Effects of Petroleum Deregulation and Petroleum Taxation Policies On Inflation In Ghana

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ABSTRACT

Inflation continues to be a canker the world over but is more pronounced in Least Developed Countries like Ghana. Having identified petroleum products as a key inflation driver inflation in Ghana, and petroleum taxes in a deregulated petroleum regime as a potentially significant driver of inflation in the wake of a hyper-inflation period, this study was necessitated.

This study uses the Chow Test and Gregory Hanson Structural Cointegration Test to find the significance of petroleum pricing regimes on Inflation. It also adopts the ARDL approach in analyzing the role of petroleum prices in general price levels. It goes futher by using a Test for Proportions to find the significance of petroleum taxes in petroleum prices having determined the significance of petroleum prices in inflation.

The findings inform policymakers to pursue petroleum deregulation but find the right balance between revenue generation via inelastic products like petroleum products and inflation control through the exaction of the right and sufficient taxes.

This study confirms existing knowledge of the relationship between inflation and petroleum products and the insignificance of petroleum deregulation policy on inflation. It goes further to add new knowledge of the significance of petroleum taxes as a proportion of petroleum prices and inflation.

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CHAPTER ONE

INTRODUCTION

1.1 Background

Deregulation is the removal of regulations or restrictions, especially in a particular industry, (Oxford Dictionary, 2022). In this context we are making reference to the deregulation of petroleum products and their aggregate effect on inflation.

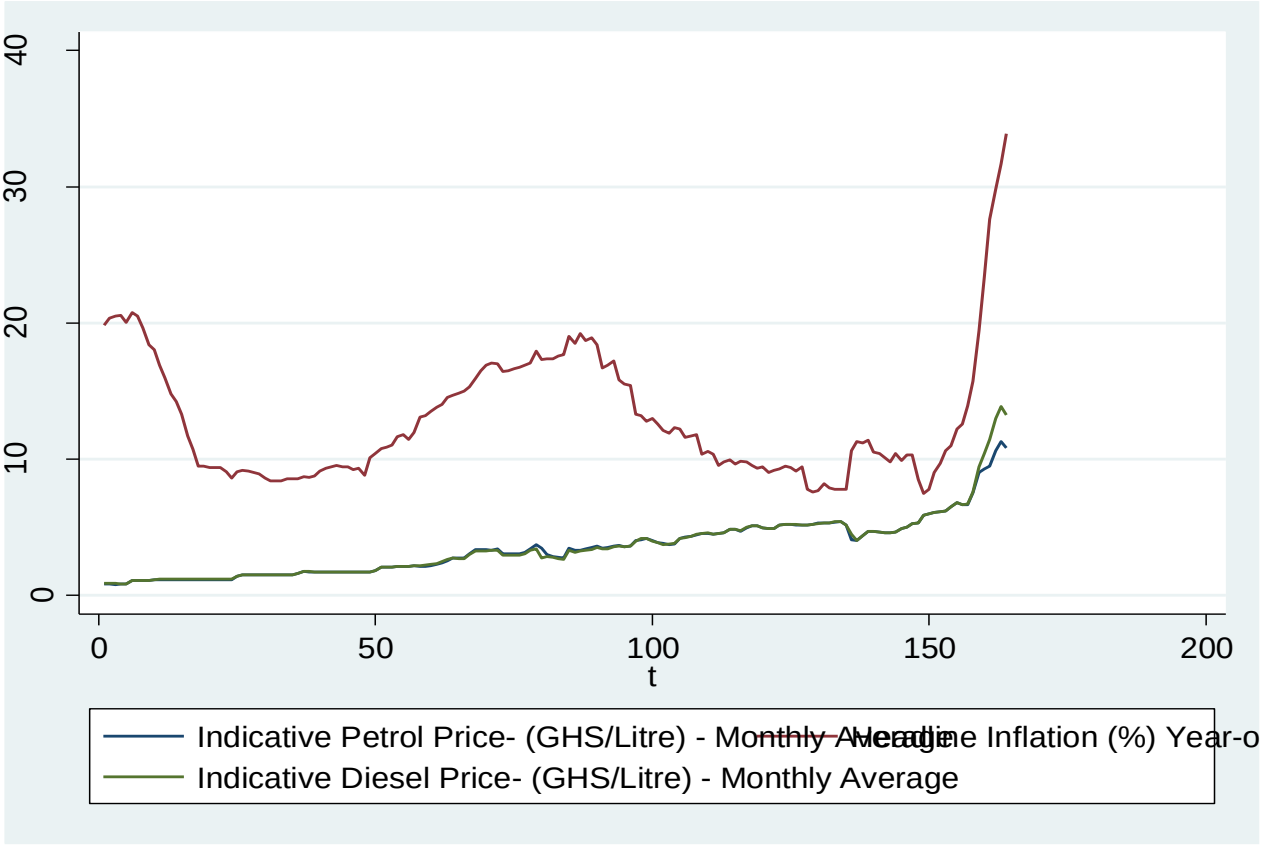
Petroleum products are widely known as factors of production. Economic theory demonstrates that increases in prices of factors of production result in increases in general price levels. These general price level increases, also known as inflation, have dire effects on the macro and micro economy of nations. Ghana before June 2015 regulated oil prices in order to keep prices at lower levels by offering subsidies to protect the welfare of Ghanaians. In 2001, Ghana started to pursue an automatic price setting mechanism which was abandoned at the end of 2002 (Ackah and Addae, 2017). By mid-2003, it had been reinstated, but could not be sustained amid pressure from general public.

As stated above, economic theory demonstrates that increases in prices of factors of production result in increases in general price levels. Some therefore argue that deregulation of petroleum prices have undesirable effects on consumers therefore are not in favour of it. In May 2023, Nigerian President, President Bola Tinubu, reintroduced petroleum subsidies in a bid to cushion consumers from the high costs of these products. According to Coady et al 2005, scrapping of fuel subsidies negatively affect the poorest households the most. There is however, general consensus on the fact that deregulation is more beneficial than the regulation of the downstream petroleum sub-sector. Petroleum products subsidies are both inefficient and inequitable (Clements 2013; IMF 2010; Parikh 2010). In no time, President Bola Tinubu had to withdraw the subsidies because it

brought about undesirable consequences within the shortest possible space of time. Based on the knowledge of the inefficiency and inequitability of petroleum subsidies, the International Monetary Fund (IMF) and the World Bank post completion of Ghana's debt relief package under the Heavily Indebted Poor Countries (HIPC) initiative had the following objectives:

1. Removal of restrictions on the establishment and operation of facilities;
2. Removal of restrictions on the importation of crude oil and petroleum products and
3. Removal of price controls.

Despite the Petroleum Authority and industry as a whole chalking some milestones, the critical component of the 2005 regulatory reforms, which deals with full-scale deregulation through the application of a transparent automatic petroleum pricing formula for cost recovery, was not implemented until 2015 - this is ten years after the supposed reform should have taken effect (Ackah and Acheampong, 2015). Years after the implementation of the automatic petroleum pricing formula, petroleum prices which are possibly significantly influenced by petroleum tax policies in the sector seem to positively influence inflation. A simple line chart of headline inflation and petrol and diesel prices from 2009 to 2022 shows that there is some kind of positive correlation between inflation and petroleum prices, that is, as petroleum prices increases inflation increases.



Source by Researcher

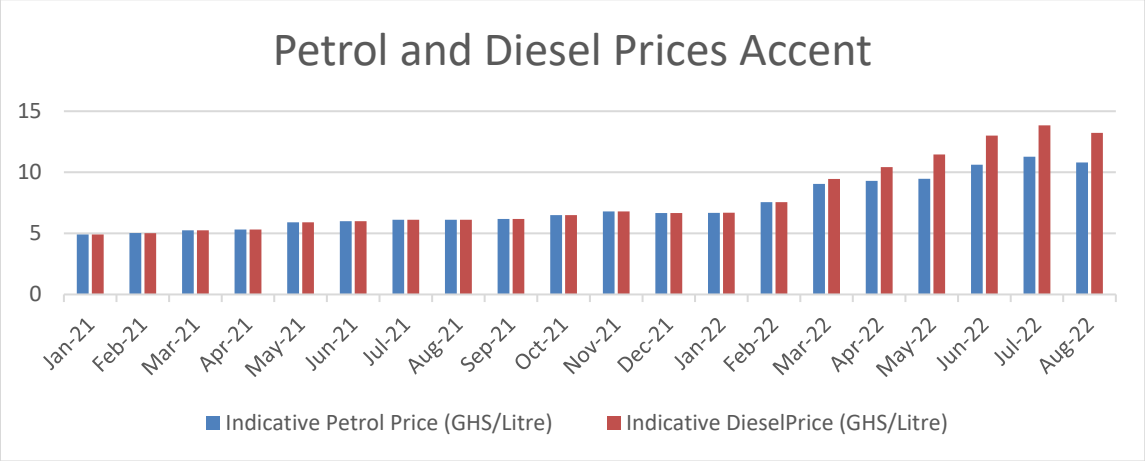
Will a detailed and balanced research show that there is a positive correlation between inflation and petroleum prices? Does Petroleum Deregulation significantly affect inflation? How significant are petroleum taxes on inflation? This study seeks to find out if the economic theory of increases in general price levels of petroleum products via deregulation causes inflation.

1.2. The Statement of the Problem

Between January and December 2022, year-on-year inflation rose from 13.9% and peaked at 54.1% in December as announced by the Ghana Statistical Service (GSS). Global inflation has risen sharply from its lows in mid-2020, on rebounding global demand, supply bottlenecks, and soaring food and energy prices, especially since Russia's invasion of Ukraine (World Bank, Global Economic Prospects, 2022). In Ghana, prices of petrol and diesel products have been consistently

rising in the last two years. Diesel in particular increased month-on-month from Jan 2021 to May 2022 except for December 2021. Prices of petroleum products have risen from ¢4.91 per liter in January 2021 to ¢12.35 per liter in May 2022 representing a cumulative increase of 152% increase in prices.

The figure below shows the consistent increases in the prices of diesel and petrol.



Source: By Researcher

The consequences of inflation can be devastating. Inflation leads to the fall of the real value of the Ghana Cedi. This implies that the purchasing power of consumers fall. Once the purchasing power of consumers fall, savings and investment also fall, leading to aggregate demand and income also falling. For governments, inflation reduces the real value of revenue thereby worsening the current account position of government and increasing the debt stock of government. This has been demonstrated in the macro-economic situation in Ghana in the year 2022. Government expenditure, namely, Interest Payments, Employee Compensation, and Grants to other government units form the biggest portion of government expenditure. These three expenditure components have grown over the last year in the first 3 quarters of the year under review. These growth can be attributed to inflationary pressures on government compensation to employees and grants to

governmental units, and the effect of exchange rate differentials on interest payments. The Bank of Ghana had to support government with what it calls overdrafts in order to keep government business running. Similarly, the state had to run to the International Monetary Fund to seek some advance of its bailout to the nation. There has been a short fall in total revenue and grants projected for 2022 by 2.8%. Government expenditure increased marginally by 5% in the first three quarters of 2022 indicating that budget deficit is largely influenced by revenue short falls and inflationary pressures. Overall fiscal deficit rose to 9.9% of GDP against a targeted 6.7% at the end of 2022 (World Bank Group, 2023). Ghana's debt stock is now significantly composed of more external debts as compared to domestic debts. This is due to increase in interest payments resulting from exchange rate differentials which is a function of inflation or vice versa.

On the micro level, fuel prices have consistently increased leading to consistent increases of transportation fares. This has fed into hikes of general price levels of the household's basket of goods. It is undeniable that every food item or commodity on the market has a component of transportation even if their source of production is very close to markets. The Ghana Statistical Service (GSS) through its monthly publications of inflation report decomposes the drivers of inflation. From its findings, food inflation is the biggest driver of inflation. Without a formal analysis, one may argue that petroleum products could be the major driver of inflation since they exogenously and endogenously drive inflation. Exogenously because they directly influence general price levels through their direct imputation into the cost of production. These imputations are energy and transportation related. That is the use of petroleum products to directly produce goods and services in the production chain. By endogenous, reference is made to the indirect production of finished or intermediate goods using petroleum products. For example petroleum will directly be used for production in the factory. In order to complete the production process the

product produced from the factory must reach consumers. Again, petroleum will be used indirectly to transport the product to consumers before the production process can be described as complete. Petroleum products therefore influence prices at the back-end and front-end possibly making them the major driver of inflation.

Of the worst of all negative consequences, inflation could ultimately lead to a breakdown of the monetary system as seen in Zimbabwe in the year 2009. With all these said, a mild form of inflation is a growth booster.

The problem identified is the lack of clarity surrounding the relationship between petroleum deregulation policy and inflation and the possibility of fiscal policies in the form of tax impositions on petroleum products significantly influencing inflation if indeed there exists a significant relationship between petroleum deregulation and inflation.

Work done by Ackah and Addae, 2017, show that changes in prices of petroleum products amid government regulation of petroleum prices had a significant effect on inflation. Surprisingly, their study analyzed that changes in prices of petroleum products during the period of deregulation of petroleum prices did not significantly affect inflation both in the short and long run. On another tangent, Ayisi, 2020, finds that inflation responds asymmetrically to oil prices in the long-run but not in the short run.

This study seeks to find whether petroleum deregulation policy significantly affects inflation - if there is any relationship at all between the two. If significant, this study will probe further to determine if fiscal policy in the form of petroleum taxes form a significant component of petroleum prices to cause inflation.

1.3. Research Questions

There is relatively little work on petroleum deregulation and its relationship with inflation as most works have focused on petroleum products and inflation not considering the various petroleum regimes. With this stated, the objective of this study is to answer the following questions:

1. Is there a direct and significant relationship between petroleum deregulation policy and inflation?
2. Is there also a significant relationship between petroleum tax policy component of deregulated petroleum prices and inflation?

1.4. Objectives

To answer the above questions, the objectives of this study are as follows.

The main objective of this study is to examine the effects of petroleum deregulation and petroleum taxation policies on inflation in Ghana. The specific objectives to be achieved are:

1. To find the relationship between petroleum deregulation policy and inflation.

2. To find the relationship between petroleum tax policy component of deregulated petroleum prices and inflation.

1.5. Significance of Study

The outcome of the first objective will inform policy makers as to loosening or intensifying measures that affect petroleum products and their pricing. For instance they can be very particular about the exchange rate and world market oil prices in order to aggressively counterbalance negative effects from these variables. One such measure can be the ensuring of enough import cover reserves to prevent pressure on the local currency. In the long term, the outcome of this study

will inform policy makers to plan in the long term to put energy security measures in place to lessen the effects of petroleum deregulation on inflation. Measures like expansion of refinery capacities and stocking of depots will eventually make Ghana a net exporter and prevent global shocks from having negative impacts on petroleum products and therefore inflation. These measures however have been thought of and partly implemented.

According to Ackah and Acheampong, 2015, Government has a strategy to lure investment into the petroleum downstream sub-sector. The investment is meant to increase the capacity of the sub-sector overtime. A deregulated sub-sector is seen as the catalyst to its expansion as it propels activities for the establishment of functioning oil refineries and bulk storage facilities.

The outcome of the second objective of this study will here again influence the tightening or loosening of petroleum tax policies. Policy makers must find the right balance between petroleum deregulated prices and tax imposition on petroleum deregulated products. If there is space for further tax increments, they will have to leverage on that. If not, policy makers would have to implement tax cuts. Further studies can be carried to ascertain these facts. Hossain, 2003 in an IMF Working Paper, explored "…what are the appropriate levels of taxation and prices of petroleum products? Or what are the relevant factors that should be considered in setting the taxes on, and prices of, such products?" (Hossain, 2003).

1.6 Organisation

This paper begins with the Introduction in Chapter One which gives the background of the study, states the research problem, objectives, and its significance. It then proceeds with the Literature Review in Chapter Two which is decomposed into the Theoretic and Empirical Literature. It is ended with a bird's eye view of what exists in the literature as as far as the concepts of inflation,

petroleum deregulation, and petroleum products subsidization and taxation are concerned. Chapter Three, Methodology, highlights the various models: Theoretic and Empirical models. Having laid the foundation of the research, it describes the variables in the would-be model and estimation techniques given available data. This chapter gives the background of data used for work. Chapter Four, Results & Discussions, discusses the results obtained from the various analytical stages and puts forward the results as analyzed. It concludes with a summary of all the results obtained. The last chapter, Chapter Five, is the Conclusion and Rcommendations. This chapter is anchored on the the results in Chapter Four. Policy recommendations are made in this chapter.

CHAPTER TWO

LITERATURE REVIEW

2.1 Theoretic Literature Review

This chapter explores the various works on Petroleum Deregulation, Inflation, and other related areas to this study.

In macroeconomics the study of inflation as a key indicator of macroeconomic performance is very important. By managing inflation with tact, a healthy economy is nurtured. Economics as a solution to mercantilism was hinged on the tenet that government was not to interfere in the market forces of demand and supply but allow the interaction of these forces for optimum performance of the economy. The Classical economic view phased out Bullionism and the government induced capitalist system but along with it came the canker of inflation. The economics school of thought discussed so far is the classical school of thought with Adam Smith as its father.

2.2 Deregulation, Inflation, and the Classicists

Classicists believed that except those interventions necessary to ensure that the market remained competitive, government was not to intervene in the market. Classical economics stressed the self-adjusting tendencies of the economy (Froyen, 2013). This school of thought is in essence against regulation using policies such as subsidies, quotas, bans among others but to allow the forces of demand and supply to play out. Classicists therefore embrace deregulation and in this context petroleum deregulation.

In relation to money and prices (inflation), Classicists believed:

1. In perfectly flexible prices and wages.

2. In the assumption that firms and individuals have perfect information about relevant prices.

3. Money had no intrinsic value and hence played only a nominal role in the economy

4. There are no barriers to the adjustment of money wages

5. The market clears

2.3 Classical Money and Prices

The Quantity Theory of Money

In the Classical school of thought supply of money influences aggregate demand which in turn determines prices.

The Equation of Exchange

The Equation of Exchange describes the relation between demand for money and supply of money which can be expressed in terms of price. It is given by

$MV_T = P_TT$ as expressed by Irving Fisher

Where

M= Quantity of money

V_T = Transactions velocity of money

P_T = Price index for items traded

T = Volume of Transactions

Alternatively, the Equation of Exchange can be expressed as

MV = PY

Where

M= Quantity of money

V = Income Velocity of money (it is the number of times the average cedi is used in a transactions involving current output)

Y = Output level

P = Price index for currently produced output

According to Fisher and other quantity theorists, *the equilibrium level of velocity was determined by such institutional factors and could be regarded as fixed for the short run.* These institutional factors are payment habits and payment technology of society. So the short run output and income velocity of money are constant.

In the short run

$Y = \bar{Y}$ where $\bar{Y}$ is constant output level

$V = \upsilon$ where υ is constant income velocity of money

Therefore

$\Delta P = \Delta M$ since $\Delta \upsilon / \Delta Y = 1$

$\Delta P = (\Delta \upsilon / \Delta Y) * \Delta M$

$\Delta P = 1 * \Delta M$

$\mathbf{\Delta P = \Delta M}$

Therefore change in quantity of money equals a change in price or price increases by the same level of quantity of money**.**

2.3 Empirical Literature

Much work has been done on regulated petroleum prices - which is a common phenomenon in developing countries – usually in the form of subsidization of petroleum price in comparison to a free market deregulated case in an economy. It is common knowledge that that the net petroleum importer country suffers from adverse effects of exchange rate depreciation and world market price increases. These effects are expressed through deregulated petroleum prices and reflected in general price increases. These general price increases represent inflation. Inflation decreases consumer welfare and unleashes the worst of it on citizens in the lowest income brackets. As stated in other the preceding chapter, it is worth noting that petroleum deregulation policy is a sustainable and better policy option than petroleum regulation policy. It has been established in many works that petroleum subsidies are inefficient and inequitable (Clements, 2013; IMF, 2010; 2013; Parikh, 2010; Ackah & Addae, 2017)

In relation to studies on deregulation being linked to inflation, works are almost non-existent. There exist a number of studies on petroleum prices and their effects on inflation but they hardly talk about the relationship between petroleum deregulation and inflation. One work that stands out in this area of study is that of Ackah & Addae, 2017.

As mentioned earlier works on the relationship between oil prices and inflation are a handful. A study by Choi et al on Oil Prices and Inflation Dynamics: Evidence from Advanced and Developing Economies using an unbalanced panel of seventy-two under-developed and developed countries between 1970 and 2015 analyzed that increases in oil prices lead to increases in inflation. They also found out that the relationship between oil prices and inflation between the periods of

observation was asymmetric. The method used in this study is the estimation of Impulse Response Functions directly from local projections. Model can be loosely defined as Inflation = f (Global Inflation, Share of Oil in Domestic basket, Global Oil Prices on Domestic Inflation).

Another study by Bola et al on the Asymmetric Impacts of Oil Price on Inflation: An Empirical Study of African OPEC Member Countries showed that Oil Prices have asymmetric effects on Inflation as increases or decreases in oil prices positively influenced inflation under the period of study and even more significant in the case of decreases of oil prices. The model is loosely identified as Inflation = f (+ Oil Prices, - Oil Prices, Money Supply, Food Production Index). The method adapted in analysis is the ARDL & NARDL.

Results from a study conducted by Francis Danjuma Bobai & Ahmadu .Bello on "An Analysis of the Relationship between Petroleum Prices and Inflation in Nigeria" showed that overall, the relationship between petroleum prices and inflation is a positive one. The study employed OLS technique in estimation. Model is Inflation = f (Premium, Gas Oil, Kerosene).

A study on Petroleum Products Prices and Inflationary Dynamics in Nigeria conducted by Bright et al analyzed that petroleum price increases has significant impact on inflation in Nigeria. Using both OLS and ARDL techniques with model given as Inflation = f (petrol, diesel, kerosene, money supply, fiscal deficit and exchange rate), they drew this conclusion.

On "The Impact of Oil Prices on Inflation" by Mukhtarov et al, they conclude that a unit increase in oil prices lead to a 0.58% increase inflation. Inflation is caused by both price increases and decreases. The ADRL was applied to model given as Inflation = f (Oil Price, Exchange Rate).

A study conducted by Muhammad et al on “Is the oil price pass-through to domestic inflation symmetric or asymmetric? new evidence from India based on NARDL” found out that global oil prices increases fuels domestic price increases whereas decreases in global oil prices has no significant effect on domestic prices. This results when obtained based on the NARDL not ARDL, as ARDL results did not show significant relationship between oil prices and inflation. Model is specified as Inflation= f (+ Brent Crude Oil, - Brent Crude Oil).

Another Asian study identified asymmetry of oil price and inflation. Contrary to other works, Davari et al on “Oil Price and Inflation in Iran: Non-linear ARDL Approach (NARDL) analyzed that there was no significant relationship between the oil price increases and inflation while there decreases in oil prices lead to increases in inflation depicting the asymmetry of oil price and inflation. The model used is given as Inflation= f (+ oil revenue, - oil revenue, M2, GDP)

Again another Asian study on “Oil Price Shock and its Impact on the Macroeconomic Variables of Pakistan: A Structural Vector Autoregressive Approach” undertaken by Malik et al analyzed that in the long run inflation increases as a result of oil price increases. The SVAR model is used in this study. Model is given as Inflation = f (Oil Prices, Real Exchange Rate, Real GDP, Interest Rate)

Du et al conducted a study on “The relationship between oil price shocks and China’s macro-economy: An empirical analysis”. The results of the paper is that oil price increases significantly fuels inflation in China but the effect is asymmetric. The VAR/ARDL is applied to the model of real GDP, Inflation, Real Oil Price, short term Interest Rates and Money Supply.

Results from the study “The asymmetry effect of oil price changes on inflation, and the welfare implication for Ghana” by Ayisi, show that in the long term, inflation is asymmetrically sensitive

to oil prices. This is not exhibited in the short run. The model makes use of a system of matrices which has variables as inflation, oil prices, and other variables.

Osman et al worked on "Structural Vector Autoregressive Analysis of Crude Oil Price Shocks on Ghana's Economy". They concluded that there is an inverse relationship between oil price and inflation. The model used a vector of endogenous variables including Crude Oil Prices, Inflation, Exchange Rate, Interest Rate, and GDP. This study focused on the effects on crude oil prices on inflation not the pump prices on inflation.

Ackah & Addae 2017 in their empirical work separately analyzed the effect of regulated petroleum policy on inflation and the effect of deregulated policy on inflation. Using the ARDL and Passthrough econometric analysis and observed data over 191months of times series data from January 2000 to October 2016, they analyzed the effect of regulation via subsidization on inflation. The results of their analysis showed that changes in prices of regulated petroleum products have a significant impact on inflation. In the case of effects of deregulation policies on inflation, it used ADF and ARDL tests to analyze time series data observed over twenty-one months, June 2015 to March 2017. They concluded that the deregulation of petroleum products does not have a significant effect on inflation in the short and long run. The data used in analyzing the deregulated period is not sufficient enough to make accurate inferences about the subject in question.

2.3 Overview of Literature

From the various studies discussed – global, regional, and national - the literature points overwhelmingly to the fact that there is an asymmetric relationship with oil prices and petroleum prices. Though a few studies conclude that oil prices have no significant effect on inflation, majority conclude that as oil prices increases, inflation increases and as oil prices decreases, inflation still increases.

The literature so far has no complete work on the effects of petroleum deregulation policy on inflation in Ghana. Osman et al focused on crude oil effect inflation rather than localized petroleum prices while Ackah and Addae did not have enough data at the time of conducting their research in order to assess the effect of petroleum deregulation on inflation. This study therefore focuses on the effects of deregulated petroleum pump prices on inflation which the literature does not contain. This research intends to assess if there is a significant effect of the regulated and deregulated regimes on inflation. Furthermore, if relevant how could policy, especially petroleum tax policy, be best managed to lessen its effects on the general price levels of goods and services and ultimately the welfare of consumers.

CHAPTER THREE

METHODOLOGY

3.1 Theoretic Model

The development of this study is hinged on the Quantity Theory of Money which states that the change in quantity of money equals a change in price by the same level of quantity of money. $\Delta P = \Delta M$. In this study changes in general price levels is analyzed by the change in quantity of money as a result of petroleum deregulation policy. The changes in general price levels is again analyzed by the change in the quantity of money as a result of petroleum price changes. Lastly, the changes in the general price levels is analyzed by the change in the quantity of money as a result of petroleum taxation.

3.2 Empirical Model

Inflation = f (Trade Balance, Food Inflation, Diesel Prices, Lending Rate, Brent Crude Price)

$$\mathbf{INF = Bo + B_1TB + B_2FINF + B_3DPx + B_4LR + B_5BPx + e \ - \ eqn1}$$

$$\mathbf{inf = bo + b_1TB + b_2FINF + b_3\ DPx + b_4\ LR\ + b_5\ BPx\ -\ \ \ eqn2}$$

where equation 1 is the actual equation and equation 2 is the estimated equation

inf is predicted Inflation rate

$\mathbf{b_i}$'s are the estimated coefficients

TB= Trade Balance

FINF= Food Inflation

DPx = Diesel Prices

LR= Lending Rate

BPx = Brent Crude Price

e is error term term

3.3 Estimation Techniques

For this study we examine the relationship between two independent variables and inflation in two separate models. To determine the necessary condition which is the relationship between deregulated petroleum prices and inflation we use inflation time series from the period of the implementation of the petroleum deregulation policy 2009 to 2022 concurrently with time series data of deregulated prices alongside other variables over the same time period. After establishing a significant relationship between deregulated petroleum prices and inflation, the next process is to proceed to establish if there is a significant relationship between the petroleum tax component and inflation.

For this study two phases of estimation will be undertaken.The first and main being the determinants of inflation being regressed on inflation. The second being the testing of petroleum taxes tested for significance in petroleum prices. The first technique used will be OLS regression and the second will be One-Sample Z-Test for Proportions.

The first phase is based on the assumption that Inflation is influenced by prices of major petroleum products such as petrol, Liquefied Petroleum Gas (LPG), gasoline, and kerosene, but the second phase of the research examines the decomposition of the price components of petroleum products to find if their tax components significantly influence inflation.

Phase 1

In this phase the objective is to find if petroleum products (Diesel, Petrol, Kerosene, Gas), in this context, Diesel has a significant effect on inflation.

To do this, a model of six variables – one dependent variable and five independent variables is used. In this model, Inflation (Headline Inflation) will be dependent on Trade Balance, Indicative Diesel Price, International Brent Crude Oil Price, Food Year-on-Year Inflation, and Average Commercial Banks Lending Rate.

So our model will be specified as

INFLATION = F (Trade Balance, Diesel Price, International Brent Crude Oil Price, Food Inflation, Average Commercial Banks Lending Rate)

First, the Chow Test is conducted to find if there is structural change in the data resulting from the 2 different regimes. The two regimes are the Regulated regime and the Deregulated regimes. The regulated regime has been in existence since January 1989 to June 2015. The deregulated regime started operation from July 2015 to date. The Chow Test is to analyze if there is a break in data because of two different policies implemented within the period under focus. This study limits the entire period of study to January 2009 to August 2022 because of unavailability of complete data within the period omitted.

Secondly, Stationarity Tests are conducted to ascertain the suitability of the data under analysis. Also the levels of stationarity specifically determine the nature of data analysis to be conducted. The Augmented Dickey Fuller and the Phillip-Perron unit root tests will be used to find if the variables are stationary or have a unit root. All variables are to be at least stationary at first difference.

Thirdly, the Co-integration Test is done to check for the existence of co-integrated variables. Co-integration among the variables is when there exist a long-run relationship among variables. When variables are co-integrated they distort the analysis of the data. If there is co-integration, it has to

be remedied in order to correct for the distortion. The outcome of the stationarity tests determine the co-integration technique to use. There are 3 possible outcomes from a stationarity test: An outcome where all variables are stationary in level, that is, are all I (0); An outcome where all variables are non-stationary at level; and an outcome where some variables are stationary at level and some at first difference, I(0) & I(1). The existence or non-existence of co-integration determines the specific tests to be used. If all variables are stationary at level then the Johansen co-integration test is used to test for co-integration. If variables are a combination of ones stationary at level and ones stationary at first difference, the Bounds test by Pesaran, Shin, and Smith (2001) is used. The hypothesis is:

Ho: No Co-integration

Ha: Existence of Co-integration

Decision rule:

If F-statistic>F-critical of upper bound, then there is co-integration.

If F-statistic<F-critical of lower bound, then there is no co-integration

Forth, if variables are not co-integrated, as desired, then Vector Autoregressive Model (VAR) is used to analyze the short-run relationship among variables. However, if there exist a co-integrated relationship, the Vector Error Correction Model (VECM) is used to correct the model and analyze the long-run relationship. In this study, if the Chow test results states that there is the existence of a structural break in the data, then the Vector Error Correction Model (VECM) will not account for the structural changes hence lead to inaccurate results. For this reason the Structural Break Test technique must be used to check for co-integration among variables. The Gregory-Hansen Co-

integration Test for structural break is used. This test will more accurately describe the relationship of the variables taking into account the structural break.

Some other relevant things with regards to co-integration are the number of co-integrated variables and the optimal lag length. The number of co-integrated variables can be found using the Johansen test for Co-integration. The hypothesis for this test is

Ho: No co-integrating equation of the number of ranks

Ha: Co-integrating equations

Decision Rule: If Trace or Max-Eigen statistic>Critical Value, reject Ho.

The optimal lag length is found using the Selection-order criteria. The selection can be done based on the AIC, HQIC, or SBIC.

Fifth, to ascertain the accuracy of the VAR or VECM results, diagnostic tests have to be conducted. Relevant diagnostic tests include test of Autocorrelation, Multicollinearity, Normality, and Stability. The model must be devoid of such existences as autocorrelation, non-normality, model instability among others in order to arrive at accurate and precise results.

Phase 2

The execution of this phase is dependent on the outcome of Phase 1. This phase is proceeded with if petroleum prices significantly affect inflation. A One-Sample Z-Test for Proportions will be conducted to find the significance of petroleum taxes as a proportion of petroleum prices. The

average petroleum price and petroleum tax sum over 5 years, 2018-2022 in which a number of petroleum taxes are exacted is used.

3.4 Data Sources

The main sources of data for this research is from the Bank of Ghana and the National Petroleum Authority. Data on Headline year-on-year Inflation, Trade Balance, International Brent Crude Oil Price, Food Year-on-Year Inflation, Average Commercial Banks Lending Rate, and Indicative Diesel Price (2009-2022) can be obtained from the Bank of Ghana" website. All the mentioned variables can be obtained from "Time Series" which is embedded under Economic Data". Note that the petroleum prices the Bank of Ghana provides starts from the era of petroleum deregulation. Also note that The NPA provides complete monthly data on regulated petroleum prices from January 2009 to June 2015. Data of Petroleum Taxes on Diesel and Petrol can also be sourced from the National Petroleum Authority.

3.5 Description of Variables

As mentioned earlier, the variables in the model are six: Inflation (Headline Inflation), Trade Balance, Indicative Diesel Price, International Brent Crude Oil Price, Food Year-on-Year Inflation, and Average Commercial Banks Lending Rate.

Inflation here is the year-on-year headline inflation which is measured from a particular month in the previous year to the month preceding the afore mentioned month in the current year in relation to the rate of change in general price levels. Therefore it is measured over 12 months.

Trade Balance is a component of Ghana's trade position that shows the exchange of goods and services between the nation and other nations. It is the difference between our exports and imports.

Indicative Diesel Price is made of the Ex-Refinery Price, the tax levies, the various margins like the Primary Distribution Margin, and other components which may vary from Oil Marketing Companies (OMCs). The Indicative Diesel price is the Indicative Maximum Price or the Ex-Pump Price. The Indicative Diesel Price used is the monthly average measured in Ghana Cedis per litre.

International Brent Crude Oil Price is the world market price of Brent Crude Oil. Brent Crude Oil is one of the three types of oil benchmarks. The prime oil benchmarks are Brent Crude, West Texas Intermediate (WTI), and Dubai/Oman. According to Investopedia, Brent Crude represents two-thirds of referenced oils sold on the world market. The International Brent Crude Oil Price used is the montly average measured in U.S.A. dollars per barrel.

Food Inflation Year-on-Year is measured in a similar fashion to Headline Inflation Year-on-Year. It is the aggregate rate of change in the general price levels of food stuff from a particular month in the previous year to the month preceding the afore mentioned month in the current year. According to the GSS it is usually the biggest component in Headline Inflation

Average Commercial Banks Lending Rate is the average rate at which commercial banks lend to the general public. It is influenced by the Monetary Policy Rate, Interbank Rate, and Treasury Bill Rate. In another sense, the Average Commercial Banks Lending Rate is influenced by the Ghana Reference Rate which is a weighted average rate of the three rates mentioned.

CHAPTER FOUR

RESULTS & DISCUSSIONS

4.1 Descriptives

SUMMARY STATISTICS OF VARIABLES

Stats	Headline Inflation (%)	Trade Balance (Millions in US$)	Diesel Price (GHC/Litre)	Int. Brent Crude (US$/Barrel)	Food Inflation (%)	Lending Rate (%)
Observations(N)	164	164	164	164	164	164
Mean	12.93628	-75.21902	3.558171	76.50896	9.130061	26.18128
Median	11.35	-87.355	3.285	73.21	7.805	26.72
Min	7.5	-733.06	.86	26.63	.87	20.04
Max	33.9	676.21	13.85	124.62	34.4	32.75
Range	26.4	1409.27	12.99	97.99	33.53	12.71
Stan Dev.	4.752682	254.1618	2.315468	25.57565	5.319394	3.231643
Skewness	1.546822	-.056024	1.815404	.2039806	2.407371	.0309769
Kurtosis	6.235446	2.917177	8.066566	1.788924	10.20723	2.661862

Source: By Researcher

Mean Headline Inflation is 12.9% with the minimum being 7.5% and maximum 33.9%. The distribution of Headline Inflation is positively skewed and not normally distributed. The mean

Trade Balance is US$ -75,230,000. The maximum balance within the period of observation is US$ 676,000,000 with minimum of US$ -733,000,000. Trade Balance is normally distributed.

Using the Skewness Test for normality, it is observed that all variables except Trade Balance and Lending Rate are not normally distributed at 5% of significance. This is shown by most P-values being below 0.05. Using the Shapiro-Wilk W Test for normal data, only the Trade Balance variable is normally distributed as it has a P-value of 0.78 showing that it is not statistically significant and therefore normally distributed. This is based on the hypothesis that

Ho is hypothesis that variable is normally distributed; Ha is hypothesis that variable is not normally distributed. The decision is made using the P-value. At 5% significance level, if P-value is less than 0.05 then variable in question is significant and not normally distributed.

The Shapiro-Wilk W Test is confirmed by the Shapiro-Francia W Test as it shows P-values close to zero for all variables except Trade Balance. Therefore all variables in model except Trade Balance are not normally distributed. These results can be confirmed with the histograms of the variables. (Find in Appendix).

In broad terms, finding the correlation between petroleum price and inflation would be necessary. A scatter plot of Headline Inflation being the dependent variable and Diesel being the independent variable shows that at very low prices of Diesel the correlation between the two variables is irregular. At increasing price levels above the lowest prices, the correlation becomes positive. As prices continues to increase the relationship changes to a negative relationship, but as Diesel prices continue to increase above the average price levels, the relationship changes to a clear and consistent positive relationship. This demonstrates that the correlation between Headline Inflation and Diesel prices may have a positive or negative relationship at moderate prices but have a positive relationship at high and higher prices.

Similarly, a two-way line chart Headline Inflation and Diesel Price against Time (t) shows the irregular or undulating pattern of Headline Inflation – it falls, maintains some stability for some time, rises gradually, recedes gradually, exhibits some instability and then rises sharply above average peaks. Diesel Price rises gradually and consistently, experiences a slight dip and then rises sharply. It can be observed that its sharp rise precedes the shaper rise of Headline Inflation.

4.2 Chow Test

The petroleum sector data at hand is one with data across regimes. The petroleum data gathered spans 2009-2022. Within this time span there have been two different petroleum regimes which are the regulated regime and the deregulated regime. The regulated regime within the given datat set spans from 2009 to 2015 while the deregulated regime spans 2015 to 2022. There is therefore the need to conduct the Chow Test to investigate there is a structural change in the data set due to differences in regimes or policies.

Hypothesis

Ho: Coefficients constant across sample (no structural break)

Ha: Coefficients differ across sample (there is at least one break)

Decision Rule

If Chow F-stat> Fcritical then reject Ho, conclude that there is at least one break.

Jan 2009 - June 2015

Residuals$_1$(RSS$_1$)= 106.615067, dof$_1$=69, n$_1$=78

July 2015 – August 2022

Residual$_2$(RSS$_2$)=145.879147, dof$_2$=77, n$_2$=86

Jan 2009 – August 2022

Residual (RSS) = 572.86331, dof=155, N=164

Fstat= $\frac{[RSS-(\text{RSS1}+\text{RSS2})]/\text{k}}{(\text{RSS1}+\text{RSS2})/\text{n1}+\text{n2}-2\text{k}}$

Fstat = 20.58

Fcritical = $F_{k,\ n_{1+}\ n_{2-2k,\ \alpha}} = F_{9,146,\ 0.05} = 1.88$

Fstat (20.58) > Fcrit (1.88)

Decision: Since the F-statistic is greater than the F-critical, we reject Ho and conclude that there is at least one break in the sample or data. There is therefore a break in the data as coefficients vary across sample.

4.3 Stationarity

Stationarity Test Table

Variable	Test	Test Statistic	Critical Value 5%	Critical Value 10%	Assessment	Order of Integration
Headline Inflation	ADF C&T	0.500	-3.442	-3.142	SaFD	I(1)
	ADF CwT	0.029	-2.886	-2.576	SaFD	I(1)
	P-P C&T	Z(rho) 3.1 Z(t) 0.8	-20.952 -3.442	-17.710 -3.142	SaFD	I(1)
	P-P CwT	Z(rho) 0.9 Z(t) 0.2	-13.826 -2.886	-11.084 -2.576	SaFD	I(1)
Trade Balance	ADF C&T	-4.923	-3.442	-3.142	SaL	I(0)
	ADF CwT	-3.362	-2.886	-2.576	SaL	I(0)
	P-P C&T	Z(rho) -72 Z(t) -6.7	-20.952 -3.442	-17.710 -3.142	SaL	I(0)
	P-P CwT	Z(rho) -36	-13.826	-11.084	SaL	I(0)

		Z(t) -4.5	-2.886	-2.576		
Indicative Diesel Price	ADF C&T	-0.997	-3.442	-3.142	SaFD	I(1)
	ADF CwT	1.096	-2.886	-2.576	SaFD	I(1)
	P-P C&T	Z(rho) 9.9 Z(t) 2.423	-20.952 -3.442	-17.710 -3.142	SaFD	I(1)
	P-P CwT	Z(rho) 6.8 Z(t) 3.304	-13.826 -2.886	-11.084 -2.576	SaFD	I(1)
International Brent Crude Oil Price	ADF C&T	-2.457	-3.442	-3.142	SaFD	I(1)
	ADF CwT	-2.163	-2.886	-2.576	SaFD	I(1)
	P-P C&T	Z(rho) -7.5 Z(t) -2.0	-20.952 -3.442	-17.710 -3.142	SaFD	I(1)
	P-P CwT	Z(rho) -6.3 Z(t) -1.8	-13.826 -2.886	-11.084 -2.576	SaFD	I(1)
Food Inflation – Year-on-Year	ADF C&T	-0.441	-3.442	-3.142	SaFD	I(1)
	ADF CwT	0.315	-2.886	-2.576	SaFD	I(1)
	P-P C&T	Z(rho) -1.9 Z(t) -0.44	-20.952 -3.442	-17.710 -3.142	SaFD	I(1)
	P-P CwT	Z(rho) 0.7 Z(t) 0.152	-13.826 -2.886	-11.084 -2.576	SaFD	I(1)
Average Commercial Banks	ADF C&T	-1.292	-3.442	-3.142	SaFD	I(1)
	ADF CwT	-1.701	-2.886	-2.576	SaFD	I(1)
	P-P C&T	Z(rho) -12 Z(t) -2.100	-20.952 -3.442	-17.710 -3.142	SaFD	I(1)

Lending Rate	P-P CwT	Z(rho) -5.2 Z(t) -1.603	-13.826 -2.886	-11.084 -2.576	SaFD	I(1)

Source: By Researcher

Key:

ADF C&T: Augmented Dickey Fuller Constant and Trend

ADF CwT: Augmented Dickey Fuller Constant without Trend

P-P C&T: Phillips-Perrons Constant and Trend

P-P CwT: Phillips-Perrons Constant without Trend

SaL:Stationary at Level

SaFD: Stationary at First Difference

All variables are not stationary at level except Trade Balance. Graphical observation of the variables show that all variables with the exception of Trade Balance is stationary. (Note: Find attached graphs at Appendix).

Conducting the stationarity tests show that all the non-stationary variables are stationary at first difference. The Augmented Dickey Fuller and Phillip-Perrons tests are used in this study. Two tests are used in order to validate results. By conducting the unit root tests, the graphical results are confirmed.

The Null Hypothesis for the test is

Ho: Presence of Unit Root (Non-stationarity)

Ha: No Unit Root (Stationarity)

We reject Ho if the test statistic is greater than the critical value at 5% level of significance and conclude that there is no unit root hence the variable is stationary.

Using the Augmented Dickey Fuller and Philip Perrons (with a constant and a trend; and with a constant without a trend), tests the stability of the variables. The results of the tests show that test statistics for five of the variables is less than critical values in most or all tests leading to the conclusion that five variables have a Unit Root hence are not stationary. So all variables with the exception of Trade Balance are non-stationary.

The table above shows the stationarity test results of the variables using the Augmented Dickey Fuller and Philip-Perron tests in the case of the presence of a constant term and a trend and then in the case of the presence of a constant term without a trend. Each Philip-Perron test produces two test results making the test results for each variable six including the Augmented Dicker Fuller. The levels of significance are 5% and 10% significance levels. At 5% or 10% significance Headline Inflation, Indicative Diesel Price, International Brent Crude Oil Price, Food Inflation – Year-on-Year, and Average Commercial Banks Lending Rate are stationary at first difference – I(1). This makes all variables suitable for onward use in data analysis.

4.4 Co-integration

Gregory Hansen

Having found out in section 4.2 that there is the presence of breaks in the data using the Chow Test, it will be useful to conduct Gregory Hansen Structural Cointegration Test . This is because there the normal test procedures will not be able to account for the break in the data.The Gregory Hansen Structural Test for co-integration will be conducted alongside the main co-integration test.

There are three criteria by which the test is assessed: the Level Shift, the Level Shift with Trend, and Regime Shift. The results of the Level Shift show that there is a break in the data in November 2013. The ADF and Zt tests with constant, constant and trend, and constant and slope show that

there is cointegration at the breakpoint since ADF t-stat (-6.66) and Zt (-6.58) > Crit(-5.56, -5.83, -6.41). The Za test shows cointegration with constant only: Za (-65.34) >Crit (-59.40). For contant and trend and constant and slope there is no cointegration at breakpoint : Za (-65.34) < Crit (-65.44, -78.52).

The Level Shift with Trend also show similar results. The break in the data is December 2013. At 5% significance and with the suitable number of regressors, the ADF and Zt tests with constant and constant and trend show that there is cointegration at the breakpoint since ADF t-stat (-6.34) and Zt (-6.25) > Crit(-5.56, -5.83). For Constant with slope, there is no cointegration at the breakpoint as ADF t-stat (-6.34) and Zt (-6.25) < Crit (-6.41). The Za test shows cointegration with constant only: Za (-62.06) > Crit (-59.40). For contant and trend and constant and slope there is no cointegration at breakpoint : Za (-62.06) < Crit (-65.44, -78.52).

Finally for the Regime Shift, the results observed show cointegration in all respects. The break for the Regime Shift is at August 2016. At 5% level of significance, the ADF and Zt tests with constant and constant with trend show that there is cointegration at the breakpoint because ADF t-stat (-6.17) and Zt (-6.34) > Crit (-5.56, -5.83). Using the ADF and Zt test, there is no cointegration at the constant and slope as ADF t-stat (-6.17) and Zt (-6.34) <Crit (-6.41) . The Za test shows cointegration with constant and constant and trend: Za (-66.19) > Crit (-59.40, -65.44) but not with constant and slope where Za (-66.19)< Crit (-78.52).

The Gregory Hansen Regime test shows that the breakpoint does not have a significant effect on the model.All the dummy variables regressed are not significant.This means that the usual ARDL can be accepted without making any adjustment for structural breaks in the model. In general, it can be concluded that that there are breaks in the model but their effect does not cause structural breaks in the model.

Bounds Test

Since variables are integrated of different orders, that is I (0) and I (1), the technique used for testing co-integration is the Bounds Test by Pesaran, Shin, and Smith (2001) is used. From the test results, the F-statistic (3.325) < F-critical of upper bounds (3.35; 3.79; 4.18; 4.68) and also F-statistic (3.325)> F-critical of lower bounds (2.26; 2.62; 2.96; 3.41). Note that the F-statistic is only lower than the last lower bound in the table. This means test results is inconclusive as F-statistic falls between the lower bound and upper bound.

Cointegration Results Summary

Dependent Variable	F-Statistic & t-statistic	Bounds (F) I(0) I(1)		Bounds (t) I(0)	I(1)	Cointegration Presence	Required Procedure
Headline Inflation	F= 3.325 t= 0.719	2.26; 2.62; 2.96; 3.41	3.35; 3.79; 4.18; 4.68	-2.57; -2.86; -3.13; -3.43	-3.86 -4.19 -4.46 -4.79	Indeterministic	Estimate ARDL short-run model
Trade Balance	F= 5.282 t= -5.617	2.26; 2.62; 2.96; 3.41	3.35; 3.79; 4.18; 4.68	-2.57; -2.86; -3.13; -3.43	-3.86; -4.19; -4.46; -4.79	Yes	Estimate Error Correction Model (ECM)
Diesel Price	F= 1.514 t= -1.045	2.26; 2.62; 2.96; 3.41	3.35; 3.79; 4.18; 4.68	-2.57; -2.86; -3.13; -3.43	-3.86; -4.19; -4.46; -4.79	No	Estimate ARDL (short-run model)
Int. Brent Crude	F= 2.313 t= -1.863	2.26; 2.62; 2.96; 3.41	3.35; 3.79; 4.18; 4.68	-2.57; -2.86; -3.13; -3.43	-3.86; -4.19; -4.46; -4.79	No	Estimate ARDL (short-run model)

Food Inflation	F= 3.016 t= -3.630	2.26; 2.62; 2.96; 3.41	3.35; 3.79; 4.18; 4.68	-2.57; -2.86; -3.13; -3.43	-3.86; -4.19; -4.46; -4.79	Indeterministic	Estimate ARDL (short-run model)
Lending Rate	F= 11.56 t= -4.897	2.26; 2.62; 2.96; 3.41	3.35; 3.79; 4.18; 4.68	-2.57; -2.86; -3.13; -3.43	-3.86; -4.19; -4.46; -4.79	Yes	Estimate Error Correction Model (ECM)

Source: By Researcher

To further probe the cointegration relationship, each independent variable is regressed of the other variables to determine cointegration.

Trade Balance regressed on the other variables show the presence of cointegration as F-statistic (5.282) > F-critical of upper bounds (3.35, 3.79, 4.18, 4.68).

Diesel Prices regressed on the other variables shows there is no cointegration as F-statistic (1.514) < F-statistic of lower bounds (2.26, 2.62, 2.96, 3.41).

Brent Crude Oil regressed on the other variables to a large extent shows there is no cointegration as F-statistic (2.313) < F-critical of lower bounds (2.62, 2.96, 3.41) but > (2.26) which is one of the four boundaries. The t-stastistic buttresses the no cointegration results as t-statistic (-1.863) > t-critical of lower bounds (-2.57, -2.86, -3.13, -3.43).

Food Inflation regressed on the other variables shows indeterminsitic results as t-statistic (-3.630) is not > t-critical of lower bounds (-2.57, -2.86, -3.13, -3.43) and is not < t-critical of upper bounds (-3.86, -4.19, -4.46, -4.79). Similarly, F-statistic (3.016) is not > F-critical of upper bounds (3.35, 3.79, 4.18, 4.68) and is not < F-critical of lower bounds (2.26, 2.62, 2.96, except 3.41).

Lending Rate regressed on the other variables shows the presence of cointegration as F-statistic (11.556) > F-critical of upper bounds (3.35, 3.79, 4.18, 4.68).

The optimal lag length is found using the Selection-order criteria. The AIC gives the least AIC of 26.0377 value corresponding to an optimal lag length of 2. The HQIC gives the least HQIC value of 26.4798 corresponding to an optimal lag length of 1. The SBIC also gives its least value of 26.9592 corresponding to an optimal lag length of 1. The best choice is that criteria that gives the least value . This therefore leaves the AIC as criteria with the optimal lag length of 2.

4.5 ARDL

ARDL Equations

ARDL Main Equation Table

Variable		Coefficient	Std Error	t-Stat	Prob.	DW-Stat	White Pvalue	Vif mean
Constant		.4714204	.8162721	0.58	0.564	2.1	0.01	2.17
Headline Inflation	L1.	1.155529	.0799593	14.45	0.000			
	L2.	-.137076	.0854996	-1.60	0.111			
Trade Balance ($m)		-.000239	.0002712	-0.88	0.380			
Diesel	--	.6510591	.2222904	2.93	0.004			
	L1.	-.6235068	.2280614	-2.73	0.007			
Int. Brent Price	- -	.0046257	.0091118	0.51	0.612			
	L1.	-.015862	.013575	-1.17	0.244			
	L2.	.017829	.0093193	1.91	0.058			

Food Inflation	- -	.1760072	.03122	5.64	0.000			
	L1.	-.094645	.042747	-2.21	0.028			
	L2.	-.0543423	.0331905	-1.64	0.104			
Lending Rate		-.0596114	.0353333	-1.69	0.094			

Source: By Researcher

For the main equation, Diesel and and Food Inflation are significant in determining Headline Inflation in the short run. At both level and the first order lag, Diesel Price is statistically significant in determining Headline Inflation at the 1% level of significance in the short run, all other things being equal. At both level and the first lag, Food Inflation is statistically significant in determining Headline Inflation at the 1% and 5% level of significance respectively.

Trade Balance, International Brent Crude Oil, and Lending Rate are all insignificant at level or when lagged in determining Headline Inflation.

Diesel Regressed on Other Variables

At level, Headline Inflation at the first lag is significant at 1% significance level in determining Diesel Prices on average in the short run. That is a one percentage point increase in the Headline Inflation will lead to 0.07 percentage increase in the Diesel Price at level on average in the short run. Interntional Brent Crude Oil is significant at level and the second order lag at 1% level of significance. Trade Balance, Food Inflation, and Lending Rate are not significant in determining Diesel Prices.

Diagnostics: Running the Durbin-Watson, the d-statistic obtained is 1.766 supported by the Breusch-Godfrey LM Test which has a P-value of 0.28. Given the Ho: No Serial Correlation, we conlude that there is no Serial Correlation. Using the White Test, the results shows the presence of heteroscedasticity as P-value is 0.0001 indicates statistical significance given that the null

hypothesis is Ho: Homoskedasticity. For Multicollinearity, the VIFs are all low and show the absence of multicollinearity: Headline Inflation (3.63), Food Inflation (3.3), Lending Rate (1.83), Trade Balance (1.63), and International Brent Crude Price (1.13).

International Brent Crude Price on Other Variables

Diesel Price is significant in determining International Brent Crude Price at level and at the first order lag at 1% level of significance. Food Inflation is significant at the 1% level of significance. Headline Inflation, Trade Balance, and Lending Rate are not statistically significant in the determination of International Brent Crude Oil.

Diagnostics: The Durbin Watson Test gives a d-statistic of 1.947224. The Breusch-Godfrey LM Test gives a P-value of 0.4258 indicating the acceptance of the null hypothesis which is given as Ho: No Serial Correlation. Both tests confirm the absence of autocorrelation. The White Test gives a P-value of 0.2658 indicating the acceptance of the null hypothesis which is Ho: Homoskedasticity. Therefore the model does not suffer form heteroscedasticity. The VIF gives the following results: Diesel (5.23), Headline Inflation (5.01), Lending Rate (4.23), Food Inflation (3.33), and Trade Balance (1.9). This is an indication of no Multicollinearity.

Food Inflation on Other Variables

Headline Inflation is the only variable that significantly determines Food Inflation. The level of significance is at 1%. Trade Balance, Diesel Price, International Brent Crude Price, and Lending Rate are insignificant in the determination of Food Inflation.

Diagnostics: The Durbin Watson gives a d-statistic of 2.19 indicating the absence of autocorrelation. This is confirmed by the Breusch Godfrey LM Test with P-value of 0.17 showing no statistical significance given the null hypothesis Ho: Serial Corrrelation. White's Test shows P-

value of 0.0235. This indicates that the model suffers from Heteroskedasticity given the null hypothesis to be Ho: Homoskedasticity. The VIF analyzes that there is no multicollinear relationship among the variables: Diesel Price (5.21), Lending Rate (4.14), Headline Inflation (3.22), Trade Balance (2.00), and International Brent Crude Oil (1.14).

Trade Balance on Other Variables

Using the Error Correction model, the adjustment term for Trade Balance is statistically significant at the 1% level of significance. In the short run Brent Crude Price is statistically significant at 1%. In the long run, Headline Inflation and Diesel Price are statistically significant at 1%, while Brent Crude Price is significant at 5%. Food Inflation and Lending Rate are not statistically significant.

Diagnostics: The model shows no sign of suffering from autocorrelation. This is shown by the Durbin-Watson Test with d-statistic of 1.99 and Breusch-Godfrey LM Test with P-value of 0.7817. There is no statistical significance given that the null hyposis Ho: No Serial Correlation. The White Test shows the presence of heteroscedasticity given a P-value of 0.0355 and null hypothesis, Ho: Homoskedasticity. Multicollinearity is absent judging by VIF results. The VIFs are within an acceptable range: Headline (4.25), Lending Rate (4.08), Diesel Price (4.07), Food Inflation (3.15), and International Brent Crude (1.02).

Lending Rate on Other Variables

The adjustment coefficient for this equation is statistically significant at 1%. In the short run Headline Inflation and International Brent Crude Price are significant at the 5% significance level in determining Lending Rate. In the long run Headline Inflation, Trade Balance, Diesel Price, and International Brent Crude Price are all statistically significant in determining the Lending Rate.

Diagnostics: The Durbin-Watson d-statistic (1.96) indicates the absence of Serial Correlation. The same can be said for the Breusch-Godfrey LM Test with P-value of 0.9491 indicating no statistical

significance to the null hypothesis Ho: No Serial Correlation. The presence of Heteroskedasticity is indicated by the White Test given P-value of 0.000 with null hypothesis Ho: Homoskedasticity. Multicollinearity is absent as VIF values are within acceptable range: Food Inflation (3.27); Headline Inflation (2.62); Diesel Price (2.29); Trade Balance (2.04); International Brent Crude Price (1.14).

4.6 Diagnostic Tests

Autocorrelation

The hypothesis for Autocorrelation are as follows.

Ho: No Autocorrelation

Ha: Autocorrelation present

Decision Rule: Reject Ho if P-value< 0.05, and accept Ha concluding that there is the presence of Autocorrelation.

The diagnostic test shows the presence of serial correlation using the Durbin-Watson Test which gives a d-statistic of 2.09149. This is supported by the Breusch-Godfrey LM Test which gives a p-value of 0.0568 which is significant at 10%. This evidence gives reason to reject Ho which states that there is no serial correlation.

Heteroscedasticity

The hypothesis for Heteroscedasticity are as follows.

Ho: Homoscedasticity

Ha: Heteroscedasticity

Decision Rule: Reject Ho if P-value< 0.05, and accept Ha concluding that there is the presence of Heteroscedasticity.

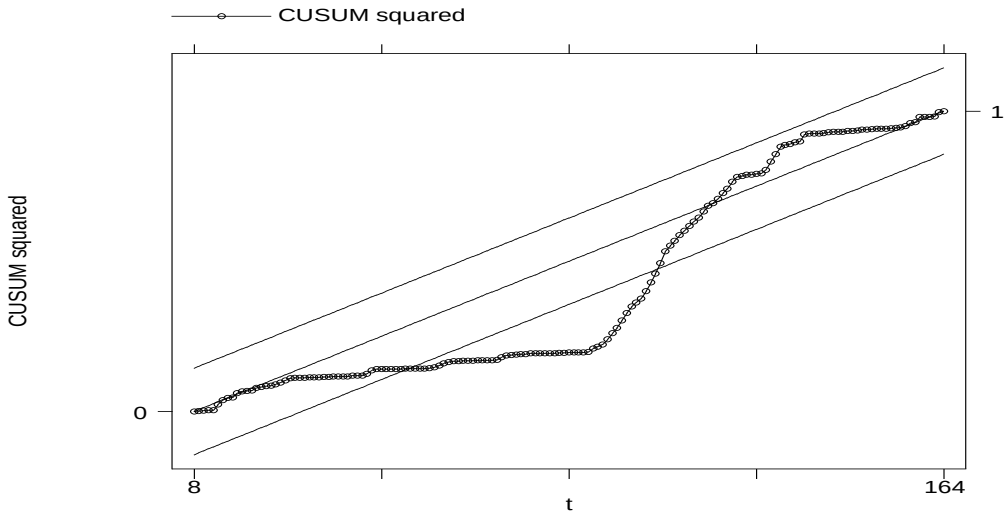
The White Test for Heteroskedasticity is also conducted. Given Ho as Homoskedasticity of data, a P-value of 0.0115 is recorded. This shows that there is statistical significance at 5%, therefore Ho is rejected and Ha is accepted. This shows the presence of Heteroskedasticity is the data.

Multicollinearity

Using the VIF technique, there is no presence of multicollinearity in the model. VIFs are Diesel Price (3.74), Lending Rate (2.16), Food Inflation (2.09), Trade Balance (1.75), and International Brent Crude Oil (1.12), all showing no sign of multicollinearity. All the regressors fall within the range of 1.12 and 3.74 lower than the greater than 5 threshold.

Model Stability Test

CUSUM Squared Graph



Source: By Researcher

The above graph is the Cumulative Sum Test also know as the CUSUM Test. The specific graph above is the Cumulative Sum Squared graph. It shows the stability of the model. The graph indicates that the model is not completely stable. This is not surprising as there are breaks in the

model or data as analyzed by the Chow test and confirmed to be insignificant by the Gregory Hansen Structural Cointegration Test. Overall the model is stable.

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4.7 Petroleum Tax-Inflation Proportions Test

Finally the proportion of petroleum taxes are to be tested for their significance in petroleum prices.

The petroleum taxes identified under the period understudy are:

1.Energy Debt Recovery Levy

2. Road Fund Levy

3. Energy Fund Levy

4. Price Stabilization and Recovery Levy

5. Sanitation and Polution Levy

6. Energy Sector Recovery Levy

7. Special Petroleum Tax

The average tax sum over per year will be tested as a proportion of the average petroleum prices for that corresponding year. The One-Sample Z-Test for Proportions is used to test the statistical significance of the petroleum taxes as a proportion of the petroleum products average prices. Diesel or Premium taxes will be used in line with model specification. Taking the years 2018 to 2022, the average tax sum for the years is Ghp 160 or GHC 1.60. The sample size is therefore 60 months.The average Diesel price over the five-year period is GHC 5.94.

The test statistic for the One Sample Z-Test for proportions is

$Z = (\hat{p} - p_0) / \sqrt{p_0 (1 - p_0)/n}$

Where

Z is the Test Statistic

$\hat{p}$ is the sample proportion

p_0 is the population proportion

n is the sample size

Hypothesis

$H_0 : p = p_0$

Ha: $p \neq p_0$

Decision Rule: Reject Ho if Z > Z critical

For a two two-tailed test, a level of significance of 5% gives Zcritical = 2.0025

Z = 5.265.

Therefore the Null hypothesis is rejected since the Zstatistic (5.3) > Zcritical (2.0025).

4.8 Results Summary

The results show that the regime shift in the petroleum sector is not significant in determining inflation. The results show significance of petroleum prices contributing to inflation. This results is given by the ARDL analysis. The One sample Z-Test for proportions also shows that the proportion of petroleum taxes which forms petroleum prices is statistically significant. This implies that petroleum taxes significantly influence inflation through petroleum products.

CHAPTER FIVE

CONCLUSION & RECOMMENDATION

5.1 Conclusion

The chapter starts by giving a background to the genesis of advocacy by policy think tanks for the deregulation of the downstream petroleum sub-sector to how it was finally sustainably institutionalized. It continues by examining the problems associated with deregulation and its association with inflation, but more importantly the possibility of government exacting excessive petroleum taxes via deregulated prices. Two key questions are of concern in this study: First, is there a direct and significant relationship between petroleum deregulation and inflation in the short or long term? And if so, is there also a significant relationship between the tax policy component in deregulated petroleum prices and inflation? The theoretical literature reviews the Classical and Keynesian schools of thought in relation to inflation laying the foundation for the discussion of the limited empirical literature review in terms of works in this area of study. The Methodology discusses the usage of secondary monthly times series inflation data and deregulated petroleum prices to be obtained from GSS and NPA respectively. It talks about the usage of econometric techniques such as ARDL and the Z-Proportions Test in data analysis and interpretation.

The findings of this work corrobated findings of existing works and built upon existing knowledge. The regime shift in the petroleum sector, that is the regulated regime and the deregulated regime does not significantly influence inflation. In other words the effect of the petroleum deregulation policy has not significant effect on inflation. However, petroleum prices significantly influence inflation. Petroleum taxes also significantly influence Petroleum Products prices.

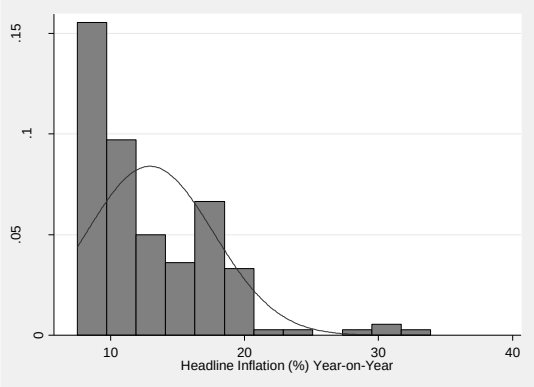
5.2 Recommendation

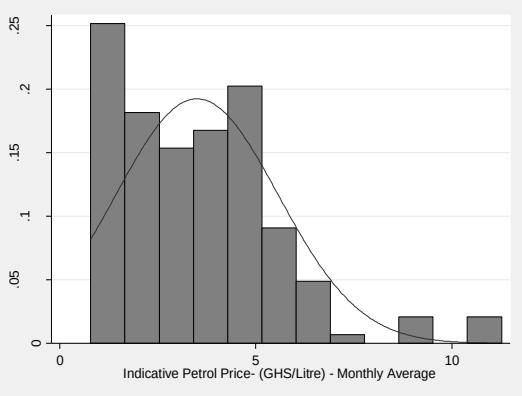
The policy prescription is that Government finds the right measure of taxation on petroleum products that will rake in the needed revenue given that petroleum products are generally inelastic in nature and at the same time will not cause inflationary pressures leading to economic imbalances. In an era of deregulation, taxation must be measured in its exaction else will lead to adverse consequences.

Tables & Graphs

4.1 Normality Tables

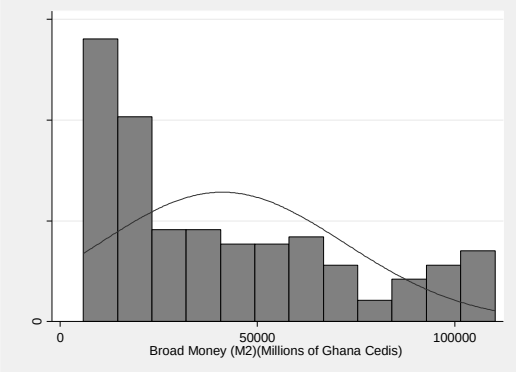
Normality

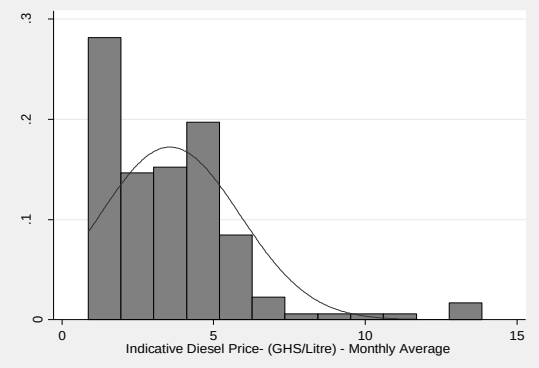




Headline Inflation

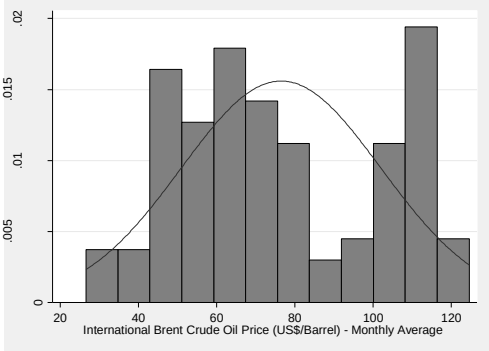
Indicative Petrol Price

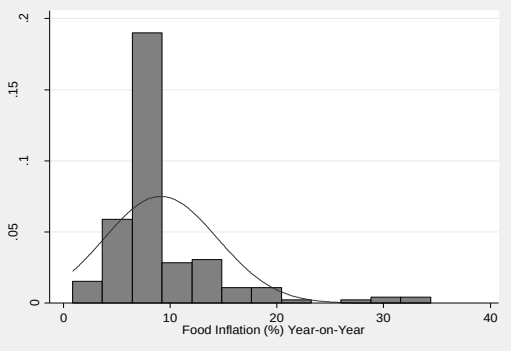




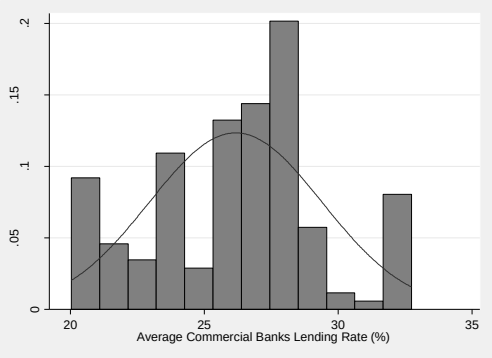
Broad Money Supply

Indicative Diesel Price

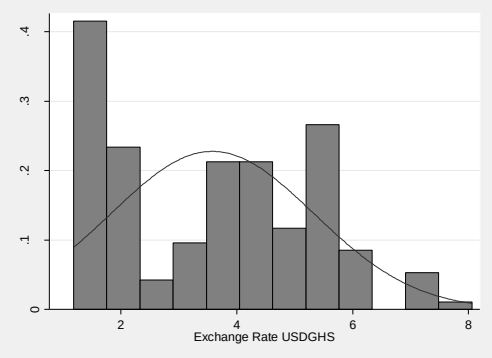




International Brent Crude Oil Price

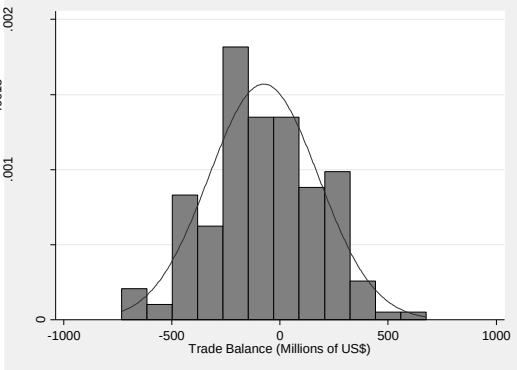


Food Inflation



Average Lending Rate

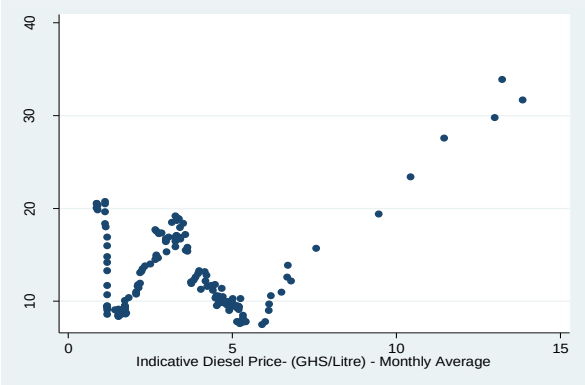
Exchange Rate



Trade Balance

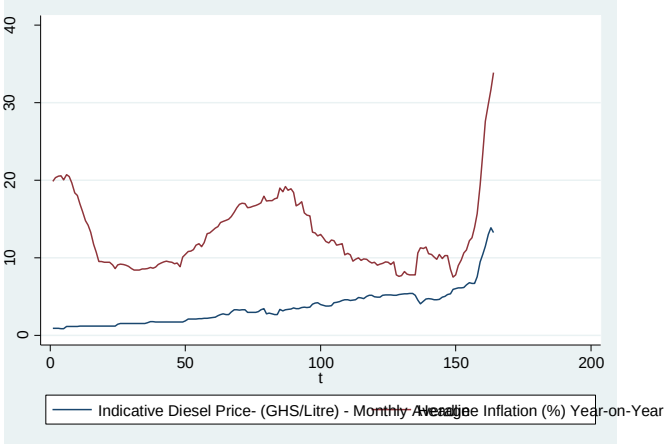
4.2 Scatter Plot & Line Plot

Scatter Plot



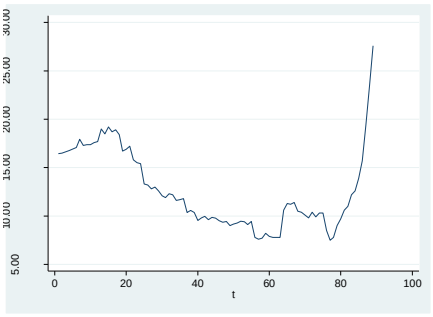
Scatter Plot: Diesel Price versus Headline Inflation

Two-Way Line Plot

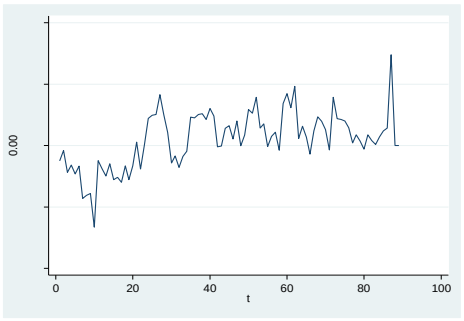


Two- Way Line Plot: Diesel Price versus Headline Inflation

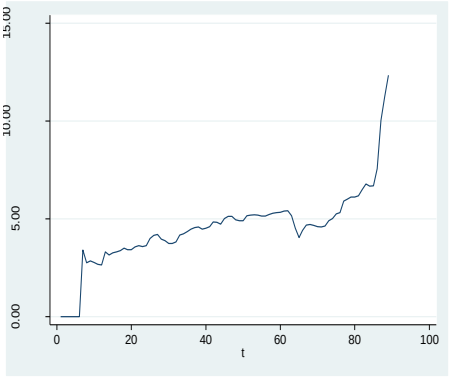
4.3 Stationarity Line Charts



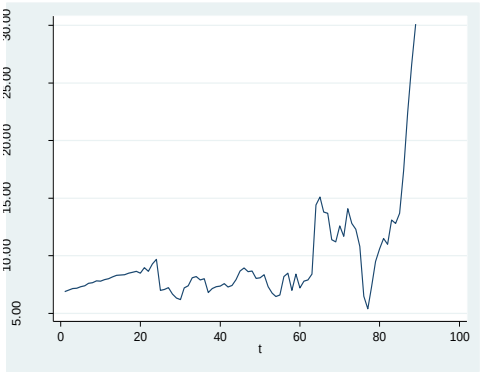
Inflation



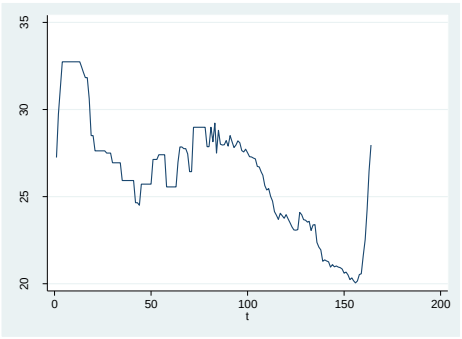
Trade Balance



Diesel Price



Food Inflation



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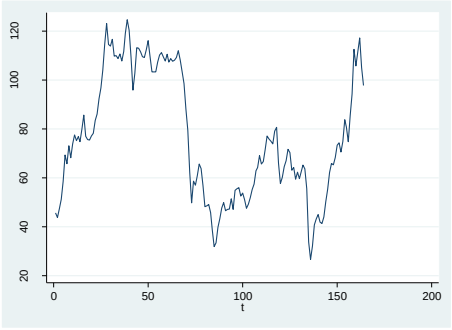
Average Commercial Banks Lending



International Brent Crude

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