods and services become cheaper relative to those of her trade partners. Therefore, the country should experience a surge in its exports (Sekkat and Varoudakis, 2000).

This therefore calls for the need for the central banks to formulate monetary policy aimed at stabilizing prices. In Ghana, Monetary Policy implementation has gone through a number of phases; evolving from a controlled regime (with the use

of direct instruments) to the use of monetary targeting arrangements (under the indirect instruments) and currently Inflation Targeting (IT). The Bank of Ghana (BoG), in May 2007, officially adopted an IT framework as a major monetary policy regime making Ghana the second sub Saharan African country to do so after South Africa. Hammond (2012) argues that the adoption of inflation targeting by Ghana came not as a response to new economic thinking but because of the failure of other monetary policy regimes.

Inflation targeting according to Mishkin (2000) refers to an economic policy through which the central bank estimates and announces in public a targeted inflation rate. The central bank then attempts to steer the actual inflation towards the targeted range by manipulating interest rate and other instruments of monetary policy. The policy rate (interest rate) is usually seen as the main or the only instrument used to achieve the target. The primary aim of an IT policy is to ensure stability in price. The central bank does not pursue any other monetary target, and the transparency and accountability of the central bank is attained. Roger (2010) explained that this approach is different from previous ones. This is because of clear public commitment to controlling inflation as the primary policy goal, and the emphasis on policy transparency and accountability. The main objective of IT is to achieve a stable inflation rate, though it is not the only goal of monetary policy under IT. In pursuing price stability, the monetary authority does so by also attempting to reduce volatility in output and ensure exchange rate stability. Svensson (1997) argues that IT reduces inflation variability, and if "flexible", it can stabilize output as well. An IT policy framework explicitly specifies the inflation objectives and a clear commitment to achieving them. This helps to anchor the

public's inflation expectations, as well as the expectations of future inflation to influence prices and wages thereby improving the general economy.

Over the last three decades the theory and practice of inflation targeting have developed together. This has led to an increase in the amount of literature on inflation targeting and its effects. The question about the effect of an Inflation Targeting regime on the performance of macroeconomic variables of an economy has been a topic of interest for several of these researches.

1.1 Statement of the Problem

According to Alagidede and Ibrahim (2016), since Ghana adopted the flexible exchange rate regime in the 1980s, the Ghana Cedi has depreciated against major currencies especially the US Dollar (US$). Studies done recently by Alagidede and Ibrahim (2016), and Tarawalie, Sissoho, Conte, and Ahortor (2013) provide evidence of depreciating exchange rate in Ghana. For instance, on an annual basis in the year 1991, the Ghanaian cedi depreciated by 11.5%. In 1992, the cedi further depreciated by 25%. In 1994, the depreciation was 21.8% and in 1996, it was 16.9%; (Bank of Ghana Annual Report, 1991; 1992; 1994 and 1996). In the year 2000, the cedi further depreciated by 49.8%, with depreciation of 13.2% in 2002 and a depreciation of 20.1% in the year 2008. (Bank of Ghana Annual Report, 2000; 2002 and 2008)

This continuous depreciation of exchange rate has been a big concern to the government, analysts, investors, and other stakeholders because it results to uncertainty of trade, employment, investment, profits, cash flows and economic growth (Musyoki, Pokhariyal, & Pundo, 2012). The ability to maintain the value of

the local currency, to a large extent, serves as a measure of how well an economy is doing.

Exchange rate has effects on the prices of imported goods in local market, the value of locally manufactured goods in foreign markets and impacts on country's competitiveness. The exchange rate affects the cost of servicing (interest payment and principal) on the country's foreign debt. For instance, according to the Annual Public Debt Report for 2020 financial year, published by Ministry of Finance, Ghana's total public debts increased from 56.8 (as a percentage of GDP) in 2016 to 62.4 (as a percentage of GDP) in 2019. When servicing these debts, the exchange rate plays a major role as it determines how much the country eventually pays.

The above discussions bring into sharp focus whether the implementation of Monetary Policy in Ghana has been successful in improving macroeconomic performance. Ghana started using Inflation Targeting policy in 2007 with a primary objective to stabilize price. Since then, there have been studies by Coleman (2012), Ayisi (2013) & Puni, Osei & Barnor (2014), Fosu (2015), Alhassan, Yussif & Buabeng (2016) suggest that inflation targeting has a positive impact on the macroeconomic performance. However, these studies have been limited to the effects of inflation targeting on inflation and economic growth. The question of whether Inflation Targeting policy has been able to combat the ruin of exchange rate and improve trade balance in Ghana remains unanswered. This work differs from what has already been done in Ghana as it focuses on other macroeconomic variables; Exchange Rate, Exports and Imports. This work will therefore add to and

expectantly play an important role to the existing knowledge on Inflation Targeting in Ghana and Africa.

1.2 Purpose of the Study

The purpose of the study is to investigate the effect of inflation targeting on exchange rate, exports and imports in Ghana.

1.3 Research Objectives

The general objective of the study is to examine the effect of Inflation Targeting Policy on exchange rate, exports and imports in Ghana from 1984 to 2019. Specifically, the study seeks to;

1. Assess the effects of Inflation Targeting on Real Exchange Rate in Ghana.
2. Examine the effect of Inflation Targeting on Export (% of GDP) and Import (% of GDP) in Ghana.

1.4 Research Questions

The research questions that emanate from the research problem and the study objectives are:

1. What is the effect of Inflation Targeting on Real Exchange Rate in Ghana?
2. What is the effect of Inflation Targeting on Exports and Imports in Ghana?

1.5 Significance of the Study

The significance of this study is premised on the fact that exchange rate stability occupies a significant space in macroeconomic discourse and policy analysis. The exchange rate functions as the primary link between the overseas and the local market for various goods, services and financial assets. Using the exchange rate, we are able to draw a comparison between prices of products and

assets quoted in different currencies. Uncertainty in the exchange rate is a risk to international trade in that it causes uncertainty to both importers and exporters. Depreciation in the exchange rate tends to directly affect domestic prices of imported goods and services. This implies that more Ghana cedi are needed to exchange for a dollar and this is not good news for Ghana which imports more than 50% of her goods and services from other dollarized nations In the case of exporters, since there is normally a gap between the time for delivery of their contracts and the receipts of their payments, they are usually exposed to exchange rate risks

It can affect the country's external sector through its impact on foreign trade. A depreciation of the cedi, for instance, could lower the price competitiveness of our exports versus the products of those competitor countries whose currencies have not changed in value. An appreciation of the cedi reduces the amount of cedi needed to buy foreign exchange to pay interest and maturing obligations.

It's very important to note that a major drive towards exchange rate stability and favourable trade balance depend very much on sound Monetary Policies and hence the motivation of this study.

Firstly, considering the significance of Exports in Ghana, the empirical findings of this study will enable policy makers to come up with a viable and focused trade balance strategy that can help the country's economic growth. Also, the findings from this research will guide government to know the kind of monetary policies which can stabilize the exchange rate and boost our export industry under inflation targeting regime is concerned. Again, for policy makers to

be informed whether it is beneficial to maintain inflation targeting or explore alternative frameworks for formulating and conducting monetary policy, an empirical study of this kind is useful in seeking to reveal the implications of inflation targeting on real aggregate economic activity. Finally, the study would provide very useful information and contribute to empirical literature on inflation targeting and policy issues relating to stabilizing the exchange rate and improving export performance in Ghana.

1.6 Scope of the Study

This study employs secondary data for its analysis. The study will be limited to the effect of inflation targeting on Exchange rate, Exports and Imports in Ghana using annual time series dataset from 1984 to 2019; thus 36 observations. The study employs the Vector Autoregressive (VAR) Model. The variables for the study are; Real Exchange Rates, Exports (% of GDP) and Imports (% of GDP). All data would be gathered from the World Bank's World Development Indicators.

1.7 Organization of the Study

This research organized into five main chapters. Chapter One dealt with the background of the study, the statement of the problem, the objectives of the study and the research questions. The chapter also dealt with the scope and significance of the study. Chapter Two dealt with the review of related literature. It was divided into three parts. The first part looked at the exchange rate policies and trends in exports in Ghana since 1984. It also looked at the overview of monetary policies in Ghana and theoretical underpinning of inflation targeting. The second part treated the theoretical review and empirical works done on inflation targeting and its effects on exchange rate, export and Import are concerned. Chapter Three looked at

the methodology of the study; the source of data to be used and the model specifications. Chapter Four discussed the analysis of the data. Here the model that was used is estimated; and the effects of inflation targeting on exchange rate, export and imports are determined. Finally, chapter five presents the summary, conclusions, policy recommendations and direction for future research.

CHAPTER TWO

REVIEW OF RELATED LITERATURE

2.0 Introduction

The review of related literature is divided into two main sections. The first section looks at the exchange rate policies that have been adopted in Ghana since 1983. The section also looks at the overview of Inflation Targeting monetary policy in Ghana as well also as the theoretical underpinning of Inflation Targeting. The second section is sub divided into two parts; Theoretical Review and Empirical Review on Inflation Targeting strategy and its effectiveness on Exchange Rate, Exports and Imports in Ghana.

2.1 Exchange Rate Policies since 1983

The economic decadence that had persisted up to this point gave way to programs that were fundamentally different and more market-oriented. The pursuit of exchange rate reforms was based on four main goals: first, to absorb the parallel market into the legal market; second, to realign the official exchange rate; third, to achieve convergence of official and parallel rates; and finally, to allow market forces (i.e., interplay between demand and supply) to determine the rate and allocate foreign exchange (Dordunoo, 1994).

Ghana began an Economic Recovery Program (ERP) in April 1983, under the auspices of the World Bank and the International Monetary Fund. The goal was to alleviate the economic hindrance caused by the overvaluation of the currency (the Ghanaian Cedi) from the 1970s to the early 1980s. In the early 1980s, Ghana's economy was in a severe decline. Current account position was bad amidst natural disasters (bush fire and drought). In that same period, the government of Nigeria

deported many Ghanaian nationals who had found greener pasture in their lands and for that matter were tripping into their country every passing day. The Provisional National Defense Council (PNDC), led by Flt Lt Jerry John Rawlings, was left with little choice but to start on the ERP under harsh conditions. During this era, trade with parts of the world was libralised and price controls were removed. Despite the predetermined mindset not to devalue the Cedi, a four-year economic reform was launched which maintained a fixed exchange rate regime but with periodic devaluation. As a result, between October 1983 and January 1986, the Ghana Cedi depreciated over 32 times the value at the onset the reform (from GH¢2.75/US$ to GH¢90.00/US$). A system of multiple exchange rates based on bonuses and surcharges was announced, in April 1983, as a step towards exchange rate liberalisation. The exchange mechanism comprised a multiple exchange rate system of two official rates of which traditional exports and imports of essential raw materials, crude oil, capital goods and basic foodstuffs were subjected to a Cedi-US Dollar exchange rate of 23.375. That for nontraditional exports and other imports was 29.975. Until October 10, 1983 when the exchange rates were merged at ¢30.00 per US Dollar, this scheme was being practiced (Yemidi, 2010).

During the second phase of the ERP (1987–1999), the devaluation procedure was modified. The government maintained control over the Cedi exchange rate, which was defined as "vital transactions." Such transactions included cocoa export, crude oil purchases, pharmaceuticals, and servicing of government debt, which were referred to as “Window One Transactions”. At the same time, the government established a Foreign Exchange Auction System under the supervision and control of the central bank, because previous efforts to correct the Cedi's overvaluation in relation to its ostensibly "equilibrium" rate, and

certainly in relation to the parallel rate, were simply insufficient. The major goal was to discourage speculations in foreign exchange. Also, this was referred to as "Window Two Transactions", and covered persons and organizations operating in key areas of the Ghanaian economy. Private individuals and commercial institutions were granted permission to open and operate Foreign Exchange Bureaux in the country's major cities as a result of the 'Window-Two Agreement'. The main objective was to use the banking system to channel foreign exchange transactions on the parallel of black market. In 1984, the real Gross Domestic Product (GDP) increased from -7 percent to percent. Although, the economy was performing strongly during the recovery period with the annual growth in the real GDP averaging in excess of 5 per cent and rate of inflation dropped to 25 per cent from 123 per cent at the end of 1989, a build-up of currency outside the banking system was on the ascendency due to less developed nature of the financial market (IMF, 1995). Furthermore, increased demand for foreign exchange in the parallel foreign exchange market was fueled by high transaction costs in the banking sector. The government implemented financial sector reforms aimed at establishing a market-oriented system of monetary regulation based on indirect investments. This system saw the introduction of the 90-day, 180-day, 1-year, and 2-year Bank of Ghana Treasury bills, among others. The government realized that the Auction method needed to be changed in 1990 because it had failed to bring the two rates to market convergence as planned.

The Cedi's market exchange rate against its major trading currencies has been established via an interbank market supported by a weekly wholesale auction since 1992. The major effects of the wholesale auction and interbank arrangements were the reduction of excess demand on the auction market, the narrowing of the gap

between the highest and lowest bid rates in the auction market, and the unification of the marginal auction and bureau exchange rates.

Under the Interbank Market, authorised dealer banks were permitted to trade in foreign exchange among themselves or with their final-user clients. The major provisions with regard to regulating the interbank auction were: one, the foreign exchange traded in the interbank auction should not be subject to surrender requirements; two, authorised dealer banks' working balances was not to exceed a given ceiling; and three, BoG was also allowed to partake in the interbank market as a buyer or seller. The exchange rate in Ghana has since been quoted using Interbank and foreign exchange bureau rates. The rate continued to increase, depreciating in 1994 by 33.31 percent over the 1993's rate. The rate of depreciation increased further in 1995 but ceased in 1996. The year 2000 witnessed the highest annual depreciation of the Cedi against the US Dollar, 85.8 percent over the period 1993-2000. The New Patriotic Party (NPP) in 2001, upon assumption of political power and with the determination to ensure stable macroeconomic environment, embarked on various policy initiatives which included the Highly Indebted Poor Countries (HIPC) initiative. Prices of petroleum products and public utilities felt an upwards adjustment. To some extent, stabilization in the economy was realised with these policies. In the same year, the Cedi depreciated against the US Dollar by 12.1 percent. However, the depreciation rate of the Cedi fell consistently from 2003 to 2005 achieving a marginal depreciation of 0.29 percent in 2005. Despite the gains made, excessive government expenditure in 2008 affected the Cedi badly losing its value against the US Dollar by 24.8 percent (Asuming- Brempong, 1999). A study conducted by IMF prior the ERP revealed that the overvaluation of the Cedi was a main source of distortion in the economy. The ERP brought to light

some major structural problems of the economy. Subsequently, the bank (1986 - 1991) launched and implemented its own parallel Structural Adjustment Programme (SAP) targeting Sub- Saharan African countries, not excluding Ghana. In this new programme, issues regarding exchange rate were usually left to the Fund to negotiate or at times team up the central bank (Asuming-Brempong, 1999). Table 2.1 provides a gist of exchange rate policies implemented since the ERP era.

Table 2.1: Summary of Exchange Rate Policies in Ghana since 1983

Date	Exchange rate regime
Feb. 1983 – Mar. 1986	Multiple Exchange Rate System
Apr. 1986 – Feb. 1987	Dual Retail Auction System
Mar. 1987 – Apr. 1989	Foreign Exchange Bureaux
Mar. 1990 – Jan. 1992	Wholesale Auction System
Feb. 1992 – To Date	Interbank Market

Source: Bank of Ghana, 2019.

2.2 Overview of Inflation Targeting Monetary Policy in Ghana

This section looks at inflation in Ghana namely, the pre inflation targeting era and inflation targeting era and the various monetary policy strategies which have been adopted by the monetary authorities in trying to maintain stable price and achieving other macroeconomic goals.

2.2.1 Background of Inflation

According to Gillepie (2011), inflation occurs when there is a sustained increase in the general price level over a given period of time. That is, inflation is an economic situation where there is a general rise in prices of goods and services and factors of production. A fall in the rate of inflation generally means there has been a fall or slowdown in the rate at which prices of goods and services are

increasing on the market. This is called the deflation rate. Inflation may also be defined as ‘a continuous rise in prices measured by an index such as the Consumer Price Index (CPI) or by the Gross Domestic Product (GDP) deflator.

The GDP deflator also known as the implicit price deflator could be defined as a measure of the price level of all final goods and services produced domestically in an economy in a year. Like the CPI, the GDP deflator is a measure of inflation with respect to a specific base year; the GDP deflator of the base year itself is 100. The GDP deflator may be said to be the more comprehensive of the two ways of representing inflation since a wider array of goods and services are taken into account in its measure. It however does not give a true reflection on consumer welfare since it does not include imported goods and services in its computation which form a large chunk of what people consume especially in Ghana.

2.2.2 Measurement of Inflation in Ghana

Ghana uses the Headline Consumer Price Index in its computation of the inflation rate. The Consumer Price Index is an index which measures the proportionate change in the prices of a fixed basket of goods and services purchased by households for consumption. The index is referenced to the price level in 2018 (Base year) which has an index of 100 (GSS statistical bulletin 2019).The rate of inflation is the relative change in the CPI between periods. Inflation is reported annually (year – on – year) and monthly (month – on – month). Key variable are prices, quantities and expenditure weights. Since independence, the Ghana Statistical Service (GSS) revised the CPI calculations seven times, with the first in 1963 and most recently in 2019. The current basket is primarily based

on the 2017 Ghana Living Standard Surveys (GLSS 7). The new series has 2018 as the base year (reference period) and it is an expanded basket over the previous one which had 2012 as the base year. This adequately reflects the peoples' purchasing habit. Currently, there are 307 items in the new basket compared with the 267 in the old basket. The points of data collection have also increased from 42 in the old market to 44 markets in this new series. The number of observations also increased from 25,444 in 2012 to 39963 (with 6358 shops in the urban areas and 3514 shops in the rural area) in the rebased period. The CPI does not directly estimate prices of different products. Instead, items are ordered in a hierarchical system of Division, Groups, Classes, Subclasses and items.

The new series takes into consideration changes in the pattern of consumption over time. One important alteration in the new series is the adoption of Classification of individual Consumption According to Purpose (COICOP classification) 2018 for the re – classification of items in the basket. This resulted in some items moving across Groups and Divisions.

Here, a market is considered urban if more than 60% of the items in the basket could be found in that market throughout a week. It is however considered rural if it does not satisfy this criterion.

2.2.3 Causes of Inflation in Ghana

The major causes of inflation in Ghana are primarily attributed to the following factors; depreciation of exchange rate, increases in petroleum price, increases in monetary aggregates (money supply, and poor agricultural output. Data available from the Bank of Ghana, Institute of Statistical, Social and Economic Research (ISSER), and the Statistical Service of Ghana demonstrate the degree to

which these factors determine level of inflation in Ghana. The highest rate of inflation since 1992 recorded was 70.8% recorded in 1995 when money supply grew at 65.3% in 1994 (www.bog.gov.gh). Petroleum prices had increased by 59.91% in 1993, 18.87% in 1994, and 23.7% in 1995 (www.npa.gov.gh). The Cedi had depreciated by 25% and 28% in 1994 and 1995 respectively Inflation declined to 12.6% after there was a slowdown in the rate of money growth accompanied by relatively stable exchange rates and improved agricultural productivity between 1996 and 1999.

In 2000, fuel price increase and increased money supply as well as depreciation of the Cedi, pushed inflation to 40. 5%. Between 2002 and 2007, the rates were better as inflation dropped to 17% in 2002, went up to 23.6 in 2003, decreased to 11. 8% in 2004, up to 14.8% in 2005, down to 10. 5% in 2006 and a little up to 12.7% in 2007 and 17.4% as at October, 2015 (www.bog.gov.gh).

2.2.4 Monetary Policy

According to Mishkin (2004) monetary policy is defined as the management of money and interest rates. That is, monetary policy refers to the policy adopted by the management of a country that seeks to control either the money supply or the interest rate payable on very short – term borrowing, which often target the interest rate or inflation to ensure stability in price and general trust in the currency.

Irrespective of the specific definition of monetary policy, the central bank has a broader aim of achieving stable (low volatility) of economic variables such as prices and growth, exchange rate, among others. The basic objectives of monetary policies are the management of inflation or unemployment and maintenance of

currency exchange rate. In Ghana this is done by the Bank of Ghana which has the mandate to formulate and implement monetary policy to achieve price stability.

2.2.5 Monetary Policy in Ghana

The primary objective of the Bank of Ghana is to follow sound monetary policies aimed at price stability and creating an enabling environment that promotes sustainable economic growth

In this context, price stability is defined as a medium-term inflation target of 8 percent with a symmetric band of ±2 percent, for which the economy is expected to grow at its full potential without excessive inflation pressures. Other tasks for the Bank of Ghana are to promote and sustain, through effective regulation and supervision, a healthy financial sector and payment systems. These tasks are important for intermediation, since they take account of the risks associated with financial markets in the formulation of monetary policy

2.2.6 Monetary Policy Strategy

In order to achieve the primary objective of price stability, operational independence was granted to the Bank of Ghana in order to employ whatever policy instruments were considered necessary to stabilize inflation around the medium-term target. The Bank of Ghana's framework for conducting monetary policy is Inflation Targeting (IT). The central bank thus uses the Monetary Policy Rate (MPR) as its primary policy instrument to determine the role of monetary policy and to anchor the expectations of inflation in the economy.

2.2.7 The Monetary Policy committee (MPC) Process

The MPC is a statutorily constituted body by the Bank of Ghana Act 612 (2002) section 27 to formulate monetary policy. The MPC is composed of seven members, five from the Bank of Ghana (including the Governor acting as Chairman) and two external members appointed by the Bank of Ghana Board. The Committee meets once in every two months to analyze the economic conditions and threats to the outlook for inflation.

After the meeting, a policy decision is made on how to position the MPR. A signal of increase (tightening), decrease (loosening) or maintenance (no change) of the monetary policy stance is given by each MPR decision. At the beginning of each year, the MPC meeting dates are decided well in advance. The policy decision is reached by agreement with each member outlining the reasons behind a preferred rate decision. An MPC policy statement is published through a press release. A press conference is held, after each MPC meeting to communicate and explain the Committee's decisions to the financial markets and the general public.

2.2.8 Evolution of Monetary Policy in Ghana

Ghana broke away from the West African Monetary Union (WAMU) to set up its own central bank shortly after independence.

Since 1964, Ghana's system for delivering price stability has emerged from essentially an exchange rate targeting approach to inflation – targeting approach. From the time Ghana adopted the Economic Recovery Program, its financial system and to a large extent ways of conducting monetary policy has gone through a considerable number of changes but with the same objective of price stability being the primary goal of monetary policy. Some of these changes include the

change in tools used in conducting monetary policy from direct monetary tools through indirect monetary tools to inflation targeting. From 1964 to 1981, exchange rate was targeted as a nominal anchor i.e., a variable used by monetary authorities to stabilize private agents' expectations. Fixed currency convertibility was preferred by monetary authorities from 1964 – 1981. During this phase, exchange rate was fixed in turns to the British pound and the US dollar from 1957 – 1966 and 1966 – 1982 respectively. Consequently, declining economic activity in the early 1980s with the accompanying macroeconomic instability led to a shift from exchange rate targeting to monetary targeting framework in 1982.

Monetary targeting comprised two phases. These are; domestic direct credit controls (from 1982-1991) and Open Market Operations (from 1992-2006). Monetary authorities later shifted monetary policy conduct from OMO to explicit inflation targeting in 2007 (Kwakye, 2012).

Monetary policy regimes that have been adopted from 1982 – 2013 are discussed as follows;

2.2.9 Monetary Targeting Regime (1982 -2006)

Monetary-targeting focuses on changes in monetary aggregates while alternative monetary policy regimes focus on price signals. Sometimes, an alternative way of describing this approach is "monetarism", where inflation is assumed to be everywhere a monetary phenomenon. The theoretical foundation for monetary aggregates targeting is the classical quantity theory of money. The monetary targeting framework was developed and popularized by McCallum (1998, 2000), known as the "McCallum rule" on the basis of the quantity theory of money. In this rule, the principal policy objective is to maintain a stable low

inflation, which may be pursued in connection with minimization of real macro-economic volatility (Kwakye, 2012).

In Ghana, monetary-targeting framework was adopted in 1982 to conduct monetary policy on the basis of less sophisticated constant money supply growth. This happened at a time the economy seemed to experience stagflation. Under this regime, growth rate of nominal GDP was the intermediate target and reserve money growth was the policy instrument. A link exists between the policy instrument and the intermediate target via the velocity path. Two variants of monetary targeting that have been applied in Ghana are the direct domestic credit control from 1982 – 1991 and OMO from 1992 – 2006.

2.2.10 Direct Domestic Credit Control (1982 – 1991)

Under the direct credit control, monetary authorities set money supply targets on regular basis, taking into consideration price stability as the principal goal and growth as secondary. This was a monetary management phase in which the central bank set out to determine the domestic source of money supply after the external source was computed based on the dynamics of the BOP. The next stage involved a measurement of the aggregate domestic credit. The BoG then scrutinized commercial banks' lending processes at monthly interval and issued authorized requests to commercial banks to vary their sectorial ceilings, and this was deemed a necessary and sufficient condition for meeting lending requirements.

In all, budget was not operated as planned and so the ceiling set for government was often exceeded. Overall, the domestic credit ceiling persistently exceeded its target and this in turn destabilized money supply targets and compromised target inflation (Kwakye, 2012). Consequently, monetary policy

transparency could not be maintained and so, direct credit control was abandoned in favour of a more liberalized monetary policy in 1992.

2.2.11 Quantitative Open Market Operations (1992-2006)

In 1992, Quantitative OMO came to replace domestic credit control as an operating target instrument. Under this system, the primary objective was to achieve price stability and other supporting macroeconomic objectives (growth), by regulating money supply through trading central bank's financial instruments and/treasury securities. The quest to attain a set target for reserve money on the balance sheet of BoG was the import of these operations. Hence, reserve money served as an operating target, money supply as the intermediate target, with inflation being the ultimate target variable (Quartey and Afful-Mensah, 2014). OMO was used to contain liquidity and maintain a low stable inflation. In addition to delivering stable inflation, the sale of treasury securities was also used to accumulate funds for the Public Sector Borrowing Requirement (PSBR).

Although the Open Market Operation framework is bi-directional in nature i.e., expand or contract liquidity in the economy, the former was commonly applied in the Ghanaian context. Persistent monetary expansion coupled with explosive fiscal programmes and excessive deficit financing created a phenomenon of excess liquidity in the economy in the early 2000s, thereby contributing to demand-pull inflationary pressures. According to Kwakye (2012), the lack of safety nets in lending, inefficiency in the financial market, absence of clear separation between Public Sector Borrowing Requirement (PSBR) and OMO, eventually stifled the ability of monetary policy to contain liquidity in the economy in the early 2000s. Consequently, GDP growth fell short of the 8% annual target from 1992 – 2006.

Table 2.2 presents the various monetary policy regimes have been used from 1980 to 2019.

Table 2.2: Monetary Policy Regimes (1980 - 2019)

Monetary Policy Regime	Period
a. Monetary Targeting	1982 – 2006
i. Domestic Credit Control	1982 – 1991
ii. Quantity Open Market Operation	1992 – 2006
b. Explicit Inflation Targeting	2007 – 2019+

Source: Author's design

2.3 Inflation Targeting in Ghana

In sub-Saharan Africa, Ghana became the second nation to implement inflation targeting. The Bank of Ghana informally adopted the IT framework in 2002. Initially, an implicit or soft form of IT was adopted by BoG in the second quarter of 2002. By the end of December 2002, there was a remarkable drop in the year – on – year inflation. Ghana however experienced high inflationary pressures in the late 2000s due to demand pull factors such as widening fiscal and trade deficits (Barimah and Amuakwa-Mensah, 2014). This led to the adoption of full-fledged inflation targeting in 2007 where an explicit inflation target or target range is published by the Monetary Policy Committee (MPC) and commitment is demonstrated towards delivering the announced target inflation.

The Bank of Ghana sets a medium – term goal of 5% inflation with a +/ - 1% band, along with some intermediate inflation – reduction targets. The target measure used is the headline CPI which target a medium term of 18 – 24 months. The key policy instrument used in the conduct of inflation targeting policy is the

interest rate. In Ghana, the central bank applies the Policy Rate (PR). The PR denotes the base or rediscount rate for lending to commercial banks and thereby functions as a yardstick for interest rates in the economy.

The main models employed by the BoG in forecasting inflation are the Autoregressive (AR) forecasting model, error correction forecasting model, macro – econometric model and calibrated macroeconomic model (being developed). Considering a wider set of macroeconomic dimensions as real economic activity, business and consumer confidence, fiscal position, foreign shocks and even the supply of money, BoG discovers its inflation forecast based on its reaction function. The core issue is that commercial banks' interest rates reflect the signal from the PR, which in turn affects loan demand, supply of money and consequently, price stability. However, conditions such as tenuous and slow transmission of PR to commercial banks' interest rates, unstable financial environment, absence of safety nets in lending and unchecked excess credit, seem to affect the effective operation of inflation targeting (Kwakye, 2012). Thus, the central bank's inflation target ranges have invariably been missed by wider margins.

2.3.1 What is Inflation Targeting?

Inflation targeting refers to a monetary policy framework which focuses on price stability as the main policy objective, expressed by an explicit numerical inflation target, pursued by a monetary authority endowed with operational and instrument independence, which conducts policy in a transparent manner and is accountable for its actions and results to political authorities and the public. The four key attributes of IT, according to Kamber et al. (2015) and Walsh (2015), can

be summarized as: political independence, an explicit target for inflation, transparency and accountability.

Inflation targeting is also defined by Bernanke et al. (1999) as "a monetary policy framework characterized by a public announcement of official quantitative targets (or target ranges) for the inflation rate over one or more time horizons and by the explicit acknowledgement that low, stable inflation is monetary policy's primary long run goal''.

Mishkin and Savastano (2001) define an IT regime as encompassing five main elements: The central bank must;

i. Publicly announce a medium-term numerical target for inflation;
ii. commit itself to pursue price stability as the primary goal;
iii. Formulate an information-inclusive strategy in which many variables are used for deciding the setting of policy instruments;
iv. Increase transparency of the monetary policy strategy through communication with the markets; and
v. Increase accountability for attaining its inflation objectives.

Under inflation targeting, the central bank releases a targeted rate of inflation. The central bank then tries to move actual inflation towards the target mostly through the use of interest rate. Inflation Targeting makes it possible for the monetary authority to have a direct control of the likely path of inflation by reducing the role of intermediary guidelines. Inflation targeting relies on targeting inflation using an inflation forecast. Svensson (1996) aligns IT with rational-expectations by referring to it as *forecast inflation targeting* since forward looking central banks should attempt to stabilize inflation expectations as a vehicle to affect

future inflation. The monetary authority will then forecast the future path of inflation and use monetary policy to deal with any deviations that may occur between the forecasted inflation rate and the actual inflation rate. The adjustment that has to be made to monetary policy will be determined by the size of the deviation. The monetary authority must to take a thorough look at factors that may have affected inflation in the past to enable them determine the path that inflation may likely take. Inflation targeting takes into consideration many macroeconomic variables in its forecasting not only the money supply which occurs in monetary aggregates targeting.

The main goal of the inflation targeting strategy as highlighted by Bernanke and Mishkin (1997) is to establish a transparent, accountable and credible way for conducting monetary policy. Transparency, accountability and credibility are asides another key goal of price stability. Judging from the experiences so far, the execution and adoption of the IT strategy varies across each nation (Bernanke et al., 1999). Bernanke and Mishkin (1997) mention different attempts to allow the system to attain dual mandates, such as full employment and price stability.

2.3.2 Distinguishing Characteristics of inflation targeting regimes

Three primary features describe a standard IT strategy. The first is the public declaration of an inflation target (in the form of single points or bands, symmetric or asymmetric) to be reached at a specified horizon or maintained permanently.

The second feature of the IT regime is a clear policy decision-making framework for achieving the specified goals, while the third feature is a high degree of transparency, and an effective communication strategy, concerning the course of

action planned by the central bank. Transparency is an important component of IT because it helps to anchor expectations and guarantee stability, at least as long as the inflation target is not too high (Ascari et al (2017). Communication is also crucial because even when the inflation target is publicized well, uncertainty about the horizon at which the target is expected to be achieved can destabilize expectations and may translate into higher inflation volatility (Branch and Evans (2017).

In addition, an effective communication strategy may boost the trade-offs faced by the authorities; particularly in, ensuring that market participants comprehend current policy and how future actions may be determined to help the central bank maintain inflation expectations focused around the target. In fact, IT has been considered by many advocates since its inception as a policy framework whose key feature is to improve the transparency and coherence of monetary policy.

2.3.3 Prerequisites for Inflation Targeting

Four basic criteria for enforcing an IT regime have been highlighted in the literature. The first is a high degree of independence of the central bank (not necessarily in setting the inflation target itself, but in selecting and controlling policy instruments), the second is the absence of a de facto targeting of the nominal exchange rate (or, similarly, the predominance of the inflation target), the third is greater transparency and accountability and the fourth is a healthy financial system.

Firstly, IT necessitates that the central bank be endowed with a clear mandate to pursue the goal of stability in price and, most significantly, with a high level of independence in the conduct of monetary policy – namely, in choosing the

instruments necessary to achieve the target rate of inflation. In particular, this implies the ability to resist political pressures to stimulate the economy in the short term and the absence of *fiscal dominance*, that is, a situation in which fiscal policy considerations play an important role in monetary policy decisions. These requirements are difficult to satisfy in countries where the inflation tax is a significant source of revenue for the government. In such conditions, fiscally induced inflationary pressures could undermine the effectiveness of monetary policy, for instance by forcing the central bank to maintain low interest rates in an attempt to prevent unsustainable public debt dynamics.

Secondly, the adoption of a low and stable inflation rate as the main objective of monetary policy requires, in principle, the absence of any commitment to a particular value of the exchange rate such as that which prevails under a freely floating exchange rate regime. However in practice, in many of the less developed countries that have gone for a de jure flexible exchange rate, considerable attention have been paid by the monetary authorities to the value of the domestic currency – often adopting a de facto target path or band.

Thirdly, transparency and openness in the conduct of monetary policy are important ways to enhance the credibility in an IT regime. Making the central bank publicly accountable for its decisions create an incentive to meet the inflation target and therefore enhances the public's confidence in the ability of the monetary authorities to do so. This may also lead to improved decision-making on the part of the central bank by revealing to public scrutiny the process through which monetary policy decisions are made. The fact that monetary authorities, for example, have to announce policy changes and clarify to the public the reasons for

these changes will help stabilize inflation expectations and improve the efficacy of IT monetary policy. In an IT system, a possible issue with transparency is related to the challenge of measuring output on the basis of inflation results alone.

The lag between policy decisions and their effect on the economy makes it possible (or tempting) for the central bank to blame unintended or totally unpredictable events for inadequate performance, instead of taking responsibility for policy mistakes.

Fourthly, in countries suffering from severe weaknesses in the financial system, the ability to conduct an independent monetary policy is hampered, which may force the central bank to repeatedly inject large amounts of liquidity to support ailing banks. Such vulnerabilities can also restrict the ability of the monetary authority to control interest rates. Indeed, a rise in these rates may lead to higher default levels among banks' borrowers and place pressure on their balance sheets. In addition, as mentioned earlier, exchange rate depreciation can have major adverse effects on their balance sheets in countries where the corporate and banking sectors retain substantial foreign currency liabilities. This may compel the central bank to be concerned with nominal exchange rate movements and follow an implicit exchange rate target – which could also be in conflict with the inflation target as note earlier. However, a weak financial system is not an argument for rejecting IT as a policy regime; rather, it calls for reforms in financial sector and strengthening of bank regulation and supervision prior to, or at the same time as, adopting or implementing IT.

2.3.4 Regimes of Inflation Targeting

Three broad classifications of inflation-targeting regimes exist, according to Carare and Stone (2003). The classifications are premised on clarity and credibility of the Central Bank's commitment to the inflation target. They are; Full-fledged inflation targeting; eclectic inflation targeting and inflation targeting lite.

Full-fledged inflation targeting is defined in accordance with the definition of inflation targeting by Mishkin.

Eclectic inflation targeting countries, on the other hand, are described as countries that "have so much credibility that they can maintain low and stable inflation without full transparency and accountability with respect to an inflation target. Their record of low and stable inflation coupled with high degree of financial stability affords them the flexibility to pursue the objective of output stabilization, as well as price stability" (ibid, 2003).

Inflation targeting lite countries "announce a broad inflation objective but owing to relatively low credibility are not able to maintain inflation as the foremost policy objective" (ibid, 2003). They vary significantly in stating their goal in the operation of monetary policy, and are typically vulnerable to economic shocks, financial instability and a weak institutional framework.

On the basis of this classification, Ghana may be treated as a full-fledged inflation-targeter.

2.3.5 Theoretical Assumptions of Inflation targeting (The Assumption of Rational Expectations)

Keifer (2008) pointed out that the fact that inflation targeting regime is based on the assumption of rational expectations generate problems in inflation forecasting because rationality is an overwhelming assumption of the economics literature. Rational expectations hypothesis is about how to predict future events, which impact the current actions of the agents. The hypothesis postulates that agents use all available information and make predictions with perfect foresight

Keifer (2008) added that the assumption of rationality is compatible with the concept of well-informed maximization of economic agents (Keifer, 2008). Chow (2011), argued that when it was accepted in the 1970s, the empirical evidence supporting the rational expectations hypothesis were not sufficient. This seems to be accurate, because most surveys of expectations struggle to demonstrate that the expectations of economic agents are realistic enough.

Mankiw (2003) pointed out that survey data from both professional economists and consumers show significant departures from rationality. Keifer (2008) observed that rational expectations do not conform well to behaviour of economic agents hence economic agents are backward looking in making economic decisions. The use of adaptive learning mechanisms would make it expensive and inefficient to enforce policies based on forward looking expectations hence it is debatable whether inflation targeting is an effective monetary policy framework (Lyziak 2012).

Lucas (1963) as cited by Mankiw (2003) postulated that the rational expectations hypothesis implies that every economic agent makes optimal use of information in forming expectations.

According to Mankiw (2003) the assumption of rational expectations is not backed by strong empirical evidence in the real world. This implies monetary policy in an inflation targeting framework can become ineffective when expectations deviate from the assumption of rationality.

Łyziak (2012) posited that the degree of rationality displayed by economic agents has important implications on macroeconomic performance and monetary policy because backward looking expectations make monetary policy inefficient and expensive. Adaptive expectations imply that economic agents' form their expectations about the future according to some rule, based on the historic values of the economic variable hence this causes persistence in economic variables and leading to erroneous forecasts. Lyziak (2012) further claimed that when expectations are formed rationally, all information available to economic agents is utilised in an efficient manner not just previous values of the economic variable under consideration thereby reducing persistence. Orphanides and Williams (2004) revealed that policies designed to be efficient under rational expectations can perform very poorly when knowledge is imperfect and expectations deviate from the rationality assumption.

Furthermore, Gasper (2009) revealed that departures from rational expectations increase the potential for instability in the economy; it is therefore, important to ensure that monetary policy is effective in anchoring inflation expectations.

2.3.6 The Target Horizon

Under an inflation targeting regime, one of the key elements in the design of monetary policy is the horizon for achieving the inflation target. This is because; the horizon determines monetary policy response to shocks. The target horizon will normally depend on whether the rate of inflation is within the range of price stability. It also depends on the length of the transmission mechanism of monetary policy. As a result, it becomes almost impossible to influence the inflation rate in the short run if a longer time is required for transmission mechanism to achieve its goal. Emerging economies will normally opt for policy horizons which are shorter since their policy to inflation pass – through is quicker.

An annual target is usually considered to be good for accountability but it can be problematic. It is likely to lead to instrument instability in which policy instrument are moved around too much in order to try to get inflation to hit its targets over the shorter horizon. Also, if the target horizon is too short, the implication is that not enough weight has been put on the output fluctuation in the central bank's loss function, Mishkin (2000). According to Hammond, (2012), Ghana's target horizon is between 18 – 24 months.

2.3.7 Which Inflation to Target, Domestic or CPI? / The Target Measure

In comparison to a closed economy where inflation is well defined, two inflation indicators co-exist in an open economy: domestic inflation and inflation in the Consumer Price Index (CPI).

The domestic inflation does not include the direct effects of exchange rate movement on domestic price. The CPI includes the price movement of imported commodities.

The CPI is the preferred operational target used by inflation targeting. Available literature indicates that attempting to stabilize CPI inflation could result in higher volatility in output, interest rate and exchange rate than targeting a measure of domestic inflation. This is because monetary policy also reacts to counter the inflationary impact of the direct exchange pass-through by targeting CPI inflation. Consequently, monetary policy becomes more sensitive to short term fluctuations in inflation, leading to greater variability in interest rate, exchange rate and output.

The headline is also preferred to the core measure. This is because, a lot of measures which involve core inflation leave out food as component in the basket of goods. However, food is a very essential component especially in developing countries. Therefore, using the core measure which does not contain the food component may cause the measure of inflation to lose credibility. Ghana uses the headline CPI to measure inflation, (Hammond 2012).

2.3.8 Specifying the Target and who set the Target

Inflation target may be defined in terms of a range or single point (Van der Merve 2004). Hammond (2012) argues that point target is very precise and so sends a strong signal to the market about the intentions and credibility of the central bank.

Compared with the range, a point target is more difficult to achieve but the latter provides a best focus for inflation expectation and sends a clear signal about the intentions of the central bank. One disadvantage with the point target is that in situations where there are deviations from the target, the credibility of the central bank will greatly be affected

A range enables the central bank to have some flexibility to pursue other target other than price stability. A number of central banks have adopted a combination of the two. Ghana's central bank is among the many central banks that have a mixture of the two (that is they express a point target but with a tolerance). According to Hammond, (2012) Ghana has a point target of 8.7% with a tolerance band of $\pm$ 2.

With regards to who should set and announce the target, countries differ in ways they implement the inflation targeting framework. Although the target is decided and declared by the government in some countries, other governments do so in consultation with the central bank. In Ghana, the target is jointly determined by central bank and the government during the preparation of the annual budget. When the target is jointly decided, the advantage is that it would enhance the credibility of the target by implicitly committing the government to conduct its fiscal policy in a manner that would support the achievement of the goal of inflation.

2.3.9 Policy Rate Transmission under Inflation Targeting

In order to study the effectiveness of Inflation targeting on these variables, the Taylor rule is of great importance. Taylor rule is a monetary-policy rule that stipulates how much the central bank should change the nominal interest rate in response to changes in inflation, output, exchange rate, or other economic conditions. Specifically, the rule stipulates that for each one percent rise in inflation, the central bank should increase the nominal interest rate by more than a percentage point. This aspect of the rule is often referred to as the Taylor principle.

Simple "Taylor rules" are directly linked to the transmission mechanism of inflation targeting policy rule. Under explicit inflation targeting regime, Svensson (1997) derives the central bank's reaction function using inflation forecasting as a guide. The basic idea is that the central bank sets the policy interest rate (i_t) in reaction to deviations of inflation (π_t) from its target rate (π^*) and some measure of the output gap (y_t).

Taylor (1993) estimated policy reaction functions and found that the monetary policy can often be well approximated empirically by a simple instrument for interest rate setting. The rule can be described by the following equation:

$$i_t = r^* + \pi_t + \alpha y_t + \beta (\pi_t - \pi^*) \qquad (2.1)$$

where

i_t is the nominal interest rate at time t or the

r^* is the target level for the nominal interest rate or the long-run equilibrium real interest rate

π_t is the current inflation rate

π^* is the target inflation rate

y_t is the deviation of output in period *t*

The rule states that the policy rate should be above its long-run level ($r^* + \pi^*$) when: actual inflation π_t is above the target π^* and the output gap is positive.

The restrictions on the coefficients to have macroeconomic stability are $\alpha, \beta > 0$. Assuming that the coefficient on inflation deviation is less than zero, then, a rise in inflation would lead to an interest rate cut, which will cause increased spending. In

turn, this would tend to increase aggregate demand, thereby increasing the inflation further (an unstable solution). On the other hand, if the coefficient on inflation deviation is greater than zero, then this instability does not arise, because then the rule ensures that inflation is equal to its targeted value π* [Taylor (1999a)].

There are four parameters r* α, β, π* in expression 2.1. Following in Taylor's footsteps, the study also assumed that the central bank has information on current output and inflation. The above rule can easily be converted into an estimable form as

$$i_t = r^* + \pi_t + \alpha y_t + \beta \pi_t + e_t \qquad (2.2)$$

2.4. Review of Theoretical Literature

Two theories have been adopted for this study. These are; the Purchasing Power Parity (PPP) Theory and the Monetarist Theory of Inflation.

2.4.1 The Purchasing Power Parity (PPP) Theory

Gustav Cassel (1916) developed the Theory of Purchasing Power Parity, which has since become the foundation for analyzing exchange rates. If the purchasing capacities of the two currencies are identical, the PPP Theory of determining exchange rates states that the exchange rates between two (2) countries are in equilibrium. Simply put, this indicates that the price levels of a specific (fixed) basket of products and services are equal. In order to maintain purchasing power parity, a country's exchange rate must be decreased when it faces high inflation. The PPP is the same as the Law of One Price, which applies to single commodities. It states that identical commodities sold in different nations should be priced the same when the prices are expressed in the same currency.

This law applies in competitive markets without trade obstacles or transportation expenses. The PPP affects the overall price level, whereas the Law of One Price affects specific goods. The Law of One Price must apply to all commodities in order for PPP to be maintained for the same baskets of goods and services across countries. Absolute Purchasing Power Parity and Relative Purchasing Power Parity are the two types of Purchasing Power Parity. Absolute Purchasing Power Parity assumes parity in the purchasing power of the two countries. When the price level in one country is multiplied by the exchange rate, the price level in the other country should be obtained. This is due to the existence of arbitrage opportunities. This phenomenon occurs when goods can be bought at cheaper prices in one country and be sold at expensive prices in another country. All this is possible when there is no barrier to trade and transport cost. This can be denoted as

$$e = \frac{Pd}{Pf} \; or \; Pd = Pf * e \qquad (2.3)$$

where e denotes the exchange rate (spot rate)

P_d denotes price levels in the domestic country

P_f denotes price levels in the foreign country

Relative Purchasing Power Parity is explained in the terms of inflation. It asserts that exchange rate is determined by the rate at which price levels of commodities in one country vary relative to the price levels in another country. It states that the purchasing power of the currency of two countries will differ by the same amount.

It can be expressed as:

$$e = Pd - Pf \quad (2.4)$$

Where e denotes the exchange rate (spot rate)

P_d denotes price levels in the domestic country

P_f denotes price levels in the foreign country

According to the purchasing Power Parity theory, when a country's inflation rate rises in comparison to another countries', increased imports and lower exports weaken the high inflation currency due to a worsening current and trade account balance.

Exchange rate movements can have an impact on local pricing in both direct and indirect ways, depending on how they affect total supply and demand. The direct channel can be shown through the law of one price in light of purchasing power parity theory (PPP). It has been reported that exchange rate between two currencies is determined by relative developments in the price levels in the two nations. The Purchasing Power Parity (PPP) principle argues that when value levels between two countries are communicated in the same currency throughout time, they are equivalent. As a result, assuming PPP holds, exchange rate volatility translates into relative changes in the domestic price level, implying that pass-through is one. A depreciation of the native currency in a small open economy (an international price taker) will result in increased import costs (both for finished goods and intermediate inputs), which will eventually be passed on to higher domestic costs (Hyder & Shah, 2004).

Exchange rate fluctuations can also have an impact on domestic prices through their direct impact on aggregate demand. Depreciation of the local

currency lowers the foreign price of domestic goods and services, so increasing foreign demand, resulting in an increase in net exports and, as a result, aggregate demand and real production. Increases in domestic demand and real income may cause input prices to rise, forcing workers to seek greater salaries in order to maintain a real wage. The increase in nominal wages may lead to an increase in prices (Hyder & Shah, 2004). Furthermore, depreciation may raise the domestic price of imported goods and services, prompting consumers to exchange for domestic goods and services, hence increasing demand and raising domestic prices.

The Purchasing Power Parity theory is used in this study as an appealing empirical and theoretical instrument for explaining the increase and decrease in exchange rates over time.

2.4.2 The Monetarist Theory of Inflation

Monetarists argue that the factors that cause inflation in Ghana are the same as those that cause inflation elsewhere in the world, and that it is essentially a question of excessive aggregate demand. As a result, monetarists see instances in which an economy's aggregate demand for goods and services exceeds its aggregate supply as the ultimate source of inflationary tendencies.

The monetarist's perspective of inflation was grounded on the quantity theory of quantity. The quantity theory of money posits that a change in the growth rate of money induces an equivalent change in the rate of price inflation (Lucas, 1980 cited in Walsh 2003). Thus, from a monetarist perspective, price movements are only impacted by changes in the quantity of money (Mishkin, 2004).

According to Lozano (2008), provided that the monetary authority exogenously decides the nominal money supply, the price level is calculated as the unique price level that will make the buying power of the money supply equal to the optimal level of real balances from an operational point of view, it means the central bank attempts to ensure the quantity of money agents desire for their transactions. As a result, if the nominal money supply differs from the intended real balances at a certain price level, the price level will vary.

Michkin (2004) noted that money supply is seen as the sole cause of changes in the aggregate demand curve in monetarist studies. Using aggregate demand and supply curves, the author shared that if monetary policy is accommodative such that money supply is always rising in response to increasing aggregate demands, output rises initially above the natural level but after some time the economy returns to its potential level of output. However, this comes at the cost of ever-increasing prices, resulting in inflation. This is because, if unemployment falls below the natural rate, wages will rise and the aggregate supply curve will rapidly decline. It will only cease shifting when it reaches the point on the long run aggregate supply curve where the economy has returned to its natural rate of output. The price level will rise at the new equilibrium. This process will continue as the money supply expands, resulting in inflation. Inflation, according to monetarists, will only happen if the central bank monetizes government debt.

2.5. Review of Empirical Literature

This section reviews empirical literature on the effectiveness of Inflation Targeting on Exchange Rate, Exports and Imports.

2.5.1 Inflation Targeting and Exchange Rate Nexus

Because there is a scarcity of research on inflation targeting and exchange rates, the study did not restrict its review to African economies, but rather reviewed as much of the extant literature as possible. Furthermore, most past research has looked at the impact of inflation targeting and the broader idea of central bank intervention on the decrease of inflation and other macroeconomic indicators' volatility. However, the few research that have been done on inflation targeting and exchange rate volatility have been inconsistent and inconclusive.

According to Allsopp *et al.* (2006); Edwards (2007); Josifidis *et al.* (2011); Khodeir (2012); Rose (2007) and Yamada (2013) inflation targeting framework evidently reduces the menace of exchange rate uncertainty in the inflation targeting countries. Furthermore, Lin (2010) also claims that IT adoption decreases volatility of exchange rate and foreign reserve of developing economies. The result however shows that the policy reduces the foreign reserve of the industrial countries. According to Pontines (2011) nominal and real exchange rate volatility tend to reduce in developing countries that implement IT framework compared to non-IT countries. However, the result on developed countries shows that volatility increases in IT countries. According to Kurihara (2013) IT policy enhances economic growth and leads to reduction in the exchange rate instability in the panel of targeting and non-targeting economies. Dahalan (2015) also found that the IT policy transition has a positive effect of exchange rate stability of the economies Ardakani, Kishor, and Song (2015) in their paper examined the causal effect of the adoption of IT on macroeconomic performance. The paper estimated the treatment effect of inflation targeting for 27 countries which practiced explicit inflation targeting. Their approach took into account the problem of model specified and

inconsistent estimation of parametric propensity scores by using a nonparametric series estimator proposed by Hirano, Imbens and Ridder (2003) and semi – parametric single index method proposed by Klein and Spady (1993) and Song (2014). The paper also examined the impact of inflation targeting regime on a wider set of macroeconomic outcomes. Their findings revealed that results are sensitive to the choice of propensity score estimates based on different methods and the semi parametric single – index model of propensity score provides the most economically meaningful results. Their findings further illustrated that the inflation targeting framework lowers inflation variability and improves fiscal discipline. They also discovered that while this monetary policy regime lowers real exchange rate volatility in underdeveloped countries, it raises volatility in developed countries. Pontines (2013) in his work empirically examined the issue of whether countries that target inflation systematically experience higher exchange rate volatility by adopting a treatment effect regression technique. According to the findings, inflation-targeting countries had lower nominal and real effective exchange rate volatility than non-targeting countries. More crucially, the study shows that inflation-targeting developing nations have lower nominal and real effective exchange rate volatility than non-targeting developing countries; in the case, however, of inflation-targeting industrial countries, it is found to be higher.

Civcir and Akcaglayan (2010) performed a VAR analysis for Turkey before and after the country adopted inflation targeting in early 2001. They found that nominal exchange rate deviations from its trend had a positive impact on interest rates after IT adoption, but not before.

Lin (2010) in his work evaluated the treatment effects of inflation targeting on exchange rate volatility, reserves and current accounts in 23 countries that adopted this policy by the end of 2004. He addressed the self-selection problem of policy acceptance, which had previously been overlooked in empirical studies. In the pool sample, the overall consequences of implementing inflation targeting on the external economy of the target country are significant, according to the study, which used propensity score matching method. In addition, the analysis discovered strong and convincing evidence that inflation targeting has a significant impact on exchange rate volatility and international reserves in different country groupings. In developing countries, it increased real and nominal exchange rate stability and reserves, but in industrial countries, it decreased them. On average, it was found that inflation targeting increases (lowers) reserves roughly by the size of 1.3 (1.8) months of import values in developing (industrial) countries. The treatment effects on the current account are found to be insignificant in both countries' groups.

Contrarily, some other studies reveal that inflation targeting is ineffective in eliminating exchange rate volatility. This is reported in the studies of Batini *et al.* (2003); Berganza and Broto (2012); Dennis (2003); Gregorio *et al.* (2005); Kollmann (2002); Pavasuthipaisit (2010) and Petreski (2012). Furthermore, another study sees lack of independence of monetary policy framework as the main cause of the menace of exchange rate volatility especially in the developing economies (Pavasuthipaisit, 2010). He examines the optimality of central bank in response to movement in exchange rate under the regime of inflation targeting in the United States. The study reveals that exchange rate and inflation are determined by the state of the economy not inflation targeting. Yeliz, Yalcin and Yuccel (2016) in their study considered 16 inflation targeting countries and 21 non – inflation

targeting ones using a difference in difference approach to evaluate the effect of inflation targeting on inflation, output growth, real exchange rates, inflation volatility and real exchange rate volatility during moving four – year period between 2007 and 2015. Their estimate show inflation targeting was not effective in stabilizing exchange rate. Cabral et al. (2016) investigate the relevance of exchange rate on the reaction function of central banks of 24 emerging market economies over the period 2000-2015 employing panel data fixed effects OLS and GMM. The findings showed that countries whose central banks do not practice inflation targeting experience more exchange rate volatility.

A review of a panel study conducted by Daboussi (2014) and a similar study by Kurihara (2013) discover that exchange rate volatility reduces with adoption of IT framework in the emerging and developing economies. Furthermore, exchange rate pass through in emerging economies also tend to decrease due to implementation of IT framework compared to non-IT economies (Coulibaly and Kempf, 2010). However, Heintz and Ndikumana (2011) argue that a strict rule-based IT policy is not an appropriate monetary rule for Sub-Saharan African economies to achieve their goals of economic stability, development, rising living standard and poverty reduction. Their argument is in support of Epstein (2008) who argues that instead of maintaining price stability, the central banks should aim at pursuing a monetary policy that brings development in the real economic performance through central banks. They however, recommend that more research need to be done to fully evaluate the appropriateness or otherwise of the IT policy in the Sub-Saharan African region. Furthermore, Berganza and Broto (2012) empirically discover that exchange rate became more volatile under IT policy compared to alternative policy regimes and non-IT countries. Pourroy

(2013) also argues that adoption of IT framework as usually applied under flexible exchange rate regime in developed countries would not be a solution in the developing and emerging economies. Petursson (2009) tried to find whether a relationship existed between inflation targeting and excessive exchange rate volatility. A sample of 44 countries was used which were made up of lower medium income countries to more developed countries. His work used a signal – extraction approach in estimating the volatility of the excessive exchange rate. GARCH specifications were used for estimations for each country and a panel model which has inflation targeting nations as the treatment group and the non – targeting nations as the control group was used. According to Petursson, the results showed that inflation targeting does not have any effect on the exchange rate volatility that can be backed by evidence though the GARCH results showed that volatility increased in some countries after the adoption in others. Petursson argues that this may be as a result of the characteristics of the foreign exchange markets as well as the institutional support for inflation targeting but not the adoption of inflation targeting itself.

Despite the existence of a few literature on inflation targeting and exchange rate, especially in the developing inflation targeting countries, most of the previous analysis are conducted under fixed or pegged exchange rate regimes which has less basis for measuring the effectiveness of IT framework. Inflation targeting should be best examined under a floating exchange rate regime due to the principle of "impossibility of the holy trinity" (Mishkin and Savastano, 2001; Carare and Stone, 2006; Edwards, 2007). Furthermore, most previous studies generally examine the performance of IT on price stability and output volatility. Furthermore, the findings of the previous studies are sensitive to various control variables and are usually

stronger when IT economies are compared to non-IT economies. Comparison between targeting and non-targeting is weaker and usually influenced by the control group (Heintz and Ndikumana, 2011).

2.5.2 Inflation Targeting and Export Nexus

In their paper on "Inflation-Targeting, Flexible Exchange Rates and Macroeconomic Performance since the Great Recession", Barnebeck et al. (2014) investigated whether inflation targeting (IT) conferred benefits in terms of economic growth on countries that followed this particular monetary policy strategy during the crisis period 2007-2012. The study revealed that OECD countries with an IT monetary policy framework have systematically outperformed OECD countries with other regimes (predominantly fixed exchange rates) in terms of economic growth during the period 2007-2012. The study also showed that part of this outperformance can likely be ascribed to the exchange rate flexibility of the IT countries and hence to an improved export performance resulting from currency depreciations.

Sobrino (2010) in his study on the effect of Inflation Targeting on the current account used an unbalanced panel data set for 19 inflation targeting countries to show that the current account balances of the countries do worsen after adoption of the inflation targeting after accounting for global shocks. The results showed that, consistent with economic theory, inflation targeting does negatively affect current account once global shocks have been properly accounted for.

2.5.3 Exchange Rate and Export Nexus

Odili (2015) analyzed the long and short run impact of real exchange rates volatility and level of economic growth on international trade (exports and imports)

in Nigeria. He used vector error correction model for the analysis and employed time series data from 1971 to 2012. His result revealed that in both short and long run, exports and imports were influenced by real exchange rate, exchange rate volatility, foreign income, gross domestic product, term of trade and changes in exchange rate policies. The findings also revealed, that exchange rate depressed import and export at the long run. The result of pairwise Granger Causality test, revealed unidirectional Causality running from export to exchange rate volatility; and from exchange rate to import. Also there is unidirectional causality flow from real GDP to import and export. Ibikunle and Akhanolu (2011) studied the impact of exchange rates volatility on the trade flow in Nigeria. They used Generalized Autoregressive Condition Heteroskdasticity (GARCH) for the analysis and annual data from 1970 to 2009 was used. The result revealed an inverse and statistical insignificant relationship between aggregate trade and exchange rates volatility in Nigeria. Oyovwi (2012) studied the effect of exchange rates volatility on economic growth in Nigeria using annual data from 1970 to 2009. He also employed the Generalised Autoregressive Conditional Heteroscedasticity (GARCH) technique to generate exchange rates volatility; his findings showed that in the short run, economic growth had positively responsive to exchange rates volatility, while in the long run; a negative relationship existed between the two variables.

Bahmani-Oskooee & Kovyryalova (2008), in their investigations on the impact of exchange rates volatility on international trade, 177 commodities trade between the United State (US) and United Kingdom (UK) were used. They used co-integration and error correction techniques to analyze the data covering the period of 1971 to 2003. The results showed that the volatility of the real bilateral dollar – pound rates has a short-run significant effect on the imports of 109 and

exports of 99 industries. In the long run, it was revealed that the number of significant cases reduced with imports of 62 and exports of 86 industries which are significantly affected by the exchange rates volatility. Lakew (2003) identified that in the long-run Ethiopia's export performance is significantly determined by real exchange rate. Borena (2009) examined the response of export forex change depreciations in Ethiopia and the result showed that real effective exchange rate is negatively correlated with export performance.

Likewise, Melesse, (2011) using data covering the period from 1981 to 2009 concluded that real exchange rate's coefficient was insignificant indicating that real Ethiopia's currency devaluation or overvaluation has no visible results to determine export performance. Menji (2010), covering the period from 1981 to 2004 and using analysis of trend & co-integration, arrived at the influence of effective real exchange rate in export performance of Ethiopia was insignificant. Erdal *et al.* (2012) conducted an empirical study of the effect of Real Effective Exchange Rate Volatility (REERV) on Agricultural Export (AGX) and Agricultural Import (AGM) in Turkey. The study period covered 1995 to 2007. The GARCH model was used. Long-term relationship between series was also determined using Johansen co-integration test. The direction of this relationship, on the other hand, was determined using pairwise Granger causality. The empirical results indicated that there was a positive long-term relationship between REERV and AGX series, while there was a negative long-term relationship between REERV and AGM. This is a position supported by (Oskooee & Bourdon, 2005). Oskooee & Bourdon (2005) assessed the impact of the RMB-dollar exchange rate and volatility on U.S. agricultural exports to and imports from China using a moving standard deviation of the real RMB-dollar rate and the GARCH-based

measure which yields more significant results. The results concluded that the exchange rate volatility has a significantly positive long-run effect only on export earnings of the non-agricultural sector while depreciation of the dollar has an expected long-run effect on the import value of the non-agricultural sector and on export earnings of the agricultural sector. This is in line with the study conducted by (Erdal, *et al.*, 2012).

On the contrary, Todani and Munyama (2005), who studied the exports and exchange rate volatility in South Africa, found that there is a positive relationship between South African exports and exchange rate volatility—both in the long-run and in the short-run. Moccero and Winograd (2007) analysed the causal link between RER volatility and export in Argentina, employing econometric models to acquire the implicit magnitudes of RER volatility. This study showed that decrease in exchange rate has a positive impact on exports to Brazil, though this impact is negative for the rest of world.

Nyeadi et al. (2014) studied the export growth in Ghana, and found that exchange rate has no significant impact on the country's export. Poonyth and Van Zyl (2000) studied the long-run and the short-run effects of RER changes on South African agricultural exports using an Error Correction Model (ECM) within the co integrated VAR (Vector Autoregressive) model, and found that there is a positive relationship between the export of agricultural products and the exchange rate both in the short-run and the long-run. South African exports and their relationship with exchange rate were studied by Nyahokwe and Ncwadi (2013) using VAR and Vector Error Correctional Model (VECM) to establish long- and short-run relationship between export and exchange rate. This study did not show a clear

effect of exchange rate on the exports in South Africa. However, it found some sensitivity of South African exports to movements of the exchange rate. It was discovered that a shock in exchange rate has significant effect on export. Godfrey and Cosmas (2014) made investigation on the impact of exchange rates on exports, imports and national output Tanzania. (1990 –2011). He adopted Vector Error correction model, Impulse Response Function, Variance Decomposition and Time series Simulation. The variables have long run relation and converging at equilibrium as times passes but lower long run impact on and export and import. Muhammed (2014) studied whether exchange rate instability in Pakistan affects import, export, trade balance, foreign exchange reserve and GDP. He used yearly data 1952 to 2010. Correlation Removal method, multi colinearity detection and granger causality test were used for the analysis. The result showed that depreciation of exchange rate has positive effect on exports. Mahmood, Ehsanellah & Ahmed (2011), they worked on whether fluctuation in exchange rates affects the macro-economic variables in Pakistan. They used monthly data from 1975 to 2011. Generalized Authoregressive Condition Heteroskedaticity (GARCH) method was used for the analysis. The result shows that exchange rate positively affected the variables. Dincer & Kandil (2011) explored the asymmetric effects of random exchange rate fluctuations on exchange rate movements on export sectors in Turkey using data from spanning 1996 to 2002 and 2003 to 2008 from 21 exporting sectors. The results support the significance of exchange rate policy to export growth in Turkey in the period 1996–2002. Caglayan *et al.* (2013) investigated the effects of real exchange rate uncertainty on manufacturers' exports from 28 emerging economies. Adopting a two-step system GMM dynamic panel data estimator for the study, they established findings which supported the claims that

exchange rate uncertainties affects trade flows emanating from emerging economies negatively. They also found out more importantly that trade effects of exchange rate uncertainties may very well depend on the direction of trade. Wong & Tong (2011) examined the effects of exchange rate variability on export demand for semiconductors, which is the largest sub-sector of electronics industry in Malaysia as reported by Malaysian Industrial Development Authority (MIDA, 2004). The empirical results, estimated based on the Johansen's multivariate co-integration tests and error correction model, suggested there is a unique long-run relationship among quantities of export, relative price, real foreign income and real exchange rate variability. The major finding was that the variability of real exchange rate has some effect on semiconductor exports in both the long run and the short run.

Onafoworaa & Owoye (2008) examined the impact of exchange rate volatility on Nigeria's exports to its most important trading-partner–the United States over the quarterly period January 1980 to April 2001. Using co-integration and vector error correction (VECM) framework, empirical tests indicated the presence of a unique co-integrating vector linking real exports, real foreign income, relative export prices and real exchange rate volatility in the long-run. The results further showed increases in the volatility of the real exchange rate raised uncertainty about profits to be made which exerted significant negative effects on exports both in the short- and long-run. The findings also showed improvements in the terms of trade (represented by declines in the real exchange rate) and real foreign income exert positive effects on export activity. Most importantly, it was found that the trade liberalization and economic reform policies implemented in the post-1986 structural adjustment period contributed to Nigeria's export

performance. The overall findings suggested Nigeria's exporting activities could be further boosted by policies aimed at achieving and maintaining a stable competitive real exchange rate.

The review of the empirical literature made so far shows that there is no common agreement with regard to the impact of inflation and exchange rate on export, especially with regard to exchange rate and export. Hence, this situation opens scope for studies in this issue

2.5.4 Exchange Rate and Import Nexus

Because most studies in this area focus on exports, there are few studies that look at the impact of exchange rate fluctuation on imports.

From 1971 to 2011, Odili (2015) investigated the impact of real exchange rate fluctuation on Nigerian imports. The methods utilized were co-integration and Parsimonious Error Correction. The findings revealed that the exchange rate has a positive and significant impact on import only in the long run, and that there is unidirectional causality between the exchange rate and import.

Jarita (2008) looked at the effect of exchange rate shocks on import and export prices in Malaysia from 1999 to 2006. He employed the Vector Error Correction Model, Impulse Response Function, and Variance Decomposition to solve his problem. The findings demonstrate that exchange rate shocks had a significant impact on import price fluctuations in Malaysia. From 1960 through 2012, Moshen (2013) studied the impact of exchange rates on imports, exports, product pricing, and other macroeconomic variables. For the analysis, he employed the Vector Autoregression Model, Cointegration Test, and Impulse Response

Function. The exchange rate has little effect on macroeconomic variables, according to his findingsUsing aggregate data for the United States, Germany, France, Japan, and the United Kingdom, J. Gotur (1985) finds conflicting evidence for the impact of exchange rate volatility on US import demand using bilateral time series for the US's key trading partners. To measure the volatility of exchange rates, Caporale and Doroodian (1994) employ the GARCH method. They conclude that exchange rate fluctuation has a considerable negative impact on US imports using monthly data from 1974 to 1992. For both Australian and German-US trade flows, McKenzie and Brooks (1997 and 1998) integrate an exchange rate volatility element into an import demand function. For the Australian estimates, they find evidence of a significant, but weak, impact of volatility on trade (Anderton and Skudelny, 2001, p.6). Cheong (2004) investigates the effect of exchange rate volatility on the UK's import trade. By applying this two-step approach, statistically significant, negative impact of exchange rate volatility on Britain’s imports has been explored. The paper by Anderton and Skudelny (2001) estimates an import demand function for the euro area vis-à-vis its main extra area trading partners which takes into account the possible impact of both intra- and extra-euro area exchange rate volatility. They derive a theoretical model which captures various mechanisms by which exchange rate volatility may influence the demand for extra euro area imports. If importers are risk averse, the model predicts not only a negative effect of exchange rate volatility, but also substitution possibilities between extra- and intra-area imports due to differences in the degree of extra- and intra-area exchange rate volatility. Arize (1998) studies the long-run relationship between imports and exchange-rate volatility in eight European countries within the period 1973 and 1995. Applying cointegration analyses, the major results show

that exchange-rate volatility has a significant negative effect on the volume of imports of six countries whereas for Greece and Sweden, it is positive and significant. These findings are reasonably robust in terms of measures of exchange-rate volatility, different estimation methods and membership in the European Exchange-rate Mechanism (ERM). More recently, studies have used panel data in order to analyze the effect of exchange rate volatility on import demand. For example, Pugh et al. (1999) estimate an import demand equation for sixteen Organization for Economic Co-operation and Development (OECD) countries over the period 1980-92 and find significant and negative effect of exchange rate volatility (Anderton and Skudelny, 2001). Campa and Goldberg (2002) perform import and exchange rate related study from different feature, *viz*. they argue that exchange rate regime optimality, as well as monetary policy effectiveness, depend on the tightness of the link between exchange rate movements and import prices. Recent debates hinge on the issue of the prevalence of producer-currency-pricing (PCP) versus local currency price (LCP) stability of imports, and on whether exchange rate pass-through rates are endogenous to a country's macroeconomic conditions. They provide cross-country and time series evidence on both of these issues for the imports of 25 OECD countries. Across the OECD and especially within manufacturing industries, there is compelling evidence of partial pass through – rejecting both PCP and LCP as short-run phenomenon. Over the long run, PCP is more prevalent for many types of imported goods. Higher inflation and exchange rate volatility are weakly associated with higher pass-through of exchange rates into import prices.

2.6 Chapter Summary

This chapter presented the theories used in the study to explain the relationship between the variables of study. Different empirical literatures have also been presented to show how inflation targeting impacts on Exchange rate, exports and import. Nonetheless, most of these studies were conducted in the advanced countries with little or nothing done in developing countries. Also, no study has actually looked at effect of IT on exports and imports. This study therefore sought to fill the gap in literature by assessing the effectiveness of inflation targeting on exchange rate, export and import in a lower middle income country like Ghana. The next chapter provides the methodology for the study.

CHAPTER THREE

RESEARCH METHODS

3.0 Introduction

The aim of this research was to examine the effect of inflation targeting on some key macroeconomic variables in Ghana. These variables are; real exchange rate, imports and exports in Ghana. According to Babbie (1992) research methodology is an account of the overall research, research design, research methods, data collection and the statistical analysis that will be carried throughout the study.

This chapter explains and discusses the methodology used for the study and is organized into subtopics which include; the research design, theoretical model specification and empirical model specification. The chapter also looks at the definition and measurement of variables, source of data, estimation procedure and tools for the study.

3.1 Research Design

Research design may reflect the totality of research process which involves conceptualizing a problem to the literature review, research questions, methodology of a study as well as conclusions (Harwell, 2011). However, in another study, research design refers only to the methodology of a study (for instance, data collection and analysis). This variation nonetheless, does not affect an examination of the role of research design in promoting rigorous study of promising ideas (Harwell, 2011).

The current study adapts the positivist philosophy and derives support from the neo-classical school of thought (Levin, 1988). Positivist philosophy allows the researcher to study social processes in an objective manner as well as explain relationships between variables. Additionally, positivist philosophy is suitable for the development of mathematical models to investigate the nexus between quantitative measurements. The research design adopted in this study for data analysis follows the quantitative approach. The quantitative approach to research is founded on the assumptions and biases to guarantee objectivity in the conduct of the study and the inferences that are drawn. Moreover, the quantitative approach is often described as deductive in nature, because conclusions from tests of statistical hypotheses lead to general inferences about characteristics of a population. Quantitative methods are also frequently characterized as assuming that there is a single "truth" that exists, independent of human perception (Lincoln & Guba, 1985).

3.2 Theoretical Model Specification

The study adopts the purchasing power theory to capture the effectiveness of inflation targeting on exchange rate, exports and imports.

Domestic prices will be affected by monetary flows until parity is attained, according to this idea (Rutherford, 2002). The concept is based on the Law of One Price, which states that in the absence of transaction costs, similar baskets of items in different markets will have the same price. The underlying assumptions of this notion are: one, there are no artificial barriers (e.g. quotas or tariffs); two, there are no transport or insurance costs; three, all goods and services are internationally traded; and four, domestic and foreign price indexes have the same commodities

with the same weighing. In the short run, however, there can exit price differentials between countries in that individuals or companies can gain an arbitrage profit but PPP doctrine says that such differentials are not sustainable as market forces will come into play to establish equilibrium in cross country prices and change exchange rates in the long run. PPP theory used in forecasting forward exchange rates are for reasons ranging from the decision on the currency denomination of long-term debt issues to the determination of siting plants.

Given good ***i*** at time ***t***, PPP holds that:

$$(i) = E_t P_t^*(i) \qquad (3.1)$$

Where, P_t (i) denotes the local currency price of good ***i*** at period ***t***; $P_t^*(i)$ represents the foreign currency price of good ***i*** at period, ***t***; and E_t representing the nominal exchange rate between the two currencies at period, ***t***.

Generally, PPP for many goods case can be expressed as:

$$P_t = E_t P_t^* \qquad (3.2)$$

Where, P_t is the price index of domestic goods at time ***t***, P_t^* represents the price index of foreign goods at time period, ***t***; and E_t denotes the nominal exchange rate between the two currencies at time ***t.***

It follows from equation (3.2) that:

$$E_t = \frac{P_t}{P_{t^*}} \qquad (3.3)$$

Multiplying the right hand side by arbitrary factor, λ gives:

$$E_t = \lambda \left(\frac{P_t}{P_{t^*}}\right) \qquad (3.4)$$

With $\lambda = 1$, is the absolute version of PPP. If $\lambda \neq 1$, then we have the relative version of PPP. Taking the natural logarithm of equation (3.4), gives:

$$lnE_t = ln\lambda + ln\left(\frac{P_t}{P_{t^*}}\right)$$

$$=> lnE_t = ln\lambda + lnP_t - lnP_{t^*} \quad (3.5)$$

Taking total differential of equation (3.5) gives:

$$dlnE_t = dln\lambda + dlnP_t - dlnP_{t^*} \quad (3.6)$$

But $dln\lambda = 0$ and the differential of the logarithm of a variable represent the growth of that variable, it follows that:

$$\hat{E}_t = \acute{P}_t - \acute{P}^*_t \quad (3.7)$$

Where $\hat{E}_t$ denotes the rate of depreciation in the nominal exchange rate; $\acute{P}_t$ indicates the inflation rate in time ***t*** in the domestic economy; and $\acute{P}^*_t$ is the inflation rate in time ***t*** in the foreign economy

Equation (3.7) depicts clearly that variation in exchange rate emanates changes in the relative prices. Therefore, an increase in inflation in the domestic economy relative to that of a foreign economy will results in a rise the exchange rate and vice versa.

Again, from equation (3.4), making lambda the subject gives:

$$\lambda = E_t\frac{P_{t^*}}{P_t} \quad (3.8)$$

Equation (3.8) is the real exchange rate expression. Real effective exchange rate is the nominal effective exchange rate (a measure of the value of a currency against a weighted average of several foreign currencies) divided by a price deflator or index of costs.

Taking natural logarithm results in (3.8)

$$ln\lambda = lnE_t + lnP_{t^*} - lnP_t \quad (3.9)$$

From equation (3.9), it can be deduced that real exchange rate must be stable for real PPP to hold. In the real world, however, it is not likely for real exchange rate to

be constant, hence the need to allow for the possibility of random deviation from real PPP.

From equation (3.8), let $\lambda =$ REER; where REER is the Real effective exchange rate.

3.3 Empirical Model Specification

The study formulated the small simultaneous equation model as expressed in equation (3.10) below where the Real Exchange Rate is expressed as a function of Export and Imports variables.

$$REER_t = (EX_t, IMP_t)^{\beta} \quad (3.10)$$

Where β represents the vector of the parameter

Reformulating equation (3.10) and introducing an intercept gives:

$$REER_t = \alpha EX_t^{\beta 1} IMP_t^{\beta 2} \quad (3.11)$$

A natural logarithm transformation of equation (3.11) and an introduction of a stochastic term results:

$$lnREER_t = ln\alpha + \beta_1 lnEX_t + \beta_2 lnIMP_t + U_t \quad (3.12)$$

Assuming $ln\alpha = \beta_0$ which is the autonomous component of the regression model, the OLS can then be estimated as presented in Equation (3.13).

$$lnERt = \beta_0 + \beta_1 lnEX_t + \beta_2 lnIMP_t + U_t \quad (3.13)$$

It must be stated that $\beta_0 \ldots \beta_2$ represents the respective elasticities and U_t is the stochastic term.

The vector Auto regression model was used to analyse data in this study. According to Brooks (2008), the model was popularized in econometrics by Sims (1980) as a natural generalization of univariate autoregressive model. A VAR is a system regression model where there is more than one dependent variable. The

VAR approach is used for multivariate time series where endogenous variables may appear on both the right hand side and the left hand side of the equation. The purpose of VAR is to see what effect a given change in a variable would have upon the future values of the variables in the system or examines the relationship between the variables. Three sets of statistics will be estimated with VAR model: block significance test/causality, impulse response and variance decomposition. (Agung, 2009).

The advantage of using the VAR approach is that, it does not entail any strict economic theory within which the model is grounded. Also, the VAR approach models every endogenous variable in the system as a function of the lagged values of all endogenous variables in the system.

The Vector Autoregressive Models in levels, for the three macroeconomic variables under consideration with the inflation targeting dummy variable are as follows:

$$LNREER_t = \alpha_1 + \beta_{11} LNREER_{t-1} - \beta_{12} LNEX_{t-1} + \beta_{13} LNIMP_{t-1} - \delta_1 1T + u_{1t} \quad (3.14)$$

$$LNEX_t = \alpha_2 + \beta_{21} LNREER_{t-1} + \beta_{22} LNEX_{t-1} + \beta_{23} LNIMP_{t-1} + \delta_2 1T + u_{2t} \quad (3.15)$$

$$LNIMP_t = \alpha_3 + \beta_{31} LNREER_{t-1} + \beta_{32} LNEX_{t-1} + \beta_{33} LNIMP_{t-1} \delta_3 1T + u_{3t} \quad (3.16)$$

Where:

$REER_t$ = The exchange rate variable at time t. Real effective exchange rate index (2010 = 100) are used for the exchange rate variable in the analysis of this work

EX_t= Exports variable at time t. Exports of goods and services (% of GDP) are used in the analysis of this work

IMP_t = Imports variable at time t. Imports of goods and services (% of GDP) are used in the analysis of this work

IT = Inflation targeting; a dummy variable for inflation targeting. It takes the value of zero during the pre-inflation targeting era and a value of one during the inflation targeting era. [1984-2006=0, 2007-2019=1]

α_i = The constant term in the various equations

β_{ii} = the parameter term for the various macroeconomic variables under consideration in the various equations for the first lag

δ_i = the parameter term for the Inflation Targeting dummy (IT) for the various equations

U_{it} = the error term in the various equations. The error term is assumed to have a mean of zero and there is no correlation among error terms.

The lagged values of the various macroeconomic variables on the right hand side of each equation serve as controls in each equation. The most important variable in each model is the Inflation Targeting dummy. This is important because the work looks at its effects on the endogenous variable in each model under consideration. The dummy variable for Inflation targeting was lagged in all cases. This work estimates the three equations above, each incorporating the objectives of the study in finding the effects of inflation targeting on these macroeconomic variables. The study used the Least Square Method (LSM) for testing if the sign and size of this parameter would satisfy our expectation. This was done by conducting a test hypothesis using the model specified above at 5% level of significance.

3.4 Definition, Measurement and a priori Expectation of Variables

This section describes the dependent variables, and the dummy variable. For the purpose of this study, the following measurement and operational

definitions were used for the variables being examined. The variables included in the study are Real Exchange Rate, Exports of goods and services (% of GDP) and Imports of goods and services (% of GDP). The choice of the variables was based on existing literature, economic theory, available data and their significance to the study and whether or not they fit in the model statistically. The basis for the signs of the respective coefficient of the variables is explained in the description of the variables below.

3.4.1 Exchange Rate

This study used Real Effective Exchange rate as a measure of the exchange rates as was used by (Jimenez – Rodriguez & Sanchez, 2005). Real effective exchange rates take account of price level differences between trading partners. Movements in real effective exchange rates provide an indication of the evolution of a country's aggregate external price competitiveness; consequently, used as an indicator of competitiveness. Exchange rate refers to the price at which the domestic currency is exchanged for the foreign currencies. It is the value of a particular foreign currency as compared to the currency of a home country. In other words, it is the rate at which a domestic currency will be exchanged for another different currency. Compared to other currencies, the exchange rate is often seen as the net worth of the currency of a particular country (Ramasamy and Abar 2015). The exchange rate can also be defined (Obura and Anyango, 2015) as the value at which a domestic currency trades for the currency of another nation. Exchange rates may be either flexible exchange rates or fixed exchange rates.

In a fixed exchange rate regime, the government determines the value of the currency. On the contrary, in a flexible exchange rate regime, the value of the

currency is determined by the market and the government does not play any role in the stabilization of the value of the currency (Semuel & Teddy, 2014).That is, a flexible exchange rate is the one that is determined by supply and demand on the open market. Other factors such as inflation, interest rate, trade balance and political stability can also influence exchange rate. Mumuni and Owusu-Afriyie (2004) also argue that, speculation and the Treasury bill rate are major determinants of the exchange rate in Ghana aside the inflation rate which influences the level of the exchange rate in Ghana. A rise in the exchange rate, also known as depreciation, results in a rise in the prices of imported goods and services. Since import prices form a significant aspect of our price level calculations, this ends up increasing the domestic price level in the economy.

When exchange rate deteriorates, it reduces the purchasing power of income and capital gains resulting from investment returns. (Lagat & Nyandema, 2016) argue that since exchange rates are fundamental economy prices, their flexibility and level affect the growth and allocation of resources. Thus exchange rates fluctuation is one of the main obstacles that developing economies face in the macroeconomic management especially during the periods of economic and financial crisis (Sarac and Karagoz, 2016).

The exchange rate practiced by Ghana since 1995 can be described as a managed float (dirty float). This system is a mixture of floating system with attempt by the central bank to influence the rate through buying and selling of currency. The exchange rate used is the interbank exchange rate from the interbank forex market. The interbank forex market is where banks exchange currencies directly with other banks. Most currency transactions in Ghana are performed here

and are less regulated, decentralized and better responds to the forces of demand and supply. The level of Ghana's economy exchange rate is usually determined against US dollar.

From the Purchasing Power Parity, the researcher expects the exchange rate to have a positive relationship with the domestic price, holding foreign prices constant. Work done in Ghana by Coleman (2012), Ayisi (2013) and Puni, Osei & Barnor (2014) and Fosu (2015) have shown that Inflation targeting leads to a fall in domestic prices (inflation). Consequently, the researcher expects that exchange rate will fall as a result of the implementation of IT. When a country's inflation rate falls relative to that of another country, increased exports and decreased imports causes the exchange rate of the low inflation country to appreciate. Therefore the a priori sign for the exchange rate variable is negative.

3.4.2 Exports of Goods and Services (% of GDP)

Exports of goods and services - represent the value of all goods and other market services provided to the rest of the world which include the value of merchandise, insurance, freight, travel, transport, royalties, fees, license and other services, such as communication, construction, business, financial, information, personal, and government services. They exclude compensation of employees and investment income (formerly called factor services) and transfer payments. For the purpose of this study, export as a percentage of GDP is used as a proxy to measure export. The researcher expects the export to have a positive relationship with the inflation targeting. That is, when the rate of inflation falls, as a result of the implementation of the IT, domestic prices will be cheaper relative to foreign prices.

As a result, export increases. Also from the PPP, the researcher expects exchange rate to have an inverse relationship with export.

3.4.3 Imports of Goods and Service

The value of all goods and other market services received from the rest of the world which include the value of merchandise, freight, insurance, transport, travel, royalties, license fees, and other services, such as communication, construction, financial, information, business, personal, and government services. In order to undertake transactions relating to the ever-increasing demand for foreign goods and services, residents in Ghana will have to increase their demand for the underlying foreign currencies. This mounts pressure on the Cedi because of the rise in price of the foreign currencies resulting from increasing demand for them. The researcher expects to have a negative relationship between Import and Inflation Targeting. A positive relationship is expected between imports and exchange rate. Import as a percentage of GDP is used as a proxy to measure import.

Table 3.1 Description of the variables

Variable	Description	a priori sign
Exchange rate:	Real effective exchange rate index (2010 = 100)	–
Export:	Exports of goods and services (% of GDP)	+
Imports:	Imports of goods and services (% of GDP)	–

3.4.4 The Dummy Variable

The dummy variable used for the study is the Inflation Targeting.

3.5 Sources of Data

The study used secondary data on Real exchange rate, exports of goods and services (% of GDP) and Imports of goods and services (% of GDP) the World Bank's World Development Indicators (WDI), and the Ghana Statistical Service. The following dataset was used:

Exchange rate: Real effective exchange rate index (2010 = 100) are used in this work

Export: Exports of goods and services (% of GDP)

Imports: Imports of goods and services (% of GDP)

3.6 Data Analysis

The data were analyzed using a statistical package called E-views. Based on the Least Squares Method (LSM), multivariate analysis model was adopted for the study and as such, multiple regression analysis technique was used to analyze the relationship between Inflation targeting and exchange rate in Ghana and Exports of goods and services (% of GDP) and Imports of goods and services (% of GDP). The analysis has two stages where firstly, the researcher carried out a descriptive analysis in order to have a general opinion on the influence of inflation targeting on exchange rate and Export and imports; then followed by regression analysis to confirm the degree of the relationship.

The researcher used descriptive methods to analyze the mean and standard deviation exchange rate, exports and imports values in the pre- inflation targeting and inflation targeting cycles for the descriptive analysis. In this section, descriptive tables are used to give a visual impression of inflation targeting results. The variances that are the standard deviations and the averages or means will be calculated for each of these variables and under each of these regimes. The standard

deviations and means for each variable under the two regimes are then analyzed using descriptive tables as done in Coleman (2012). The mean gave the arithmetic mean of the macroeconomic variable for the periods before and after inflation targeting whereas the standard deviation measure the variability of these variables. The data was thus divided between periods before inflation targeting (1984 – 2006) and after (2007 – 2019) in order to best assess the impact of inflation targeting on selected macroeconomic variables.

The researcher used the test of mean differences to ascertain the differences in means of the macroeconomic variables between the pre and post inflation targeting period. Further analysis involved multiple regression analysis using the Vector Auto Regression (VAR) Technique.

3.7 Econometric Techniques

Econometric techniques were used to estimate the effect of inflation targeting on real exchange rate and export (% of GDP) and Imports of goods and services (% of GDP). This work used a "before-and-after" strategy. This strategy involves looking at the extent to which inflation targeting has influenced the performance of these macroeconomic variables in the pre inflation targeting period and inflation targeting era. The performances of these variables are compared to see whether the effect of inflation targeting has been positive or negative.

3.8 Impulse Response and Variance Decomposition

In VAR models, F-test will not reveal whether changes in the value of a given variable have positive or negative effects on other variables or how long it would take for the effect of the variable to work through the system. Such information will however be given by an examination of the VAR's impulse

responses and variance decompositions. Impulse response traces out the responsiveness of the dependent variables in the VAR shocks to each of the variables, so for each variable from each equation separately, a unit shock is applied to error, and the effects upon VAR system are noted. Thus, if there are g variables in a system, a total of g^2 impulse response could be generated. This is achieved in practice by expressing the VAR model as vector moving average (VMA). Variance decomposition gives the proportion of the movements in dependent variables that are due to their own shocks versus shocks to the other variables. It determines how much of the step ahead forecast error variance of a given variable is explained by innovations to each explanatory variable.

3.9 Unit Root Test

Stationarity test is also called unit root test. When time series are used in the analysis, it is important to establish the stationarity of the variables. Tary (2005, p.393) argues that in time series analysis, it is necessary to see first whether the series are stationary or not. The sequence is not stationary when there is unit root in a time series. Hendry et al. (1995) explained that the estimation of time series models with non – stationary variable could generate deductions and conclusions which are not logical as the conventional t and F tests are biased. That is, if the series are not stationary, not only will it create problem for the researcher but also give deceptive conclusions. According to Enders (1995, pp.155 – 195), if two – time series are not stationary, even though a significant correlation does not exist between them, it may cause the R^2 value which shows the correlation between the variables when regression is set to be very high. This is called a spurious regression which may stem from a strong tendency or a trend to the same direction that time series have. Gujarati (2009) defines stationarity as a situation where the mean and the variance

of a stochastic process are constant over time and covariance between the two time periods depends only on the distance or gap lag between the two time periods and not the actual time at which the covariance is computed. Thus, the variables used in our analysis should have a constant mean and a constant variance. Based on this explanation, any Yt series is assumed to have the following features

Mean: $E(Yt) = \mu$ (3.17)

Variance: $Var\ (Yt) = \gamma_o = E\ (Yt - \mu)^2$ (3.18)

Covariance: $Cov\ (Y_t, Y_{t+k}) = Yk = E[(Yt - \mu)\ (Y_{t+k} - \mu)$ (3.19)

A Yt time series that has the above features is defined as a weak stationary stochastic process. Weak stationarity is considered enough for most application. One way to check for stationarity is to conduct the unit root test. The unit root tests used for the study are the Augmented Dickey Fuller test and Phillips – Perron test. Unit roots in the series are examined using the Augmented Dickey-Fuller (ADF) Test to ensure that results generated are not spurious and then the Phillip-Perron (PP) Test is used to check for robustness of the results derived from the ADF test.

By examining the presence of unit root in the time series, the series is decided whether to be stationary or non – stationary. It is stationary if a time series does not have a unit root. It is non – stationary if the time series has a unit root. As a result unit root test were conducted to establish the order of integration of the independent variable and dependent variables. Series that are integrated of order zero are said to be stationary at levels and those that are integrated of higher order are said to be stationary at first differentiated.

If the variable is tested to be stationary, then Vector Autoregressive model can be estimated in levels. If some of the variables are found not to be stationary,

co – integration test are needed to bring out any long run relationship between the systems variables. In the presence of co – integration, an Error Correction Model (ECM) representation of the VAR is needed for estimation. This allows for long run relationships among the system variables.

3.10 Appropriate Lag Length Selection

Choosing an appropriate lag length is as important as determining the variables to be included in any system of equations (Enders 1995). To ensure that the VAR estimate is accurate, it is crucial to select the correct lag order in the VAR. When the lag length is short, it can result in autocorrelation problem and a fairly large number of lags will cause a rise in the mean square forecast errors of the VAR (Lutkepohl 2007). The problems mentioned above therefore necessitate the importance of selecting an optimal lag length so as to avoid misspecification and loss of degrees of freedom. The researcher chose the Schwarz Information Criterion (SC) to determine the number of appropriate lags to be used. Whereas the SBIC is used when the main aim of the modeling application is to develop a model that will feature the most meaningful factors influencing the outcomes based on an assessment of relative importance, the Akaike Information Criterion is more suited in the predictive models.

3.11 Cointegration Test

Johansen (1991) discovered that cointegration could be used to test for cointegration among variables. It is used to establish long-term linear relationships among variables. He argued that co-integration allows specification for a procedure of modification among cointegrated factors. Asteriou (2007) also noted that when there are more than two variables in a given model, there is a probability of having

more than one cointegrating variable. The tests of co-integration are based on eigenvalues of transformations of the data, and this represents linear combinations of the data that have maximum correlation (Dwyer, 2015).

3.12 Serial Correlation

Serial correlation is a major problem for the time series data. Serial correlation occurs when error terms for different time periods are related. Kirchgassner and Wolters (2007:52-53) argue that serial correlation occurs when error terms from previous periods affect future time periods. Serial correlation may lead to problems with efficiency estimates. It may also lead to the understatement of the variance as well as the overstatement of the R^2 which will invalidate the t and F test (Yin – Feng 2002). This may lead to some hypothesis being rejected when they should not.

The study therefore tests for serial correlation using the Breusch – Godfrey Lagrange Multiplier (LM) test for serial correlation. The Breusch – Godfrey Lagrange Multiplier test for serial correlation is best suited for models where the dependent variable is represented in the model as independent variables through using lagged values of the dependent variables. This is therefore best suited for this study.

3.13 Heteroscedasticity Test

Basically, heteroscedasticity refers to a situation in time series data where the error terms have different scatterplots irrespective of the value of the explanatory variable (X). In the presence of heteroscedasticity OLS estimates are consistent but their standard errors are not valid. The Breusch-Pagan test, which involves the auxiliary regression of the squared residuals on the original regressors and all their

squares, is used to test for heteroscedasticity. This test simply determines whether or not the estimated variance of the error (residual) terms is dependent on the values of the regressors/explanatory variables (Harvey, 1990:43-45).

3.14 Normality Tests

Statistical data require that the data used for analysis should be normally distributed. In order to check whether this assumption is violated, a normality test was conducted on the dataset. The Jaque – Bera test was used to check the normality of the model

3.15 Stability Test

Finally, when analyzing the stability of the coefficients, the Cumulative Sum (*CUSUM*) and Cumulative Sum of Squares (*CUSUMQ*) are applied. Following Pesaran and Pesaran (as cited in Bahmani-Oskooee, et al. 2004), the stability of the regression coefficients is evaluated by stability tests and they can 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.

3.16 Chapter Summary

This chapter developed and presented the methodological framework suitable for conducting the study. The study adopted the purchasing power parity theory to capture the effectiveness of inflation targeting on exchange rate, export and imports. The model was developed from a small simultaneous equation where Real exchange rate is expressed as a function of exports and imports variables. Annual time-series data on real exchange rate, exports (% of GDP) and imports (%

of GDP) from 1984 to 2019 were used for the study. Unit roots test was conducted using ADF and PP tests.

Following these linkages, the study used a VAR model to examine the effectiveness of inflation targeting on real exchange rate, exports (% of GDP) and imports (% of GDP) in Ghana. Definition, measurement and a priori expectation issues were also discussed based on the theoretical literature. In addition, the study used the Schwarz Information Criterion to select the optimal lag lengths. The chapter finished by discussing some of the diagnostic tests that were to be performed on the time series data before regression is run in order to come up with accurate, efficient and unbiased results. The next chapter provides a comprehensive account of the research findings, and discussion on the findings.

CHAPTER FOUR

RESULTS AND DISCUSSION

4.0 Introduction

This chapter presents the discussion of empirical results based on the specific objectives of the study. The chapter begins with an examination of the descriptive statistics of the various variables. The test of unit root and co-integration tests, VAR regression results and model diagnostic results would be provided and briefly explained. Finally, the results obtained from the analysis will be discussed and compared with existing literature on the subject.

4.1 Results from Descriptive Statistics

Table 4.1: Results of the descriptive statistics

	REER	EX	IMP
Mean	136.8747	28.61932	40.01211
Median	103.9996	29.38429	39.29138
Maximum	562.1309	48.80226	67.24617
Minimum	64.24100	8.044027	10.77058
Std. Dev.	96.88777	9.871968	13.82948
Skewness	3.064530	-0.084334	-0.013831
Kurtosis	12.86336	2.331256	2.540837
Jarque-Bera	202.2770	0.713502	0.317394
Probability	0.000000	0.699947	0.853255
Sum	4927.491	1030.296	1440.436
Sum Sq. Dev.	328553.4	3410.951	6693.908
Observations	36	36	36

Note: Std. Dev. and Sum Sq. Dev. Represent Standard Deviation and Sum of Squared Deviation respectively. *Source: Author's computation using E-views 10 software*

Table 4.1 presents the descriptive statistics of the macroeconomic variables under study (Real Exchange Rate, Exports and Imports). The number of observations is 36. Statistical measures examined include the mean, median, maximum value, minimum values, standard deviation (dispersion), Skewness (Peakness), and kurtosis. In the descriptive statistics, Real Exchange Rate (REER) has a mean value of 136.8747. It has a maximum value of 562.1309 with a minimum figure of 64.24100 and a Standard Deviation of 96.88777. Also, Export (EX) has 28.61932, 29.38429, 48.80226, 8.044027 and 9.871968 as values for mean, median, maximum, minimum and standard deviation respectively. Import (IMP) on the other hand has a mean, median, maximum, minimum and standard deviation of 40.01211, 39.29138, 67.24617, 10.77058 and 13.82948 in their respective order.

It can be observed from table 4.1 that all the variables have positive average values (mean and median) in their raw forms. The variables also have positive standard deviation. Export has the lowest standard deviation of 9.871968 whereas the real effective exchange rate has the highest of 96.88777. All the macroeconomic variables have positive maximum values. The variable with the least minimum value is export 8.044027 while exchange rate is the variable with the highest minimum value (64.24100). With the exception of real exchange rate, all the other macroeconomic variables the study considers are negatively skewed. The Kurtosis indicates their respective heaviness of tail.

4.2 Results from Unit Root Test

The study adopted both the augmented Dickey – Fuller and Philips – Perron unit roots tests. These tests were simultaneously carried out to ensure the variables enter their corresponding models in a non – explosive form and are robust. Also, the tests were carried out to ensure that the variables under investigation satisfy the preconditions for the econometric techniques adopted for the study. The variables were tested in their log levels. We took the natural logarithm to remove the effect of changing variables on units and patterns. The outcomes of the tables 4.2 showed that both the Augmented Dickey Fuller and Philips Perron tests reject the hypothesis of non – stationarity for the data series ln REER, and ln Ex and ln Imp at the levels of 5% level of significance. The results are presented below in table 4.2;

Table: 4.2 Results of the Augmented Dickey – Fuller and Phillips-Perron Unit Root Test (in Level Form)

	ADF		PP		
Variables	't' Statistics	P – Value	Adj. 't' Statistics	P – Value	Results
lnREER	-4.360129	0.0015	-4.089605	0.0031	Stationary
lnEx	-3.320218	0.0215	-3.320218	0.0215	Stationary
lnImp	-3.619955	0.0103	-3.619955	0.0103	Stationary

Source: *Author's computation using E-views 10 econometric software*

Table 4.2 shows the results obtained from the Augmented Dickey Fuller and Phillips-Perron stationarity tests. The Augmented Dickey Fuller test and Philip Perron tests were conducted on the series above. The two tests use a null hypothesis that the data is non-stationary. The outcomes from the table show that both Augmented Dickey – Fuller and Philips – Perron test reject the hypothesis of

non-stationarity. In sum, the results obtained in the ADF test are consistent with result of the PP test, thus confirming that all the variables that we are utilizing for our analysis are I(0). From the table, all variables are significant at the 5 percent level of significance. That is, the corresponding probabilities values of all the variables were less than the value of 0.05 in all the series The null hypothesis of the presence of a unit root is rejected since the values for the 't' statistics for the various macroeconomic variables fall within the rejection zone. This paves the way for the study to estimate the VAR model in levels. The results for the appropriate choice of lags are presented below.

4.3 Results from Lag Selection

Before proceeding with the co integration tests, there is the need to first of all determine the order of the Vector Auto Regression (VAR); the optimal lag length to be used. The study employed the sequential modified LR test, the Final Prediction Error (FPE) test, Akaike Information Criterion (AIC) test, Schwarz Information Criterion (SIC) test and the Hannan Quinn (HQ) Information Criterion at 5 percent level of significance to carry out the selection. Table 4.3 presents some statistical criteria in selecting lag length for the VAR model.

Table 4.3: Results of lag selection

Lag	LogL	LR	FPE	AIC	SC	HQ
0	10.32329	NA	7.92e-06	-0.395206	-0.211989	-0.334474
1	92.16537	138.1085*	1.31e-07	-4.510336	-3.594251*	-4.206680*
2	108.5753	23.58921	1.34e-07	-4.535954	-2.887001	-3.989373
3	127.2764	22.20756	1.30e-07*	-4.704773*	-2.322952	-3.915267
4	140.7643	12.64490	2.02e-07	-4.547766	-1.433077	-3.515335

* indicates lag order selected by the criterion
LR: sequential modified LR test statistic (each test at 5% level)
FPE: Final prediction error
AIC: Akaike information criterion
SC: Schwarz information criterion
HQ: Hannan-Quinn information criterion

Source; Author's computation using E-views 10 econometric software

As per table 4.3, the results show that SC, LR and HQ recommend an order of 1, whereas the AIC and FPE recommend an order of 3. For the purpose of this study, the researcher uses the Schwarz information criterion to determine the optimal lag length. From the table, the appropriate number of lags to use given the data is one lag.

4.4 Results from Cointegration Test

Cointegration was conducted to test the existence of a long run relationship between two or more time series. The result of the unit root test indicated that all the variables are stationary at levels I(0) and the optimal VAR order has been determined as 1, there is need to test for cointegration between the variables. The study used the Johansen Cointegration to test for possible existence of cointegration. The Johansen cointegration approach uses the maximum likelihood method (i.e. Eigen values and Trace). With this, the test is able to identify more than one cointegration vector. It gives hypothetical values to the coefficients of all the variables to see which combination makes the error term stationary. The null

hypothesis for the Johansen test implies that there is no cointegration among the variables.

Table 4.4: Results of Johansson's Test for number of cointegration vectors

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None	0.487571	42.12694	47.85613	0.1552
At most 1	0.251955	19.39479	29.79707	0.4648
At most 2	0.176954	9.524873	15.49471	0.3190
At most 3	0.081855	2.903588	3.841466	0.0884

Trace test indicates no cointegration at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None	0.487571	22.73215	27.58434	0.1852
At most 1	0.251955	9.869917	21.13162	0.7568
At most 2	0.176954	6.621285	14.26460	0.5348
At most 3	0.081855	2.903588	3.841466	0.0884

Max-eigenvalue test indicates no cointegration at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Source; Author's computation using E-views econometric software

From table 4.4, the trace test indicates that there is no cointegration among the variables. The Eigen values and trace statistics are both lower than their respective critical values at the 95% significance level. We therefore fail to reject the null that there is no cointegration. Thus on the basis of the Johansen cointegration test, we can conclude that the variables under study have no cointegration vector at the 95% significance level as per the maximum Eigenvalue level and Trace statistics. The results of the VAR model with one lag are presented below.

4.5 Regression Results

This section deals with the discussion of the results obtained from running a regression based on the model specified above. This is meant to prove or disprove what was obtained from the descriptive statistics above. The estimated equations are presented and discussed below.

4.5.1 Inflation Targeting and Real Exchange Rate

With reference to equation (3.14), thus;

$$LNREER_t = \alpha_1 + \beta_{11} LNREER_{t-1} - \beta_{12} LNEX_{t-1} + \beta_{13} LNIMP_{t-1} - \delta_1 1T + u_{1t} \quad (3.14)$$

Table 4.5 : Regression Results for Real Exchange Rate

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LNREER(-1)	0.716479	0.096147	7.451893	0.0000
LNEX(-1)	-0.049133	0.167099	-0.294033	0.7692
LNIMP(-1)	0.014569	0.156258	0.093237	0.9259
IT(-1)	-0.123849	0.056641	-2.186575	0.0307
CONSTANT TERM	1.449253	0.766795	1.890015	0.0612

R-squared	0.931089	Mean dependent var	4.736886
Adjusted R-squared	0.921901	S.D. dependent var	0.399913
S.E. of regression	0.111761	Sum squared resid	0.374713
Durbin-Watson stat	1.813299		

LNREER = C(1)*LNREER(-1) + C(2)*LNEX(-1) + C(3)*LNIMP(-1) + C(4)*IT(-1) + C5

Regression results for the exchange rate variable are shown in equation (3.14) above. C(1), C(2), C(3), C(4) and C(5) represent the coefficients of the first lag of real exchange rate, first lag of exports, first lag of imports, IT dummy variable and constant term respectively.

According to the results, both Exports and imports variables have a statistically insignificant effect on exchange rate. Real exchange rate is negatively associated with first lag of export and but positively related with the first lag of import.

The inflation targeting dummy carries a negative coefficient signifying a fall in the exchange rate as result of the implementation of inflation targeting. The inflation targeting dummy variable was measured at 5% level of significance. This relationship is statistically significant with a p-value of 0.0307. The coefficient of the IT dummy variable (inflation targeting) was found to be –0.123849. This means that the exchange rate in the period in which inflation targeting is implemented has fallen compared with the pre Inflation Targeting period by 0.12% on average. The result reveals that adoption of IT policy has helped in combating the ruin of exchange rate in Ghana.

This result is consistent with the findings of Edwards (2007) for Brazil, Chile and Israel; Pontines and Siregar (2012) and Kurihara (2013) in the panel of developing Sub-Saharan Africa and East Asian IT targeting and non-targeting economies among others who found an insignificant relationship between inflation targeting and the exchange rate. The direction of movement also conforms to Petursson (2004), who found a negative relationship between inflation targeting and the exchange rate in developing countries.

When a country's inflation rate rises relative to that of another country, decreased exports and increased imports depress the exchange rate of the high inflation country. Theoretically, inflation and the exchange rate are related negatively and so a fall in the inflation rate through inflation targeting as discussed

above, should lead to an improvement in exchange rate. However, Mumuni and Owusu-Afriyie (2004) argue that, apart from the inflation rate which influences the level of the exchange rate in Ghana, speculation and the Treasury bill rate are major determinants of the exchange rate in Ghana. This could explain the reason for the continuous depreciation of the local currency though the exchange rate has fallen from the pre inflation targeting era to the inflation targeting era.

4.5.2.1 Inflation Targeting and Export

With reference to equation (3.15), thus;

$$LNEX_t = \alpha_2 + \beta_{21} LNREER_{t-1} + \beta_{22} LNEX_{t-1} + \beta_{23} LNIMP_{t-1} + \delta_2 1T + u_{2t} \qquad (3.15)$$

Table 4.6 : Regression Result for Export

VARIABLE	Coefficient	Std. Error	t-Statistic	Prob.
LNREER(-1)	0.085076	0.137906	0.616915	0.5385
LNEX(-1)	0.818029	0.239674	3.413092	0.0009
LNIMP(-1)	0.024550	0.224124	0.109535	0.9130
IT(-1)	0.069920	0.081241	0.860656	0.3911
CONSTANT TERM	0.117710	1.099829	0.107026	0.9149

R-squared	0.818841	Mean dependent var	3.318161
Adjusted R-squared	0.794687	S.D. dependent var	0.353774
S.E. of regression	0.160300	Sum squared resid	0.770887
Durbin-Watson stat	1.945407		

LNEX = C(6)*LNREER(-1) + C(7)*LNEX(-1) + C(8)*LNIMP(-1) + C(9)*IT(-1) + C(10)

Regression results for the export variable are shown in equation (3.15) above. C(6), C(7), C(8), C(9) and C(10) represent the coefficients of the first lag of real exchange rate, first lag of exports, first lag of imports, IT dummy variable and constant term in their respective order.

According to the results, import, exchange rate and the IT dummy variables all have a positive but statistically insignificant effect on exports in Ghana. The lag of export however has a statistically significant effect on export with a p – value of 0.0009.

The coefficient of the IT dummy variable (inflation targeting) was found to be 0.069920. This relationship is statistically insignificant with a p – value of 0.3911. This means that inflation Targeting does not have any effect on export in Ghana.

4.5.2.2 Inflation Targeting and Import (% of GDP)

$$LNIMP_t = \alpha_3 + \beta_{31} LNREER_{t-1} + \beta_{32} LNEX_{t-1} + \beta_{33} LNIMP_{t-1} + \delta_3 1T + u_3 \quad (3.16)$$

LNIMP = C(11)*LNREER(-1) + C(12)*LNEX(-1) + C(13)*LNIMP(-1) + C(14)*IT(-1) + C(15)

Table 4.7: Regression Result for import

VARIABLES	Coefficient	Std. Error	t-Statistic	Prob.
LNREER(-1)	0.088543	0.130870	0.676569	0.5000
LNEX(-1)	0.144857	0.227446	0.636885	0.5254
LNIMP(-1)	0.724638	0.212689	3.407022	0.0009
IT(-1)	-0.007951	0.077096	-0.103130	0.9180
CONSTANT TERM	0.134033	1.043716	0.128419	0.8980

R-squared	0.837694	Mean dependent var	3.653771
Adjusted R-squared	0.816053	S.D. dependent var	0.354687
S.E. of regression	0.152122	Sum squared resid	0.694234
Durbin-Watson stat	2.075994		

LNIMP = C(11)*LNREER(-1) + C(12)*LNEX(-1) + C(13)*LNIMP(-1) + C(14)*IT(-1) + C(15)

Regression results for the import variable are shown in equation (3.16) above. C(11), C(12), C(13), C(14) and C(15) represent the coefficients of the first lag of

real exchange rate, first lag of exports, first lag of imports, IT dummy variable and constant term respectively.

The results from table above show that all the variables have a statistically insignificant effect on imports in Ghana. Import (IMP) has a positive but insignificant effect on both exchange rate and export (REER) at first lag

The inflation targeting dummy carries a negative coefficient signifying a negative impact of inflation targeting on the import. The coefficient of the IT dummy variable (inflation targeting) was found to be -0.007951. The coefficient is statistically insignificant with a p – value of 0.9180. This means that inflation targeting has no effect on imports in Ghana.

4.6 The Impulse Response Function

This explains the reaction of an endogenous variable to one of the innovations. Thus, the impulse response function traces the effect on present and future values of the endogenous variable of one standard deviation shock to one of the innovations. This may also explain the evolution of a variable of interest along a specific time horizon after a shock in a given moment and may help in describing the causal analysis and policy effectiveness analysis. The impulse response function is often applied because individual coefficients in the estimated VAR models are often difficult to interpret.

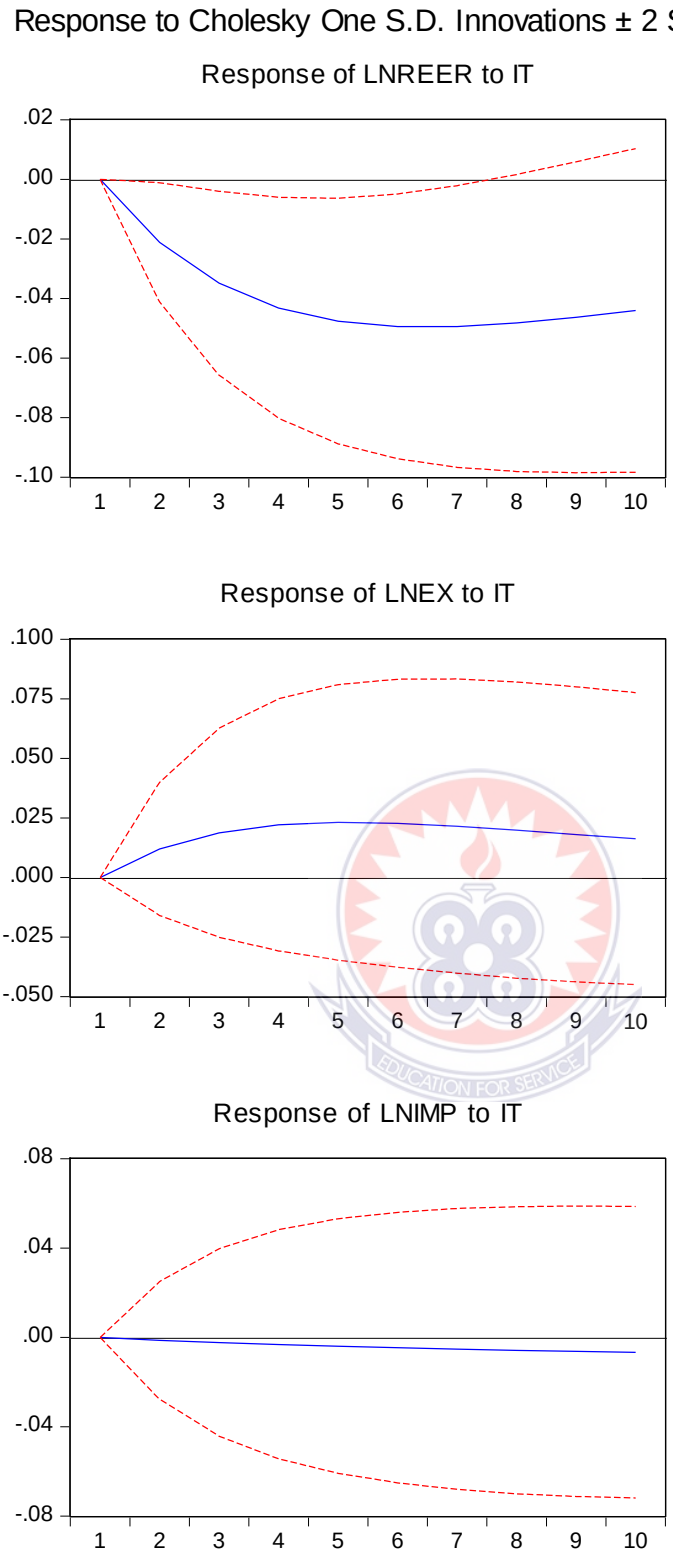

Figure 4. 1 :Result From Impulse Response

Response of exchange rate to one standard deviation shock (innovation) to inflation targeting: A one standard deviation shock to inflation targeting initially decreases real exchange rate sharply to its negative regions in period one. From the second period, the response continues to decline and remain in the negative region. This means shock to inflation targeting will have a negative effect on exchange rate in both short and long run.

Response of export to one standard deviation shock (innovation) to inflation targeting: A one standard deviation shock to inflation increases export sharply from the first to the 3rd period. This positive effect continues from the fourth to the 10th period. This means shock to inflation will have a positive effect on export in both short and long run.

Response of import to one standard deviation shock (innovation) to inflation targeting: A one standard deviation shock to inflation targeting decreases import to negative regions in period one. From the second period, the response continues to remain negative until the 10th period. This negative response fluctuates till the 4th period but remains positive. This means shock to inflation targeting will have negative impact on import both in the short and long run.

4.7 Variance Decomposition

To determine the importance of a shock in one variable to the others, VAR adopts variance decompositions as their tools. If the forecast error variance of a variable is not affected by shocks besides its own shocks, it can be concluded that the variable is exogenous/ independent (Enders 2003). Variance decomposition assesses the relative contribution of the variables under study to the fluctuations in Inflation Rate, GDP Growth rate, Exchange Rate and Exports. This is done by

decomposing the forecast variance of the macroeconomic variables over different time horizons. The statistics in the tables below indicate the percentage contribution of innovations in each of the variables.

Table 4.8: Variance Decomposition of Lnreer

Period	S.E.	LNREER	LNEX	LNIMP
1	0.118380	100.0000	0.000000	0.000000
2	0.155452	99.41291	0.084449	0.502637
3	0.178224	98.32015	0.315720	1.364133
4	0.193952	96.93348	0.704667	2.361850
5	0.205525	95.40457	1.235879	3.359552
6	0.214402	93.83949	1.877879	4.282635
7	0.221416	92.31007	2.592820	5.097109
8	0.227077	90.86256	3.343648	5.793791
9	0.231715	89.52429	4.098350	6.377358
10	0.235557	88.30892	4.831821	6.859261

Variance decomposition to Real Exchange Rate shows that shocks to exchange rate are important source of variation in inflation accounting for 88.30% shocks after 10 periods, while export and imports explained 4.83%, 5.73% and 6.85% respectively.

Table 4.9: Variance Decomposition of Export

Period	S.E.	LNREER	LNEX	LNIMP
1	0.159629	28.65446	71.34554	0.000000
2	0.204004	28.57140	71.40520	0.023405
3	0.227563	28.53952	71.39768	0.062803
4	0.241163	28.54283	71.34937	0.107801
5	0.249276	28.56802	71.27989	0.152092
6	0.254187	28.60476	71.20298	0.192256
7	0.257178	28.64564	71.12755	0.226805
8	0.259005	28.68580	71.05875	0.255456
9	0.260120	28.72240	70.99900	0.278598
10	0.260801	28.75410	70.94896	0.296939

Variance decomposition to export shows that shocks to export are important source of variation in export accounting for 70.94% shocks after 10 periods, while exchange rate and imports explained 28.75% and 0.29% respectively.

Table 4.10: Variance Decomposition of Imports

Period	S.E.	LNREER	LNEX	LNIMP
1	0.149675	11.82718	48.21119	39.96163
2	0.194367	10.92475	52.70912	36.36613
3	0.220330	10.13289	56.16483	33.70228
4	0.237032	9.471673	58.77353	31.75480
5	0.248300	8.939580	60.71888	30.34154
6	0.256119	8.523995	62.15652	29.31949
7	0.261649	8.207747	63.21140	28.58085
8	0.265619	7.972869	63.98079	28.04634
9	0.268505	7.802596	64.53895	27.65846
10	0.270629	7.682300	64.94183	27.37587

Variance decomposition to Import shows that shocks to imports are not important source of variation in imports accounting for just 27.37% shocks after 10 periods, while exchange rate and export explained 7.68% and 64.940% respectively.

4.8 Results from Serial Correlation Test

Table4.11: Results from the Breusch-Godfrey Lagrange Multiplier (LM) test for serial correlation.

B-G Serial Correlation LM Test:		**Null Hypothesis: No Serial Correlation**	
F-statistic	0.544787	Prob. F(2,31)	0.5854
Obs*R-squared	1.215729	Prob. Chi Square(2)	0.5445

Source; Author's computation using E-views 10 econometric software.

The serial correlation test is based on the hypothesis that there is no serial correlation in the model used in the empirical analysis. Based on the p-value from

table 6 above, the study fails to reject the null hypothesis of no first order serial correlation. This is because the p – value of the Obs* R – squared is greater than 0.05 (p>0.05). The conclusion therefore is that there is no presence of serial correlation. The error terms from different periods are not correlated. The estimates can therefore be said to be efficient.

4.9 Results from Heteroscedasticity Test

Table 4. 12: Results from the Breusch-Pagan- Godfrey test for Heteroscedasticity.

Heteroskedasticity Test: Breusch-Pagan-Godfrey		**Null Hypothesis: No Heteroscedasticity**	
F-statistic	0.858351	Prob. F(2,33)	0.4331
Obs*R-squared	1.780160	Prob. Chi-Square(2)	0.4106
Scaled explained SS	0.568624	Prob. Chi-Square(2)	0.7525

Source; Author's computation using E-views 10 econometric software.

The Heteroscedasticity test is based on the assumption that there is no heteroscedasticity in the model used in the analysis. The Breasch – Pagan Godfrey test for heteroscedasticity was used in this study. Results from the test as can be seen from the table above show that the p – value of the obs* R – squared is 0.4106 which is greater than 0.05. Therefore the researcher fails to reject the null hypothesis of no heteroscedasticity in the model. The conclusion is that there is no heteroscedasticity in the model.

4.10 Results from Normality Test

Statistical data require that the data used for analysis should be normally distributed. In order to check whether this assumption is violated, a normality test

was conducted on the dataset. The Jaque – Bera test was used to check the normality of the model. The result from the Jaque – Bera test shows that all the variables are normal with a probability of 0.339. This is shown in figure 2

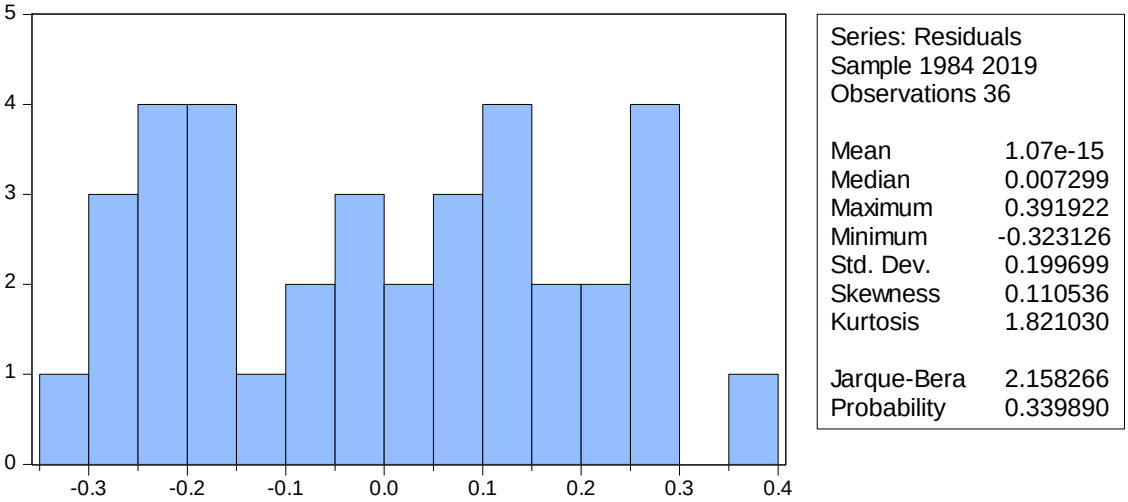

Figure 4.2: Result from Normality Test

Source; Author's computation using E-views 10 econometric software.

4.11 Results from Stability Test

Finally, to determine whether the VAR model was suitable for analysis, a VAR stability test was conducted. The results of the stability test are shown on the figure below when analyzing the stability of the coefficients, the Cumulative Sum (*CUSUM*) and Cumulative Sum of Squares (*CUSUMQ*) are applied. Following Pesaran and Pesaran (as cited in Bahmani-Oskooee, 2004), the stability of the regression coefficients is evaluated by stability tests and they can 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 result for *CUSUM* and *CUSUMQ* are shown in Figures 3 and Figure 4. The null hypothesis is that the coefficient vector is the same in every period and the alternative is that it is not (Bahmani-Oskooee, 2004). The

CUSUM and *CUSUMQ* statistics are plotted against the critical bound of 5 percent significance level. According to Bahmani-Oskooee (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.

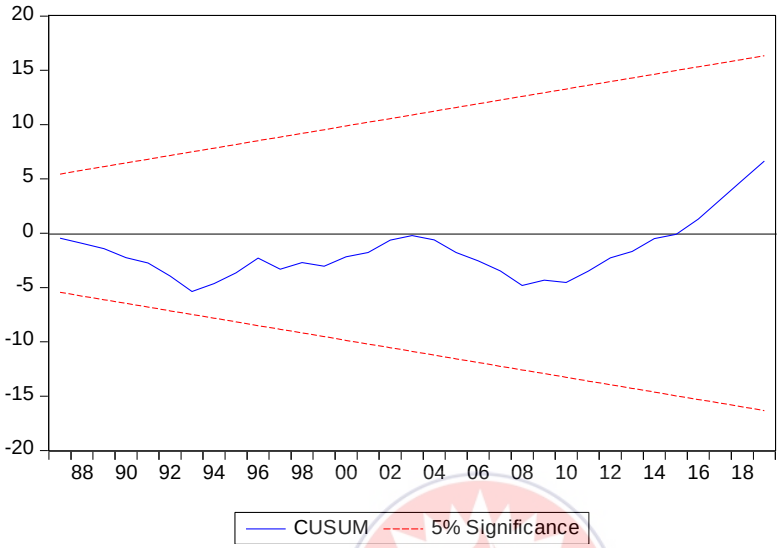

Figure 4.3: Result from Cusum Test

Source; Author's computation using E-views econometric software.

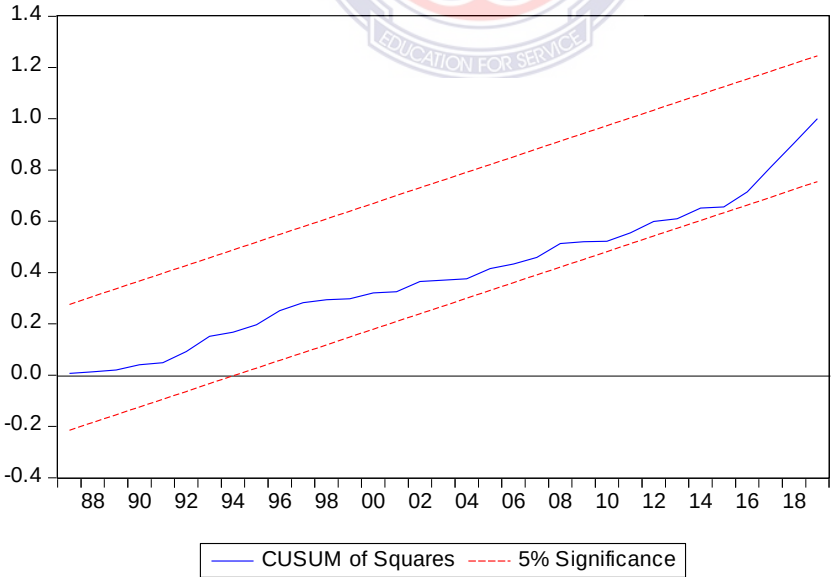

Figure 4.4: Result from Cusum of Squares Test

Source; Author's computation using E-views econometric software.

As shown in Figures 4.3 and 4.4, 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 3 and 4 that both *CUSUM* and *CUSUMQ* tests confirm the stability of the coefficients.

4.12 Chapter Summary

The objective of this research was to examine the effectiveness of inflation targeting on real exchange rate, export and import in Ghana. All variables were transformed into natural logarithm. This chapter presented and discussed the estimated results obtained in E-views 10 econometric software in both table and graphical forms. The first part of the analysis involved descriptive statistics by comparing the means of the variables between the pre – inflation targeting era and the inflation targeting era. ADF and PP unit roots procedures were undertaken to establish the stationary properties of these variables. Both the ADF and PP rejected the existence of unit roots in the four variables.

Diagnostic tests (Serial Correlation, Heteroscedasticity, and Normality tests) were all in favour of the variables and for that matter the model. This therefore eliminated any possibility of conducting spurious regression. The validity and robustness of the regression model was therefore ensured. The stability test conducted on the model established that the model was stable over the sample period. Annual time series data from 1984 to 2019 were used to estimate the coefficients of the VAR model used.

After running the regression, the study found that Inflation Targeting has a negative but statistically significant effect on real exchange rate. Also, inflation targeting has a positive and statistically insignificant effect on export in Ghana. Again, Inflation targeting had a negative but statistically insignificant effect on imports in Ghana.

Finally, impulse response and variance decomposition analysis was done. The next chapter concludes the study and presents policy recommendations based on the results from the econometric analysis.

CHAPTER FIVE

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.0 Introduction

This chapter presents the general summary of key findings, conclusions as well as policy recommendations obtained by the study. While the summary focuses more on the result of the main findings, the conclusions capture the overall outcomes regarding the findings of the study in light of the hypotheses advanced in chapter one. The chapter then concludes on the major findings of the research before advancing policy recommendations. Limitations for the study as well as direction for future research are equally featured in the chapter

5.1 Summary

The study examined the effectiveness of inflation targeting on Real Exchange rate, Exports and Imports. The work first gave a theoretical background to inflation targeting and then empirically analyzed its effects on Real Exchange rate, Exports and Imports in Ghana. The study sought to establish whether inflation targeting has had a favourable effects on these macroeconomic variables using annual time series data from 1984 – 2019; a period of 36 years. This time frame was further divided into two periods; the pre – inflation targeting period (which covered a total of 23 years) and the inflation targeting period (which had a total of 13 years). Specifically, the study sought to; assess the effects of inflation targeting on exchange rate; examine the effect of Inflation Targeting on export (% of GDP) and import (% of GDP) in Ghana.

A dummy variable for inflation targeting was used to capture the effect of inflation targeting on Real Exchange rate, Exports and Imports variables. The dummy variable took the value of zero during the pre-inflation targeting era and a value of one during the inflation targeting era, [1984-2006=0, 2007-2019=1].

The first part of the analysis involved descriptive statistics by comparing the means, the standard deviations, the skewness, minimum and maximum values of the variables. Regression analysis was then used to prove (or disprove) the results obtained under the descriptive statistics stage. It investigated what kind of relationship existed between inflation targeting and the macroeconomic variables under consideration. In this regard, the linkage between the inflation rate and the selected macroeconomic variables rate was examined using an unrestricted VAR model. The VAR model was selected to suit the theoretical and empirical linkages established between inflation targeting and Real Exchange rate, Exports and Imports variables in Ghana. The empirical analysis was performed using EVIEWS 10 statistical software.

The stationarity properties of the variables were tested using the Augmented-Dickey Fuller (ADF) and Phillips-Perron test statistics. The preliminary results obtained showed that all the variables are integrated at order 0, i.e. I (0). This means that all the variables did not have unit roots but were stationary at levels. The lag selection criteria revealed that the optimal number of lags for the VAR model was 1. The work used the Schwarz information criterion. Cointegration test was done using the Johansen Cointegration Test. The results from the trace test and maximum eigen value showed that there was no cointegration in the model. The lag 1 model was tested to be stable using Cusum

test. The presence of serial correlation in the model was tested using Breusch-Godfrey Serial Correlation LM Test and it was established that there was no serial correlation in the model. Also the presence of heteroscedasticity was tested using the Breasch – Pagan Godfrey test and it was established that there was no heteroscedasticity in the model. The Jaque – Bera test was used to check the normality of the model and it was found to be normal.

The study estimated three equations, each incorporating the objectives of the study in finding the effects of inflation targeting on Real Exchange rate, Exports and Imports variables. The most important variable in each model was the Inflation Targeting dummy. This was important because the work looked at its effects on the endogenous variable in each model under consideration.

With an empirical analysis and through a comparison between the periods before and after the adoption of the inflation targeting strategy, the effects of inflation targeting on Real Exchange rate, Exports (% of GDP) and Imports (% of GDP) were subjected to a regression analysis based on the LSM Least Square Method (LSM). The major findings of the study are as follows;

- Inflation targeting has had a negative but statistically significant effect on the real exchange rate. The implication of the above result is that the adoption of inflation targeting in Ghana has been able to combat the ruin of exchange rate to some extent.
- Also, the study found that inflation targeting had a positive but statistically insignificant effect on exports in Ghana. This implies that Inflation Targeting has no effect on exports.

- Inflation targeting had a negative but statistically insignificant effect on import. This implies that the implementation of Inflation Targeting has no effects imports in Ghana.

5.2 Conclusions

The main objective of this study is to analyze the effectiveness of inflation targeting on Real Exchange rate, Exports and Imports in Ghana. The study adopted the Vector Autoregressive (VAR) model since all the variables are stationary at levels. Theoretical and empirical foundations were established to ensure that results obtained could be interpreted within conventional research requirements. The revelations that emerged from the study are; Inflation targeting has had a negative but statistically significant effect on the real exchange rate. Also, the study concludes that inflation targeting had a positive but statistically insignificant effect on export in Ghana. Again, Inflation targeting had a negative but statistically insignificant effect on import.

5.3 Recommendations

Based on the findings and conclusions of the study, the following recommendations are made;

Policy measures towards the stabilization of the exchange rates are highly recommended so that level of imports can be controlled and exports encouraged. The capacity of Exports should be enhanced through acquisition of means of production and improved technology. This will consequently pull down demand for imports.

The study suggests that government implement policies that are directed towards the patronization of locally produced goods. Subsidies should be given to

local manufacturers and tariffs should be levied on imports. These policies will ensure that Ghanaians switch from too much spending on imports to spending on locally produced goods (Made-in-Ghana) since the locally produced goods will become cheaper than the imported ones. A switch from imports will improve the trade balance since excess imports over exports results in trade deficit. This will lead to an improvement in the trade balance.

In trying to address the challenges of export in order to enhance exports in Ghana, policy makers should be mindful not to be overly concentrated on inflation targeting since it does not have any significant effect on export of Ghana. More attention should rather be directed at how to increase GDP in order to enhance our export industry since the country is blessed beyond bounds with natural resources. Exports capacity should be enhanced through acquisition of improved technology and means of production; this will in turn further pull down demand for imports.

Bank of Ghana should adopt a mechanism that leads to stability of the exchange rate. This is because an unstable exchange rate caused by inappropriate exchange rate policies promotes parallel market activities that create uncertainty in the foreign exchange rate markets. This reduces export viability, as more risk in the foreign exchange rate market reduces the county's trade position in relation to other trading partners

5.4 Limitations of the Study

The setbacks encountered in this study mainly involve data availability. There were not enough data points for all variables included in the study, thereby restricting the sample period of 1984 – 2019. It must, however, be emphasized that the above limitations do not in any way undermine the outcome from the study

It should be noted that it is not possible to cover all the aspects of a particular field of enquiry in a single study. In this section, the aspects of research that were not covered are highlighted and these will identity priorities for future research.

5.5 Direction for Future Studies

Further studies should also consider adopting more variables in the model for the study since inflation affect many parameters in an economy. By using more variables, future studies will contribute towards refinement of these findings by providing a more holistic effect of inflation targeting in the economy. Future works should look at the response of other macroeconomic variables such as real interest rates to inflation targeting so as to help in assessing the overall effect of the inflation targeting regime.

Further research should be done on a relatively longer horizon time scale provided supportive data are available. Again, if available, high frequency data should be employed to capture large variations in the series.

The study employed the Vector Autoregressive model to examine the effect of inflation targeting on the selected macroeconomic variables. Future study can consider exploring other estimation techniques to confirm the result obtained in this study. This will likely improve upon our results and may provide more sturdy conclusions.

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APPENDICES

APPENDIX 1

(Data)

Appendix 1: Data Used for Estimations:

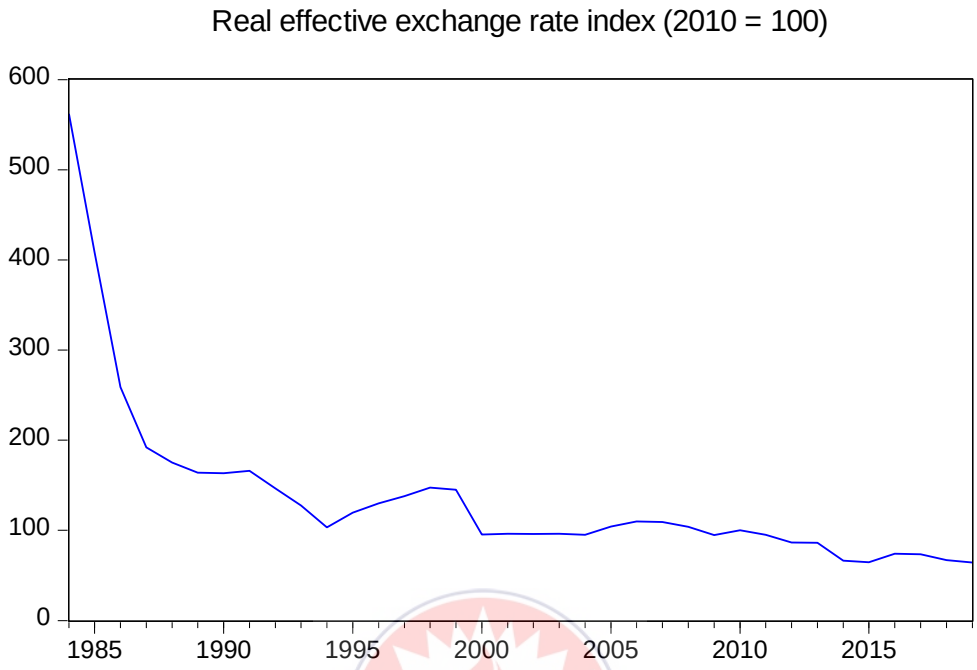
Table 1 gives the data used in this study for estimation

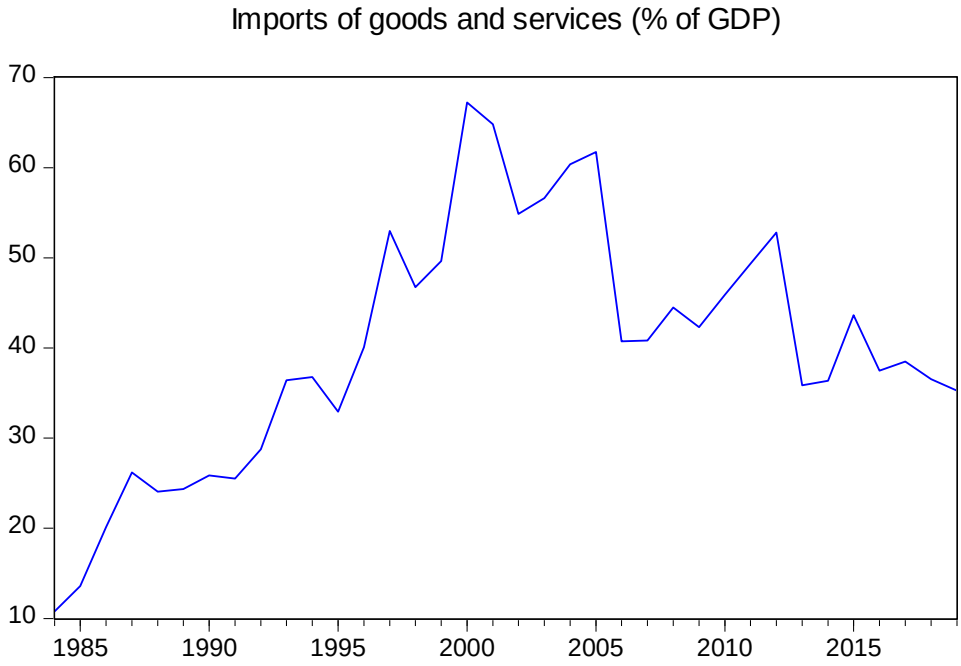
Year	LNREER	LNEX	LNIMP	IT
1984	6.331735	2.084930	2.376819	0
1985	6.012881	2.365981	2.609287	0
1986	5.556943	2.807962	3.002489	0
1987	5.258209	2.978718	3.265207	0
1988	5.165674	2.900508	3.180639	0
1989	5.099064	2.817959	3.192255	0
1990	5.096139	2.826005	3.252322	0
1991	5.112403	2.831067	3.239651	0
1992	4.986379	2.846417	3.359251	0
1993	4.849896	3.008348	3.594986	0
1994	4.638597	3.229168	3.604479	0
1995	4.785473	3.198528	3.494282	0
1996	4.866148	3.469235	3.691196	0
1997	4.927532	3.478476	3.970132	0
1998	4.993206	3.522570	3.844348	0
1999	4.977537	3.468181	3.904530	0
2000	4.557126	3.887777	4.208360	0
2001	4.568419	3.811827	4.171504	0
2002	4.564058	3.752236	4.005021	0
2003	4.568465	3.705713	4.036152	0
2004	4.555334	3.671309	4.100443	0
2005	4.646094	3.595920	4.122645	0
2006	4.699673	3.226551	3.706948	0
2007	4.694727	3.199697	3.709398	1
2008	4.642678	3.220053	3.795147	1
2009	4.552146	3.377310	3.744855	1
2010	4.605170	3.383601	3.826489	1
2011	4.556123	3.609203	3.899117	1
2012	4.459768	3.697820	3.966678	1
2013	4.457242	3.251513	3.579562	1
2014	4.195326	3.361107	3.593179	1
2015	4.169224	3.464447	3.775690	1
2016	4.307057	3.462000	3.623727	1
2017	4.298962	3.562693	3.650398	1
2018	4.204678	3.562872	3.598626	1
2019	4.162642	3.582874	3.563004	1

Source: World Development Indicators (2018)

APENDIX 2

Figure 1: Graphs of Variable APENDIX 2 (Graphical Representation)





APPENDIX 3

(VAR Estimation Results)

Regression Results for VAR Model

System: UNTITLED
Estimation Method: Least Squares
Date: 10/20/21 Time: 02:17
Sample: 1984 2019
Included observations: 36
Total system (balanced) observations 140

	Coefficient	Std. Error	t-Statistic	Prob.
C(1)	0.716479	0.096147	7.451893	0.0000
C(2)	-0.049133	0.167099	-0.294033	0.7692
C(3)	0.014569	0.156258	0.093237	0.9259
C(4)	-0.123849	0.056641	-2.186575	0.0307
C(5)	1.449253	0.766795	1.890015	0.0612
C(6)	0.085076	0.137906	0.616915	0.5385
C(7)	0.818029	0.239674	3.413092	0.0009
C(8)	0.024550	0.224124	0.109535	0.9130
C(9)	0.069920	0.081241	0.860656	0.3911
C(10)	0.117710	1.099829	0.107026	0.9149
C(11)	0.088543	0.130870	0.676569	0.5000
C(12)	0.144857	0.227446	0.636885	0.5254
C(13)	0.724638	0.212689	3.407022	0.0009
C(14)	-0.007951	0.077096	-0.103130	0.9180
C(15)	0.134033	1.043716	0.128419	0.8980
C(16)	-0.170443	0.148417	-1.148407	0.2531
C(17)	-0.293750	0.257942	-1.138823	0.2570
C(18)	0.159519	0.241207	0.661336	0.5097
C(19)	0.902534	0.087433	10.32260	0.0000
C(20)	1.264621	1.183657	1.068401	0.2875
Determinant residual covariance		3.30E-08		

Equation: LNREER = C(1)*LNREER(-1) + C(2)*LNEX(-1) + C(3)*LNIMP(-1) + C(4)*IT(-1) + C(5)
Observations: 36

R-squared	0.931089	Mean dependent var	4.736886
Adjusted R-squared	0.921901	S.D. dependent var	0.399913
S.E. of regression	0.111761	Sum squared resid	0.374713
Durbin-Watson stat	1.813299		

Equation: LNEX = C(6)*LNREER(-1) + C(7)*LNEX(-1) + C(8)*LNIMP(-1) + C(9)*IT(-1) + C(10)
Observations: 36

R-squared	0.818841	Mean dependent var	3.318161
Adjusted R-squared	0.794687	S.D. dependent var	0.353774
S.E. of regression	0.160300	Sum squared resid	0.770887
Durbin-Watson stat	1.945407		

Equation: LNIMP = C(11)*LNREER(-1) + C(12)*LNEX(-1) + C(13)*LNIMP(-1) + C(14)*IT(-1) + C(15)
Observations: 36

R-squared	0.837694	Mean dependent var	3.653771
Adjusted R-squared	0.816053	S.D. dependent var	0.354687
S.E. of regression	0.152122	Sum squared resid	0.694234
Durbin-Watson stat	2.075994		

Equation: IT = C(16)*LNREER(-1) + C(17)*LNEX(-1) + C(18)*LNIMP(-1) + C(19)*IT(-1) + C(20)
Observations: 36

R-squared	0.890732	Mean dependent var	0.371429
Adjusted R-squared	0.876163	S.D. dependent var	0.490241
S.E. of regression	0.172518	Sum squared resid	0.892879
Durbin-Watson stat	2.009513		

APENDIX 4

UNIT ROOTS TEST (REAL EXCHANGE RATE)

AUGMENTED DICKEY – FULLER TEST AND PHILLIPS – PERRON TEST

Null Hypothesis: LNREER has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=9)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-4.360129	0.0015
Test critical values:	1% level	-3.632900	
	5% level	-2.948404	
	10% level	-2.612874	

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

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(LNREER)
Method: Least Squares
Date: 10/20/21 Time: 02:24
Sample (adjusted): 1985 2019
Included observations: 35 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LNREER(-1)	-0.185260	0.042489	-4.360129	0.0001
C	0.827061	0.204850	4.037404	0.0003

R-squared	0.365515	Mean dependent var	-0.061974
Adjusted R-squared	0.346289	S.D. dependent var	0.144082
S.E. of regression	0.116494	Akaike info criterion	-1.406510
Sum squared resid	0.447838	Schwarz criterion	-1.317633
Log likelihood	26.61392	Hannan-Quinn criter.	-1.375829
F-statistic	19.01073	Durbin-Watson stat	1.569597
Prob(F-statistic)	0.000120		

Null Hypothesis: LNREER has a unit root
Exogenous: Constant
Bandwidth: 2 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-4.089605	0.0031
Test critical values:	1% level	-3.632900	
	5% level	-2.948404	
	10% level	-2.612874	

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

Residual variance (no correction)	0.012795
HAC corrected variance (Bartlett kernel)	0.015631

Phillips-Perron Test Equation
Dependent Variable: D(LNREER)
Method: Least Squares
Date: 10/20/21 Time: 02:26
Sample (adjusted): 1985 2019
Included observations: 35 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LNREER(-1)	-0.185260	0.042489	-4.360129	0.0001
C	0.827061	0.204850	4.037404	0.0003

R-squared	0.365515	Mean dependent var	-0.061974
Adjusted R-squared	0.346289	S.D. dependent var	0.144082
S.E. of regression	0.116494	Akaike info criterion	-1.406510
Sum squared resid	0.447838	Schwarz criterion	-1.317633
Log likelihood	26.61392	Hannan-Quinn criter.	-1.375829
F-statistic	19.01073	Durbin-Watson stat	1.569597
Prob(F-statistic)	0.000120		

UNIT ROOTS TEST (EXPORTS)

AUGMENTED DICKEY – FULLER TEST AND PHILLIPS – PERRON TEST

Null Hypothesis: LNEX has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=9)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-3.320218	0.0215
Test critical values:	1% level	-3.632900	
	5% level	-2.948404	
	10% level	-2.612874	

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

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(LNEX)
Method: Least Squares
Date: 10/20/21 Time: 02:28
Sample (adjusted): 1985 2019
Included observations: 35 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LNEX(-1)	-0.216363	0.065165	-3.320218	0.0022
C	0.751466	0.215038	3.494579	0.0014

R-squared	0.250406	Mean dependent var	0.042798
Adjusted R-squared	0.227691	S.D. dependent var	0.176132
S.E. of regression	0.154786	Akaike info criterion	-0.838097
Sum squared resid	0.790640	Schwarz criterion	-0.749220
Log likelihood	16.66671	Hannan-Quinn criter.	-0.807417
F-statistic	11.02385	Durbin-Watson stat	1.870846
Prob(F-statistic)	0.002203		

Null Hypothesis: LNEX has a unit root
Exogenous: Constant
Bandwidth: 0 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-3.320218	0.0215
Test critical values:	1% level	-3.632900	
	5% level	-2.948404	
	10% level	-2.612874	

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

Residual variance (no correction)	0.022590
HAC corrected variance (Bartlett kernel)	0.022590

Phillips-Perron Test Equation
Dependent Variable: D(LNEX)
Method: Least Squares
Date: 10/20/21 Time: 02:30
Sample (adjusted): 1985 2019
Included observations: 35 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LNEX(-1)	-0.216363	0.065165	-3.320218	0.0022
C	0.751466	0.215038	3.494579	0.0014

R-squared	0.250406	Mean dependent var	0.042798
Adjusted R-squared	0.227691	S.D. dependent var	0.176132
S.E. of regression	0.154786	Akaike info criterion	-0.838097
Sum squared resid	0.790640	Schwarz criterion	-0.749220
Log likelihood	16.66671	Hannan-Quinn criter.	-0.807417
F-statistic	11.02385	Durbin-Watson stat	1.870846
Prob(F-statistic)	0.002203		

UNIT ROOTS TEST (IMPORT)

AUGMENTED DICKEY – FULLER TEST AND PHILLIPS – PERRON TEST

Null Hypothesis: LNIMP has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=9)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-3.619955	0.0103
Test critical values:	1% level	-3.632900	
	5% level	-2.948404	
	10% level	-2.612874	

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

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(LNIMP)
Method: Least Squares
Date: 10/20/21 Time: 02:33
Sample (adjusted): 1985 2019
Included observations: 35 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LNIMP(-1)	-0.220678	0.060962	-3.619955	0.0010
C	0.832719	0.222079	3.749658	0.0007

R-squared	0.284228	Mean dependent var	0.033891
Adjusted R-squared	0.262538	S.D. dependent var	0.171836
S.E. of regression	0.147566	Akaike info criterion	-0.933644
Sum squared resid	0.718594	Schwarz criterion	-0.844767
Log likelihood	18.33877	Hannan-Quinn criter.	-0.902964
F-statistic	13.10408	Durbin-Watson stat	1.969752
Prob(F-statistic)	0.000975		

Null Hypothesis: LNIMP has a unit root
Exogenous: Constant
Bandwidth: 0 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-3.619955	0.0103
Test critical values:	1% level	-3.632900	
	5% level	-2.948404	
	10% level	-2.612874	

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

Residual variance (no correction)	0.020531
HAC corrected variance (Bartlett kernel)	0.020531

Phillips-Perron Test Equation
Dependent Variable: D(LNIMP)
Method: Least Squares
Date: 10/20/21 Time: 02:34
Sample (adjusted): 1985 2019
Included observations: 35 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LNIMP(-1)	-0.220678	0.060962	-3.619955	0.0010
C	0.832719	0.222079	3.749658	0.0007

R-squared	0.284228	Mean dependent var	0.033891
Adjusted R-squared	0.262538	S.D. dependent var	0.171836
S.E. of regression	0.147566	Akaike info criterion	-0.933644
Sum squared resid	0.718594	Schwarz criterion	-0.844767
Log likelihood	18.33877	Hannan-Quinn criter.	-0.902964
F-statistic	13.10408	Durbin-Watson stat	1.969752
Prob(F-statistic)	0.000975		

APENDIX 5

SERIAL CORRELATION

Breusch-Godfrey Serial Correlation LM Test:

F-statistic	0.544787	Prob. F(2,31)	0.5854
Obs*R-squared	1.215729	Prob. Chi-Square(2)	0.5445

Test Equation:
Dependent Variable: RESID
Method: Least Squares
Date: 20/10/21 Time: 02:37
Sample: 1984 2019
Included observations: 36
Presample missing value lagged residuals set to zero.

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LNGDP	0.041677	0.190687	0.218562	0.8284
LNEXCH	0.002792	0.036025	0.077512	0.9387
LNEXPO	-0.018982	0.093424	-0.203179	0.8403
RESID(-1)	0.092458	0.178685	0.517435	0.6085
RESID(-2)	-0.173172	0.183514	-0.943647	0.3526

R-squared	0.033770	Mean dependent var	0.005751
Adjusted R-squared	-0.090905	S.D. dependent var	0.422729
S.E. of regression	0.441525	Akaike info criterion	1.331082
Sum squared resid	6.043273	Schwarz criterion	1.551015
Log likelihood	-18.95947	Hannan-Quinn criter.	1.407844
Durbin-Watson stat	1.976035		

APENDIX 6

HETEROSKEDASTICITY

Heteroskedasticity Test: Breusch-Pagan-Godfrey

F-statistic	0.858351	Prob. F(2,33)	0.4331
Obs*R-squared	1.780160	Prob. Chi-Square(2)	0.4106
Scaled explained SS	0.568624	Prob. Chi-Square(2)	0.7525

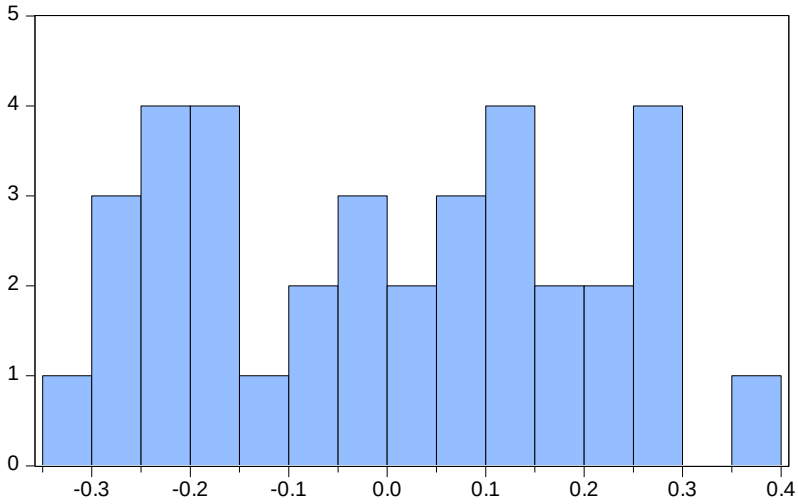
Test Equation:
Dependent Variable: RESID^2
Method: Least Squares
Date: 10/20/21 Time: 02:41
Sample: 1984 2019
Included observations: 36

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.150228	0.092300	1.627594	0.1131
LNEX	0.076608	0.075002	1.021408	0.3145
LNIMP	-0.091980	0.074175	-1.240053	0.2237

R-squared	0.049449	Mean dependent var	0.068988
Adjusted R-squared	-0.008160	S.D. dependent var	0.061007
S.E. of regression	0.061255	Akaike info criterion	-2.667882
Sum squared resid	0.123822	Schwarz criterion	-2.535922
Log likelihood	51.02187	Hannan-Quinn criter.	-2.621824
F-statistic	0.858351	Durbin-Watson stat	0.711255
Prob(F-statistic)	0.433107		

APPENDIX 7

NORMALITY TEST



Series: Residuals	
Sample 1984 2019	
Observations 36	
Mean	1.07e-15
Median	0.007299
Maximum	0.391922
Minimum	-0.323126
Std. Dev.	0.199699
Skewness	0.110536
Kurtosis	1.821030
Jarque-Bera	2.158266
Probability	0.339890

APPENDIX 8

VAR STABILITY TEST