

**THE IMPACT OF OIL PRICE CHANGES ON  
INFLATION IN GHANA**

**BY**

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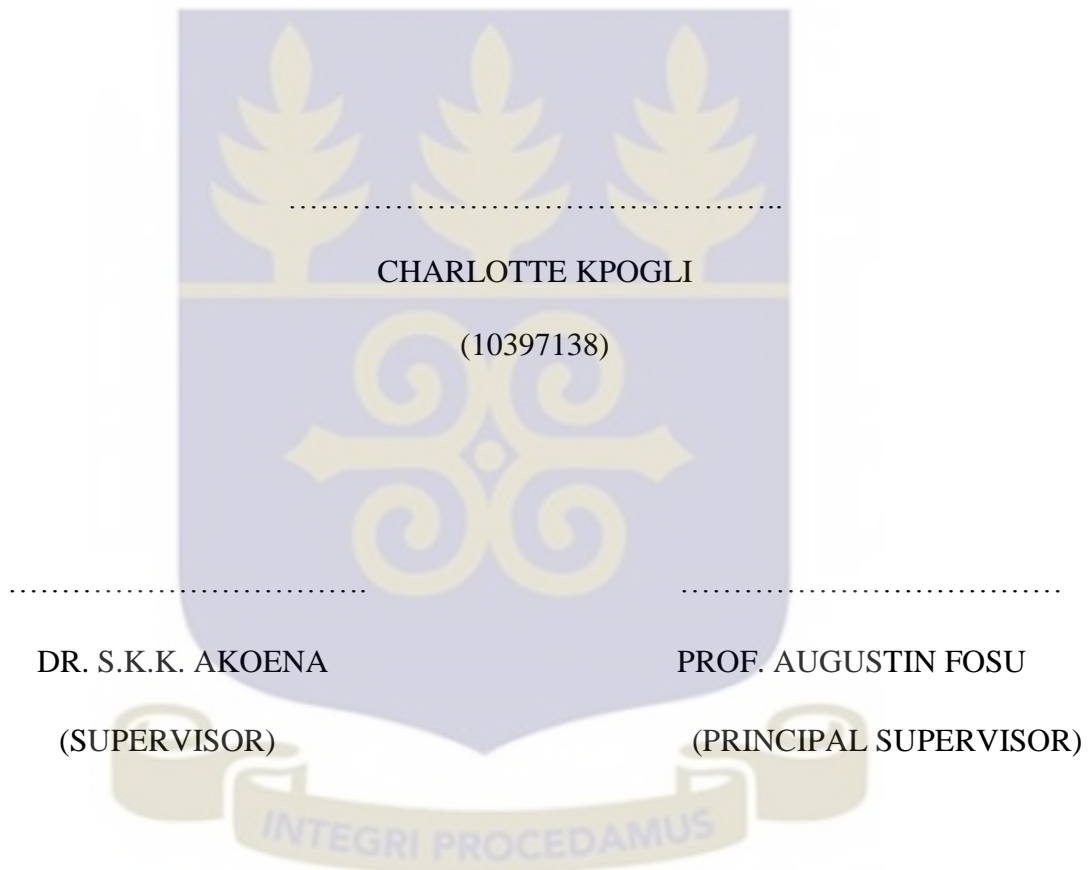
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INTEGRI PROCEDAMUS

## DECLARATION

This is to certify that this thesis is the result of research undertaken by Charlotte Kpogli towards the award of the Master of Philosophy (MPHIL) degree in Economics at the Department of Economics, University of Ghana under the supervision of the under signed lecturers.



## ABSTRACT

Ghana still depends largely on imported crude oil to meet its crude oil needs since oil is an integral part of her economy. This dependency makes most macroeconomic indicators such as inflation of the Ghanaian economy vulnerable to fluctuations in the world price of crude oil. This study therefore employed Vector Autoregression (VAR) to examine the impact of oil price changes on inflation in Ghana using monthly data from 1998 to 2013. Unlike previous studies on oil price inflation relationship conducted on developed countries, this study is done for Ghana as a developing nation.

The study aimed at finding the nature of the relationship between oil price changes and inflation in Ghana. To achieve this aim, it dealt with three main objectives. The study first estimated a relationship between oil price changes and inflation. The next objective was to determine the presence of asymmetry in the relationship. The last objective was to find the direction of causality and hence the transmission mechanism through which oil price changes might affect inflation.

The result indicates a positive effect of oil price on inflation in both the short run and the long run. The study reveals that in Ghana as a developing country, oil price increase results in higher inflation directly and through the exchange rate.

To reduce the inflationary pressure in Ghana, government should find a way to blunt this cost-push inflation emanating from oil prices.

## DEDICATION

I dedicate this work to the Almighty God, Whose grace and love has brought me this far and to my son, Cyril Dzorgbenyui Letsa.



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Charlotte Kpogli

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## TABLE OF CONTENTS

<b>DECLARATION</b> .....	ii
<b>ABSTRACT</b> .....	iii
<b>DEDICATION</b> .....	iv
<b>ACKNOWLEDGEMENTS</b> .....	v
<b>LIST OF FIGURES</b> .....	ix
<b>LIST OF TABLES</b> .....	x
<b>LIST OF ABBREVIATIONS</b> .....	xi
<b>CHAPTER ONE</b> .....	1
<b>INTRODUCTION</b> .....	1
<b>1.1 Background to the study</b> .....	1
<b>1.2 Problem Statement</b> .....	4
<b>1.3 Objectives of the study</b> .....	9
<b>1.4 Hypotheses of the study</b> .....	10
<b>1.6 Justification of the study</b> .....	10
<b>1.6 Organization of the Study</b> .....	12
<b>CHAPTER TWO</b> .....	13
<b>OVERVIEW OF THE OIL PRICES AND INFLATION IN GHANA</b> .....	13
<b>2.1 Introduction</b> .....	13
<b>2.2 Overview of the Petroleum Sub-Sector in Ghana</b> .....	13
<b>2.3 The Projected Future Demand for Petroleum Products in Ghana</b> .....	15
<b>2.4 The Pricing of Petroleum Products in Ghana</b> .....	17
<b>2.5 A Background on Inflation</b> .....	23
<b>2.6 Historical Overview of Inflation in Ghana</b> .....	27
<b>2.7 Trend of Inflation, Oil price, Exchange rate and Interest rate in Ghana</b> 32	
<b>2.8 Petroleum Pricing Policies in Ghana</b> .....	34
<b>CHAPTER THREE</b> .....	37
<b>LITERATURE REVIEW</b> .....	37
<b>3.1 Introduction</b> .....	37
<b>3.2 Definition of Inflation</b> .....	37
<b>3.3: Theoretical Literature</b> .....	40
<b>3.3.1 Monetarists and Structuralists</b> .....	40
<b>3.4 Empirical Literature</b> .....	52
<b>3.6 Inflation in Sub-Saharan Africa Countries (SSA)</b> .....	60
<b>3.7 Inflation in Ghana</b> .....	63
<b>3.8 Conclusion</b> .....	67
<b>CHAPTER FOUR</b> .....	68

<b>THEORETICAL FRAMEWORK AND METHODOLOGY .....</b>	<b>68</b>
<b>4.1 Introduction .....</b>	<b>68</b>
<b>4.2 The Econometric Model.....</b>	<b>69</b>
<b>4.2.1 Theoretical Framework.....</b>	<b>69</b>
<b>4.2.2 The Empirical Model.....</b>	<b>71</b>
<b>4.3 Description and Justification of Explanatory Variables.....</b>	<b>74</b>
<b>4.4 The Econometric Technique.....</b>	<b>76</b>
<b>4.4.1 Vector Autoregression (VAR).....</b>	<b>76</b>
<b>4.4.2 Correlation Test .....</b>	<b>78</b>
<b>4.4.3 Stationarity Test.....</b>	<b>78</b>
<b>4.4.4 Cointegration Test.....</b>	<b>81</b>
<b>4.4.5 Diagnostic Check.....</b>	<b>82</b>
<b>4.5 Relationship between Inflation and the Explanatory variables .....</b>	<b>82</b>
<b>4.5.1 Relationship between Oil Prices and Inflation.....</b>	<b>82</b>
<b>4.5.2 Interest rate and Inflation.....</b>	<b>83</b>
<b>4.5.3 Exchange Rate (Trade) and Inflation .....</b>	<b>84</b>
<b>ANALYSIS AND DISCUSSION OF RESULTS .....</b>	<b>86</b>
<b>5.1 Introduction .....</b>	<b>86</b>
<b>5.2.1 Data Description and sources. ....</b>	<b>86</b>
<b>5.2.2 Descriptive Analysis.....</b>	<b>87</b>
<b>5.2.3 Correlation analysis .....</b>	<b>88</b>
<b>5.3 Examination of the Stationarity Properties of the Variables .....</b>	<b>89</b>
<b>5.3.1 Stationarity Test or Unit Root Test.....</b>	<b>89</b>
<b>5.5 Short Run Dynamics .....</b>	<b>97</b>
<b>5.6 Diagnostic Test for Parsimonious Result.....</b>	<b>101</b>
<b>5.8 Causality test.....</b>	<b>102</b>
<b>5.7 Conclusion .....</b>	<b>103</b>

<b>CHAPTER SIX</b> .....	104
<b>SUMMARY, CONCLUSION AND POLICY RECOMMENDATIONS</b> .....	104
<b>6.1 Introduction</b> .....	104
<b>6.2 Summary of the study</b> .....	104
<b>6.3 Conclusions</b> .....	105
<b>6.4 Policy Recommendations</b> .....	106
<b>6.5 Limitations of the Study</b> .....	107
<b>6.6 Recommendation for Future Studies</b> .....	107
<b>REFERENCES</b> .....	108



## LIST OF FIGURES

Figure 2.1... Trend of growth rate of CPI, growth rate of oil price and growth rate of exchange rate.....	35
Figure 2. 2...Trend of interest rate.....	36
Figure 5.1 ...Graph of Level variables.....	91
Figure 5.2 ...Graph of First difference of variables used .....	92



## LIST OF TABLES

Table 2.1 ... The Projected Demand for Petroleum Products in Ghana (Moderate Growth).....	18
Table 2.2 ...The Projected Demand for Petroleum Products in Ghana (High Growth).....	19
Table 2.3 ... Petroleum Ex-pump Price Reviews from 1993 to 2013 (cedi/litre or cedi/kg).....	23
Table 5.1... Definitions and sources of variables.....	88
Table 5.2 .... Summary of descriptive statistics.....	88
Table 5.3.... Correlation matrix.....	89
Table 5.4 .....ADF and PP-test at levels.....	92
Table 5.5 ..... ADF and PP unit root test at first difference.....	93
Table 5.6 .....Unrestricted Cointegration Rank Test (Maximum Eigenvalue)....	95
Table 5.7 ..... Normalized cointegrating coefficient (standard error in parentheses).....	96
Table 5.8..... Over- parameterization (Dependent variable: D (LCPI)).....	99
Table 5.9.....Parsimonious Result for Error Correction Model (Dependent variable: D(LCPI)).....	100
Table5.10.....Diagnostic Test for Parsimonious result.....	102
Table5.11..... Causality Test.....	103

## LIST OF ABBREVIATIONS

ADF	Augmented Dickey-Fuller
AIC	Akaike Information Criterion
BOG	Bank of Ghana
BOST	Bulk Oil Storage and Transport
BRV	Bulk Road Vehicles
CEPA	Centre for Policy Analysis
CFA	Communauté Financière Africaine (African Financial Community)
COICOP	Classification of the Individual Consumption by Purpose
CPC	Central Product Classification
CPI	Consumer Price Index
ECM	Error Correction Model
ECT	Error Correction Team
ERP	Economic Recovery Programmes
GDP	Gross Domestic Product
GHAIP	Ghanaian Italian Petroleum Company Limited
GLSS	Ghana Living Standards Survey
GNPC	Ghana National Petroleum Corporation Law
GPRS	Ghana Poverty Reduction Strategy
GSS	Ghana Statistical Service
IEA	International Energy Agency
IMF	International Monetary Fund
ISSER	Institute of Statistical, Social and Economic Research
LDC	Less Developed Countries
LPG	Liquefied Petroleum Gas
NLC	National Liberation Council
NPA	National Petroleum Authority
NPP	New Patriotic Party
OECD	Organisation for Economic Cooperation and Development
OLS	Ordinary Least Square
OMC	Oil Market Companies
OPEC	Organization of Petroleum Exporting Countries
P.N.D.C.L	Provision National Defense Council Law
PCGEM	Philippine Computable General Equilibrium Model
PIDS	Philippine Institute for Development Studies

PNDC	Provision National Defence council
PP	Phillips-Perron
RFCC	Residual Fluid Catalytic Cracking
RFO	Residual Fuel Oil
SBM	Single Buoy Mooring
SIC/SBC	Schwartz Bayesian Information Criteria
SSA	Sub-Saharan Africa
TOR	Tema Oil Refinery
UK	United Kingdom
UPPF	Unified Petroleum Price Fund
USA	United States of America
VAR	Vector Auto-Regression
VEC	Vector Error Correction
VECF	Vector Error Correction Forecasting
VLTC	Volta Lake Transport Company Limited



## CHAPTER ONE

### INTRODUCTION

#### 1.1 Background to the study

Oil has powered the world in the form of transportation fuels for more than a century, and demand for oil is expected to grow over the long term and oil, natural gas and coal are expected to meet most of that demands. Oil prices have been fluctuating over the years. A major characteristic of the world oil market is the uncertainty and high levels of price fluctuations. These fluctuations have corresponding effects on exports and public revenues. Changes in prices are usually induced by movements in supply and demand (CEPA, 2010). Other reasons include speculation, geopolitical conflicts (recent happenings in Libya), natural disasters, etc.

As oil prices have climbed over the last several years, the memory of the 1970s and early 1980s has not been far from the minds of the public or of monetary policymakers. In those earlier episodes, rising oil prices were accompanied by double-digit overall inflation in the U.S. and in several other developed economies. Recently, the price of oil began rising in October 2003 and reached record levels in 2004 and again in 2005. As a result of these price increases, consumers' budgets have been under pressure, business costs have risen, and oil producers' profits have increased. The world crude oil market has witnessed profound fluctuations over the past few decades, with oil price rocketing to a record \$147 per barrel in July 2008. These persistent oil price shocks could have severe macroeconomic implications and present crucial challenges for policymaking, making it essential to empirically understand their effects on economic

activities in Ghana as a net-oil importing nation. The consequences of energy price shocks are particularly negative for energy importers, as they may suffer losses because of the higher price of inputs. Energy exporters may experience some gains and budget revenue increases, but may also suffer inflation (Cantore, Antimiani and Anciaes, 2012).

Inflation is a very important macro-economic issue. It is defined as the continuous increase of the general price level in a country. Inflation may arise as a result of the pressure of demands in an economy (demand-pull) or pressure caused by an increase in production costs (cost-push).

Ghana has had often very high and volatile rates of inflation particularly in the late 1970s through to the early 1980s. Various reasons have been assigned for this trend, notable among which are high public expenditure, excessive money supply growth, rapid depreciation of the cedi against major trading currencies, external shocks, drought (in 1983), and low agricultural production.

Oil prices have both direct and indirect effects on inflation. Rising oil prices tend to affect the overall consumer price index (CPI) directly by raising its energy cost component, which includes the prices of energy-related items, such as household fuels, motor fuels, gas, and electricity. Among these, gasoline and fuel oil are directly derived from crude oil, so their prices follow oil prices very closely. An increase in the price of oil may also affect energy costs through the prices of other items that are close substitutes. The extent to which rising oil prices translate into higher overall inflation

through higher energy costs depends on their persistence. If they continue to rise, they may lead to sustained increases in the overall price level, that is, to an increase in the overall inflation rate.

Rising oil prices tend also to affect the core portion of the CPI indirectly, because energy prices represent a considerable portion of the production cost for many of the items in it, such as transportation services. In addition, if workers have to pay higher energy prices themselves, they may bargain for compensating wage increases, which also increase the production costs of items in the core CPI. The extent to which rising oil prices translate into higher core inflation through higher production costs depends, among other things, on how much they break into the overall inflationary expectations of those who set prices and wages. In fact, if rising oil prices lead to higher inflationary expectations over the longer term, rising energy and wage costs are more likely to be passed through in terms of rising consumer prices. In this case, rising oil prices may lead to sustained increases in the core portion of the CPI, that is, to an increase in core inflation. This implies that oil price changes affect inflation through the two main causes of inflation: demand-pull and cost-push inflation.

In Ghana, the prices of refined petroleum products have impacts on almost every economic activity; as a result, the government of Ghana has a keen interest in petroleum prices. Before December 2011, the government of Ghana most often subsidized the increase of oil price from the world market. The Reuters news agency reports December 29, 2011 that “Ghana, which joined the club of oil producers in West Africa last year, has come under increased pressure from the International Monetary Fund (IMF) to

remove fuel subsidies”. According to the report, the IMF argued that the fuel subsidies are not effective in directly aiding the poor but rather promotes corruption and smuggling. It seems that because of the important place petroleum products occupy in the national economic system, their pricing is treated differently from other equally essential imports. Currently, the National Petroleum Authority (NPA) sets the prices of petroleum products in the country.

The need for crude oil for both household and commercial consumption cannot be over emphasized. Similar studies in this area have been conducted in most advanced countries such as United State, United Kingdom, Japan, China, Euro and others (see Hooker (1999),Cogni&Manera (2005),L’oeillet&Licheron (2008), and others). However, the magnitude and direction of the impact of oil price changes on inflation of these developed countries may not be the same as in the case of a developing country like Ghana. This study fills the gap so far as the literature for Ghana and Africa is concerned.

## **1.2 Problem Statement**

The interest of this study is propelled by the need to empirically measure the effect of oil price changes on inflation in Ghana. The issue of oil price changes is crucial as oil prices affect macroeconomic indicators of every country. In April 2011, the price of oil hit a high of \$127 a barrel; this was because of the conflict in Libya leading to the shutdown of its supplies. In Ghana, during the study period from 1998-2013, the inflation rate has been unstable mostly because of oil price increases.

However, at the end 2003, inflation rose to 23.6%. This was due to the adjustments and corrective measure instituted in the petroleum sector of the economy. The main sources of inflationary pressures in 2003 came mainly from the housing and utility sub-sector as well as the transportation and communication sector of the economy (Bank of Ghana Annual Report, 2003). The effects of the average increase of 95% in petroleum prices in February 2003 and the increase in communication tariffs in October 2003 were responsible for the high increase in inflation (Bank of Ghana Annual Report, 2003).

It may be recalled that by the end of the first quarter of 2003, the inflation surged by almost 18% from its December 2002 level mainly on account of the upward petroleum prices adjustment that was made at that time. By the end of the third quarter of 2004, inflation started easing downward, reducing by 0.8% to 11.8% by the end of December 2004.

Inflation picked up marginally in 2005 in response to higher prices of crude oil and increased demand pressures on the economy originating from the large budget deficit and election year spending in 2004 (Bank of Ghana Annual Report, 2005). Inflation was at its peak in March presumable after the petroleum adjustment in February 2005, and reduced considerable by the end of the year dropping from 16.7% in March 2005 to 14.8% in December 2005. This drop reflected the tightening of monetary policy by the Central Bank and supportive fiscal policy by the government.. The fall in the rate of inflation reflected a combination of improved food supply conditions in the market for foodstuffs, relatively stable exchange rate environment and a well-crafted monetary

policy to contain inflation expectations often associated with the fuel price shocks to the economy (Bank of Ghana Annual Report, 2006).

The surge in the inflation rate in the latter part of the 2007 emanated from two successive upward adjustments in retail prices of petroleum products, the upward adjustment in tariffs on utilities and higher food prices from the cost associated with food distribution (Bank of Ghana Annual Report, 2007). The inflation jumped up mainly on the strength of pass-through effects of the fuel price adjustment that was made.

Inflation increased in the first quarter of 2013 from 10.1% in January to 10.8 % by March 2013 and peaked at 11.8% in July before declining to 11.5% in August. The upward trend in inflation during the first seven months of the year was attributed to a combination of demand and supply side factors, including the hike in petroleum product prices and the impact of the expansionary fiscal policy of 2012. In August, however, inflation declined on the back of favourable developments in non-food prices, an indication that the pass-through effects of earlier petroleum price adjustments may have eased. (BOG Monetary Policy Report, 2013).

The International Energy Agency (IEA) has repeatedly said that oil prices pose a threat to growth. In 2011, the IEA estimated nominal oil prices of \$114 a barrel in 2015, revising its 2010 estimate of \$104 a barrel upward. The role of oil price changes on Ghana's inflation is not clear, however, as there is scanty documentation of the issue.

The present study was conducted to fill this gap in the literature and to provide important information for policy.

According to the Classical Macroeconomics approach, an increase in the money supply causes a rise in inflation in the same ratio as seen in the Fisher Equation. According to the Keynesian approach, on the other hand, it is assumed that an increase in demand in an economy will trigger inflation which rejects the Fisher Equation that stability in the circulation rate of money and national income at full employment levels prevents inflation. In line with the monetarist view adopted by Friedman, the most important cause of inflation is when increases in the money supply exceed the economic growth rate. According to Friedman, the money supply should be increased at the same rate as real economic growth in order to prevent inflation. According to the Rational Expectations theory, which is based on the assumption that individuals are rational beings and therefore will not make systematic mistakes, inflation is a consequence of the economic policies applied by governments. This theory argues that the best politics is “policy-free politics”.

Imported inflation has been observed as another channel through which oil price changes affect local inflation. Bjornland (1997) asserts that shocks such as oil price hikes have had long-run effects on core inflation and on output. He argued that imported core inflation is a major determinant of the total inflation and therefore oil price shocks are a major driving force of long-term inflation trends.

A study by Hooker (1999) estimated the effects of oil price changes on U.S. inflation in a Phillips curve framework, allowing for some of the asymmetries, nonlinearities, and structural breaks. It finds strong evidence of a structural break, with oil price changes making a substantial direct contribution to core inflation before 1980 but little or no pass-through since that time. According to Hooker (1999), oil price effects on overall inflation are not significantly changed, and are consistent with their direct shares in price indexes. The structural break specification provides a better fit to the data than do several asymmetric and nonlinear specifications stressed in the literature on the real effects of oil price shocks, and is robust to different specifications of the Phillips curve, measures of oil prices, details of sample period, and lag structure.

Wu, Li and Zhang (2011) conducted a similar study on China and U.S. They concluded that, in a free market economy like U.S., a doubling of oil price will only raise the inflation rate by 1.30%, which is even lower than the simulation result of China under price control.

L'oeillet&Licheron (2008) examined the empirical relationship between oil prices and headline inflation in the euro area, by estimating an augmented backward –looking Phillips curve. They concluded that, headline inflation is affected by the variation of oil prices and most notably by their increases. A nonlinear pattern in the relationship is reported. According to them, the established link does not seem to have remained stable over the whole sample. The Ghana case may or may not have a similar outcome.

Çelik, and Çetin, (2007) revealed that continuous fluctuations are observed in fuel oil prices in the Turkish economy because fuel oil distribution firms have recently adjusted their prices in accordance with developments in the international oil market. As a result of these fluctuations, changes in the prices of fuel oil products used intensively in sectors like production, transportation, the chemical industry and agriculture are expected to cause an inflationary effect. In their analysis, estimation results based on the vector error correction model revealed that a 1% increase in fuel oil prices with an approximate one year lag resulted in a 1.26% increase in the CPI index (Consumer Price Index). Furthermore, the analysis could not reject the hypothesis that an increase in oil prices is also the one-way Granger cause of an increase in CPI. This result may conform to the case of Ghana but the magnitude may differ.

In the light of the above some research questions arise. They include:

- What are the short-run and the long-run effects of oil price shocks on inflation in Ghana?
- Is there asymmetric or symmetric relationship between inflation and oil price in the case of Ghana as a developing country?

### **1.3 Objectives of the study**

The study's objectives are to;

- Determine the magnitude and direction of the relationship between oil price change and inflation in Ghana.
- Determine the presence of asymmetry of oil price and domestic inflation in Ghana.

- Uncover the direction of causality and the transmission mechanism through which inflation as a macro-economic factor is affected in Ghana by oil price changes.

#### **1.4 Hypotheses of the study**

H<sub>0</sub>: Oil price changes do not influence the inflation rate. In other words, oil price changes do not Granger-cause inflation.

H<sub>1</sub>: Oil price changes influence the inflation rate. In other words, oil price changes Granger-cause inflation {there is a positive effect of oil price changes on inflation}.

#### **1.6 Justification of the study**

Inflation, the condition of a continually rising price level, has become a major concern of politicians and the public, and how to control it frequently dominates the discussion on economic policy. According to Milton Friedman, inflation is always and everywhere a monetary phenomenon. He postulates that the source of all inflation episodes is a high growth rate of the money supply: simply by reducing the growth rate of the money supply to low levels, inflation can be prevented (Mishkin, 2007).

It seems that everywhere we look, we are reminded of how well or badly our economy is doing. But there is no simple way of figuring out how the economy is doing. There are however many different indicators that, once put together, can give us a rather clearer picture of the economy's health. One such economic indicator is the consumer price index (CPI); hence the need for research on inflation.

The price of oil is one of the most familiar economic indicators for many people as it is closely related to daily life. People are sensitive to changes in the price of gasoline or that of gas for example. Therefore, changes in the price of oil and their causes have been an interesting issue for economists (Yoshizaki, 2011). In Ghana, a change in the price of crude oil affects the cost of living of Ghanaians since the effect of the change leads to changes in the prices of goods and services. In Africa, few studies have been conducted into estimating the effect of oil price changes on inflation (Central Bank of Kenya, 2011; African Development Bank, 2012). Ghana, Nigeria, Ethiopia and Kenya are among the few countries where research has been carried out in this area. However, the results are inconclusive. While the results of Central Bank of Kenya (2011) showed that the main determinants of inflation in Kenya emanate from the money market and external sector the same could not be inferred from the findings of African Development Bank (undated) which revealed that oil prices are the main determinants of inflation in Kenya.

The present study differs from others conducted on inflation in that a majority of the earlier empirical studies have focused on the effects of oil shocks on real output; however, this thesis emphasizes the responses of inflation to oil price change. It also identifies the transmission mechanism through which inflation as a macro-economic factor is affected by oil price changes, unlike Adu and Marbuah (2011) for instance.

This study is also significant for other reasons as follows: overall, it will reveal how much a change in the international price of oil can cause inflation in Ghana. Such a

finding would help the government and policy makers to assess the economic cost of oil price changes and to consequently put in measures to address the problem.

## **1.6 Organization of the Study**

This study is organized in six chapters. Chapter one includes the background to the study, the statement of the research problem, hypotheses, the research questions, the objectives of the study, and the justification for the study. Chapter two gives an overview of the oil price changes and inflation in Ghana. Chapter three reviews the relevant literature, theoretical and empirical. Chapter four details the theoretical framework and methodology. The fifth chapter presents and discusses the results from the study. The final chapter concludes the study and offers recommendations for policy based on the findings. Limitations encountered in the course of this study as well as recommendations for further research are also presented in the concluding chapter.



## **CHAPTER TWO**

### **OVERVIEW OF THE OIL PRICES AND INFLATION IN GHANA**

#### **2.1 Introduction**

This chapter gives a general overview of the oil prices and inflation in Ghana with particular attention to petroleum sub-sector in Ghana, projected future demand for petroleum products in Ghana, and pricing of petroleum products in Ghana. The chapter also touches on some stylized facts of inflation in Ghana.

#### **2.2 Overview of the Petroleum Sub-Sector in Ghana**

The petroleum sub-sector constitutes the second largest energy consumption in Ghana. The petroleum sub-sector in Ghana is made up of upstream and downstream activities. The upstream activities mainly involved in the exploration of petroleum and related activities. The oil exploration activities started as far as the late 1980s with 89 wells drilled and 7 fields' discovered. Between 1978 and 1985 oil was produced in Saltpond and 75% of the 50 exploratory wells drilled have encountered varying degrees of hydrocarbons. The extension of exploration activities to deep water since 2000 has yielded some results with the discovery of oil in commercial quantities at Cape Three Point in Central Region. The Ghana National Petroleum Company (GNPC)-established by Ghana National Petroleum Corporation Law 1983 (P.N.D.C.L 64), Petroleum (Exploration and Production) Law, 1984 (P.N.D.C.L 84) and Petroleum Income Tax Law 1987 (P.N.D.C.L.188) - facilitates and promotes the exploration, production and

development of hydrocarbons and regulates the upstream activities (Ministry of Energy, 2003).

The downstream activities comprise the refinery, storage, transportation, distribution and retailing of petroleum products. The Tema Oil Refinery (TOR), formally known as Ghanaian Italian Petroleum Company Limited (GHAIP) and incorporated in 1960 under the company's code of Ghana, imports and refines all crude oil into the country, except for the consignment going to the thermal plant. Over the years, TOR has restructured its refinery capacity by changing from simple hydro skimming to modern complex refinery in 2002, with the commissioning of Residual Fluid Catalytic Cracking (RFCC) unit (Ministry of Energy, 2003).

Apart from the storage facilities at TOR, there are other strategic storage facilities at different parts of the country. The Bulk Oil Storage and Transport (BOST) – a private limited liability company incorporated under company' code of Ghana-oversees the planning and management of strategic storage of petroleum products in the country. The BOST is expected to keep strategic stock of three weeks national petroleum demand and is expected to increase its capacity to six weeks though existing facilities cannot accommodate that. BOST has seven storage depots across the country, but lease five to TOR. The two remaining are located in Kumasi and Bolgatanga with capacity of 5,000 and 15,400 metric tons of premium gasoline and diesel respectively (Ministry of Energy, 2003). The strategic storage capacity of existing depots as at 2000 were 6,400, 8,470, and 4,580 tonnes for premium gasoline, diesel and kerosene respectively ( Energy Commissions, 2006).

The transportation in the petroleum sub-sector is in three stages; the unloading of crude oil to TOR, conveying of petroleum products from TOR to storage depots and the conveying of the petroleum products from either TOR or storage depots to retailers. Crude oil is unloaded from ocean tankers docking at Tema seaport to TOR through pipelines. The unloading of petroleum products from the seaport to oil tankers is facilitated by the Single Buoy Mooring (SBM). The transportation of petroleum products from TOR to the strategic storage depots is by four modes: the first mode is pipeline from refinery to Mami water depot and Akosombo transit depot; the second mode is through the ocean by using small vessels from Tema to Takoradi; the third mode is fuel barges on the Volta lake from Akosombo to Buiepe by Volta Lake Transport Company Limited (VLTC) vessels; and the last mode is by Bulk Road Vehicles (BRVs) operated by Oil Market Companies (OMCs) and private owners. The conveyance of petroleum products from storage depots to distribution outlets is done by OMCs and private companies by BRVs.

The retailing of petroleum products in Ghana is solely done by OMCs and private companies throughout the country. The government, through Ministry of Energy, fabricated and distributed 994 storage tanks to selected locations in the promotion of Rural Kerosene Distribution Improvement Programme in 2005 (Budget Statement, 2006).

### **2.3 The Projected Future Demand for Petroleum Products in Ghana**

The demand for petroleum products in Ghana is growing by leap and bound and the future demand will continue to grow. The projections of demand for petroleum products

are under two economic growth scenarios, namely; high economic growth and moderate economic growth scenarios of the Ghana Poverty Reduction Strategy (GPRS). The current demand for petroleum products in Ghana is within the high economic growth scenario.

**Table 2.1**

**The Projected Demand for Petroleum Products in Ghana (Moderate Growth)**

<b>Years</b>	<b>2008</b>	<b>2012</b>	<b>2015</b>	<b>2020</b>
<b>GPRS Moderately High Economic Growth Scenario In Thousands Of Tonnes.</b>				
<b>LPG (No Constraints)</b>	121-134	231-259	324-352	418-445
<b>LPG (With Constraints)</b>	704-711	121-132	167-178	223-275
<b>Kerosene &amp; Jet Fuel</b>	215-219	215-219	283-300	330-350
<b>Gasoline Premium</b>	704-711	822-825	964-970	1,115-1,200
<b>Gasoline Premix</b>	68-70	73-75	76-80	81-85
<b>Diesel</b>	1,030-1,128	1,420-1,470	1,720-1800	2,030-2,100
<b>RFO (No Natural gas)</b>	124-125	134-136	146-147	156-159
<b>RFO (With Natural gas)</b>	41-42	44-45	48-50	52-53

Source: Energy Commission 2006.

**Table 2.2****The Projected Demand for Petroleum Products in Ghana (High Growth)**

Years	2008	2012	2015	2020
<b>GPRS High Economic Growth Scenario In Thousands Of Tones.</b>				
LPG (No Constraints)	200-225	231-259	324-352	418-445
LPG (With Constraints)	100-110	115-130	162-178	210-223
Kerosene & Jet Fuel	218-225	225-265	283-300	330-350
Gasoline Premium	704-711	822-825	964-970	1,115-1,200
Gasoline Premix	68-70	73-75	76-80	81-85
Diesel	1,030-1,128	1,420-1,470	1,720-1800	2,030-2,100
RFO (No Natural gas)	124-125	134-136	146-147	156-159
RFO (With Natural gas)	41-42	44-45	48-50	52-53

Source: Energy Commission, 2006

#### **2.4 The Pricing of Petroleum Products in Ghana**

Prior to the 2003 reform importation of crude and refining were exclusively handled by the government through the Ghana National Petroleum Company (GNPC). Prices of petroleum products were heavily subsidized. In 2003, due to the heavy indebtedness of GNPC and near insolvency of the Tema Oil Refinery and under pressure from the International Monetary Fund (IMF), a new pricing mechanism was introduced. The new pricing scheme which has come to be known as the Price Adaptation Mechanism

involves the calculation of the ex-refinery prices using world market crude oil prices with mark-ups for insurance, transportation, suppliers' commission, refining costs and other charges. A host of taxes and levies make up the other charges, depending on the specific product involved. These include Cross-Subsidy levy, Unified Petroleum Price Fund (UPPF) levy, Road levy, Social Impact Mitigating Levy, Exploration Levy, Energy Fund Levy, Debt Recovery Levy and Excise Duty. The cross-product subsidy and UPPF levies are particularly interesting in that they seek to provide cross products and cross regional subsidies respectively. In the case of Cross-subsidy, the levy imposed on petrol serves as a subsidy fund for kerosene.

The UPPF levy on the other hand generates funds needed to smoothen prices across the coastal and hinterland regions. The scheme is administered by the National Petroleum Authority (NPA) established by an Act of Parliament in 2005. The NPA, after establishing ex-refinery prices and applying all legislated levies and margins, sets maximum indicative ex-pump prices of different products for the OMCs and reviews same from time to time.

In June 2008, reacting to escalating prices of petroleum products, parliament enacted an Act suspending any further upward adjustments in the prices of petroleum products and abolishing some of the levies applicable to specific products. In 2009, the NPA established an ex-refinery differential fund into which was paid the proceeds of a levy to ensure that import-parity prices could be paid to those who import products and the Tema Oil Refinery when international prices were in excess of the domestic ex-refinery

price. The legality of this was challenged in court and on 28 November 2012 a High Court ruled that,

- The introduction of the ex-refinery differential in the prescribed petroleum pricing formula was an illegal imposition of tax not approved by Parliament in accordance with Article 174 of the 1992 Constitution of Ghana. The judge also made the following consequential orders:
- NPA must publish the amounts obtained in the ex-refinery differential account in the Daily Graphic and Ghanaian Times within 4 months of the judgment;
- Pay all amounts accrued on the ex-refinery differential margin from 6th June 2009 to date into the Consolidated Fund; and
- NPA is restrained from imposing the ex-refinery differential on petroleum products in the country until approved by Parliament or the relevant procedures are complied with (National Petroleum Authority, 2012).

Given that international prices continue to be higher than the ex-refinery prices and that the domestic refining capacity cannot fully cater for domestic consumption, the issue of government subsidy has been reawakened.

Petroleum price increases have always been associated with political and social upheavals. Petroleum pricing in Ghana was characterized with heavy subsidies prior to the economic reforms in early 1980s. The policy of cheap energy, according to Sanda et al (2005), has seriously distorted energy markets. When prices are fixed below market clearing prices, governments do not send the signals to the consumers about the real costs of energy use. Similarly, low prices do not allow supplies to receive enough returns to maintain their infrastructure and also to expand their capacities. The end

result is inefficiency in the use of energy. However, following the adoption of Structural Adjustment Programme, the government's long-term objective was the reduction of the economy's dependence on crude oil import. And to accomplish this objective, the government adopted upward review of petroleum products price to reflect user cost in order to improve energy efficiency in the production, distribution and consumption. The upward review of petroleum prices will send a signal to the consumers as well as the suppliers of petroleum products. To the consumers, it provides information on the real costs of using petroleum product and allows the possibility of shifting away from inefficient methods to an efficient methods as well as substitute one energy product for another energy product. And to the suppliers, it gives them enough cash flow needed to finance their maintenance and expansion of their supplies.

Since 1983, the prices of petroleum products have been reviewed upwards, at least to either cover costs or reflect border prices. The ultimate objective of petroleum product pricing in the country was the removal of governmental interference in the petroleum market and allow the market forces to determine prices of crude oil products.

The main reason behind the cheap energy policy by developing countries, which is advanced on welfare grounds, is the impact of petroleum prices on the poor and vulnerable groups in the society through inflation. Governments of developing countries have often sighted this as their reason for regulating the energy markets, especially the petroleum products. But the impact of petroleum imports and subsidies on government's budget, balance of payment flows and debt burden are often cited as the reasons why government should deregulate the petroleum sector. The major concern

of deregulation is the impact of petroleum price increases on the poor and the vulnerable groups as well as price stability goal of the government. Since 1997 when the deregulation policy was initiated, it has gone through different phases. For instance, the National Petroleum Act (ACT 691) was passed in 2005. Subsequently, the Governing Board of National Petroleum Authority (NPA) was constituted and inaugurated in the same year. Thereof, the NPA review ex-pump petroleum prices to reflect the international crude oil prices. There have been many small changes in the ex-pump prices of petroleum products in Ghana since 1993. Table 2.3 provides the annual average prices of petroleum products since 1993;

**Table 2.3**

**Petroleum Ex-pump Price Reviews from 1998 to 2013 (cedi/litre or cedi/kg)**

<b>Year/product</b>	<b>Petrol</b>	<b>Diesel</b>	<b>Kerosene</b>	<b>LPG</b>
1998	748.15	720.95	495.47	825.60
1999	968.89	910.56	742.50	1,092.50
2000	1,420	1,325	1,325	2,070.00
2001	3,333.33	1,955.56	1,955.56	2,200
2002	4,444.44	3,888.89	3,888.89	3,800
2003	4,444.44	3,888.89	3,888.89	3,800
2004	4,444.44	3,888.89	3,888.89	3,800
2005	6,851.85	6,133.33	5,037.04	5,348.28
2006	8,189.66	7,660.57	6,447.45	6,846.42
2007	9,253.89	8,730.55	7,743.45	8,231.92

2008	82.00	88.99	70.00	65.00
2009	116.98	118.05	91.00	83.81
2010	116.98	118.05	91.00	83.81
2011	175.48	177.09	91.00	136.19
2012	170.80	172.36	91.00	129.90
2013	219.00	226.00	202.00	252.00

Source: NPA website

*NB: From 2007, the cedi was redenominated hence the movement from thousands to hundred.*

The historical price review shows a period of stable nominal prices with sudden adjustment by the government.

The three most important determinants of petroleum product prices in Ghana are the exchange rate, crude oil price tax and margins of petroleum products. The exchange rate and crude oil price directly feed into the ex-refinery price of petroleum products. The taxes and margins are added to the ex-refinery prices to produce the ex-pump prices. Thus, ex-pump prices include taxes and margins on petroleum products in Ghana (NPA, 2007).

The increase in crude oil price over the past years has, to the large extent; influence the domestic prices of the petroleum products. The international crude oil price has risen from \$26 in January 2001 to \$140 in June 2008.

The exchange rate, the price of foreign currency in terms of domestic's currency, is another important factor affecting the domestic petroleum prices. The crude price is quoted in dollars whereas the domestic ex-pump prices are in cedi. The depreciation of domestic currency against the dollar implies that higher domestic prices for petroleum products, even if the price of crude oil remain the same.

## **2.5 A Background on Inflation**

Inflation is said to be the persistent and appreciable rise in the general price level. However, one should be circumspect in defining inflation, because for inflation to occur there must be a continuous and rapidly increasing price level. More often than not, inflation has been mistaken to be just high price. If prices are high but remain so without any appreciable change then there is no inflation. There must be changes in the general price level for inflation to exist. This is why sometimes non-economist argues erroneously that the rate of inflation has not reduced because average price levels have increased. The fact that inflation in Ghana reduced from say 122.8% in 1983 to 40.2% in 1984 did not imply that average price level for the period fell. Rather it implied that the rate of increase in the average price level in 1984 was slower compared to the rate of increase in 1983. In other words, prices increased faster and more rapidly in 1983 than in 1984.

Inflation is measured by calculating the percentage rate of change of a price index, which is called the inflation rate. There are several ways in which inflation can be measured but two widely known indices for which inflation rates are reported in many countries are the Consumer Price Index (CPI), which measures consumer prices, and

the Gross Domestic Product (GDP) deflator, which measure prices variations associated with domestic production of all goods and services. In Ghana, however, the Ghana Statistical Service introduced a new rebased series of the Consumer Price Index. This new CPI is based on the average prices of 2002 and became the official release of the CPI in Ghana from January 2007. The new version of the CPI is a shift from the traditional classification, which was based on the Central Product Classification (CPC) to the most recent version of the international standard. This new series is called the COICOP- Classification of the Individual Consumption by Purpose.

Under the new measure- COICOP, the aggregate national rate of consumer price inflation is derived from very detailed price information at individual product and service level, which is collected monthly by Ghana Statistical Serve. This information is then organized into COICOPs, and then assigned expenditure weights derived from Ghana Living Standards Survey (GLSS IV). The weights of the consumption basket have been updated from 1991/92 GLSS to 1998/99 GLSS IV expenditure levels for the new series. This is because as consumers 'expenditure patterns change over time, any fixed set of weights used in CPL runs risk of becoming unrepresentative and therefore bias the inflation rate. This therefore makes it imperative to change the weights of the consumer basket from time to time to reflect the latest household survey. The Ghana Statistical Service (GSS) has decided that the CPI basket, which was established about 10 years ago, is now obsolete and becoming increasingly inappropriate. Rapid technological changes have also led to the appearance of new items which are substitutes for the original ones. In the nature of things, however, the new items differ, sometimes significantly, in quality — compact discs and audio cassette tapes or mobile phones increasingly replacing land lines. The improved quality has typically meant

higher prices and hence automatic substitution would impart an upward bias to CPI inflation. On the other hand, deletions could create the so-called “zero-entry” problem which could result in a downward bias in the CPI inflation. The GSS plans to replace the consumer basket later this year or early next year. CEPA urges that this be done. (CEPA, 2013)

Inflation has become one of the most popular subjects of discussion all over the world. It is more like a universal language for all economies because most economies are actively engaged in bringing its rate to barest minimum. The subject matter of inflation is a very sentimental issue particularly in the developing economies such as Ghana and the rates of inflation appear most of the time in the manifestos of opposition political parties so as to solicit for votes from the electorates. This makes it very clear that inflation is not just an economic issues, but also political as well as social and thus its effects cut across the entire economy and society.

Some levels of inflation generally viewed as having a positive effect on the economy. One reason for this is that it is difficult to renegotiate some prices, and particularly wages, downwards, so that with generally increasing prices it is easier for relative prices to adjust. Many prices are sticky downwards and tend to creep upward, so that efforts to attain a zero inflation rate (a constant price level) punish other sectors with falling prices, profits, and employment. Most generally because modest inflation means that the price of any given good is likely to increase over time, there is an inherent advantage to making purchases sooner than later. This effect tends to keep an economy active in

the short term by encouraging spending and borrowing and in the long term by encouraging investment.

However, in general, inflation rates above the nominal amounts required to give monetary freedom, and investing incentive, are regarded as bad, particularly because in current economic theory, inflation begets further inflationary expansions. Increasing uncertainty may discourage investment and saving. Inflation also has redistributive effect. It redistributes income from those on fixed incomes, such as pensioners, and shifts it to those who dwell on variable income, from wages and profits which may keep pace with inflation. Similarly, it redistributes wealth from those who lend a fixed amount of money to those who borrow. High inflation rate also result in relative price distortions: Firm do not generally synchronize adjustment in prices. If there is higher inflation, firms that do not adjust their prices will have much lower prices relative to firms that do adjust them. This distorts economic decisions, since relative prices will not be reflecting scarcity of different goods.

Inflation is also seen to have moral costs and these moral costs are impossible to quantify. Inflation is seen as theft and thus any economy built on inflation is but on deception. In an inflationary economy, those who are good at theft and deception will be rewarded and so more effort will go into sharp practices of one sort or another. The evident decline of morality in some segments of the business community and in aspects of private behaviour can be traced partly to the incentives and distortions created by inflation.

## 2.6 Historical Overview of Inflation in Ghana

In recent time, the tempo of price increases in Ghana has decreased significantly. During the period when Ghana was part of the West African Currency Board up to 1972, inflation in Ghana was moderately low (Ocran, 2007). During that period the average rate of inflation was below 1%. After independence in 1957, Ghana embarked on an industrialization drive with the setting up of many import substitution industries and infrastructure to step up economic development. These industries relied heavily on imported raw materials and other inputs. However, due to poor management and lack of foreign currency, these industries performed badly. The accumulated external reserve which was used to finance initial development soon run out, and during that period Ghana was out of the Currency Board and had established its own Central Bank; financing deficit through the printing of money was an obvious choice.

In 1998 and 1999, inflation averaged 14.2%. At the end of 2000, year-on-year inflation increased to 40.5%. This was due to the expansionary monetary policies pursued, the terms of trade shocks, the general loss in the confidence in the Ghanaian economy and the high government borrowing from the Bank of Ghana.

At the end of the first quarter of the year 2001, inflation had increased to 41.9% from 40.5% at the end of December 2000. This was caused by excessive money supply growth in the last quarter of 2000, as well as a rundown of local food stocks and the upward adjustment in petroleum prices in February 2001. However, through prudent fiscal management, as well as tight monetary policies, the New Patriotic Party (NPP) government brought down the inflation from 41.9% in March 2001 to 21.3% at the end of December 2001.

In line with the broad objectives of Ghana's Medium Term Economic Programme in 2002, the then government set a target to reduce inflation drastically to a single digit. To meet this target, the government together with the monetary authorities continued with the prudent fiscal management and tight monetary policy coupled with the slow pace of depreciation of the cedi help reduce the rate of inflation to 15.2% by the end of December 2002. However, at the end 2003, inflation rose to 23.6%. This was due to the adjustments and corrective measure instituted in the petroleum sector of the economy. The main sources of inflationary pressures in 2003 came mainly from the housing and utility sub-sector as well as the transportation and communication sector of the economy (Bank of Ghana Annual Report, 2003). The effects of the average increase of 95% in petroleum prices in February 2003 and the increase in communication tariffs in October 2003 were responsible for the high increase in inflation (Bank of Ghana Annual Report, 2003).

The Ghanaian economy in 2004, continued to witness a disinflation process. The fiscal and monetary policies in the year strengthened the much anticipated downward trend in inflation. The process of fiscal adjustment was manifested in the central government's net domestic financing of the budget which was reduced as compared with earlier years (Bank of Ghana Annual Report, 2004). Efforts at containing the excess liquidity in the market were strongly pursued by the Central Bank. The first quarter of the year saw a significant drop in the rate of inflation from 23.6% at the end of December 2003 to 10.5% by March 2004. It may be recalled that by the end of the first quarter of 2003, the inflation surged by almost 18% from its December 2002 level

mainly on account of the upward petroleum prices adjustment that was made at that time. By the end of the third quarter of 2004, inflation started easing downward, reducing by 0.8% to 11.8% by the end of December 2004.

Inflation picked up marginally in 2005 in response to higher prices of crude oil and increased demand pressures on the economy originating from the large budget deficit and election year spending in 2004 (Bank of Ghana Annual Report, 2005). Inflation was at its peak in March presumably after the petroleum adjustment in February 2005, and reduced considerably by the end of the year dropping from 16.7% in March 2005 to 14.8% in December 2005. This drop reflected the tightening of monetary policy by the Central Bank and supportive fiscal policy by the government. Inflation measured as the year –on-year changes in consumer price index dropped significantly from 14.8% recorded at the end of December 2005 to 10.5% by the end of December 2006. The fall in the rate of inflation reflected a combination of improved food supply conditions in the market for foodstuffs, relatively stable exchange rate environment and a well-crafted monetary policy to contain inflation expectations often associated with the fuel price shocks to the economy (Bank of Ghana Annual Report, 2006).

The year 2007 started with a consumer price index rate of 10.9% year-on-year, falling to 10.1% in July and October; however, it shot up to 12.8% in December, against the single-digit target established for the year. The surge in the inflation rate in the latter part of the year emanated from two successive upward adjustments in retail prices of petroleum products, the upward adjustment in tariffs on utilities and higher food prices from the cost associated with food distribution (Bank of Ghana Annual Report, 2007).

The inflation jumped up mainly on the strength of pass-through effects of the fuel price adjustment that was made. This level was quite high, and it called for appropriate measures and the commitment of government to reduce the inflation to a single digit. Fortunately, government indicated in its 2007 budget statement that it will remain committed to bring inflation rate down to a single digit. To achieve this objective, the government and the Bank of Ghana indicated their respective intention to keep pace of fiscal discipline and monetary expansion consistent with the target level of inflation.

Inflation rose to 18.1% in 2008 which was attributed to the combined effects of the global food crises, fuel price hikes as well as significant fiscal expansion.

In 2009, the combined effects of policies and established seasonal trends for food staples resulted in inflation dropping during the third quarter, falling from 20.7% recorded in June 2009 to 18.4% by the end of September 2009. Inflation went down further in October 2009 to 18.0%. During the last quarter of 2009 CPI inflation declined by 2 percentage points (BOG Monetary Policy Report, 2009).

After falling to 9.5% in June 2010, inflation dropped to 9.46% in July 2010 and then marginally to 9.44% in August 2010. Inflation at this stage seems to have reached its trough as the full effects of earlier stabilization policies and base drift effects seems to have fallen off the inflation series. Inflation performed better than target turning in at 8.6% at December 2010 compared with the target of 9.2% set at the beginning of the year (BOG Monetary Policy Report, 2010).

Annual CPI inflation for November 2011 was 8.55%, down marginally from 8.56% in October 2011. The November inflation outturn was 0.53 percentage points lower than that of the corresponding period in 2010. Inflation increased to 8.6% in December 2011. The principal factors that have supported stable inflation conditions include stable exchange rate and favourable food supply conditions (BOG Monetary Policy Report, 2011).

In 2012, the rate of inflation declined marginally in the third quarter after recording sharp increases during the second quarter of the year. From 9.1% in the first quarter of 2012 (8.6% in Dec. 2011), inflation rose to 9.4% in June 2012 and further up to 9.5% in July before declining marginally to settle at 9.4% at the end of the third quarter of 2012. October 2012, inflation declined further to 9.2 percent from 9.43 in September. This is due to the impact of the sharp depreciation of the exchange rate in the period. Developments in the price conditions indicated that headline inflation slowed down from 9.4% by the end of the third quarter to 8.8% by the end of the year. This was driven largely by non-food inflation due to the absence of the usual seasonal increases in prices during the last quarter (BOG Monetary Policy Report, 2012).

Inflation increased in the first quarter of 2013 from 10.1% in January to 10.8 % by March 2013 and peaked at 11.8% in July before declining to 11.5% in August. The upward trend in inflation during the first seven months of the year was attributed to a combination of demand and supply side factors, including the hike petroleum product prices and the impact of the expansionary fiscal policy of 2012. In August, however, inflation declined on the back of favourable developments in non-food prices, an indication that the pass-through effects of earlier petroleum price adjustments may have

eased. (BOG Monetary Policy Report, 2013) The new Consumer Price Index (CPI) measures the change over time in the general price level of goods and services that households acquire for the purpose of consumption, with reference to the price level in 2012, the base year, which has an index of 100. The year-on-year inflation as measured by the CPI stood at 13.5 percent in December 2013, up from the 13.2 percent recorded in November 2013. This rate of inflation for December 2013 is the percentage change in the Consumer Price Index (CPI) over the twelve-month period, from December 2012 to December 2013. (GSS, 2014)

## **2.7 Trend of Inflation, Oil price, Exchange rate and Interest rate in Ghana**

Figure 2.1 shows the trend of growth rate of CPI, growth rate of oil prices and growth rate of exchange rate from 1998 to 2013, while Figure 2.2 shows the trend of interest rate over the period of study.



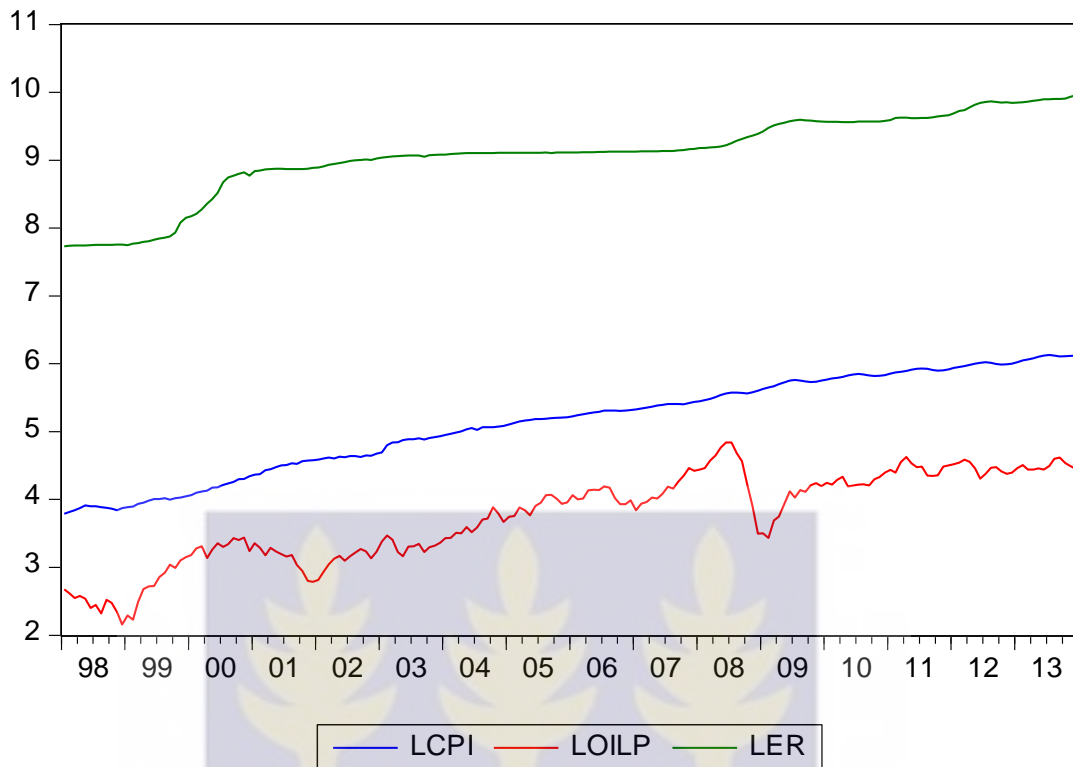


Figure 2.1: Trend of growth rate of CPI, growth rate of Oil Prices, and growth rate of Exchange rate.

Source: Constructed from BOG & IMF data

The trends of the variables are graphed and presented in Figure 5.1. The growth rates of all the three variables have been rising and falling at a low rate. On the average, LCPI had a minimum of 4 in the initial years and rises over the year to a maximum of 6 by the end of 2013.

Over the 15 year period, oil price on the average reached a high level of 6 in July 2008 and a low level of 2 in December 1998. On the average, exchange rate initially was constant at 8 from 1998 to 1999 and started rising in 2000.

R

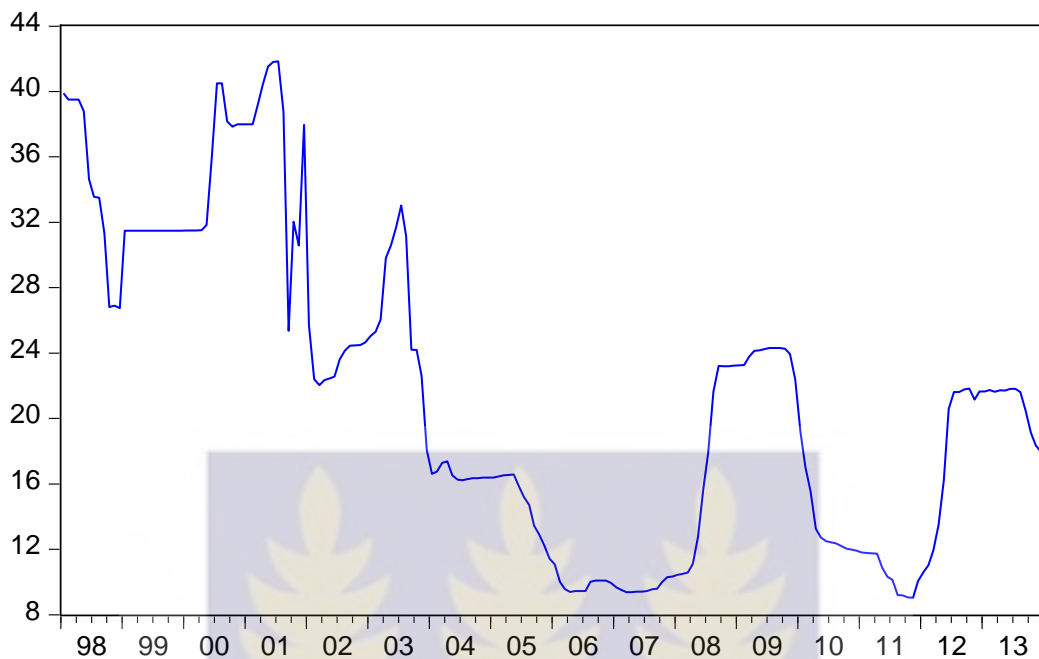


Figure 2.2: Trend of interest rate.

Source: Constructed from BOG.

Over the years, interest rate was as high as 40% in January 1998 and as low as 9% in March 2007.

## 2.8 Petroleum Pricing Policies in Ghana

Ghana liberalized fuel prices in Feb 2005 and began setting price ceilings in line with world prices. A 2005 law establishing the National Petroleum Authority (NPA) also established the Unified Petroleum Price Fund (UPPF) to equalize transport costs. A UPPF levy is imposed on each fuel, about US\$0.03/liter in Feb 2013. The ex-refinery differential, which operates like a price stabilization fund, was introduced in the last quarter of 2006 to pay fuel marketers for under-recovery of costs for selling kerosene, LPG, and premix. Government began reviewing prices twice a month in Oct 2007, but suspended price adjustments between May and Nov 2008. The frequency of price

adjustments fell sharply beginning in 2009. There was a 30% price increase in Jun 2009. There were no price adjustments in 2010, two price increases in 2011, and one downward price adjustment in 2012, with several of these adjustments tending to be large.

In Feb 2013, prices were raised by between 15% (kerosene, the price of which had been frozen since end of Oct 2009. and 50% LPG). The price of pre-mix was not adjusted, widening the price difference between gasoline and pre-mix to a factor of nearly 4. A cross-subsidy levy is charged on each fuel, with gasoline contributing to the cross-subsidy and all other fuels benefiting from it. The bulk of the subsidy is provided not by the cross-subsidy levy but at the point of setting the ex-refinery price.

In Nov 2011, the ex-refinery price differential was declared illegal, and the stay of execution was denied in Jan 2012. Premix (gasoline mixed with lubricant) is used in fishing boats and heavily subsidized, priced at less than one third of gasoline since Dec 2011. In Feb 2013, NPA called on government to eliminate subsidies by Dec 2013.

Protests: A price increase of 30% for gasoline and diesel in Jan 2011 sparked street protests in Accra.

Consequences of subsidies: NPA said in Feb 2012 that the fuel subsidy in 2011 was in excess of 450 million cedis (US\$276 million). There have been fraudulent claims against UPPF of products being delivered to remote areas when they were actually delivered to major consumption centers in urban areas. LPG subsidies have led to

soaring consumption of automotive LPG, causing shortages and prompting commercial LPG vehicle drivers to ask government for subsidy removal so as to ensure reliable supply.

Hedging: Ghana's cabinet in Mar 2010 approved a Commodity Price Risk Management Policy, paving the way for hedging petroleum products and crude oil. Ghana hedged half of its crude oil requirements in 2010–11. In Jun 2011, the finance minister announced that government would hedge 100% of crude output and about half of crude purchase. IMF reported in Feb 2012 that sizable hedging gains in the first half of 2011 allowed fuel subsidies to be covered through July. In Jan 2012, government announced that it was hedging crude on a quarterly basis.

Information: NPA posts detailed information on current and historical prices and price structures on its Web site, although subsidies at the refinery gate are not made explicit.

(Source: Kojima, Masami. (2013, forthcoming). "Petroleum product pricing and complementary policies: Experience of 65 developing countries since 2009." Washington DC: World Bank.

## **CHAPTER THREE**

### **LITERATURE REVIEW**

#### **3.1 Introduction**

The literature on inflation in Ghana is limited. The few available papers were mostly conducted during the economic reforms of the early 1980s and 1990s. Nonetheless, the limited amount of work can still be catalogued on the basis of the monetarist and structuralist paradigms. This chapter reviews the relevant literature in the study area. The review incorporates the theoretical and empirical literature.

#### **3.2 Definition of Inflation**

To talk about inflation, there is need to have a definition of what inflation is. Inflation is defined as the persistent increase in the general price level. In other words, it is the tendency for a persistent and appreciable increase in the general price level. More often than not, inflation has been mistaken to be high prices. High prices do not necessarily imply inflation. If prices are high but remain so without any appreciable change then there is no inflation. Thus, for inflation to exist there must be continuous increase in the general price level. It is erroneous for anyone to argue that the rate of inflation has not been reduced because average price levels have increased.

The Consumer Price Index (CPI) in Ghana, calculated by the Ghana Statistical Service, is known as an inflation indicator. The CPI is the most important inflation indicator in Ghana. The way it is calculated is pretty simple, yet it serves a very important purpose. The CPI is used by the central banks when deciding the changes that need to be made to the interest rate as well as by investors when trying to predict the future price of securities. Indeed, when inflation is rising, it causes people to buy fewer goods, thereby reducing the profit of companies. The loss of profit in turn causes the company's stock prices to drop as well. This shows how important it is to monitor the CPI whether you are an individual investor or simply someone who is trying to estimate future costs and spending.

The CPI has been an important economic indicator for many years and actions related to movements in it have had direct or indirect effects on all citizens. In the past it has been used as a starting point by parties to the national wage hearing and by the Industrial Relations Commission or union in determining the size and nature of wage adjustments. The CPI has also been used in recent years in the indexation of pension and superannuation payments (that is, the pension or payment is automatically adjusted, or 'indexed', using movements in the CPI) Many business contracts are regularly adjusted to take account of the changes on the CPI or in some components of it. Rental agreements, insurance coverage and child support payments are frequently tied in some way to changes in the CPI.

In short, a CPI is used for a multiplicity of purposes. They include the following:

- Measure of changes in consumer prices.
- General measure of inflation.

- Prices, wages and salary adjustments in contracts.

The most common measure of inflation is the rate of change in the Consumer Price Index (CPI). Once the CPI is known, the rate of inflation is the rate of change in the CPI over a year (year-on-year inflation rate), a month (monthly inflation) or average over a year (yearly average). For example if the CPI in 1998 was 100, 1999 was 115 and 2000 was 135, then inflation rate in 1999 would be 15% and 17.4% in 2000.

Generally, the CPI calculations can be based on either the Laspeyres or Paasche weight index. Ghana's consumer price index is a Laspeyres base-weight index using results from a nation-wide household economic survey. In 2003 when the Bank of Ghana introduced new measures of the CPI, year-on-year, monthly or yearly average inflation rates have been in use. The Bank of Ghana now makes use of the new CPI to compute two main inflation indices, namely headline inflation and core inflation. Headline inflation is computed using the CPI figures and it is the rate of change in the CPI over time (either year-on-year, monthly or year average). The core inflation index tries to remove volatilities associated with some components of the CPI used in computing the headline inflation index. The rationale for monitoring the core measures of inflation is to isolate disturbances in the CPI from items that are considered as being volatile and creating noise to inflation.

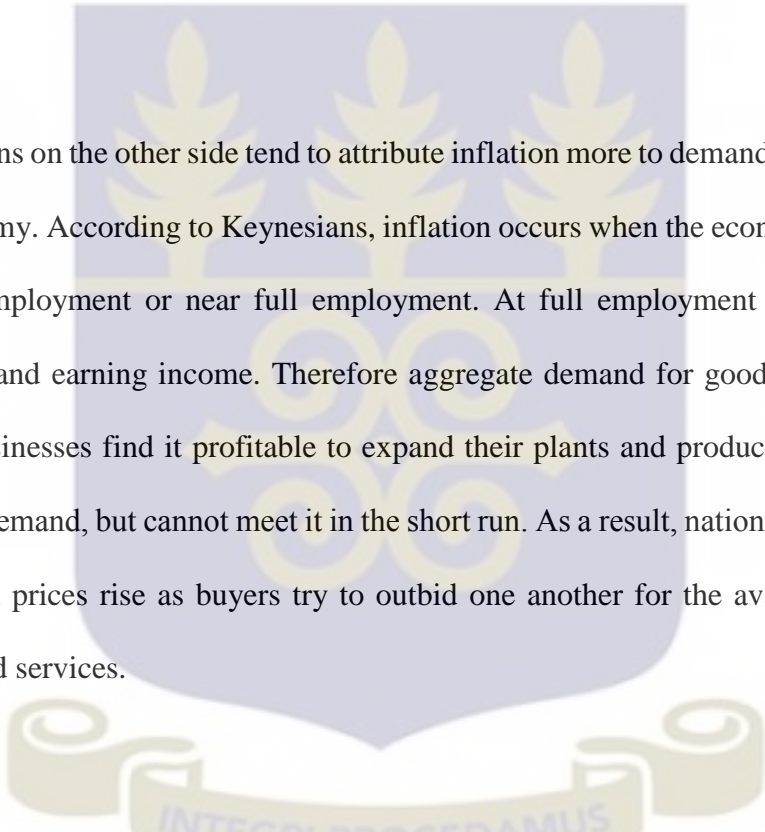
### **3.3: Theoretical Literature**

#### **3.3.1 Monetarists and Structuralists**

In order to verify the various sources of inflation in an economy, we have to look at the various schools of thought with regards to the causes of inflation. According to classical economists, the cause of inflation in an economy is based on the quantity theory of money. The quantity theory of money held its central tenet on the position that in the long run, increases in the money supply is a necessary condition for increases in the general price level and the rate of growth of the money supply which uniquely determines the rate of inflation. The main prediction of the quantity theory is that, if the velocity of money remains constant, any change in money supply affected by the central bank may lead to an exact proportionate change in output. Since real output remains constant in the short run when factor supplies remain fixed and technology remain unchanged, any change in output must represent a change in the general price level. According to the quantity theory of money the price level is proportional to the money supply.

The classical economists further explain that the quantity theory which is a theory of the general price level is also the theory of inflation. So the growth in the money supply which is under the control of the central bank determines the rate of inflation. Thus the central bank, which is the monetary authority, has ultimate control over the price situation or the rate of inflation. If the central bank keeps the money supply fixed, the price level will remain stable. In an economy where output does not rise or fall the quantity theory of money implies that the price level would be proportional to the money supply. More money supply raises prices.

The central bank can choose whatever rate of inflation it wants just by raising the money supply by that percentage each year. For price stability the central bank should keep the money supply constant from one year to the other. If output is growing overtime some money growth is needed just to keep the price level from falling from one year to the other. Therefore, the rate of change in the price level equals to the rate of change in the money supply.

The crest of the University of Ghana is a watermark in the background. It features a shield with three golden leaves at the top, a central emblem with a cross and four circles, and a banner at the bottom with the Latin motto 'INTEGRITAS QUAE DAMUS'.

Keynesians on the other side tend to attribute inflation more to demand pressures within an economy. According to Keynesians, inflation occurs when the economy is operating at full employment or near full employment. At full employment most people are working and earning income. Therefore aggregate demand for goods and services is high. Businesses find it profitable to expand their plants and productions to meet the buyer's demand, but cannot meet it in the short run. As a result, national output remains fixed and prices rise as buyers try to outbid one another for the available supply of goods and services.

The Keynesians view also state that the money supply increases effect of inflation through interest rate movements. In this view, money is considered a close substitute for a limited number of financial assets (such as bonds), and thus an increase in money supply causes excess demand for those assets, leading to increase in their prices and subsequent fall in the interest rate. The decline in the interest rate leads to an increase in investment, depending on the interest rate sensitivity of investment. In turn, increased

investment leads to an increase in aggregate demand, thereby leading to inflationary pressures in the economy. This explanation may only apply in the short run.

A fall in the interest rate may stimulate increased investment, thereby aggregate demand and increased inflation in the short run. However, in the long run, increased inflation may cause output to contract thereby leading to reduced demand for money in the economy. From the money demand relationship, the reduced demand for money would lead to a rise in the nominal interest rate in the long run.

However, the argument on an increase in the money supply having an effect on inflation remains questionable in the light of the endogeneity of money. Critics argue whether monetary expansion is in itself a cause of inflation, or simply an indication of other more fundamental factors. To the monetarist, inflation is a domestic monetary phenomenon that comes about when the central bank increases the money supply in excess of the demands for money. This (large) increase in the money supply can be caused by the monetary financing of fiscal deficits or by extending too much credit to the private sector. Monetarists see the short-term solution to inflation as the implementation of a contractionary or restrictive monetary policy. Friedman (1956) has always claimed that “inflation is always and everywhere a monetary phenomenon” and some empirical studies have supported this theoretical position. In the long run, it seems likely that money supply has a major impact on inflation, but in the short run there are other phenomena, such as food shortages, oil price increases or wage increases, that are important factors which affect inflation. Furthermore, critics have argued about the causality problem between inflation and nominal interest rate in particular, and whether

there is a direct effect between the two variables, or an indirect effect through the money supply.

The monetarist school of thought is that inflation is always and everywhere a monetary phenomenon. Thus the current rate of inflation is expected to vary, *ceteris paribus*, positively in relation to the rate of change of money supply and negatively with respect to the rate of change of real gross domestic product. From the monetarist's perspective, the money supply is exogenous, thus determine without regard to the value of other variables such as money incomes and interest rates in the economy. Monetarists tend to focus on the importance of domestic or international money supply and on policies to control money supply growth.

Monetarists argue that inflation is caused when the monetary authorities allow the money supply to increase at a faster rate than the growth in national income. As a result, if there is a significant increase in the money supply then there must be an equal rise in the price level. An increase in the money supply causes a rise in aggregate demand. In the short term this may cause a rise in actual output, since workers receive higher wages. However, this may cause an increase in inflation. As a result, firms' cost increase therefore the short run aggregate supply shifts to the left causing output to return to full employment and the price level increases. This type of inflation is therefore termed demand pull inflation because it is caused by too much money chasing few goods.

The monetarist insist that substantial and continuous increases in the general price level are the direct cost of monetary expansion, and that a monetary policy that permits such

as a state of affairs to continue will generate other forces that will accelerate the inflationary movement. Rather than enabling growth to continue in the face of structural obstacles, inflation will create new impediments to economic progress based on rational share of resources.

According to the monetarist, the cure for inflation is simple to state but hard to implement. Just as an excessive increase in the quantity of money is the one and only important cause of inflation, so a reduction in the rate of money growth is the one and only cure for inflation. The problem however is not one of knowing what to do, but to have the political will to take the essential measure. It is worth noting that the early side effects of a slower rate of monetary growth are painful; lower economic growth, high unemployment. However, the benefits appear only after one or two years in the form of lower inflation, healthier economy, and the potential for quick non-inflationary growth. This pleasant outcome reduces monetarist arithmetic which occurs in a sizable part of the important parameter space.

It therefore presents a serious challenge to the straight wisdom that tight money cannot work unless it is in line with measures to reduce the primary fiscal deficit. To beat inflation down with tight money alone is dangerous but not prudent.

The structure of the policy rule is significant. Tight money is a great deal less likely to succeed if the government commits only to monetize a small share of the deficit. Satisfying monetarist arithmetic then disappears or is confined to a small part of the parameter space that requires domestic and foreign currency to be much closer substitutes than when the policy rule fixes the growth rate of the money supply (Saini,

1982). The most important tool for justifying the side effect of inflation is to reduce inflation slowly but progressively by a policy announced in advance and sticking to it so that it becomes credible. It takes time for inflation to develop therefore it will take time for inflation to be cured.

The structuralists, on the other hand, see both the basic causes and the socially acceptable cure of inflation in the economic and social structure of a country. The key bottlenecks identified in the structuralists' analysis include distorting government policies, the conflicts between capitalists and workers over the distribution of income between profits and real wages, the inelastic supply of foodstuffs, the foreign exchange constraint and government budget constraint. In this view, the bottlenecks lead to price increases, which are converted into a process of inflation by distributional struggles.

The structural sources of inflation include:

- An agricultural system which fall short to increase output in response to a rise in demand
- Fiscal system which does not produce enough revenues.
- Imperfect markets for goods, labour and capital and
- An unstable or stagnating foreign market for export.

The structuralists' point is that it is not sufficient to show that inflation is accompanied by monetary expansion, however, by the mechanism through which the rise in way of payments occurs. The theory of structural inflation emphasizes the relation existing between changes in relative prices and increases in the general price level. Changes in relative prices are the outcome of changes in economic structure.

Olivera (1977) demonstrates that under some linearity assumption ‘there exists a one-one correspondence between economic processes and economic structures and so to each economic structure there corresponds a unique vector of relative prices. This shows that every change in structure requires a change in relative prices. If money prices are rigid downward, changes in relative prices require increases in the general price level. Structural changes then generate inflationary pressure that in a passive money environment results in an inflationary process. A positive aggregate excess demand is not a necessary condition in a process of structural inflation, however, a continual increase in the general price level requires either the existence of some sort of propagation elements linking changes in money wages to changes in other money prices and changes in money prices to changes in costs or repeated changes in economic structure over time, or both at the same time (Sunkei 1958).

For that reason, structural inflation theory is based on three main elements:

- ❖ Relative price that change when economic structure changes;
- ❖ Downward rigidity of money prices; and
- ❖ A passive money supply closing the deflationary gap caused by price increases, as pointed out by (Olivera, 1957).

The structuralists’ point on inflation had been criticized on the following foundation:

- Several Latin American countries, e.g. Argentina, Brazil and Chile, have experienced periods of serious and continuous inflation under circumstances that do not fit the stylized structuralists’ model.

- The structuralists disagreement of the use of monetary control as a means of dealing with disequilibrium leaves open such questions as the role of monetary policy in developing maximum growth.

The disagreement between monetarists and structuralists in Latin America has been overstated beyond all bounds. It is well-known that in the short run all structuralists when entrusted with policy making responsibilities become monetarists, while all monetarists in the long run, tends to structuralists (Canavese, 1982). We may define a monetarist as a structuralist in a hurry and structuralist as a monetarist without policy-making responsibility.

Although the sources of inflation are argued along the lines of monetarists and structuralists, inflation can also be argued along the lines of cost-push and demand-push. Cost-push factors, on the one hand operate through the supply side of the economy by increasing the unit cost of production, so that real output or GDP short from co-exists with resulting inflation. In other words, there is a possibility that increases inflation may have a negative shock on real GDP growth, which suggests again that the relationship between the variables should be investigated. Other potential cost-push causes of inflation that could be looked at in the Ghana contexts are:

- ❖ Increases in the nominal wages in the economy in excess of productivity increases.
- ❖ A rise in imported raw material prices and costs of other goods and services caused by external shocks (leading to increase foreign prices of imports) or domestic currency depreciation.

- ❖ Increases in profit margins and mark-up (on imports especially) of local business.

Considering the first factor, it can be argued that trade unions, because of their monopolistic bargaining power, become ambitious in their wage claims, which may exceed productivity growth. As labour cost constitutes a large proportion of production and distribution costs, such large wage claims may force producers of goods and services to increase producer prices, thereby sparking off inflation. According to Chhibber and Shafik (1990), in a typical Sub-Saharan African country, wages constitute only a very small fraction of national income and organized labour unions are not very strong. In the case of Ghana, however, the opposite may be true in the sense that wages form a significant part of national income in the country and that there are relatively strong and well organized labour unions in the country.

In the case of rising import prices and exchange rate depreciation, the major justification for including these variables is that they determine the export competitiveness of the economy. Conversely, in an open and import dependent economy, where domestic inflation is largely determined by foreign prices and normal exchange rate depreciation, the initial improvement of export competitiveness resulting from depreciation may eventually be mostly balanced by the following increase in prices of importers goods or raw materials.

In the extreme case, there is a complete and immediate “pass through” of exchange rate and foreign prices to domestic prices. Consequently, an exchange rate policy that entails a nominal depreciation, or devaluation, cannot promote export competitiveness in the

economy, as it simply creates inflationary pressures. On the other hand, if “pass through” is incomplete or is a relatively slow process, then this allows exchange rate policy to become relatively effective in influencing short run export competitiveness, although it will be less effective in the long run (Dornbusch, 1987).

Demand-pull factors are those causes of inflation that operate by increasing aggregate demand, so that unless the theoretical full employment situation has already been attained in the economy, real output or GDP expansion should accompany or co-exist with inflation. Monetary expansion is one of these demand-pull factors and fiscal deficit is another-the two are of course, inter-related though much of the literature is dominated by demand theories of inflation, partly because they are more amenable to quantitative assessment. The studies of Cagan (1956), Harberger (1963), Azhar (1973) and de Silva (1977) were basically in the monetary demand framework, with their results largely confirming demand-pull inflation. It is also worth nothing that demand-pull causes of inflation is basically the same as the monetarists view and the cost-push sources of inflation basically a structuralist’s position.

Another important determination of inflation is expectations of future inflation. Expectations do not affect current inflation independently, but work through demand and supply factors. There are other factors such as poor climatic conditions, wars, crop failures of drought that could also act as cost-push or supply reducing factors causing inflation in an economy such as Ghana since their impact is only significant in the short run.

There is common belief among policy makers and politicians in developing economies that devaluation leads to inflation. Whereas more complicated analysts recognize that the link between the two is close-devaluation which is often the messenger bearing bad news about more fundamental shocks, the correction has contributed to the disregard with which many governments treat this policy tool. In many less developed countries (LDCs), including almost all of Africa, official exchange rate adjustment is employed only at the insistence of international lenders (Hanson, 1983).

The real structure of the economy determines an equilibrium real exchange rate which nominal changes cannot alter, at least in the long run. Starting from a position of equilibrium, a normal devaluation would cause prices to rise, and in exact proportion to the devaluation. However, more careful consideration of the trade policy of many LCDs leads one to temper this conclusion. Trade is often tightly controlled by complicated systems of quotas and state-controlled marketing of export goods, especially in Africa. Official exchange rates are highly overvalued and the market for foreign exchange is dominated by complex rules for its allocation that have little to do with market prices.

On the demand-side, quantity limitations clear the market for foreign exchanged. As a result, a devaluation that is less than or equal to the difference between the official and the shadow exchange rates for imports should have no direct impact on prices, it simply squeezes out some of the rent that importers received before the devaluation. One might expect a larger response to a devaluation on the supply-side of the foreign exchange market, since the same people who insist on a devaluation (international creditors) are

also likely to insist that it be passed on to exporters in terms of higher producer prices. Nonetheless many export commodities in Africa both agricultural and mineral, are not important in local consumption basket, so the increase in producer prices should not affect domestic inflation.

If a country devalues its official exchange rate, its interest payment on foreign debt measured in domestic currency will rise, therefore increasing public spending. Government expenditure on inputs measured in domestic currency will rise and both factors would tend to increase the budget deficit. The impact of debt servicing on the budget will depend on the magnitude of the debt in foreign currency. Theoretically devaluation stimulates the production of exports. It encourages people to produce and export more in order to earn more foreign currency. It also raises the income of exporters and subsequently increase revenue generated from taxes (Corden, 1989). Revenues from export duties rise with an increase in exports following the devaluation. The extent to which the volumes of exports decrease after devaluation depends on the price elasticity of demand for imports. It can be argued that due to the long nature of import contracts, imports will not fall immediately in response to devaluation; hence imports are rather likely to increase in value in the domestic currency terms. What each branch thinks is that, it follows that the net effect of the exchange rate devaluation depends on taxes generated out of the exports induced income which increases export duties, as well as expenditures.

On the other hand, budget deficit and inflation are easily realized when the deficit is financed through an increase in central bank credit to the government. The increase in

bank credit to the public sector expands aggregate demand and public expenditure which has the tendency to raise private sector income and leads to demand for goods and services through the multiplier effect. For any developing country that has limited supply of domestic goods and services, the expansion in aggregate demand tends to exceed supply which leads to a rise in the general price level and therefore resulting in inflation.

### **3.4 Empirical Literature**

Given the expansive theoretical and empirical literature on the subject, the researcher attempts to present few related empirics with focus on the threshold effect of oil price shocks on inflation to support the present study.

Burbige and Harrison (1984) tested the effects of increases in oil prices using a seven variable vector auto-regression (VAR) model for five countries (United States, Japan, Germany, United Kingdom and Canada) in the Organisation for Economic Cooperation and Development (OECD) using monthly data from January 1961 to June 1982. They found out that substantial effects of oil-price shocks on the general level of prices were evident on the U.S. and Canadian economies and exerted great pressure on industrial production on U.S. and U.K. They also pointed out that the oil shock in 1973 only worsened the incoming recession of that period.

Hooker (1999) studied the effects of oil price changes on U.S. inflation in a Phillips curve framework. He allowed for some of the asymmetries, nonlinearities, and structural breaks that have been found in the literature on the real effects of oil price

shocks. His work finds strong evidence of a structural break, with oil price changes making a substantial direct contribution to core inflation before 1980 but little or no pass-through since that time. Oil price effects on overall inflation according to him, are not significantly changed, and consistent with their direct shares in price indexes. His study revealed that, the structural break specification provides a better fit to the data than do several asymmetric and nonlinear specifications stressed in the literature on the real effects of oil price shocks, and is robust to different specifications of the Phillips curve, measures of oil prices, and details of sample period, lag structure, etc. His evidence suggests that monetary policy has become less accommodative of oil price shocks, perhaps sufficiently so to prevent oil price changes from passing directly into core inflation.

Cororaton (2000) of Philippine Institute for Development Studies (PIDS) identifies the world oil price increases and the depreciation of the country's exchange rate as the primary reasons for high domestic oil prices. Using Philippine Computable General Equilibrium Model (PCGEM), simulations show that the macroeconomic effects of world oil price increases resulted to a decline in real GDP by 2.3 percent but with an improvement in the balance of trade mainly due to the reduction in the importation of oil products. World oil price increases also had a regressive impact on incomes (income declines are more significant among the low-income groups) but welfare-decreasing (greater decline in welfare among higher income brackets vis-à-vis lower income classes) (Cororaton 2000).

Celik& Cetin (2007) contributed to the literature by using VAR analysis to estimate the effect of changes in fuel oil prices in Turkey and came out that continuous fluctuations are observed in fuel oil prices in the Turkish economy. As a result of these fluctuations, changes in the prices of fuel oil products used intensively in sectors like production, transportation, the chemical industry and agriculture are expected to cause an inflationary effect. Their estimation results based on the vector error correction model revealed that a 1% increase in fuel oil prices with an approximate one year lag resulted in a 1.26% increase in the CPI index (Consumer Price Index). Furthermore, in accordance with the analysis results they were unable to reject the hypothesis, that an increase in fuel oil prices is also the one-way Granger cause of an increase in CPI.

Cunado and de Gracia (2004) found out that the effects of oil price shocks on economic activity and inflation are significant but limited only in the short-run. If shocks are transformed in terms of the local currency of the country under study, results provide more significant evidence on the effects of the shocks. Asymmetric response of oil price inflation relationship is found in the cases of Malaysia, South Korea, Thailand and Japan and solely in South Korea if oil-economic growth relationship is considered. Furthermore, they stressed that Asian countries respond differently to oil price shocks (Cunado and de Gracia 2004).

Cologni&Manera (2005) empirically estimated a vector autoregressive model for the G-7 countries in order to verify if the oil price changes of the last twenty years have been transmitted to the monetary policy action. They have introduced not only long-run but also short-run relationships; while the former, expressed as linear restrictions

on the cointegrated vectors, have had the aim to verify the presence of a money demand function and/or an excess demand relationship, the short-term restrictions have been imposed on the residual covariance matrix and considered six short-run relationships. Their results suggest that, for most of the countries considered, an unexpected oil price shock is followed by an increase in inflation rate and by a decline in output growth. The response of some central banks has been directed to reduce - through lower interest rates - the impact of the shock on output growth rate. In contrast, monetary authorities of most countries reacted by raising interest rates, suggesting a contractionary monetary policy directed to fight inflation.

Moreover, the results of simulation exercises directed to estimate the total impact of the 1990 oil price shock indicate that a significant part of the effects of the oil price shock resulted indirectly from the response of monetary policy.

Furthermore, De Gregorio, Lauderretche & Neilson (2007) sought to ascertain the pass-through from the price of oil to the general price level. The study estimated the traditional Phillips curves augmented to include oil and test for structural breaks in 34 countries and rolling vector autoregressions for a subsample of countries for which there are sufficient data to derive impulse response functions of inflation to oil shocks. Their result presented evidence of a significant fall in the pass-through of oil price changes to general inflation in recent decades. They concluded that there is a clear fall in the average estimated pass-through for industrial economies and to a lesser degree for emerging economies, and a significant part of the decline in the oil pass-through around the world is explained by the reduction in the effects of exchange rate changes

on inflation and by declining oil intensity. By using rolling VARs for a subsample of countries, they derived impulse responses functions of inflation to oil shocks and find that, the effect of oil shocks on inflation for a 24-month window has fallen for most of the countries in the sample. This implies that the high oil price in recent years has been the result of high demand rather than supply shortages as in the past.

L'oeillet&Licheron (2008) investigated the relationship between oil prices and headline inflation in euro area by estimating a backward Phillips curve on European data between 1970 and 2007. They examined nonlinearities using asymmetric oil price indicators and potential breakpoint using endogenous stability tests. Their estimation result suggested that headline inflation is affected by the variation of oil prices, and most notable by their increases. The study reported a nonlinear pattern in the relationship.

A related work by Tweneboah& Adam (2008) estimated a Vector Error Correction Model to explore the long run and short run linkages between the world crude oil price and economic activity in Ghana for the period 1970 to 2006. The study indicated that there is long run relationship involving oil prices, prices, GDP, exchange rate and interest rate in Ghana in which oil price positively impact the price levels while negatively impacting output, whereas in the short run, an unexpected oil price shock is followed by an increase in inflation rate and decline in output in Ghana.

Focusing on 19 industrialized countries, Chen (2009) uses a state space approach to estimate time-varying oil price pass-through coefficients. The paper finds a significant

decline in the average pass-through and attributes this to changes in monetary policy, the behavior of nominal exchange rates, and higher trade openness. The analysis, however, did not find evidence that a lower inflation environment is associated with lower pass-through.

Nwosu (2009) in her work, the impact of fuel price on inflation, which used the variance Autoregressive analysis model to assess the relative contribution of fuel price on inflation. The study used available quarterly data series spanning 1995 to 2008. The finding of the study revealed that the policy of subsidizing the price of fuel should be continued so as to help cushion the Nigerian economy from the adverse effects of oil-price shock.

Pedersen (2010) assesses the propagation of food and energy prices shocks in 46 countries for the period 1999–2010 using structural VAR models. His results indicate that in general, the propagation effect of food price shocks is larger than that of energy price shocks, and that emerging economies are more affected by propagation than advanced ones.

One of the most important contributions to the oil price-inflation literature in the last decade has been made by Wu, Li & Zhang (2011). They examined the impact of oil – price shocks on China’s price levels using input-out model. They compared China’s economy to that of United State and considered U.S as a reference. According to them, U.S is the freest market in the world with little intervention from the government, whiles the baffled price transmission mechanism in China is a result of both government

intervention and market forces, therefore a comparison between China and the U.S is to give valuable information regarding the relative impact of different transmission functions in price pass-through mechanism. The study revealed that, the impact of oil-price shocks on price levels depends on five major factors; industrial structure oil intensity, market factors, price control, and technology substitution. It also shown that, China will experience a 4.91% increase in general price level when oil price doubles. They concluded that in a free market economy like U.S, a doubling of oil price will only raise the inflation rate by 1.30%, which is even lower than China under price control.

With different econometric model and comparing three industrialized countries; the US, the UK and Japan, Yoshizakim (2011) investigated the cause for wild fluctuations in oil price since mid-2000s and empirically assessed the effects of oil price shocks on the real economic activity and price development using structural VAR model of the global crude oil market. The study show that oil-specific demand shocks as well as aggregate demand shocks played an important role in the wild fluctuation in oil prices since the mid-2000s. He concluded that the way oil price changes affect economy is very different depending on where the changes fundamentally come from is also true for Japan and UK. Oil specific demand shocks increase real GDP in Japan, which is very different from the US and UK where oil-specific demand shocks lead to reduction in GDP.

Arinze (2011) in his work “the impact of oil price on the Nigerian economy,” he asserted that there is a direct relationship between fuel price increase and inflation rate

in Nigeria and also recommended that more resources should be tapped to diversify the economy.

Zhihua, Meihua & Bo (2011) used cointegration test, ECM model, impulse response function and other econometric methods in their study to analyze the impact of coal prices fluctuation on the effectiveness of CPI and its delay impact, taking into account the characteristics of coal energy production and consumption. They selected CPI and COP index data from January 2002 to October 2010 of China to reveal that coal price fluctuation and CPI are positively correlated. They concluded that as coal price fluctuates 1% given other condition unchanged, CPI will vary 0.157%. According to them, when short-term fluctuation deviates long-term equilibrium, the model constructed by coal price and CPI will adjust from non-equilibrium status to equilibrium with the adjustment magnitude of -0.03.

Another study by Anandan and Ramaswamy (2013) on crude oil price behavior and its impact on inflation of India showed that the relation is positively correlated for crude oil prices and inflation growth rate during 2002-2011. According to them, mankind is using up world's energy resources in a way no other animal has ever done, now petroleum based fuel economy is ruling the world. Although there are so many alternative fuels, they are still able to meet only small proportion of the actual demand globally. The price of oil and inflation are often seen as being connected within a cause and effect framework. As oil prices move up or down, inflation follows in the same direction. Their study revealed a Pearson Correlation value of 0.726 and a positive relationship between crude oil prices and inflation growth rate. According to them,

India's oil price increases at the same time the world oil prices have also constantly increased. The oil prices have started rising significantly since the beginning of the twenty first century. The immediate effect of the oil price shock is the increased cost of production due to increased fuel cost. As a result of inflation in the economy, the cost of production would also rise and in turn causing a decrease in supply. They concluded that a significant part of the decline in the oil pass-through around the world is explained by the reduction in the effects of exchange rate changes on inflation and by declining oil intensity. However, their estimates show that, even after controlling for these factors, part of the decline in the oil pass-through remains unexplained.

### **3.6 Inflation in Sub-Saharan Africa Countries (SSA)**

Inflation rates in Sub-Saharan region are among the highest in the contemporary world. Particularly outside the CFA zone-the CFA zone comprises 14 Sub-Saharan countries that have a common currency CFA franc that is pegged to the French franc. Where the inflation rates now appear to match if not surpass what is being recorded in Latin America.

There is a considerable body of studies on inflation in the SSA economies. Some of these studies have tried to estimate causes of inflation from a structuralism and monetarist point of view. Chhibberet *al* (1989) developed an econometric model for Zimbabwe, which includes both monetary and structural factors of inflation. The study showed that nominal monetary growth, foreign prices, exchange and interest rates, unit labour costs and real income are the determinants of inflation in that country.

A similar model for Ghana was also used by Chhibber and Shafik (1990) covering 1965-88, using annual data. This model suggests that money supply is the key determinant of inflation in the Ghanaian economy, and variables such as the official nominal exchange rate and real wages were found to be insignificant. These findings were re-confirmed by Sowa and Kwakye (1991) on Ghana, leading to the overall conclusion that Ghanaian inflation is monetary and structural in character.

Elbadawi's (1990) research on inflation in Uganda revealed that rapid monetary expansion and the depreciation of the parallel exchange rate were the main determinants of inflation during the 1988-89 period, and generally supported the findings of Ghana by Chhibber and Shafik (1990) and Sowa and Kwakye (1991) that the influence of the official exchange rate was insignificant. Tegene (1989) departed from the common application of an econometric model, and used Granger and Piece causality tests in order to investigate the role of domestic money supply on inflation in six Africa countries. Evidence indicated uni-directional causality from monetary growth to inflation in the sample countries. A similar analytical methodology was employed by Canetti and Greene (1991) on ten African countries during 1978-89, and the results are similar to that of Tegene (1989) that monetary growth and the nominal exchange rate had a significant causal influence on inflation. These findings also lend support on the issue of the exogeneity of the money supply.

London (1989) engaged a pure Harberger monetarist model in 23 African countries with the growth of money supply, exchange rates, expected inflation and real income as determinants of inflation and found out that between 1974 and 1985 all variables

were highly significant. In Botswana, earlier studies (Huda, 1987; Leith, 1991; and Ncube, 1992) concentrated on price and nominal exchange rate and foreign price relationships. They found a high explanatory power for the South African price index (used as a proxy for foreign prices) suggesting strongly the hypothesis that inflation in Botswana is essentially imported. These studies also found a small impact of nominal exchange rate changes on prices in Botswana (Huda, 1987, Leith 1991), except in the case of Ncube (1992) where it was found insignificant. The above studies on Botswana used more traditional econometric approaches, which is the specific to general approach. The regressions were undertaken without testing for stationarity of the variables and as a result the spurious regression, or correlation issue, was not resolved by means of estimating the equations in first differences. Masale (1993), however, solved this problem by testing for stationarity and employing cointegration analysis in order to identify both short and long run relationships in the equation. The findings were that Botswana and South African CPI's as well as Rand/Pula exchange rate were indeed found to be non-stationary. However, the cointegration tests between the relative prices and the exchange rate did not confirm the existence of a long-run relationship. Estimation of a short-term relationship between the variables using first differences and error correction factor also led surprisingly, to the rejection of the PPP model. Atta et al (1996), building upon the model by Masale (1993), used monthly data from 1975 to 1993, thereby extending the sample size since the latter had used quarterly observations. The approach also employed a general to specific method using an unrestricted autoregressive distributed lag model, stationarity testing, and cointegration analysis and error correction model to distinguish clearly between short-run and long-run price relationships.

A research conducted by Laryea and Sumaila (2001) on the determinants of inflation in Tanzania established that in the short-run, output and monetary factors are the main determinants of inflation in Tanzania. They also pointed out that in the long-run, parallel exchange rate also influences inflation. In their conclusion, they emphasized that; inflationary situation in Tanzania is basically a monetary phenomenon.

### **3.7 Inflation in Ghana**

Over the years, there has been a considerable amount of empirical research in the field of inflation. Most of the works were directed towards the establishment of the causal agents (determinants) of inflation in Ghana. Inflation in Ghana has been investigated by Lawson (1966), Naseem (1970), Ewusi (1977), Oti-Boateng (1979), Aghevli and Khan (1978), Kwakye (1981), Chhibber and Shafik (1990), Chhibber and Shafik (1991) Dordunoo (1994), and Bawumia and Atta-Mensah (2003).

Lawson (1966) identified some major contributory factors to the inflationary process which was generated soon after independence. The major factor was the deficits incurred on government accounts which were financed through borrowing from the central bank. This is very much in line with the monetarist argument. She also identified the shortage of essential consumer goods and restrictions on imports as other factors leading to inflation. She sighted factors which operate in the agricultural sector which bring about serious deficiencies in the supply of local foodstuffs. This idea is not unlike the inelastic food supply hypothesis by the “structuralists”. In terms of causality, Lawson traces a chain of deficits-money creation which leads to inflation.

Naseem's (1970) study on Ghana for the period 1960 to 1965 also concluded that excessive monetary expansion arising from government borrowing from the central bank generated strong inflationary pressures in the economy. This finding agrees with Lawson's study over the same period. Naseem noted that government shifted resources from the private sector into its own spending but did not succeed in stimulating growth. For that reason the magnitude of the investments, which were not productive, caused inflation.

Ewusi (1977) categorized inflation in Ghana according to their levels. He called the 1956 – 1960 period the years of “relative price stability” when prices rose at less than 2% per annum. 1961-1965 saw an “incipient inflation” when all the price indices were beyond 5% per annum but not beyond 10%. This was a period of major government expenditure in all sectors of the economy. 1966-1969 was a period of “moderately rising prices” when inflation rates became double digits. The year to year changes showed that the inflationary problem had assumed alarming dimensions. He identified, among many causes, excessive deficit financing through monetary expansion activities, balance of payments constraints, wage and salary increases, low productivity and inelastic food supply.

Aghevli and Khan (1978) developed a model with both monetarist and structuralist features. In their model, fiscal deficit was considered as the original force and the propagating mechanism in the inflationary process.

Oti-Boateng (1979) gave evidence to show inflation in Ghana is not primarily due to global and imported inflation but was rather domestically generated. He also identified the causal factors as deficit financing, the balance of payments crisis, increased money supply, wage and salary increases and low level of productivity in the agricultural sector.

Kwakye (1981) undertook a multi-equation econometric analysis of the inflationary situation in Ghana. His preoccupation was not however limited to the role of fiscal deficits and monetary expansion, but to investigate the causes of inflation in its entirety in the Ghanaian economy. In his analysis it was known that excess liquidity is a significant source of inflation in the economy. The excess liquidity comes from borrowing by the government from the central bank to finance budget over-runs. This confirms other findings and reinforces the contention that inflation is solely caused by governments (Friedman, 1956). The contribution of local food production was once again established in Kwakye's work. To a weak level the role of price expectations was also established. This was mainly only relevant for long periods of price increases. The role of international inflation was not significant and could only be proved significant for particular periods when it was strong especially the oil crisis of 1973.

Chhibber and Shafik (1990) did a study on the inflationary trends in Ghana. They conducted the study on the impact of fluctuating exchange rates on inflation. Their preoccupation was to ascertain the suspicion that devaluation, especially since the ERP, has inflationary consequences for the economy. Like Jacobs (1977) and Frenkel (1977), Chhibber and Shafik (1990) contend that it is not enough to explain inflation in Ghana

by the usual processes, that is the fiscal and monetary process, the direct cost-push factors (such as cost of foreign exchange and food prices) and through real factors like output. This is because in spite of their importance, these mechanisms lack the interrelationships which make them meaningful. The authors argue, for example, that changes in individual prices and the exchange rate have budgetary implications. The way the resulting change in the budgets is financed in turn has implications for the availability of working investment capital which in turn has real output effects. This has implications for the management of inflation. The statistical evidence reveals that both before and after 1983, the relevant exchange rate for pricing decisions were the shadow price of foreign exchange and hence cannot be inflationary. They also noticed that the wage-push gap which alludes to wage-push inflation is not significant. This is because only a small share of the nation's work force is in the formal sector and unionized. With real output, they detected a negative relationship between inflation and real output. The pattern showed that inflation peak is preceded by output slumps, which showed an indication of the contribution of supply shocks to the inflationary process.

Chhibber and Shafik also found that the relationship between government deficit and inflation shows no clear pattern. This is because periods of high inflation have been associated with relatively low deficits through the 1960s and early 1970s. This is to be expected, because the impact of the budget deficit on inflation is through its impact on monetary growth. For instance, high fiscal deficits are financed by borrowing from abroad or the central bank through printing of money which caused inflation. They concluded that the ability to check monetary expansion should be an important component of any anti-inflationary package.

What is useful and relevant for the study is the addition of four supply-side variables, namely, the rate of change in the exchange rate, shocks to import prices, food prices and oil prices in the inflation model. Ghana, like most developing countries, has had shocks that have historically impacted significantly on the general price level. Unfortunately inflation-related studies in Ghana do not seem to have given these relevant shocks the necessary attention, which the current study does. Dordunoo (1994) observes that rapid exchange rate depreciation and resultant hikes in import prices were in themselves inflationary. In contrast, a school of thought championed by Chhibber and Shaffik (1991) holds the view that since most prices with the exception of petroleum prices were transacted at the parallel exchange rate, depreciation of the official exchange rate could not have affected inflation significantly.

Bawumia and Atta-Mensah (2003), using a vector error correction forecasting (VECF) model, conclude that inflation was a monetary phenomenon in Ghana. They did not, however, explore the potential for real factors in price determination.

### **3.8 Conclusion**

The review of the literature points to the fact that both structural and monetary variables influence inflation. The extent of their respective influences however varies from year to year and this is explained by the determinants of inflation specifically like money supply, exchange rate, real output, domestic interest rates, prices expectation and budget deficit as well as oil prices. It can be argued that any model of inflation must consider these factors.

In conclusion, the literature suggests that the primary determinants of inflation are the growth in the nominal money stock, expected inflation, nominal interest and exchange rates, real income and foreign prices. This suggests that inflation in Ghana could be the result of monetary and structural factors, as well as being import-price dependent.

## **CHAPTER FOUR**

### **THEORETICAL FRAMEWORK AND METHODOLOGY**

#### **4.1 Introduction**

This chapter is devoted to the research methodology and theoretical framework adopted for the study. It provides the analytical framework. The justification is to place the study in the right methodological perspective with regards to the necessary tools for estimation and analyses. The chapter will provide the basis for the presentation of the results and the provision of appropriate policy recommendations contained in the last two chapters, respectively. It comprises model specification, definition and justification of variables, theoretical framework, relationship between inflation and the explanatory variables, data and sources of data, and finally the data analysis technique.

## 4.2 The Econometric Model

### 4.2.1 Theoretical Framework

The monetarists argue that excess money supply is the cause of inflation. According to them, if more money is supplied than people want, they will have to get rid of the excess and this is the cause of inflation. In countries where there is high money supply, inflation also tends to be high. The monetarists therefore argue that inflation is a monetary phenomenon. Monetarists focus on fiscal deficit, money creation and inflation while the new structuralists emphasize the link between full bottlenecks, income distribution and social conflict over the determination of real wages (Agenor & Montiel, 1996).

Mathematically,

$$\text{➤ Inflation} = f [M^s - M^d] \dots\dots\dots(4.1)$$

If the result of equation 4.1 is positive then there is excess supply of money.

In the money market,

$$\text{➤ } \frac{M}{P} = f(i, y) \dots\dots\dots (4.2)$$

$$\text{➤ } P = \frac{M}{f(i, y)} \dots\dots\dots(4.3)$$

$$\text{➤ But } \frac{1}{f(i, y)} = k \dots\dots\dots (4.4)$$

➤ Where  $k$  is a constant

$$P = Mk \dots\dots\dots (4.5)$$

Where  $P$  is price and  $M$  is money supply.

According to the monetarists, in the long-run inflation is explained solely by monetary supply as shown in equation 4.5 above.

Fisher examined the link between the total quantity of money (money supply) and the total amount of spending in final goods and services produced in an economy ( $P \times Y$ , where P is the price level and Y is the aggregate output or income). Accordingly, the concept that provides the link between money supply (M) and  $P \times Y$  is velocity of money (V). Mishkin (2007)

$$v = \frac{P \times Y}{M} \dots\dots\dots (4.6a)$$

He obtained the equation of exchange by multiplying both sides of the equation 4.6a by M.

$$M \times V = P \times Y \dots\dots\dots (4.6b)$$

The quantity theory of money was derived from the equation of exchange based on Fisher's view that velocity is fairly constant. According to the classical economists, the quantity theory of money explains that the movements in the price level result solely from the quantity of money.

Quantity equation is therefore the same as:  $M \times V = P \times Y$ ,..... (4.6b)

- Where
- M= money
  - V= velocity
  - P= price
  - Y= output

- Velocity – the average frequency with which a unit of money is spent on new goods and services produced domestically in a specific period of time.

#### **4.2.2 The Empirical Model**

The main objective of the study is to assess the impact of oil price changes on inflation. Therefore, oil price change is the key explanatory variable in the model specified below, which among other variables, is expected to have an influence on the dependent variable (inflation).

Using monthly time-series data for oil prices, consumer price index, exchange rates, and interest rates, this study analyses the influence of oil price change on inflation. Two related questions are formally examined: first, do oil price changes generate inflation in Ghana? If so, how does inflation respond? And what is the magnitude of the response? Second, does an asymmetric response exist during the sample period? That is, does the impact on inflation differ between the rise and decline in oil prices?

For the purposes of this study, inflation is measured by the first difference of the log of consumer price index (CPI). The CPI is chosen since it is the best measure for adjusting payments to consumers when the intent is to allow consumers to purchase, at today's prices, a market basket of goods and services equivalent to the one that they could have purchased in an earlier period. It is also the best measure to use when one wants to translate retail sales and hourly or weekly earnings into real or inflation-free figures. For this study, CPI re-basing is conducted using 2002 as the base year.

The interest rate and exchange rate may also affect the inflation rate ( $\Delta lcp_i$ ), Therefore, in addition to the oil price change ( $\Delta lroilp_i$ ), interest rate change ( $\Delta r_i$ ) and the exchange rate change ( $\Delta er_i$ ) are included as independent variables.

The possibility of asymmetric response of inflation from oil price change is taken into account in the model. The asymmetrical relationship between oil price shocks and an economy is investigated in many papers such as Mork (1989), Hamilton (1996), Hooker (1999), and Cuñado and Pérez de Gracia (2005)

The present study first utilizes Hansen’s (1992) parameter stability tests to perform the asymmetry test. Real oil price increases and decreases are entered as separate variables in the equation, comparatively with when the oil price change is entered without such separation.

The dependent variable is the log change in CPI, and all the explanatory variables are lagged. Apart from the log change of CPI and oil price variables, interest rate change and exchange rate change are included in the model. In absence of long-run equilibrium among the variables and with the presence of asymmetrical transmission from oil prices to inflation rates, the following model is presented:

$$\Delta lcp_i = \sum_{i=0}^p a_i^+ \Delta lroilp_{t-1}^+ + \sum_{i=0}^p a_i^- \Delta lroilp_{t-1}^- + \sum_{i=1}^p \gamma \Delta r_{t-1} + \sum_{i=1}^p \delta_i \Delta er_{t-i} + \sum_{i=1}^p \beta \Delta lcp_{t-i} + \mu_t$$

..... (4.7)

Where  $\Delta lroilp_i^+$  and  $\Delta lroilp_i^-$  are respectively real oil price increases and real oil price decreases,  $\Delta lcp_i$ ,  $\Delta lroilp$ ,  $\Delta r$ ,  $\Delta er$  represent respectively the difference of consumer price index and real oil price (after logarithm) as well as the difference of interest rates

and exchange rates. The error term,  $\mu_t$  is assumed to be independently and identically distributed with  $N(0, 1)$ . The optimal lag length in the model is chosen by minimizing the Akaike information criterion (AIC).

If there exist neither a cointegration relationship among the variables nor asymmetrical responses of inflation from oil price, then equation (4.7) can be reduced to a linear regression model shown as equation (4.8):

$$\Delta lcp_i = \sum_{i=0}^p a_i \Delta lroilp_{t-i} + \sum_{i=1}^p \gamma_i \Delta r_{t-1} + \sum_{i=1}^p \delta_i \Delta er_{t-i} + \sum_{i=1}^p \beta_i \Delta lcp_{t-i} + \mu_t \dots \dots \dots (4.8)$$

If there is a cointegration relationship among the variables in conjunction with the presence of asymmetrical relation between oil price changes and inflation rates, our four-variable estimation equation can be specified as in equation (4.9):

$$\Delta lcp_i = \sum_{i=0}^p a_i^+ \Delta lroilp_{t-i}^+ + \sum_{i=0}^p a_i^- \Delta lroilp_{t-i}^- + \sum_{i=1}^p \gamma_i \Delta r_{t-1} + \sum_{i=1}^p \delta_i \Delta er_{t-i} + \sum_{i=1}^p \beta_i \Delta lcp_{t-i} + \lambda \varepsilon_{t-1} + \mu_t \dots \dots \dots (4.9)$$

Where  $\varepsilon_{t-1} = (lcp_{t-1} - \phi lroilp_{t-1} - \eta r_{t-1} - \varphi er_{t-1})$  is the error correction term in t-1.

The coefficients in the error correction term are  $\phi$ ,  $\eta$  and  $\varphi$ . The signs of these coefficients explain the relationship each variable has with CPI.

$\phi$  is the coefficient of oil price which explains by how much CPI will change as a result of a unit change in oil price. The coefficient of interest rate is  $\eta$  which explains the amount of unit CPI will change when interest rate change by a unit.  $\varphi$  is the coefficient of exchange rate which explains the amount of unit CPI changes as exchange rate change by one unit.

### 4.3 Description and Justification of Explanatory Variables

The justification for including the following explanatory variables used in the study - oil price, exchange rate, and interest rate- are that they are often predicted by economic theory. Also, empirically inflation studies have informed the choice of these explanatory variables. These factors were chosen upon a careful consideration of their impacts on inflation in Ghana.

#### ❖ Oil price

Oil price is the main explanatory variable in studying the impact of oil price changes on inflation in Ghana. This is because the aim of the study is to examine critically the impact of the changes in oil price on inflation. The oil price considered suitable for this study is international crude oil price. This is because the crude oil price in Ghana is determined in the international market which makes it exogenous. Domestic oil price is made up of international oil price plus other components such as tax and/or subsidies. The domestic oil price is not appropriate for this study since under the domestic oil price system, oil becomes refined or finished product. Also, the filling stations in Ghana do not charge the same oil price making it difficult to capture the actual oil price to examine the impact of oil price on inflation in Ghana. The discontinued observations in the data for domestic oil prices also make it inappropriate for this study. The study uses nominal oil price as a proxy for oil price because apart from oil price being set by OPEC making it exogenous with respect to Ghana's economy, consumers of refined oil products choose to respond to changes in the nominal price of oil rather than the real price of oil perhaps because the nominal price of oil is more visible.

❖ Interest rate

Interest rate is one of the important instruments for monetary policy. It is also an important variable in the money, goods and capital market; since the monetary policy is the primary tool to prevent inflation. Central banks may fine-tune inflation to a significant extent through targeting interest rates. For this reason, the study chooses the interest rates as one of its control variables in the model. The 91-Day Treasury bill rate is used as proxy for interest rate since Treasury bill serves as the opportunity cost of holding money or shares and as a benchmark for measuring interest rate.

❖ Exchange rate

The inclusion of the real exchange rate can be seen from the fact that crude oil prices are quoted in US dollars, which in turn, determines the domestic prices of petroleum products. The exchange rate is the price of domestic foreign currency in terms of domestic currency. According to Krichene (2007), changes in the exchange rate are different from changes in one tradable good price. He asserted that whereas changes in one good price affect only the relative price of the good concerned, changes in the exchange rate affect the prices of all tradable and their relative prices in terms of non-tradable; the exchange rate has a wealth effect .

Moreover, exchange rate has been largely omitted from the related literature, thus the inclusion of this variable seems appropriate because it surely play a major role in monetary policy in the international economy as pointed out by Krugman (1983) and Rogoff (1991). It is also important because we need US dollars to be able to import

crude oil in Ghana hence the use of cedi/dollar rate as a proxy for exchange rate. Accordingly, it is also necessary to take exchange rate into account.

#### **4.4 The Econometric Technique.**

##### **4.4.1 Vector Autoregression (VAR)**

The essence of regression analysis is to estimate the long run economic relationships in order to test economic theory. The VAR methodology is a better approach for investigating the long-run relationship because it approximates well the unknown model of true economic structure by taking dynamic interactions among the variables in the system into consideration.

Conventionally, econometric investigations are carried out through extensive models. Typically, a full set of structural equation is estimated. In order to identify the impact of policy variables in the model, the investigation is designed at conveying a value to the policy instrument that will achieve a given target for macroeconomic variables. The model assumed that the policy variables are exogenous on the grounds that these variables are the instruments controlled by the policy makers.

The main development of VARs as a modelling tool was in the early 1980s, originating from concerns about the validity of some of the assumptions used in traditional macroeconomic models. In particular, Sims (1980) argued that the restrictions used to identify the parameters in traditional models - which often took the form of excluding

variables or their lags from equations or assuming that a particular variable was exogenous - were 'incredible'. He contended that theory was rarely sufficiently well-defined to justify such exclusion restrictions or exogeneity assumptions, and that such models were likely to be under-identified once these problems were taken into account. As a result, some of the economic interpretations drawn from such models were unlikely to be robust.

The above concerns led to the development of VAR as an alternative modelling approach. VARs are dynamic systems of equations in which the current level of each variable in the system (CPI, oil price, exchange rate or interest rate) depends on past movements in that variable and in all the other variables in the system. In contrast with traditional models, such as the Bank's macro-econometric model, basic VAR systems make few assumptions about the underlying structure of the economy and instead focus entirely on deriving a good statistical representation of the past interactions between economic variables, letting the data determine the model.

However, even VARs are not completely devoid of assumptions, since the choice of variables to include in the system and the length of lags allowed represent a type of restriction, which can have important implications. Nevertheless, the VAR approach is useful for exploring what a given theoretical view implies for the dynamic behaviour of the variables of interest. Or, according to Breitung (1998), VAR models are useful for take a theory-guided look at the data.

Thus a benefit of the VAR approach is that it does not entail any strict economic theory within which the model is grounded. Most of the empirical literature has analyzed the relationship between oil prices and key macroeconomic variables using some type of a VAR framework. The cointegration analysis and VAR technique can be used to model the long-run and short-run relationships between non-stationary variables (Johanson, 1988). Cointegration techniques are used to establish whether or not a long run equilibrium (i.e. stationary) relationship exists between non-stationary variables in a single or system of equation(s). Such long-run relationships are normally hypothesized by economic theory, where the theory postulates the existence of an equilibrium relationship that links the variables in question. The concept of cointegration is in essence a statistical characterisation of a situation where the variables in the hypothesized relationship should not diverge from each other in the long run, or if they should diverge from each other in the short-run, this divergence must be stochastically bounded and diminishing over time (Banerjee et al., 1993:136).

#### **4.4.2 Correlation Test**

To assess the relationship among the variables of interest in the model, the study carried correlation tests. It is expected that there will be a positive and high correlation between oil price and inflation. The exchange rate is also expected to have a positive sign whereas interest rate is expected to have a negative sign.

#### **4.4.3 Stationarity Test**

Studies involving time series analysis necessarily employ data from the past to quantify historical relationships, such that if the future happens to be like the past, then the historical

relationship can be used to forecast the future. But if the future happens to be essentially different from the past, then those historical relationships may not be reliable in forecasting the future. Hence it is fundamental that time series variables follow at least a stochastic process and are stationary.

A stochastic process for a variable  $y_t$  is said to be covariance stationary or weakly stationary if its first and second moments (mean and co-variance) are all time invariant, or if its probability distribution does not change overtime. This is accomplished when the following three conditions are satisfied:

$$E(y_t) = c \text{ for all } t$$

$$Var(y_t) = \sigma^2 \text{ for all } t$$

$$Cov(y_t, y_{t-1}) = \delta_t$$

If it so happens that all these three conditions are violated, then the variable in question has a unit root and doing estimation with it will produce spurious results. It is imperative to perform unit root tests to verify whether the variables are not integrated of an order higher than one, to avoid spurious results. This is necessary, because the computed F-statistics provided by Pasaran et al. (2001) are not valid in the presence of I (2) variables. Though the problem of unit root can be identified by inspecting the series of the variable in question pictorially, there are various statistical procedures that can detect this nuisance more easily. These include the Augmented Dickey-fuller (ADF) test and the Phillips-Perron (PP). In general, the ADF test uses the following model to examine unit root:

$$\Delta y_t = \beta_1 + \beta_2 t + \delta y_{t-1} + \alpha_t \sum_{t-1}^m \Delta y_{t-1} + \varepsilon_t \dots\dots\dots (5.10)$$

Where  $y_t$  is *the dependent variable in question*,  $t$  is a time trend,  $\Delta$  is the differencing operator and  $\varepsilon_t$  is a white noise process. With the above equation the following hypothesis is tested for the null of unit root.

$$H_0 : \delta = 0 \text{ ( } y_t \text{ is non-stationary or has a unit root)}$$

$$H_1 : \delta < 0 \text{ ( } y_t \text{ is stationary or has no unit root)}$$

Dickey and Fuller (1979) showed that under the null hypothesis, the t-statistic that is used for most hypotheses testing procedures are inappropriate, since it does not follow the conventional t-distribution. They thus generated a special set of values using Monte-Carlo Simulation (called  $\tau$ -*statistic*) for their test and this is reported in many econometric software packages including E-views and Stata. The result of this test is compared to the critical values generated by MacKinnon (1996), such that if the calculated  $\tau$ -*statistic* happens to be less than the critical value at a given level of significance, the null hypothesis of no unit root is rejected (i.e. the variable is stationary), otherwise it is not. This same analogy applies for the Phillips-Perron test. Rather than  $\tau$ -*statistic*, a PP test statistic is compared to the critical values generated by Mackinnon (1996) to conclude on the null of unit root. The PP test deals with potential serial correlations in errors by employing a correction factor that estimates the long run variance of the error process with a variant of the Newey- West formula. In principle, the PP test may be more powerful than the ADF alternative.

Two measures have been identified in the literature for solving the problems associated with unit roots. First, taking the log of the time series and second, differencing the series. Taking the log of the variables *linearizes* the possible exponential sequence in the series and thus stabilizes the variance or spread of the stochastic process. Alternatively, differencing the variables stabilizes the mean of the variable - this procedure requires that a non-stationary variable be differenced sequentially until it attains stationarity. Some empirical studies have

employed the two measures simultaneously by taking the logs, followed by the first difference of the variables. This generates the growth rate of the variable instead of either the log or the first difference of the variables (Sinha and Macri, 1999).

A time series variable that appears to be persistently trending overtime is problematic and the conventional hypothesis testing and forecasting procedures are unreliable. Which most likely will produce spurious results since the OLS estimates and the necessary tests may have non-standard distributions even in large samples.

#### **4.4.4 Cointegration Test**

A unit root test tells us the number of times a variable has to be differenced in order to make it stationary. By carrying unit root tests, the long-run information would be lost due to differencing the data series. To obtain the long run information, a cointegration analysis was employed by testing to see whether long run theoretical relationships between the variables existed. The study used Johansen cointegration approach to specify dynamic adjustment among the variables in the model.

If there is cointegration between the dependent variable (inflation) and the independent (oil prices, interest rate and exchange rate), then according to the Engle-Granger Representation Theorem, there exists a valid error correction model between the variables. The study did a check for error correction model in order to verify if the adjustment parameter is negative, implying that the estimated equation is a valid error correction model which then was used to check the speed with which the system adjusts to equilibrium whenever there is departure.

An over- parameterized equation of inflation was first estimated, and then OLS estimation was applied in order to arrive at the parsimonious model. A diagnostic test was conducted on the error correction model to check for autocorrelation, heteroscedasticity, model specification and normality.

#### **4.4.5 Diagnostic Check**

To evaluate the statistical properties of the model, a series of tests was conducted to check if the model performs well on statistical grounds. To check for autocorrelation, Bruesch-Godfrey serial correlation LM test was used. A check using autoregressive conditional heteroscedasticity (ARCH) on heteroscedasticity was also done and then to check whether the model was misspecified or not, a misspecification error test in the form of Ramsey RESET was conducted. In addition, a normality test was conducted using Jarque-Bera test.

### **4.5 Relationship between Inflation and the Explanatory variables**

#### **4.5.1 Relationship between Oil Prices and Inflation**

Positive or negative developments that occur in the international oil market create certain effects, especially on the economies of nations like Ghana where large portions of their oil requirements are imported. Unfavorable developments, such as international oil bottlenecks and extreme price increases, have negative effects on national production as well as on the balance of international payments. For example, manufacturing industries use oil intensively, especially to fulfill their transportation needs and operation needs since most manufacturing industries in Ghana use oil as a fuel for their machines used in production; when they experience an increase in

production costs (cost-push inflation), there is a rise in the inflation index values in the oil industry and in energy production (M. Cavollo, 2008). During the first oil crisis experienced in the early years of the 1970s, many countries were adversely affected considerably by increasing oil prices. Conducting research on the effects of oil-dependent developments on national economies became an attractive subject.

#### **4.5.2 Interest rate and Inflation**

If inflation is rising the central bank raises the interest rate, meaning that the cost of borrowing increases so the amount of money borrowed by individuals and companies decreases, which in turn decreases the amount of money in the economy (money supply), resulting in decreased inflation. The effect of inflation on interest rate is simply caused by the bank's attempt to reduce it. However, businesses borrow at higher costs due to the higher interest rate, which may be passed on to consumers.

Asset pricing and term structure of interest rate models, suggest a positive relationship between inflation risk and interest rates. Berument (1999), Chan (1994), Kandel et al. (1996), Fama (1975), Fama and Gibbons (1982), Fama and Schwert (1977) and Mishkin (1981). Juster and Taylor (1975), Juster and Wachtel (1972a, b), Hahn (1970), reports a negative relationship between inflation uncertainty and interest rates. Another line of literature, initiated by the theoretical works of Fischer (1975),

Merton (1975) and Malliaris and Malliaris (1991), argues that there is a positive relationship between inflation and real interest rates. In effect, the relationship between interest rate and inflation is not known a priori.

### 4.5.3 Exchange Rate (Trade) and Inflation

Exchange rate is one of the important economic policy tools. These are some of the ways exchange rate affect inflation:

When the exchange rate depreciates (Ghana operates the floating exchange rate system), a trader requires more units of the cedi to buy foreign currency, thus increasing the cost of imported goods. The trader passes this cost on to the consumer, which increases the prices of consumer goods.

The exchange rate variable is the monthly exchange rate derived as the number of units of the local currency (Cedi) per unit of US dollar. The use of the Cedi/Dollar exchange rate is because the US dollar dominates the foreign exchange market in Ghana with over 80% of the turnover being in US dollars. In recent years, all businesses are directly and indirectly affected by international activities as a result of globalization. In other words, exchange rate changes may affect the competitive position of companies and hence industries operations. As a result, cost of goods and services, sales and cash flows may change with changes in the exchange rate. In Ghana the cedi-dollar being the major international trading currency, any change in the exchange rate is translated in the cost of importing raw material, together with other imports. Since Ghana's economy is also import-demand driven, changes in the exchange rate affects most sectors of the economy as well as the pricing of goods and cost of production. The exchange rate therefore affects business cash flow and profitability. Investors may also evaluate this as an important risk factor.

One of the most debated aspects of the exchange rate is that it is associated with inflation. Exchange rate depreciation is perceived as one leading indicator of inflationary pressures and therefore used as one of the instruments of policy. A most persistent concern is that the rate of depreciation of the exchange rate causes inflation. This concern has led to calls on the Bank of Ghana to stabilize the exchange rate.

In small open economies such as Ghana, exchange rates become key variables in the sense that movements in the nominal exchange rate often account for a significant part of the variation in consumer prices. Fluctuations in exchange rates influence the prices of tradables both for direct consumption and for inputs in the production process. A number of studies have covered the exchange rate pass-through to various domestic price measures, including McCarthy (1999), Ajakaiye (1994), Ndung'u (1993), Leigh and Ross (2002), Bhundia (2002), Acheampong (2005), and Loloh (2014).



## CHAPTER FIVE

### ANALYSIS AND DISCUSSION OF RESULTS

#### 5.1 Introduction

This chapter is divided into two main sections. The first section includes the definition and sources of the variables and examines the basic characteristics of the data using graphs and correlation matrix. The second section presents the results on the effect of oil price changes on inflation in the long and short runs.

#### 5.2 Characteristics of data

This section presents the definitions of variables and results on the basic characteristics of the variables used in the study. The section first presents the definitions of variables used for the analysis then summary statistics of the data, after which the simple correlation among the variables is examined, and then followed by time plots of the variables.

##### 5.2.1 Data Description and sources.

To examine the oil price-inflation relationship in Ghana, secondary data was used. The study used monthly data which span the period of 1998 to 2013. All the variables used for the study are presented in the table below with their definitions and sources.

**Table 5.1: Definitions and sources of variables**

Variable	Definition	Source	Denotation
Domestic price level	consumer price index	Bank of Ghana (BOG)	CPI
Oil price*	International crude oil prices	Institute for fiscal Studies (IFS) (IMF website)	OILP
Exchange rate**	Cedi/ US dollar rate	BOG	ER
Interest rate**	91 day-treasury bill	BOG	R

Source: Author's note

\* denotes main explanatory variable. Change in oil price can be negative which implies a decrease in oil price or positive implying an increase in the price of crude oil. The increase and decrease in oil prices are treated as dummy variables and the value depends on the stock. If the change in oil price is positive, the dummy will take the value of 1 for oil price increase and 0 otherwise. Also if the change is negative, the dummy will take on 1 for oil price decrease and 0 otherwise.

\*\* denotes control variables

## 5.2.2 Descriptive Analysis

**Table 5.2: Summary of descriptive statistics**

	LCPI	LOILP	LER	R
Mean	5.123	3.744	9.078	21.451
Median	5.219	3.9	9.114	21.66
Maximum	6.13	4.839	9.957	41.85
Minimum	3.789	2.156	7.728	9.04
Std. Dev.	0.705	0.66	0.596	9.549
Skewness	-0.362	-0.434	-0.912	0.451
Kurtosis	1.916	2.165	3.254	2.125
Sum	983.632	718.816	1742.985	4118.65
Sum Sq. Dev.	94.83	83.185	67.895	17416.93
Observations	192	192	192	192

Source: author's estimate

*Note ; LCPI denotes log of domestic price level, LOILP represents log of oil price, LER is the log of exchange rate and R is the interest rate.*

The mean and standard deviation of LCPI are found to be 5.12 and 0.71, respectively. The minimum and maximum values for LCPI are 3.79 and 6.12, respectively. Similarly, oil price has a mean of 3.74 for the period under investigation. The maximum value of oil price is 4.8 and the minimum is 2.16. The spread of oil price around the mean is less than the spread of LCPI around the mean. The exchange rate and the interest rate variables are found to have means of 9.08 and 21.45, respectively, and respective standard deviations of 0.596 and 9.55.

### 5.2.3 Correlation analysis

The correlation among the variables in the model is presented in Table 5.3. The correlation matrix suggests a positive correlation between oil price changes and changes in CPI in Ghana. This relationship is expected since in Ghana, high oil prices are likely to translate into inflationary pressures, as previously discussed. The correlation coefficient is significant at 1%.

**Table 5.3: Correlation matrix**

	LCPI	LOILP	LER	R
LCPI	1.000			
	-----			
LOILP	0.922	1.000		
	(0.000)	-----		
LER	0.949	0.863	1.000	
	(0.000)	(0.000)	-----	
R	-0.709	-0.724	-0.588	1.000
	(0.000)	(0.000)	(0.000)	-----

*Probability values in parentheses.*

*Source: author's estimates.*

*Note: LCPI is the log of domestic price, LOILP is the log of oil price, LER is the log of exchange rate, and  $R$  is the interest rate.*

The correlation matrix indicates a positive relationship between exchange rate and CPI as expected. The correlation coefficient is significant at 1%. The positive correlation suggests that the depreciation of the cedi moves in the same direction with a rise in prices of goods and services and hence inflation. Again, as the cedi appreciates, general price level falls. Similarly, the correlation between the interest rate and CPI is negative. The implication is that, the use of government interest rate as a tool in curtailing inflation may be an important tool.

### **5.3 Examination of the Stationarity Properties of the Variables**

#### **5.3.1 Stationarity Test or Unit Root Test**

The stationarity properties of the variables used in the study are examined in this section. These include the use of a graphical approach before a formal test was conducted. From fig 5.1, it is clear that none of the variables is stationary. However, the graphs suggest that the variables used in the study have intercepts. This indicates that the performing unit root must contain intercept terms.

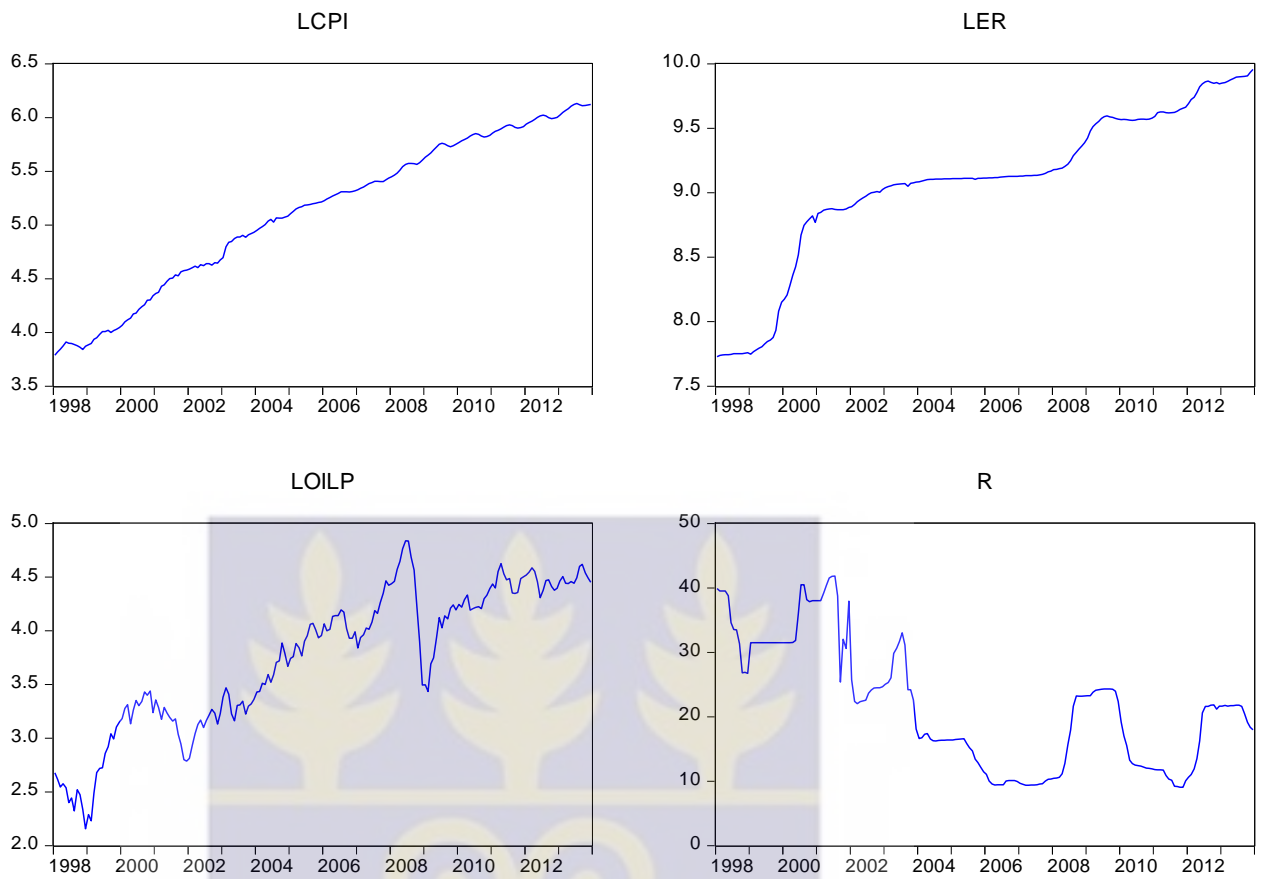


Figure 5.1: Graph of level variables.

Source: Constructed from BOG & IMF data

Note: LCPI is the log of domestic price, LOILP is the log of oil price LER is the log of exchange rate, and R is the interest rate.

To further test for stationarity, the graphs of the first differences of the variables are presented in Fig 5.2.

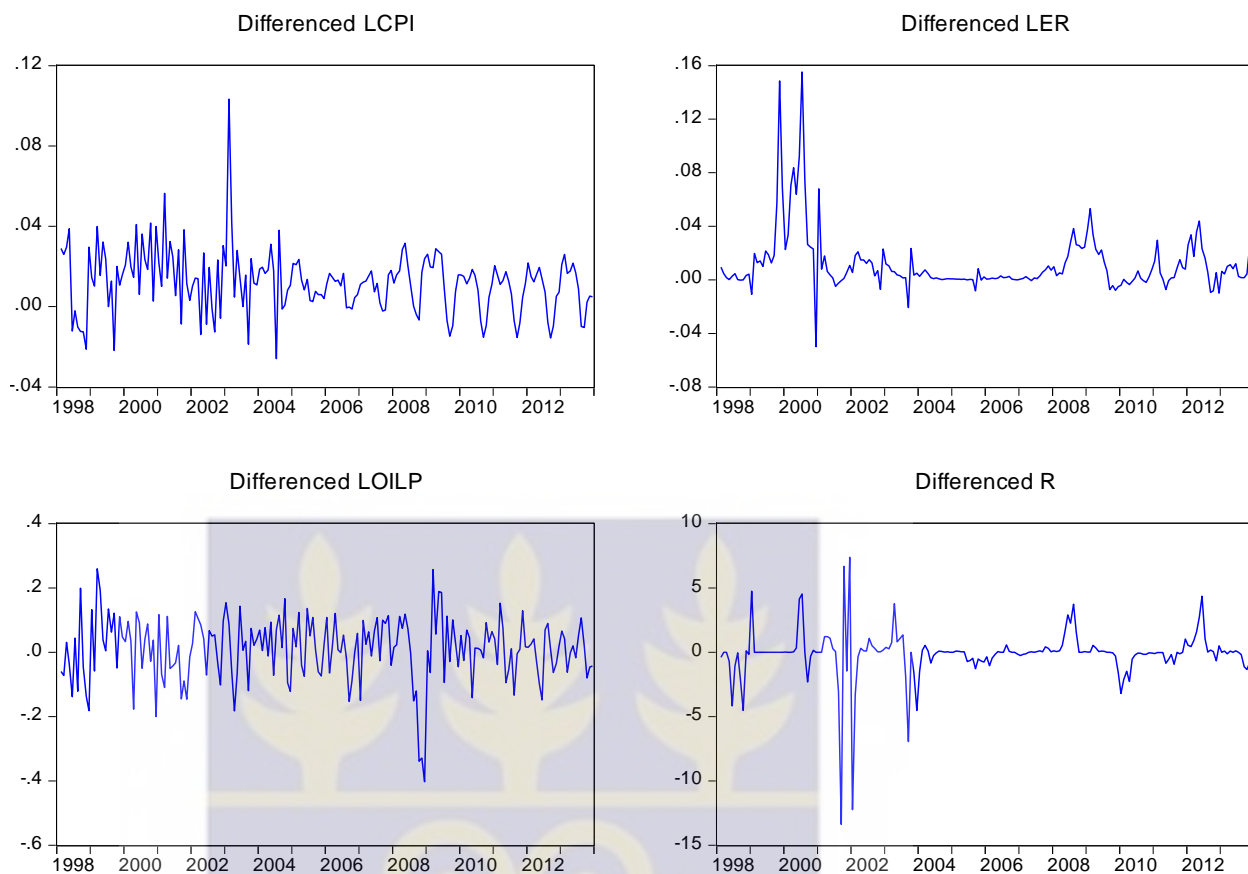


Figure 5.2: Graph of First difference of variables.

Source: Constructed from BOG & IMF data

Note: DLCPI is the growth of domestic price, DLOILP is the growth rate of oil price, DLER is the growth rate of exchange rate, and R is the interest rate.

Table 5.4: ADF and PP-test at levels.

Variable	Augmented Dicky-Fuller	Phillips Perron
LCPI	-2.57518*	-2.362
LOILP	-1.6687	-1.5476
LER	-1.9135	-1.901
R	-2.0857	-2.185

Note \* denote sig. @ 10%

*Source: Author's estimate.*

*Note: LCPI is the log of domestic price, LOILP is the log of oil price LER is the log of exchange rate, and R is the interest rate.*

Table 5.4 presents the results from the ADF and the PP unit root tests. The result indicates that other variables apart from Consumer Price Index are not stationary at their levels, confirming the result from the graphical presentation from Fig. 5.1. However, it must be said that LCPI is significant at 10% indicating that the variable is stationary. However, the PP test gives a contrary result to this effect. Unit root tests are then conducted on the first difference of the variables to check if they will be stationary at their first difference. The results are then presented in Table 5.5 which corresponds with the graphical presentations in Fig. 5.2.

**Table 5.5: ADF and PP unit root test at first difference**

Variable	Augmented Dicky-Fuller	Phillips Perron
DLCPI	-7.5160***	-10.7898***
DLOILP	-11.2028***	-11.1740***
DLER	-6.3478***	-6.5724***
DR	-5.9007***	-13.1932***

*Note \*\*\* denotes sig. @ 1%*

*Source: Author's estimate.*

*Note: DLCPI is the growth rate of domestic price, DLOILP is the growth rate of oil price, DLER is the growth rate of exchange rate, and R is the interest rate.*

The result in Table 5.5 indicates that the growth rate of domestic price (DLCPI) is stationary at first difference according to both Augmented Dickey-Fuller and Phillips-Perron. The implication is that the null hypothesis of unit root is rejected at 1% significant level and concludes that domestic price level (CPI) is integrated of order 1. Similarly, interest rate is also significant at 1% after first differencing. Both the ADF and the PP tests suggest that the variable does not contain a unit root. The variable is stationary at first difference. Oil price was found to be stationary and is integrated of order 1.

Lastly, exchange rate is also difference stationary. That is, after first difference, the variable became stationary. The null hypothesis of the presence of a unit root was rejected at the 1% significant level, thus leading to the conclusion that the variable is integrated of order one.

#### **5.4 Cointegration Analysis**

This section presents the result on the Johansen cointegration analysis. In the face of non-stationary series with a unit roots, first differencing appears to provide the appropriate solution to our problems. However, first differencing has eliminated all the long-run information which economists are invariably interested in. According to Johansen (1991), cointegration can be used to establish whether there exists a linear long-term economic relationship among variables of interest. It is in the same vein that Pesaran and Shin (1995) added that cointegration enables researchers to determine whether there exists disequilibrium in various markets. In this regard, Johansen (1991)

asserts that cointegration allows us to specify a process of dynamic adjustment among the cointegrated variables and in disequibrated markets.

**Table 5.6: Unrestricted Cointegration Rank Test (Maximum Eigenvalue)**

Hypothesized		Max-Eigen	0.05	
No. of CE(s)	Eigenvalue	Statistic	Critical Value	Prob.**
None *	0.189193	38.37973	27.58434	0.0014
At most 1	0.082735	15.80358	21.13162	0.2365
At most 2	0.068548	12.99501	14.26460	0.0786
At most 3 *	0.039951	7.461143	3.841466	0.0063

Source: Author's estimate

Given that the series are  $I(1)$ , the cointegration of the series is a necessary condition for the existence of a long run relationship. Under the assumption of linear trend in the data, and an intercept and trend in the co-integration equation, the results of maximum-eigenvalue statistic of the Johansen cointegration test is presented in Table 5.6. It is evident from Tables 5.6 that the maximum-eigenvalue statistic indicates the presence of cointegration among the variables. The study fails to accept the null hypothesis of no cointegrating relationship or vector ( $r = 0$ ) since the computed values of the maximum-eigenvalue statistics are greater than the critical values at 1 percent. That is, applying the Johansen test to the monthly series spanning 1998 to 2013 leads to conclude that there is one or two cointegration relationship among the variables.

Since there is one or two cointegrating vector among the variables, the estimated long-run equilibrium relationship for LCPI is derived from the unnormalised vectors as presented in Table 5.7. From the normalised cointegrating coefficients in Table 5.7. The

choice of this vector is based on sign expectations about the long- run relationships as indicated by theory.

**Table 5.7: Normalized cointegrating coefficient**

LCPI	LER	LOILP	R
1.0000	-0.7117	-0.4541	0.014
	(0.1055)	(0.1243)	(0.0058)

Source: Author’s estimate.

Note: LCPI is the log of domestic price, LOILP is the log of oil price, LER is the log of exchange rate, and R is the interest rate.

$$LCPI = -aLER - bLOILP - cR \dots\dots\dots (5.1a)$$

Substituting the coefficients from table 5.7:

$$LCPI = 0.71*LER + 0.45*LOILP - 0.01*R \dots\dots\dots (5.1b)$$

(0.1055)      (0.1243)      (0.0058)

Note: Standard errors in parentheses.

An error correction model is then formulated after the unrestricted cointegration rank test. The idea behind such a model is the need to recover the long-run information lost from differencing the variables. The error correction model rectifies this problem by introducing an error correction term (ECT). This term is derived from the long-run equation based on economic theory and enables us to measure the speed of adjustment of LCPI to its long-run equilibrium. It gives us the proportion of disequilibrium errors accumulated in the previous period that are corrected in the current period.

Therefore, the error correction term from equation 5.1b is given as;

$$ECT = LCPI + aLER + bLOILP + cR \dots\dots\dots (5.2a)$$

$$ECT = LCPI - 0.71*LER - 0.45*LOILP + 0.01*R \dots\dots\dots (5.2b)$$

The long run effect of oil price on the domestic price level is examined. The result indicates that oil price increases result in increases in the price level. The results from the cointegration analysis indicate a positive relationship between the oil price and of price levels. The oil price is an important variable in determining the variations in CPI in Ghana in the long run. The variable is found to be statistically significant at 1%. The positive effect of oil price is consistent with the study of Burbige& Harrison (1984), Hooker (1999), Cunado& de Gracia (2004), L'oeillet&Licheron (2008), Arinze (2011) and Yoshizakim (2011), which found a positive effect of oil price changes on the price changes

An increase in oil price level by 1% would result in an increase in the domestic price level by 0.45%, according to equation (5.1b). When compared with various other studies, the results suggest a rather a small effect of oil prices on the inflation in Ghana. For example, Celik&Akgil (undated) found that a 1% change increase in fuel oil price led to 1.26% increase in the domestic price level of Turkey. For a country like Ghana, government has been subsidizing petroleum product, so that increases in oil prices in the world market are not fully reflected in domestic petroleum prices.

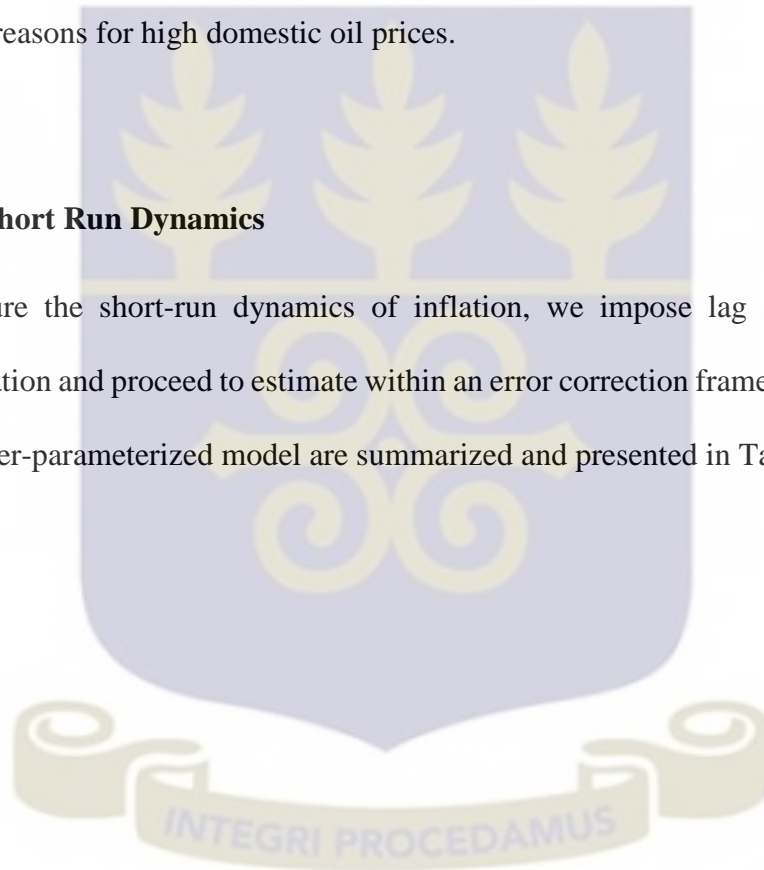
The effect of interest rate on inflation is negative. Interest rate is found to be significantly and negatively related to price levels in the long run. This finding is consistent with that of Tweneboah and Adam (2008), and with the notion that higher interest rates reduce the money supply and hence price inflation [Cologni&Manera (2005)].

The exchange rate has been one of the variables that has seen an extensive examination on its influence on price levels in Ghana. Dordunoo (1994) observes that rapid exchange rate depreciation is one of the main causes of inflation in Ghana. Therefore,

the study examined the effect of exchange rate on price levels. The result showed that exchange rate depreciation had a positive and significant relationship with inflation in the long-run. The result indicates that a depreciation of the cedi by 1% results in an increase in domestic price level by 0.71%. The result is also a confirmatory case for the findings of Huda (1987), Canetti & Greene (1991), Leith (1991), Dordunoo (1994) and Tweneboah and Adam (2008), and conforms with Cororaton (2000) who identifies the world oil price increases and the depreciation of the country's exchange rate as the primary reasons for high domestic oil prices.

### **5.5 Short Run Dynamics**

To capture the short-run dynamics of inflation, we impose lag structures on the cointegration and proceed to estimate within an error correction framework. The results of the over-parameterized model are summarized and presented in Table 5.8.



**Table 5.8: Over-parameterization (Dependent variable: D(LCPI))**

Variable	Coefficient	Std. Error	t-Statistic	Probability
ECT(-1)	-0.032295	0.007054	-4.578018	0.0000
DLCPI(-1)	0.107451	0.079473	1.352044	0.1784
DLCPI(-2)	0.072665	0.077174	0.941585	0.348
DLCPI(-3)	0.047935	0.07576	0.632721	0.5279
DLCPI(-4)	-0.281461	0.075684	-3.718909	0.0003
DLCPI(-5)	0.040689	0.07546	0.53922	0.5906
DLCPI(-6)	-0.317356	0.075084	-4.226684	0.0000
DLCPI(-7)	-0.066175	0.078622	-0.841686	0.4013
DLCPI(-8)	-0.189672	0.079091	-2.398138	0.0177
DLER(-1)	-0.005655	0.059936	-0.094357	0.925
DLER(-2)	0.071246	0.06887	1.034494	0.3026
DLER(-3)	-0.036653	0.066873	-0.548104	0.5845
DLER(-4)	-0.040196	0.066751	-0.602173	0.548
DLER(-5)	-0.031366	0.068161	-0.460168	0.6461
DLER(-6)	0.029623	0.067909	0.436209	0.6633
DLER(-7)	-0.096822	0.067985	-1.424165	0.1565
DLER(-8)	0.074182	0.062781	1.181597	0.2393
DLOILP(-1)	-0.009911	0.010556	-0.938937	0.3493
DLOILP(-2)	0.00135	0.01068	0.126363	0.8996
DLOILP(-3)	-0.011613	0.010531	-1.102772	0.2719
DLOILP(-4)	-0.011295	0.010549	-1.070684	0.2861
DLOILP(-5)	-0.005447	0.010484	-0.519507	0.6042
DLOILP(-6)	-0.011065	0.010454	-1.058424	0.2916
DLOILP(-7)	0.000856	0.010618	0.080633	0.9358
DLOILP(-8)	-0.008388	0.010568	-0.793683	0.4287
DR(-1)	-0.000764	0.000555	-1.375933	0.1709
DR(-2)	-0.000175	0.00055	-0.317484	0.7513
DR(-3)	-0.000329	0.00054	-0.608698	0.5437
DR(-4)	0.000727	0.00055	1.321649	0.1883
DR(-5)	4.62E-05	0.000545	0.084678	0.9326
DR(-6)	-3.92E-05	0.000527	-0.074409	0.9408
DR(-7)	0.001781	0.000524	3.397602	0.0009
DR(-8)	-0.000404	0.000541	-0.747887	0.4557
OILPDEC	-0.005363	0.012988	-0.412942	0.6803
OILPIN	-0.002106	0.012955	-0.162599	0.8711
C	0.02405	0.013145	1.829625	0.0693
R-squared	0.451332	Mean dependent var		0.012277
Adjusted R-squared	0.320696	S.D. dependent var		0.015319
S.E. of regression	0.012626	Akaike info criterion		-5.731727
Sum squared resid	0.023434	Schwarz criterion		-5.100353
Log likelihood	560.453	Hannan-Quinn criter.		-5.4758
F-statistic	3.454896	Durbin-Watson stat		2.091412
Prob(F-statistic)	0.0000			

To arrive at a more parsimonious and congruent model, OLS regression is then carried out starting from the lowest insignificant variable one after the other. The result summarized in Table 5.8 indicates that the parsimonious model has nice statistical properties. All the variables have their expected signs, including the error correction term.

**Table 5.9: Parsimonious Result for Error Correction Model (Dependent variable: D (LCPI))**

Variable	Coefficient	Std. Error	t-Statistic	Prob.
ECT(-1)	-0.006621	0.003795	-1.744718	0.0828
DLCPI(-1)	0.164084	0.072630	2.259189	0.0251
DLCPI(-2)	0.287537	0.095593	3.007932	0.0030
DLCPI(-4)	-0.293468	0.091524	-3.206450	0.0016
DLER(-2)	0.110679	0.060025	1.843878	0.0669
DLOILP(-3)	0.082481	0.012282	0.671558	0.0001
DLOILP(-8)	0.016493	0.008535	1.932395	0.0549
DR(-1)	-0.006090	0.000550	-1.107317	0.2697
DR(-2)	-0.002201	0.000421	-0.522226	0.6022
OILPDEC	-0.009919	0.003552	-2.792271	0.0058
OILPINC	0.012686	0.003199	3.965794	0.0001
C	-2.42E-05	1.98E-05	-1.223691	0.2227
R-squared	0.88123	Mean dependent var		0.011818
Adjusted R-squared	0.76412	S.D. dependent var		0.015482
S.E. of regression	0.013893	Akaike info criterion		-5.642934
Sum squared resid	0.033392	Schwarz criterion		-5.401033
Log likelihood	541.6144	Hannan-Quinn criter.		-5.544916
Durbin-Watson stat	1.966800			

As expected, the coefficient of change in the inflation rate in the short run, which is the first difference of log of CPI, has the correct sign (positive) and is significant at the 5 percent level, which is in accordance with the study of Cunado & de Gracia (2004). The result shows that the speed of adjustment of change in inflation rate to the long run equilibrium path is low. The speed of adjustment (ECT (-1)) is statistically significant

at 10 percent and had the right sign. The coefficient of the error correction term is 0.66 percent meaning 0.66 percent of disequilibrium due to shocks is corrected in the short run. The remaining 99.34 percent of the disequilibrium is corrected in the subsequent months. In other words, only about 0.66 percent of disequilibrium error that occurred in the previous month is corrected in the current month.

The short run dynamic analysis result shows a positive sign for exchange rate as expected. Its coefficient is significant at 10 percent. This implies that as the cedi depreciates by 1 percent, inflation will rise by approximately 11 percent in the short run.

The negative sign for interest rate and inflation relationship is expected. It means that in the short run as the Treasury bill rate in Ghana increases people buy more treasury bill leading to a fall in the money supply, thereby reducing inflation.

The effect of oil price on the short-run inflation rate is positive as shown in table 5.9. The variable is statistically significant at 1%. The result means that in Ghana, a percentage change in oil price will lead to 0.08% change in inflation in the short run, is similar to the findings of Tweneboah and Adam (2008) and several other studies that have found short-run positive impacts of oil price on inflation.

The coefficients for both period of increase in oil price (OILPINC) and decrease in oil price (OILPDEC) have their expected signs and are both statistically significant at 1%.

The table indicates that there is no asymmetric relation between OILPINC and OILPDEC since the difference between their coefficients seems insignificant. Table 5.9 indicates that, in Ghana any period where oil price decreases by 1% inflation in the short run will also fall by 0.0099% and also as oil price increase by 1%, inflation will also increase by 0.0127%. This finding is consistent with the BOG (2008) annual report that claims that increases in inflation for the year 2008 were mainly due to increases in oil prices.

### 5.6 Diagnostic Test for Parsimonious Result

The VAR model presented is subjected to diagnostic test to examine the fitness of the model for inference. Table 5.10 presents the results of the diagnostic test. The study conducted a LM test for serial correlation, heteroskedasticity test, normality and the Ramsey Reset test for function form specification. The result for Ramsey Reset test suggests non rejection of the null hypothesis that the model is correctly specified.

**Table 5.10: Diagnostic test for parsimonious result**

Test	F-statistics	Probability
Jarque-Bera: Normality	.52142	0.1103
LM Test: Autocorrelation	0.4208	0.5112
ARCH Test: Hetero	2.1173	0.32100
RESET Test: Model Spe	1.1250	0.2907
Log Likelihood ratio	1.8202	0.8193

*Source: Author's estimate.*

The serial correlation test is conducted using the LM test and the result fails to reject the null hypothesis of no serial correlation. The study concluded that the model has no problem of serial correlation or autocorrelation. Normality test is also conducted and the residual from the VEC was found to be multivariate normal. The heteroskedasticity test suggests that the model had a constant variance for the residuals.

## 5.8 Causality test

The study presents the test for causality to determine the direction of causality between oil price and domestic prices. The study first examines the causality focused on the effect of oil price on domestic prices.

**Table 5.11: Causality test**

Null Hypothesis:	Obs	F-Statistic	Probability
LER does not Granger Cause LCPI	184	1.75316	0.08974
LCPI does not Granger Cause LER		1.53973	0.14698
LCPI does not Granger Cause LOILP	184	1.06468	0.39031
LOILP does not Granger Cause LCPI		1.96660	0.05353
R does not Granger Cause LCPI	184	2.54190	0.01227
LCPI does not Granger Cause R		2.67118	0.00871
LOILP does not Granger Cause LER	184	2.27548	0.02457
LER does not Granger Cause LOILP		1.19747	0.30337
R does not Granger Cause LER	184	0.40810	0.91479
LER does not Granger Cause R		2.21807	0.02846
R does not Granger Cause LOILP	184	1.32927	0.23213
LOILP does not Granger Cause R		0.76898	0.63055

*Source: Author's estimate.*

Table 5.11 indicates that the effect of oil price on the domestic price level can either be direct, or indirect through the exchange rate.

## 5.7 Conclusion

The chapter sought to empirically examine the effect of oil price on domestic prices. It presented the unit root tests based on the PP and ADF. The variables were found to be stationary at first difference. The chapter went on to present the cointegration and the short-run dynamics. The results indicate a positive effect of oil price on domestic prices. The dummy variables capturing increases and decreases in oil prices indicated that oil price changes did not significantly show asymmetric effects on domestic prices. The results from the cointegration analysis indicated a positive relationship between the oil price and domestic price levels in Ghana in the long run. The causality tests indicated that the channels through which oil price affects domestic prices are both direct and indirect, the latter through the exchange rate. Based on these findings, the summary, recommendations and conclusions of the study are presented in the next chapter.



## CHAPTER SIX

### SUMMARY, CONCLUSION AND POLICY

### RECOMMENDATIONS

#### 6.1 Introduction

This chapter concludes the study by providing a summary and the major conclusions of the entire study. These findings serve as a basis for policy recommendations. Limitations of this study are also outlined in this chapter, and the final section gives recommendations for future research.

#### 6.2 Summary of the study

The study aimed at finding the relationship between oil price changes and inflation in Ghana. To obtain this, the study dealt with three main objectives. It first examined the impact of oil price changes on inflation. The next objective was to determine the presence of asymmetry in the effect of oil price on inflation. The last objective was to find the direction of causality and hence transmission mechanism through which oil price changes affect inflation.

To achieve these objectives, the study went through three steps of estimation. At the first stage, the ADF and the PP unit root tests were used to examine the presence of unit roots in the data and the orders of integration. The two approaches yielded similar

results. The variables used in the regression model were not stationary at levels but became stationary after first differencing.

The study then examined the effect of international oil price change on domestic price inflation using the Johansen's cointegration approach. The variables that were used in the cointegration test included oil price, inflation, interest rate, exchange rate, and dummy variables for oil price increase and for oil price decrease. The cointegration result showed one or two cointegrating equations among the variables, indicating a long run relationship among the variables under consideration. Based on the long run model, the short run dynamics were also estimated.

### **6.3 Conclusions**

1. There is a positive relationship between the oil price and the consumer price index in the long run. Similarly, exchange rate was found to be statistically significant and positively related to domestic price levels in the long run.
2. In the short run oil price was also found to be positively related to inflation. Exchange rate was also positive and significant. However, expectation measured by the lag of inflation was found to be significant. This result indicated that price expectations have a significant role in inflation levels.
3. A decrease in oil price was found to result in a decrease in inflation and an increase in oil price was found to result in an increase in inflation in the short run. It was observed that, the effect of an increase in oil price on inflation was greater than when the oil price decreases, but the difference appeared insignificant. This latest result implies that there is not sufficient evidence for

an asymmetric relationship between an increase and a decrease in oil price, on the one hand, and domestic inflation, on the other.

4. The error correction term for the model was found to be significant and had the right sign. That is, any disequilibrium in the short run due to shocks could be adjusted for in the long run.
5. There was also causality due to both direct and indirect effects between oil price change and inflation. The study found that oil price had a uni-directional effect on domestic prices. Oil price also Granger-caused domestic prices indirectly through the exchange rate; that is, as oil price increases tended to depreciate the cedi, thus increasing import prices and hence domestic prices.

#### **6.4 Policy Recommendations**

From the conclusions of the study, it is obvious that there are effects of oil price changes on inflation. The following recommendations are made for policy consideration.

1. Since there is a positive relationship between international oil price changes and domestic price inflation in Ghana, it is recommended that government should more heavily subsidize kerosene, for instance, so as to relieve the poor from inflationary pressures during an era of increases in the oil price.
2. Government could also provide a public transport system at a reduced fare in order to shield the poor from the implications of oil price increases in Ghana.
3. One of the channels through which oil price changes affect inflation is through the exchange rate; therefore, government and the monetary authorities in Ghana should strive to achieve a stable exchange rate. This is in part due to the fact

that Ghana is a net importer, and hence depreciation of the cedi would further increase import prices, with an ultimate impact on inflation.

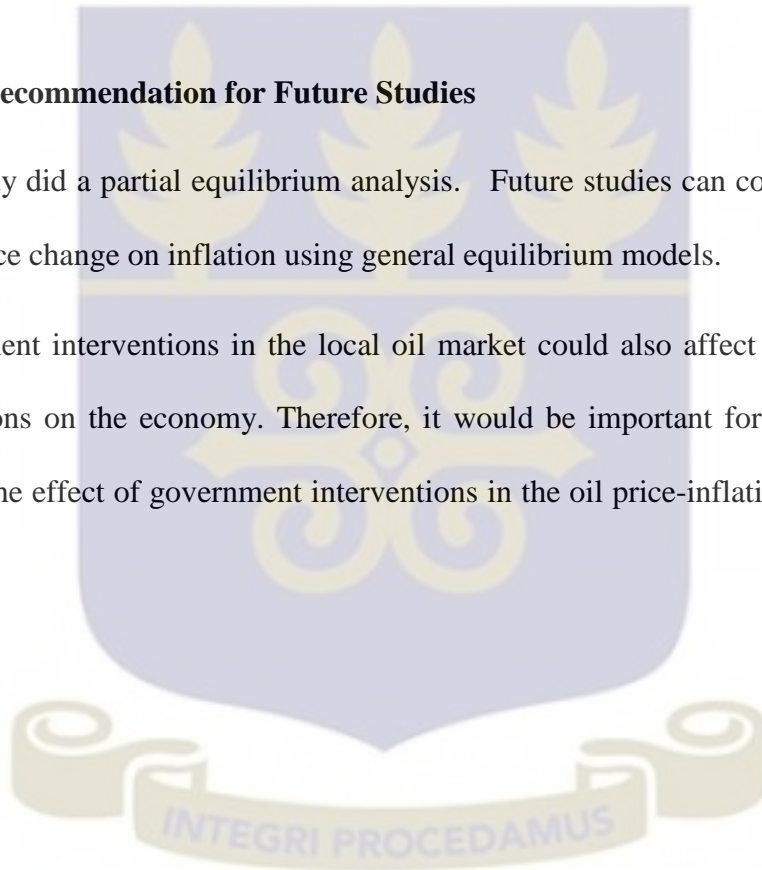
### **6.5 Limitations of the Study**

There was difficulty in obtaining data, and non-availability of data limited the study period to 1998 -2013. Time constraints partly limited the study.

### **6.6 Recommendation for Future Studies**

This study did a partial equilibrium analysis. Future studies can consider the impact of oil price change on inflation using general equilibrium models.

Government interventions in the local oil market could also affect the impact of oil fluctuations on the economy. Therefore, it would be important for future studies to capture the effect of government interventions in the oil price-inflation relationship in Ghana.



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