EFFECT OF SUPPLY SHOCKS ON FUEL PRICE FLUCTUATIONS IN KENYA

BY

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16/04175

MASTER OF SCIENCE IN COMMERCE (FINANCE AND INVESTMENT

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DECLARATION/APPROVAL PAGE

I declare that this dissertation is my original work and has not been previously published or submitted elsewhere for award of a degree. I also declare that this contains no material written or published by other people except where due reference is made and author duly acknowledged.

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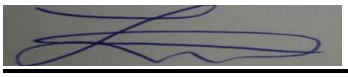
Signed:  **Date:** 11/10/2023

I do hereby confirm that I have examined the master's dissertation of **Julius Gordon Ouma** and have certified that all revisions that the dissertation panel and examiners recommended have been adequately addressed.

Signed: **Date: 11/10/2023**

Dr. Ibrahim Tirimba

Dissertation Supervisor

ABSTRACT

The Kenya government is on its edge to make the economy to be more conducive to both investors and its citizen on oil and petroleum businesses. The government had gone ahead to form a commission and other authorities to enhance affordable petroleum and energy to the economy. There were challenges that were still hindering provision of fuel at stable prices. The purpose of this study was to establish the effect of shocks on fuel prices fluctuations in the Kenyan economy. The objective of this study was to determine the effect of supply shocks on pipeline transportation cost, inflation rate, world oil prices and foreign exchange rates on fuel price fluctuation. The population of study was identified to be Kenya while the unit of analysis was Energy and Petroleum Regulatory Authority (EPRA). The study adopted time series data design for 8 years from 2015 to 2022 in monthly intervals to make 96 observations. Stata version 13 was used to assist in data analysis and presentation after the data went through diagnostic test. VECM model was employed to analyze the relationship between dependent and independent variables after which conclusions and recommendations were made. The study came out with a number finding. First, it was determined that rate of inflation shocks have significant effect in fuel price fluctuation as study revealed that there was a negative relationship with fuel price fluctuation. Second, it was ascertained that world oil prices shocks have significant effect in fuel price fluctuation as there was a positive relationship existing between world oil prices and fuel price fluctuation. Third, the study established that exchange rate shocks had significant effect on fuel price fluctuation as there was a negative relationship between exchange rates and fuel price fluctuation. Forth, it was established that there was a positive relationship between pipeline cost shocks and fuel price as it has a slight significant influence in fuel price fluctuation. The study recommended that; the government should establish fixed exchange rates to cub losses from exchange of currencies. It was also recommended that tax subsidies to be introduced to control impact of taxes proportion on fuel prices.

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I greatly pass my gratitude to my supervisor who sacrificed lots of his time in guiding me to come up with an appropriate topic for my project, he gave me guidance and encouragement throughout the project period. Your direction, assistance and constructive criticism enabled me to be more creative and give out my best. I would also like to give my gratitude to the entire KCA University for such a wonderful program within the curriculum for postgraduate students. In addition, I would further be thankful to all lecturers who impacted me with ideas and acknowledge that helped me to complete this project. Above all, I thank almighty God for giving me the strength, knowledge resources and ability to start and complete this assignment.

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DEDICATION

I wish to dedicate this project to my aunt Sween for having provided financial support and technical advices throughout my study period. I would like also to dedicate this project to my brother Kenneth and my sisters Emily and Sarah for having given me a humble time during project period. In addition, I dedicated the project to my friends Hosea and Deborah for having spent much of their time as we consult each other whenever need arises. Last of all, I dedicated this work to my supervisor Dr. Tirimba for having challenged me and ensure all I do as per the required standards in academia.

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ACRONYMS AND ABBREVIATIONS

CB	Central Bank
EPRA	Energy and Petroleum Regulatory Authority
ERC	Energy Regulatory Commission
GDP	Gross Domestic Product
KITA	Kenya Income Tax Act
KPC	Kenya Pipeline Corporation
LP	Linear Programming
OPEC	Organization of the Petroleum Exporting Countries
PSC	Petroleum Service Company
PMS	Premium Motor Spirit
SBM	Single Buoy Mooring
SPR	Strategic Petroleum Reserves
SPSS	Software Package for Social Sciences
US	United States.
WOM	World Oil Market
VAT	Value Added Tax
VECM	Vector Error Correction Model.

CHAPTER ONE

INTRODUCTION

1.1 Background of the study

Fuel is referred to as any material such as gas, coal or oil that can be burned to produce heat or power (Solarte, 2018). Fuel also referred as Crude oil that is a liquid fuel source found underneath the earth surface that is extracted through drilling. Oil products were used for heating, transportation and electricity generation and in manufacturing of variety of products as well as of plastics, therefore fuel is considered the core component for many products. Fuel is required in almost all sectors in the economy therefore it forms a rich ground that a lot of concern is required. In this project, the study majored on the fuel product like petroleum, diesel and kerosene that are mainly regulated by Energy Regulatory Commission (ERC) as the regulatory authority established by the law for that mandate. Petroleum and energy provide the lifeblood in the lager section of the country and it is an important commodity that propels the expansion of the world's economy. Since 1950s, oil and natural gas were the major sources of energy as world population increases and therefore it was expected to continue for several years to come, (Edwards, 1997). Energy and petroleum sector was a category of stocks that are related to production or supplying energy in a given state therefore it comprised of companies involved in the exploration and development of oil or gas reserves, oil or gas drilling and refining, (Scott, 2021).

Supply shocks are abrupt and unforeseen events that profoundly disturb the production and provision of goods and services within an economy. These disruptions can emanate from various origins, such as natural disasters, geopolitical incidents, technological breakdowns, or sudden alterations in resource availability. When a supply shock transpires, it directly influences the broader economy by impacting both price levels and tangible output (Blinder, A. S., & Rudd, J.

B. 2013). These shocks impede firms' capacity to generate gross domestic product (GDP), thereby directly influencing the prices or quantities of factor inputs or the production technology. The resultant alterations in output can be fundamentally neoclassical. The changes in output manifest due to shifts in the aggregate supply curve, representing the total volume of goods and services that firms are ready and capable of producing at different price levels. Depending on the nature of the shock, supply shocks can induce an augmentation or reduction in aggregate supply. For instance, a sudden upswing in resource availability may result in an expansion of production capacity, causing an upward shift in the aggregate supply curve. Conversely, a natural calamity or geopolitical occurrence disrupting production may lead to a contraction in aggregate supply (Blinder, A. S., & Rudd, J. B. 2013). These supply shocks have significant repercussions on the overall economy, influencing prices, employment rates, and economic expansion. Policymakers often need to respond promptly to these shocks by implementing measures to stabilize the economy and alleviate any adverse impacts. In summary, supply shocks are dynamic events that directly alter the production landscape, necessitating strategic and swift responses to maintain economic stability.

In the real-life situation, healthy competition was found to a very important tool for controlling price of some products against consumer exploitation. In an economy of higher level of competition with incorporation of the law of demand supply, commodities like petrol and diesel were fairly priced. For that reason, it was noticed that market power and forces play integral part in price control in an economy. This therefore brought a question as to why some economies like Kenya may be experiencing instability in fuel prices, (Angelich, 2019). In Kenya, there was no competition as the fuel prices ware controlled by the authority making it very impossible for the market force to operate fully as expected. The main purpose for this project was to examine the

factors i.e., exchange rates, rate of inflation, world oil prices and transportation cost that cause oil fuel price instability in Kenya arising from the supply shocks. The price of oil and other petroleum products was found to be very sensitive to the economy as crude oil forms part of inputs of major productions across sectors making it more valuable and important commodity in each and every industry thus being considered as the major factor of production therefore, its instability is a major harm to the economy.

According to Economou and Agnolucci in (2016), supply shocks can have a major impact on fuel prices, causing swings in energy markets. Supply shocks are sudden and unexpected changes in the availability or production of a commodity, such as oil, which can result from geopolitical events, natural disasters, technological disruptions, or changes in production patterns. These shocks can have ripple effects throughout the economy, affecting not only fuel prices but also industries reliant on energy, such as transportation and manufacturing. Additionally, supply shocks can lead to increased uncertainty in the market, making it difficult for businesses and consumers to plan and make informed decisions. For example, when there is a sudden disruption in the production or extraction of oil, the supply of fuel can decrease, leading to higher prices. Conflicts, mishaps, or maintenance problems in important oil-producing regions could be to blame for this. Drone attacks on Saudi Aramco's oil processing facilities in September 2019 temporarily halted the production of about 5.7 million barrels per day (bpd), or about 6% of the world's oil supply. Because of this, the price of crude oil increased by almost 15% in a single day, raising fuel prices everywhere, Isa (2019). Political unrest and geopolitical conflicts in oil-producing regions can disrupt fuel supply systems, causing volatility in global energy markets. This turbulence can cause swings in oil prices, affecting not only the energy sector but also a variety of industries that rely on fuel for transportation and manufacturing. Furthermore, the uncertainty surrounding fuel

supply may push countries to investigate other energy sources and invest in renewable technology in order to offset the dangers associated with oil reliance, (Isa, 2019).

Trade wars and sanctions can also hinder the flow of oil, causing fuel prices to rise. Conflicts in the Middle East, for example, such as the current tensions between Iran and Saudi Arabia, have the potential to impair regional oil production and transportation, (Kesicki, 2010). Furthermore, economic sanctions imposed on nations such as Venezuela or Russia might limit their ability to export oil, affecting global fuel supply networks. Following the Yom Kippur War in October 1973, several Arab countries imposed an oil embargo on countries perceived to be supporting Israel. This led to a significant reduction in oil supply, causing a global energy crisis and a sharp increase in fuel prices (Ross, 2013). Natural disasters, such as hurricanes, earthquakes and floods, can disrupt oil refineries and transportation infrastructure, leading to temporary supply shortages and fuel price spikes. These disruptions occur when the infrastructure is damaged or destroyed, making it difficult to extract and transport oil. As a result, consumers may experience higher prices at the pump and limited access to fuel until repairs are made. Hurricane Katrina devastated the Gulf Coast region of the United States, where a significant portion of the country's oil refineries were located. This led to disruptions in fuel production and distribution, resulting in higher fuel prices (Cruz & Krausmann, 2013).

Kenya is a net importer of petroleum products, relying heavily on imports to meet its domestic demand. Any changes in international oil prices can directly affect fuel prices in Kenya. This reliance on imports makes Kenya vulnerable to fluctuations in global oil markets. As a result, any increase in international oil prices can lead to higher fuel prices for consumers in Kenya, impacting the overall cost of living and the economy. The outbreak of the COVID-19 pandemic in early 2020 led to a significant decrease in global oil demand due to lockdowns and travel

restrictions. This sharp decline in demand caused oil prices to plummet, impacting fuel prices in Kenya and leading to reductions in fuel costs for consumers (Akrofi & Antwi, 2020). Because Kenya imports a substantial amount of its petroleum products, fluctuations in exchange rates can affect import costs and, as a result, fuel prices. For example, if the Kenyan shilling depreciates against major currencies, the cost of importing petroleum goods rises, resulting in higher fuel prices for consumers. On the other side, if the currency appreciates, it may reduce import costs and cause fuel prices to fall. The Kenyan shilling depreciated significantly against major foreign currencies between 2011 and 2012, resulting in higher import costs for petroleum products. As a result, Kenyan fuel costs rose, causing inflationary pressures in the economy (Odongo, 2012). This depreciation also had a negative impact on the overall economy, as higher fuel prices increased transportation costs for businesses and households. Additionally, the increased cost of imported petroleum products put pressure on the government's budget, as it had to allocate more funds towards fuel subsidies to cushion consumers from the price hikes.

1.1.1 Fuel Price

Oil supply shock was defined as a sudden disruption in the availability of oil induced by unforeseen events such as geopolitical wars, natural disasters, or significant changes in oil production or delivery (Effiong, 2014). This shock has the potential to have far-reaching effects for global economies and businesses that rely heavily on oil, resulting in higher prices, slower economic growths and potential political upheaval. The most famous example of an oil supply shock was the 1973 OPEC oil embargo, which caused a dramatic increase in oil prices and had a significant economic impact. A sharp increase in the price of oil is frequently accompanied by a decrease in supply. Because oil is the primary source of energy for advanced industrial economies in most locations, a crisis might jeopardize economic and political stability throughout the global

economy, which is still recovering from a pandemic (Effiong, 2014). Since Hamilton's foundational study in 1983, there has been a considerable body of literature examining the impact of oil price shocks on the macroeconomic of both oil-importing and oil-exporting countries (Hamilton, J. D. 2009). Oil price fluctuations can have a considerable impact on the economies of both oil-importing and oil-exporting countries. Oil price shocks, according to the standard supply-side model, may hinder economic growth and boost inflation in oil-importing countries while enhancing oil revenues in oil-exporting countries via the wealth transfer effect. Despite the fact that the oil price-macroeconomic relationship has been thoroughly examined, a rising body of scholarship examines the impact of oil price shocks on financial markets, particularly the stock market (Hamilton, 2009).

According to Cashin in (2014), the macroeconomic consequences of a negative oil supply shock differ substantially between countries that import oil and export energy. In terms of actual output, following an oil supply shock, the Eurozone and the United States, two large energy-importing countries, experienced a long-term dropped in economic activity, whereas China and Japan enjoy a positive impact. This disparity in outcomes can be linked to each country's reliance on oil imports and the flexibility of its economy. Oil-importing countries that rely significantly on oil for energy suffer higher production costs and decreased consumer spending power, resulting in a reduction in economic activity. Increased oil prices, on the other hand, help energy-exporting countries by increasing export revenues and supporting economic growth. Oil price shocks can be transferred to the stock markets via stock price movements. Because stock markets are known to be informationally efficient, stock prices are fairly expected to reflect all current and available information, including oil price shocks. In theory, oil price shocks affect stock market values by influencing predicted earnings (Huanget, 1996). With conflicting results, an increasing body of

literature has explored the influence of oil price shocks on stock market prices (or returns). According to the literature, oil price shocks should result in stock market decreases. However, depending on the relative importance of oil to their macroeconomics, such an influence may differ across oil-importing and oil-exporting countries, (Bjrnland, 2009).

Recent developments in the crude oil market, such as the wide volatility of oil prices and rising demand for oil from emerging economies such as China and India, had led to an acknowledgement that the impact of oil price shocks may vary depending on their origin or source. In contrast to the implicit assumption in typical macroeconomic models that unexpected oil price increases were solely attributable to exogenous supply shocks in the crude oil market, researchers such as Hamilton (2009) and Kilian (2009) have demonstrated that oil prices can also be driven by demand. Thus, oil price shocks had been dissected by Kilian (2009) into shocks generated by demand (aggregate demand and oil-specific demand shocks) and supply (oil supply shocks), and their effects on macroeconomic variables were anticipated to differ. The analysis of stock markets for only developed oil-importing and oil-exporting countries and emerging economies had been expanded to the impact of oil price shocks based on their origin (Wand et al., 2013). Since the 1970s oil price shocks, there had been an extant literature identifying the relationship between oil prices and various macroeconomic variables such as real GDP growth rates, inflation, employment, exchange rates, current account and trade balances and so on, using various econometric methodologies and oil price specifications (Kilian & Peersman, 2009). Another recent body of work examined the influence of oil price shocks on financial markets, particularly asset prices such as stock prices. While variations in oil prices are critical for understanding stock market swings, the literature reveals that there was little agreement among researchers and economists on their impact.

The economic impact of oil price changes was a topic that has received a lot of attention recently, especially because oil prices that had continued to rise globally. High oil prices had a direct impact on businesses, households, and governments, prompting the Kenyan government, through the ERC, to implement a capping guide for retail prices of diesel, gasoline, and kerosene in December 2010, citing the need to protect consumers from petroleum industry cartels. The capping guidance aimed to moderate gasoline prices and relieved consumer burdens, as high oil prices can contribute to greater transportation and production expenses and thus higher pricing for goods and services. Furthermore, governments ware frequently pressed to address the economic effects of increased oil costs, which can contribute to inflationary pressures and impede economic progress.

1.1.2 Fuel Price Fluctuations

A fuel is a substance capable of undergoing reactions that release energy in the form of thermal energy or for performing work. The cost of fuel, known as the fuel charge or price, represents the expense of obtaining the necessary fuel to generate each kilowatt-hour of electricity. This study concentrates on fuel retail prices, specifically the price per liter, commonly referred to as the pump price. Establishing stable and optimal fuel prices poses a challenge for countries, requiring accurate predictions due to frequent on-the-spot price fluctuations (Espinoza, 2017). Customer responses to fuel pricing varied based on factors such as location, distance and fuel grade, rendering it complex to set a uniform price nationwide. Achieving proper pricing optimization was difficult without effective tools and user-friendly methods. The absence of reliable predictive capabilities can hinder stakeholders from employing strategic analysis and instead resorting to trial-and-error approaches. Market dynamics, including rapid cost changes, consumer behavior shifts, and competitive pressures, further complicate the task of maintaining consistent fuel prices. Balancing

volume and profit considerations adds complexity as petroleum companies strived for break-even operations. Raising fuel prices could increase profit per gallon but would also decrease sales volume. Therefore, effective fuel price setting emerges as a critical factor for sustaining a stable economy (Suri, 2019).

Crude oil at times referred to as black gold as it was the most precious natural resources including gold, which was also valuable and precious commodity around the world. Any country with the two commodities was considered richer and compared to other developed country. A slight price change in oil product felt and can affects the economic at every level that is from family budgets, corporate earnings as well as the national gross domestic product (GDP). With any unexpected price drops or spikes could send a big signal into global financial market in agitation, (Bajpai, 2021). Crude oil prices fluctuations would be quickly felt in the economy with response to policy changes by the regulatory authority, news cycles and fluctuations bought by the world markets. From the beginning of 2014, petroleum prices had experienced downward journey with unfavorable prices charged per barrel. In March 2020, crude oil prices accelerated their decline in response to the effects of coronavirus pandemic that hit the world's economy adversely and unexpected sharp drop demand of oil. On top of that, main oil producers failed to form an agreement to make production cut thus worsening the situation, (Miswa, 2019). Fuel prices and changes ware measured using consumer price index (CPI) which is published monthly by the regulatory body to the general public for each region and area level. All fuel types ware considered for this (CPI), the price per gallon being published i.e., regular unleaded, premium unleaded and diesel for all fuel products in Kenya. The dataset for all types of fuel includes the daily mean price per gallon observed for a specified fuel type at each outlet, (Friedman, 2019).

OPEC, was the major and main influencer of oil prices that was made of 13 countries cutting across the world. According to 2018 statistics, OPEC was in a position to control at least 80% of the world's supply of oil reserves, (John, 2018). The organization sets to a level that could be met by the global demand and also to influence the commodity of oil and gas price by either increasing or decreasing level of production. Early before 2014, the organization planned to maintain oil prices above $100 per barrel for a given period, but in the middle of set time, the price of oil began to fall down suddenly below set price, which was $100, (Rousan, 2018). Any product traded in the open market is control by the law supply and demand thus affects the price of such stock. For example, the price of oil will automatically change with response to demand of supply operating in the market. When supply of a commodity is more than the demand of such commodity the price fall as well the inverse will be observed in the case demand is greater than the supply. The drastic drop prices in 2014 was due to low demand for oil in country like Europe and China, coupled with steady supply of oil from OPEC nations thus resulted to excess supply in the market causing fall of oil prices, (Khan, 2017). Natural phenomenon and political instability were also major factor that could lead to oil price fluctuations. This was experienced in the Middle East countries that was observed as the region could but into account, the higher share of oil supplied worldwide. This became evidential as they could charge $ 128 per barrel because of unrest by the consumers between Afghanistan and Iraq (Fattouh, 2018).

In many developing countries like Kenya, governments have tried to manage oil product prices through measures like subsidies and promoting renewable energy sources. Budget pressures led to brief reform efforts, particularly after the 2008 price collapse, when rising fuel prices caught governments unprepared due to inadequate action on fuel subsidies. Global price increases prompted countries to implement strategies like wage rate hikes, oil reserve releases, tax cuts, and

subsidies to mitigate the impact. However, the transmission of fuel price changes into domestic economies varied due to differing regulatory systems and authorities across countries (Vatansever, 2020). Various interconnected factors have influenced the availability, costs, and prices of oil and petroleum products in many countries. Escalating prices strained the financial positions of oil companies in some states, leading to procurement difficulties and fuel shortages. Power shortages further exacerbated the situation in certain countries, driving up the demand for diesel and subsequently raising its price (Krane, 2017). In the Kenyan market, fuel costs are notably higher compared to neighboring countries due to the imposition of multiple taxes, including excise duty, value-added tax (VAT), petroleum development levy, and road maintenance levy, which contribute significantly to the overall fuel price (Durevall & Sjö, 2012). These elevated fuel costs have direct repercussions on the cost of living and transportation expenses for both citizens and businesses in Kenya. This situation emphasizes the inflationary impact of elevated fuel prices, particularly in developing nations. Industries relying heavily on fuel for energy pass on the increased costs to consumers through higher prices for goods. The transportation sector, burdened by added tax costs at the fuel pump, also adjusts prices accordingly (Brian, 2021).

Furthermore, the repercussions of high fuel costs extend to reduced economic growth as businesses struggle to maintain profitability and consumers experience diminished disposable income. This can exacerbate income inequality and hinder poverty reduction efforts within the country. Additionally, escalated transportation expenses can have broader effects on various sectors, including tourism, as the increased travel costs discourage both domestic and international visitors.

1.1.3 Supply Shocks and Fuel Prices

Economic shocks affect various variables thereby transmitted and affect the prices of goods and services. The variables in question that affected price of goods like oil products are inflation, cost of transportation, world oil prices and exchange rates. Therefore, they formed the major determinants of fuel prices in the economy thereby a little shock affects them and the impact is felt on prices of good chargeable, (Batten, 2018). The demand for oil, according to (Huntington, 2019), was a critical element in influencing fuel costs. Fuel costs typically increased as worldwide demand for oil increases, such as during periods of economic development or increased industrial activity. A fall in demand, on the other hand, could result in cheaper pricing. Furthermore, the supply of oil, which was influenced by factors such as production levels and OPEC (Organization of Petroleum Exporting Countries) choices, had a substantial impact on fuel price changes. For example, if OPEC decides to raise oil output, it would result in a market surplus and as a result, lower fuel costs. On the other hand, if production levels went down or oil supply was disrupted due to geopolitical tensions or natural disasters, gasoline prices could go up owing to scarcity. As a result, when assessing fuel price variations, both demand and supply aspects must be considered.

According to Aloui (2015), industrial activity and economic growth were the main factors influencing oil demand. Oil demand went up as more energy was needed for manufacturing, transportation and other economic activities during times of economic expansion and increased industrial production. On the other hand, as economic activity slowed down during economic downturns or recessions, oil demand typically declined. Ghalayini (2018) posited that the Organization of the Petroleum Exporting Countries' (OPEC) decisions as well as the levels of production in major oil-producing nations had an impact on the supply of oil (OPEC). As a

significant player in the world oil market, OPEC had the power to significantly affect the supply of oil and by extension, fuel prices through its decisions regarding production quotas.

Oil supply disruptions could have a big impact on fuel costs. Supply interruptions can occur as a result of political conflicts, wars, natural disasters or unanticipated events in key oil-producing regions. Such disruptions might lower overall oil supply, causing price increase owing to shortage. Political crises and wars in key oil-producing regions have the potential to impede oil production and delivery. Armed conflicts would cause the closure of oil fields, refineries and pipelines, resulting in a significant decrease in oil supplies (Perez, 2019). Natural calamities like hurricanes and earthquakes had a big influence on oil production and transportation infrastructure. Severe storms, for example, might destroy offshore drilling platforms or interrupt shipping routes, aggravating the supply deficit and driving up fuel costs (Wang & Krupnick, 2018). According to Espinasa & Vera (2018), unplanned outages at oil facilities would result from equipment failures, technical challenges and accidents, lowering oil production and disrupting supply. These unanticipated outages would have serious economic ramifications, such as higher oil prices and major disruptions in the global energy sector. To reduce the risk of equipment breakdowns and technical challenges, oil firms must emphasize regular maintenance and invest in innovative technology. Economic sanctions or trade embargoes imposed on nations that produce oil may restrict their capacity to export oil, which would disrupt the supply. The availability and prices of oil on a global scale would be significantly impacted by these disruptions. Additionally, they could deteriorate diplomatic ties between the parties involved and lead to geopolitical tensions (Nikkinen, 2017).

The exchange rate between the Kenyan Shilling (KES) and the US Dollar (USD) played a crucial role in fuel price determination. Since oil was predominantly traded in USD, fluctuations

in the exchange rate would affect the cost of imported petroleum products. If the Kenyan Shilling weakens against the US Dollar, it would require more Shillings to purchase the same quantity of oil, leading to higher fuel prices. Indeed, the exchange rate between the Kenyan Shilling (KES) and the US Dollar (USD) was critical factor in determining fuel prices in Kenya. As oil was predominantly traded in USD on the international market, changes in the exchange rate between KES and USD directly affected the cost of imported petroleum products in Kenya. When the Kenyan Shilling weakened against the US Dollar, it meant that one USD became more expensive in terms of KES. As a result, it would take more Kenyan Shillings to purchase the same quantity of oil, which is priced in USD. This led to an increase in the cost of importing oil, which was subsequently passed on to consumers in the form of higher fuel prices. The impact of exchange rate fluctuations on fuel prices could be significant for an oil-importing country like Kenya, as it directly affected the country's import bill for petroleum products. In such situations, consumers experienced a rise in transportation costs, leading to higher prices for goods and services across the economy. To mitigate the impact of exchange rate fluctuations on fuel prices, some countries engaged in currency hedging or enter into bilateral agreements with oil-exporting countries to stabilize oil prices in local currency terms. Additionally, governments implemented energy conservation measures and promote domestic energy production to reduce reliance on imported petroleum products.

The key feature of Kenya’s upstream petroleum regime on the tax remitted to the tax authority by PSC including share of profit generated from the trading period. Income taxes payable from firm’s petroleum operations under PSC are deducted from state’s share of production through gross-up calculation. The Kenya Income Tax Act (KITA) established rules and regulations governing taxation of oil and gas firms in Kenya. The ninth schedule KITA law provided for

specifications on rules applicable to upstream oil and gas sector. These general rules ware applied to oil and gas sector where necessary, but the ninth schedule provision is considered where there is conflict. There are special deductions for oil and gas companies, which are provided by the ninth Schedule. Exploration cost that includes capital expenditure that is incurred through finance exploration operations, which is fully deductible for tax purposes. Development expenditure but excludes plant, machinery and social infrastructure is therefore subjected to depreciation to tax at a minimum rate of 20% per annum on straight-line basis commencing from the year of purchase of the asset and production commencement dates. Lastly are the operation costs including geological, geophysical and intangible drilling that are fully deductible as per the year they are incurred (Bjørnebye, 2019).

From the beginning of January 2015, Kenyan government came up with new rules and regulations to govern direct and indirect taxation gains from disposal of petroleum license interests. Any direct and indirect net gains on disposal of petroleum service company (PSC) in Kenya are subjected to a corporation tax rate of 30% for residents while 37.5% for non-residents persons. Disposal of interest can take the form of sale, assignment or exchange and transfer therefore in this case standardized corporate tax rates would be applicable, (Marcel, 2016). The implemented new rules also sought to ensure tax gains on the disposal of shares and other interest from offshore are formulated and implemented fully where a minimum of 20% of underlying value are derived from petroleum service company interests in Kenya. However, it is still not clear whether the provisions provided on the new rules achieve what was required on taxation offshore share disposal. On the same it is not well framed by the Kenya Income Tax Act (KITA) the specific tax rate would be applicable for the disposal and the revenue be submitted to the tax man. On regard to that, the Kenya Revenue Authority (KRA) clarified through the Value Added Tax (VAT)

act September 2018, such that VAT chargeable on all petroleum products at a percentage rate of 16% of transaction value (Mania, 2019). This law effect fuel prices more and other interest parties like oil importers, depot operators, distributors, retailers e.g., service stations.

At current, crude oil market is globally rich for every state whereby oil cargoes can move easily between countries and across the ocean without many difficulties. This made it easy to conclude that all most all countries had a say in the oil market since oil move freely from one location to another across the world therefore globally, oil market was considered as a global pool instead of a network of suppliers and buyers. In case one supplier shrinks by withholding supply, the effect will be felt uniformly and equally throughout the pool, (Lesage & Graaf, 2016). Petroleum products fuel economic growth of many states across the world more so to those countries that had petroleum as a mineral. Despite of that, products from petroleum had been experiencing price fluctuations and instability among many countries that were importing oil products and thus affected growth prosperity of the state's economy (Santos, 2016). Crude oil was a major source of energy in most of the countries worldwide because of its high energy density, ease of extraction, refining and transportation. Up to the mid-1990s Organization of the Petroleum Exporting Countries (OPEC) had played an important role in oil pricing, thereby the market was purely affected by supply factors across the word (Smil, 2010). However, from then the power had moved from to non-OPEC oil suppliers and more so the oil-consumers and this mostly happened because of the high economic growth in Asia specifically in India and China as well, that was accompanied by need for increased energy consumption requirements in oil. Increased number of populations resulted into increased demand thus caused diversification on the supply side. In the late-1990s, OPEC no longer became the main oil exporter.

To those energy-exporting states, oil accounts provided significant share of total export and material contribution to the national budget, thereby oil market prices became volatile. The volatility was because oil products supply and demand had a low-price elasticity, thus resulted into wide price fluctuations and therefore there was direct effect on countries' economy through oil exportation as there was dependence on export revenues, (Yoshino & Alekhina, 2016).

1.1.4 Energy and Regulation Commission (ERC)

ERC is under the mother Min. of petroleum and mining which is a state organization formed to regulate commissions and other state parastatals under the ministry. This included ERC as commission, other parastatals like Kenya pipeline and national oil corporation. Kenya Pipeline Company had the responsibility to pipeline systems in transportation of refined petroleum products from the port of Mombasa to other major towns in Kenya. KPC operated in five storage including distribution depots to enhance channeling petroleum products which were supplied with refined petroleum products from Kenya petroleum refinery. It also collaborated with government to enhance implementation of policies like ensuring efficient operations of petroleum sub-sectors. The national oil corporation was a fully integrated government urgency involved in all aspects of the petroleum supply chain covering the upstream oil and gas exploration, midstream petroleum infrastructure development and downstream marketing of petroleum products.

National oil helped in facilitating oil and gas exploration related activities in the Kenyan economy. Its task was to ensure marketing exploration acreage, management of gas and exploration data and the running of the Petroleum Laboratory in Kenya. It was one of the few national oil firms in Africa that were directly involved in the search for oil and gas. It also facilitated midstream development of petroleum infrastructure whereby it works on major three projects like development of offshore floating jetty technically well referred to as Single Buoy

Mooring (SBM), establishment of Strategic Petroleum Reserves (SPR) and crafting of a Petroleum Development Master Plan for Kenya.

Energy Regulatory Commission (ERC) as the sector regulator was established under the Energy Act, (2006). It was the authority that regulate, accompanied with responsibility for economic and technical regulation mandate of electric power, renewable energy and downstream petroleum sub-sectors as well as tariff setting, licensing, dispute settlement, enforcement, power purchase approvals and network service contracts. There after The Energy and Petroleum Regulatory Authority (EPRA) was established to succeed to the (ERC) under the Energy Act, (2019) with an expansion of mandates and responsibilities as regulation of upstream petroleum and coal is concerned. The authority guaranteed the following responsibilities by the law of Kenya (Hufbauer, 2017): first is to regulate generation, exportation/importation, distribution, refining, storage and sale of petroleum and products with the exception of crude oil as well as monitor and supervise upstream petroleum. Secondly, was to provision of information and data in relation to upstream petroleum operations on timely basis, in Kenya it's done on monthly basis. Third, receiving, carryout review and also grant an application for a nonexclusive exploration.

1.2 Statement of the Problem

Fuel price fluctuations, influenced by factors such as transportation costs, inflation, global oil prices, and currency exchange rates, have substantial implications for consumers and the economy. These fluctuations, intricately linked to all facets of production, contribute to inflationary pressures, posing a challenge for policymakers and industry stakeholders (Fogarassy, 2018). Examining the trend in fuel prices in Kenya from 2010 to 2022, data from the Kenya National Bureau of Statistics (KNBS) reveals a notable volatility, with average annual percentage changes ranging from -10% to +15%. This reflects the dynamic nature of fuel prices as an economic

parameter (KNBS, 2022). Recognizing fuel price instability as a significant issue impacting the economy, this study underscores the necessity for a comprehensive understanding of the intricate relationships between supply shocks and fuel price fluctuations.

Zhou (2021) posits that fuel prices are influenced by various factors, including OPEC dynamics, supply and demand, COVID-19 impacts, natural disasters, political instability, and production/storage costs, leading to price volatility. Colgan (2014) highlights OPEC's influence in lowering fuel prices, even in the face of government resistance. González and Nabiyev (2009) find delayed effects of oil price fluctuations on GDP growth, varying across countries based on energy production shares. Van de Ven and Fouquet (2017) analyze historical energy price shocks, revealing vulnerability changes linked to energy source demand and availability. Maina (2015) observes significant impacts of crude oil price shocks on Kenya's economy, affecting the exchange rate, money supply, and real GDP growth. Oil shocks contribute to 2.16% of real exchange rate volatility and 3.46% of GDP fluctuations over 12 quarters in Kenya, with the key disruptors identified as the real exchange rate and money supply.

Previous studies have primarily focused on oil price fluctuations, neglecting the specific pathway of supply shocks causing fuel price changes in Kenya. Given Kenya's heavy reliance on imported oil, understanding this mechanism becomes crucial. Addressing this gap is the primary aim of this research, providing valuable insights for policymakers and energy stakeholders. By comprehensively exploring the effects of pipeline transportation costs, inflation, world oil prices, and currency exchange rates, the study contributes to a more accurate predictive model for fuel price fluctuations. This holistic understanding aids effective planning and decision-making, benefiting stakeholders across sectors and serving as a reference for similar studies in other regions.

1.3 Objective of the Study

1.3.1 General Objective

To investigate the effect of supply shocks on fuel price fluctuations in Kenya.

1.3.2 Specific Objectives

i. To determine the effect of pipeline transportation cost shocks on fuel price fluctuation in Kenya.
ii. To assess the effect of the inflation rate shocks on fuel price fluctuations in Kenya.
iii. To evaluate the effect of world oil price shocks on fuel price fluctuations in Kenya.
iv. To investigate the effect of currency exchange rates shocks on the fuel price fluctuations in Kenya.

1.4 Research Questions

i. What is the effect of pipeline transportation costs shocks on fuel price fluctuations in Kenya?
ii. How do inflation rate shocks affect fuel prices and fuel oil fluctuations in Kenya?
iii. What is the effect of world oil prices shocks on fuel price fluctuations in Kenya?
iv. What is the effect of currency exchange rates shocks on fuel price fluctuations in Kenya?

1.5 Justification of the Research

Energy Regulatory Commission (ERC) was established by the Kenyan constitution with full mandate as energy regulatory body under the energy act, 2006. Its role goes overboard as the agency with whole responsibility for economic as well as technical regulation of renewable energy, electric power and downstream petroleum sub-sectors, including tariff setting, review, licensing, enforcement, settlement of disputes, power purchase and network service contracts approvals in Kenya hence it is considered as one of the vibrant public sectors. Each economy (states) has a

public corporate body that controls energy sector to protect the nation from exploitation by the foreign and domestic investors. The project was able to generate required data on factors affecting fuel prices in the Kenya economic set up. Results were based on information gathered from pipeline transportation cost, taxes, exchange rates and world oil prices whereby they were converted into a common currency i.e., Kenya shilling thus the findings were interpreted to provide more knowledge to be used in more academic research in the future.

1.6 Significance of the Study

This research study would be of beneficial to different individuals and several stakeholders who play important and material roles in economic activities of Kenya. Some of these beneficiaries were put into account for this study would include central government, State Corporation, fuel dealers and citizens at large. It would help the government in economic planning as petroleum and energy sector for a fiscal financial year.

1.6.1 The Government

The government plays an important role as it has the full mandate to control the economy and ensure every activity is done under controlled and manageable environment. The government ensure that balance of payment is at equilibrium without deficit or surplus that may affect operations adversely. In this regard, the government may set quotas and tariffs to control volume and prices of oil imported to protect its economy from exploitation by oil stakeholders and investors. Therefore, this study is of more beneficial to the government as the factors identified should be managed well to prevent adverse effect on fuel prices.

1.6.2 State Corporation

State Corporation like ERC has done a tremendous role on regulating fuel prices in Kenya. Even at times of crisis it has been frontline in protecting the economy from exploitation by other

investors through setting oil prices on monthly basis and ensure reviews are done based on other considerations after stipulated period of time. The study would help the ERC to make recommendations on oil levy and other tariffs chargeable. ERC would be the great beneficiary since they have the constitutional mandate in fuel price determination. Further, the study provided some light on factors affecting oil prices that helps to address this problem in the economy.

1.6.3 Fuel Dealers and Customers

The fuel dealers were also found to be other beneficiaries as they were able to understand why fuel prices fluctuate and this could help them predict future fuel prices for cost analysis benefits. By being certain on factors that affect goods and services especially fuel, the dealers became less vulnerable to losses incurred a result of prices changes. This as well became a plan to risk mitigations and plan before economic exposure. Customers benefited from this study, as they were the one who face the risk such that the price hike would be transferred to them. Fuel consumers were prone to greater challenges as pertaining price fluctuations as they could not plan well with their income due to economic uncertainty. Through this study, they would be able to know the possible factors causing fuel price instability and help come up with measures to have proper planning.

1.6.4 Academicians

Academicians do carry out a lot of research across the world on different sectors of the economy. For those doing research on oil and petroleum sector this research would be of great benefit to them since it would enrich them with study review material. It would be as well study material to most students globally for academic purposes as they read wide for more knowledge on why fuel prices fluctuate in some of developing countries like Kenya.

1.7 Scope of the Study

This study research sought to address the topic the effect through which supply shocks causes fuel price fluctuations in Kenya. The research would be limited to study petroleum and energy sector within Kenyan economy. The subject scope was to cover through ministry of energy and petroleum and cover all the way to other state and non-state corporations. The core respondents were ERC itself and the major companies or dealers in fuel business where by data were obtained from their published financial statement. The researcher was endeavored to explain the importance of this project study as increasing knowledge towards identifying supply shocks pathways that cause fuel price fluctuations in countries like Kenya.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

This chapter presented the literature review as per the study variables. The empirical literature and the theoretical literature were presented as well as the conceptual framework and the operationalization of variables.

2.2 Theoretical Review

This chapter covered the theoretical review of this study and supported the literature behind factors affecting fuel prices in the Kenyan economy. This accomplished through the study of selected variable pipeline cost, inflation rates, currency exchange rate and world oil market. Theoretical review would be based on actual scrutiny of a subject of the accumulated theories concerning a subject, idea, an assumption or phenomena also known as the theories (Miswa, 2019).

2.2.1 The Peak Oil Theory

Geophysicist Marion Hubbert developed this theory in 1956 and it stated that oil production follows a bell-shaped curve. Peak oil is a hypothetical point at which global crude oil production reaches its maximum rate, after which production will start to decline as time goes by. As the production decline, more extraction challenges and new reserves goes down. This would exert more pressure and extraction of reserves will be overwhelmed and drawn down gradually. In the case that new reserves are not put in operation more rapidly before the existing reserves got drowned, then it's said that the peak oil has been reached, (Hubbert, 1956). Peak oil had been brought into the public attention in several occasion, but in each occasion, it decelerated prematurely this was due to introduction of modernized new extraction technology infrastructure

such as hydraulic fracturing and other better surveying techniques leading to innovation undiscovered reserves, (Akobi, 2016).

In 1998, American Scientific named Colin Campbell published a research study titled, "The End of Cheap Oil" giving a preposition on depletion of oil that would have continued to present dates. This was a further suggestion that was provided for by Hubbert (1956) 40 years down the line of which most of people had forgotten. In his study Campbell provided an advanced knowledge on Hubbert's (1956) viewpoint where he proposed that the world's crude oil production would be at its peak between 2004 and 2005 then followed by an irreversible decline. Afterwards, Campbell proposed a term "peak oil" to represent highest global oil level of production of which the term became popular which led to generation of more ideas later referred to peak oil movement, (Campbell, 2018). Deffeyes (1981) provided assertion that peak oil would happen on a thanks giving day 2005. The researcher argued further that there was trouble in determining the time peak oil would occur that is, if it had occurred or it would occur dependent on continuously changing assumptions and variables of which the basic assumption was that you would have prior knowledge of what the available reserves are (Bardi, 2019). Reserves were considered to be the amount of oil to be extracted in the current prices and under the current technology of which peak oil was based on oil prices and availability of suitable technology (Wiseman, 2014).

This theory suggests that as global oil production approaches and undergoes this peak, the expenses related to extracting and transporting oil rise, potentially causing unforeseen spikes in transportation costs (Maina 2015). In the Kenyan context, we can scrutinize the impact of shocks in pipeline transportation costs on the fluctuation of fuel prices through the lens of the Peak Oil Theory. As the global oil production nears its peak, readily accessible and cost-effective oil diminishes. This scarcity of resources may result in amplified transportation costs, especially

impactful for nations like Kenya heavily dependent on imported oil. The heightened costs associated with transporting oil through pipelines may contribute to domestic fuel price fluctuations. Pipeline transportation stands as a vital element in the oil supply chain. If pipeline transportation costs surge due to resource scarcity, it has the potential to disrupt the seamless movement of oil from production centers to consumers in Kenya (Maina 2015). Such disruptions can lead to inefficiencies in the supply chain, causing increased distribution costs and influencing fuel prices at retail. The Peak Oil Theory contends that as oil production diminishes, global oil markets become more responsive to geopolitical events and supply disruptions. Shocks in pipeline transportation costs due to resource scarcity could intensify Kenya's susceptibility to global market dynamics, thereby contributing to increased volatility in fuel prices. Governments often play a pivotal role in mitigating challenges related to peak oil. In response to potential shocks in pipeline transportation costs, the Kenyan government may implement strategic policies aimed at enhancing energy security. This could involve investments in alternative energy sources or negotiating favorable trade agreements to effectively manage fuel prices (Van de Ven and Fouquet 2017).

Acknowledging the potential impact of peak oil prices on transportation costs, stakeholders in Kenya may contemplate diversifying energy sources and investing in alternative transportation infrastructure. This adaptive approach has the potential to mitigate the adverse effects of shocks in pipeline transportation costs on fuel prices (Zhou 2021). In essence, the Peak Oil Theory suggests that as global oil production reaches its peak and subsequently declines, the resulting scarcity of resources may lead to unexpected shocks in pipeline transportation costs, thereby impacting fuel prices in Kenya. An exploration of this theory within the Kenyan context offers valuable insights for policymakers, energy stakeholders, and researchers, facilitating a better understanding of and response to the challenges associated with fuel price fluctuations. This theory was relevant to this

study and gave an elaboration to meet the objective on how world oil prices affect fuel price fluctuations in Kenya (Zhou 2021). This was brought about in the essence that if the oil production reached its peak the market became saturated and therefore oil supply was at its peak. With relevance to the low of demand and supply if the supply is higher than the demand the prices goes down while if the supply is lower than the demand the prices goes up. On this reason if the world oil prices go up, the Kenyan fuel price increase whereas if it decreases the fuel prices goes down therefore fuel prices fluctuates depending on the oil prices across the world.

2.2.2 Hoteling Theory

Harold Hoteling in 1929 developed this theory in his article of stability in competition. It is also known as Hotelling's rule, which stated that time holders of nonrenewable commodities should produce such resources first then compared to the revenue received if the proceeds were used to invest in financial instruments, (Hoteling, 1929). It had been observed that, the price chargeable on non-renewable economic resources have been unstable dramatically for some past years. This brought a concern that needs to be addressed by a number of individuals like policymakers, economists and business owners, (Raymond, 2017). He brought an idea of alternative investments returns generated from the sale of nonrenewable resources, which is recommendable for diversification of investments. Okullo (1931) on his classical model of non-renewable resource depletion with reference to Hoteling model provided that, the resource rent (marginal revenues minus marginal extraction or production costs) should be increasing over a time at a discount rate, (Okello, 1931). He further explained geological constrain on oil depletion capable of rationalizing U-shaped time path for revenue generation, succeeds in reconciling exhaustible natural resource. This model rationalizes observed industry discount rates and identification to find the influence of

geological constraints on extraction and therefore concluded that uncertainty of discoveries induces precautionary behavior in the depletion of reserves.

Pindyck (1978) on optimal production and exploration of nonrenewable resources to provide more details Hotelling's principle. Pindyck (1978) explained that, if there was an increase in reserves from exploration known with certainty, then the exploration might decrease the unit extraction costs. In a case whereby the reserves were low or extraction was costly, the prices would tend to be higher and exploration would not occur hence results to accumulation of more reserves resulting to low extraction costs accompanied with stable demand hence price would rise. On the other hand, as reserves accumulate, this would also depress incentives more, while lower extraction costs hence concurrently result into higher rate of overall depletion of resource that would eventually result into price increase of resource, (Mlambo, 2017). The price of a final product is determined by several factors this includes production cost, transportation and other factors like marketing. To be specific production and transportation costs form the major determining factors to be considered in calculation of surplus made on transacting a given product. Transportation could be done through train, planes and pipeline as well by roads. For transportation and distribution of oil, fuel and other liquid products, pipeline is recommended since it is most effective. In that sense this theory was relevant to this as it helped to provide a lot of information to meet its objective of determining the effect of pipeline transportation in fuel price fluctuations (Mlambo, 2017).

The Hoteling Theory suggested that the price of non-renewable resources would increase over time at a rate equal to the interest rate in a competitive market (Fattouh, 2007). This meant that as fuel reserves become scarcer due to supply shocks, the price would steadily rise to reflect its diminishing availability. This compounding effect had significant economic repercussions, as

sudden reductions in fuel supply could have a more pronounced effect on price fluctuations. The growing scarcity of fuel resources could encourage the development and adoption of alternative energy sources, impacting both producers and consumers' long-term planning. According to (Fattouh, 2007) producers must carefully control resource extraction to optimize earnings, while consumers would become more sensitive to variations in fuel prices and seek alternative energy sources or energy-efficient techniques. Producers must also consider the possibility of fuel resource depletion and the necessity for sustainable practices to ensure long-term availability. Consumers would consider investing in renewable energy technologies or supporting policies that promote a transition to cleaner, more sustainable fuel sources. The Hoteling Theory also had ramifications for energy investment decisions, as it encouraged investments in technologies for discovering new reserves, upgrading extraction techniques, and developing alternative energy sources (Backlund & Mihkelson, 2016). This could result in a more dynamic reaction to supply shocks and swings in fuel prices. Policymakers and governments should consider the Hoteling Theory when developing energy and environmental policies, as fuel price increases may motivate policies that promote energy efficiency, renewable energy adoption, and conservation initiatives.

The Hoteling Theory would have consequences for how supply shocks drive fuel price changes in Kenya, as they do in other countries that rely on finite resources like oil (Schneider & Schneider, 2003). It was crucial to highlight, however, that the specific dynamics of fuel price variations in Kenya will be influenced by a number of factors, including the country's distinct economic, political and energy situation. Kenya is a net importer of petroleum products, which implies it significantly relies on imports to meet its local fuel needs (Mulugetta, 2009). Kenya, as an importer, is sensitive to swings in global oil prices caused by supply shocks or changes in international oil markets. Because import prices are controlled by international market dynamics,

the Hoteling Theory's influence on long-term price trajectories may not have a direct impact on them. Kenya has discovered some oil reserves, particularly in Turkana County (King'ong'o, 2022). However, the level of domestic oil production is relatively small compared to the country's total demand. The Hoteling Theory could potentially influence investment decisions in domestic exploration and production, but the impact on overall fuel prices in the country may be limited unless significant production levels are achieved. The Hoteling Theory suggested that as finite resources like oil become scarcer, their prices tend to increase (Solow, 1974). Therefore, if Kenya was able to significantly increase its domestic oil production, it could potentially reduce its dependence on imported oil and stabilize fuel prices in the long run. However, until then, the country would still rely heavily on imports to meet its energy demands and maintain affordable fuel prices for its citizens.

The Kenyan government's policies on gasoline pricing, taxation, and subsidies significantly impacted fuel prices in the country (Coady, 2018). While the Hoteling Theory provided a long-term view on price trajectories, short-term pricing decisions are often influenced by government actions to stabilize prices or protect customers from unexpected changes. Interventions would include price restrictions, fuel taxes, transportation expenses, distribution infrastructures and taxation. Furthermore, fluctuations in the exchange rate affected Kenyan fuel prices, as local currency fluctuations could result in higher gasoline import costs. Government policies and regulations related to gasoline subsidies or price controls also affected the final cost of fuel for Kenyan consumers. Future changes in customer demand, such as a sudden rise in tourism or a significant event, could cause short-term swings in fuel prices. Economic factors like inflation or changes in government regulations can also impact fuel prices (Coady, 2018). Kenya had been working to diversify its energy mix and boost renewable energy sources to reduce its reliance on

imported petroleum products. In summary, the Hoteling Theory provided insight into the long-term behavior of gasoline costs, but its direct impact on fuel price variations in Kenya may be restricted due to the country's status as a net oil importer. Short-term changes will likely be driven by a mix of global market dynamics, government initiatives, and domestic demand considerations.

2.2.3 Real Business Cycles Theory (RBC)

In the early 1980s, the RBC hypothesis arose in reaction to some of the inadequacies of traditional Keynesian and monetarist models in describing the business cycle (Kydland & Prescott, 1982). In their 1982 study, "Time to Build and Aggregate Fluctuations," Finn Kydland and Edward Prescott offered three new ideas. They envisioned technology shocks as this factor, i.e., random fluctuations in productivity that changed the steady growth trend up or down. Finn Kydland and Edward Prescott are two well-known economists who contributed significantly to the development of real business cycle theory in the 1980s (González & Nabiyev, 2009). Rather than attributing business cycles entirely too monetary reasons, their approach attempted to explain swings in economic activity by adding real shocks and productivity shocks. The basic premise of the real business cycle hypothesis was that changes in technology and productivity levels cause economic oscillations. These changes, according to the idea, can cause variations in the business cycle because individuals and corporations adapt their behavior in response to productivity shocks. For example, as technology advances, productivity rises, resulting in increased output and economic prosperity (Kydland & Prescott, 1982).

The work of Kydland and Prescott has had a significant impact on macroeconomic research, contributing to our knowledge of how real-world swings in economic activity occur. Their theory provides a framework for investigating the role of real causes in driving economic cycles, providing useful insights into business cycle dynamics. Kydland and Prescott's work

emphasizes the relevance of technical advancement in generating economic growth by focusing on the influence of productivity shocks. Their approach also emphasizes the importance of capital-goods investment as a fundamental driver of productivity growth. Overall, this research advances our understanding of how technological and investment changes can cause swings in economic activity and affect the business cycle (González, & Nabiyev, 2009).

RBC Theory, or genuine Business Cycles, holds that business cycle fluctuations are influenced by genuine shocks that affect market dynamics. Economic crises and fluctuations, they believe, are the result of external shocks such as technological shocks. Previous studies discovered that a model driven solely by technological shocks cannot explain many cyclical phenomena. This resulted in models that contain extra disturbances such as severe weather, natural disasters, oil shocks, tougher environmental and safety rules and so on (George 1994). These new disruptions are thought to have a substantial impact on market dynamics and can contribute to economic crises and volatility. Researchers hope to provide a more thorough knowledge of the complex structure of economic cycles and improve the accuracy of their predictions by including these aspects into models. Another technique to classify RBC models, according to (George, 1994), is to distinguish the greatest impulses driving the cycle. Do they emerge from a demand shock or a supply shock in the economy? Some economists blame the latest oil shock on OPEC supply limits, while others blame it on Asian demand.

The fundamental idea underlying RBC theory is that when an external shock occurs, it directly affects the effectiveness of capital and/or labor. This, in turn, has an impact on worker and company decisions, which vary their consumption and production habits and, as a result, have a negative impact on output (Finn 1982). The supply shocks caused by OPEC's two oil price rises in the 1970s made macroeconomists more aware of the role of supply-side issues in understanding

macroeconomic instability (Blinder, 1979). These events, combined with the apparent failure of the demand-oriented Keynesian model to account adequately for rising unemployment and accelerating inflation, compelled all macroeconomists to devote increasing research effort to the development of macroeconomic theories with coherent micro-foundations on the supply side (Gazda, 2010).

Real shocks may be significantly more important than monetary shocks in understanding the direction of aggregate output over time, according to the foundational work of Nelson and Plosser (1982) and Kydland and Prescott (1982). According to Nelson and Plosser, the evidence supports the idea that output follows a course that is best described as a "random walk." According to the RBC theory, economic production changes can result from an oil shock. The Prescott and Kidland (1982) model served as a starting point in order to find a model that allows for the inclusion of the variable of energy represented by oil into a GDP growth model because they show that Solow's (1956) neoclassical growth model is capable of replicating many of the features of modern business cycles. Prescott and Kidland's (1982) real business cycle (RBC) model has been tinkered with, with various variables aimed in various ways. Oil importing countries incur three forms of expenses when oil exporting countries opt to raise oil prices over the competitive market level, (Greene 2000). Production output falls because a crucial component of production has grown more expensive. Unexpected swings in oil prices raise unemployment, reducing economic output. Oil-consuming countries' wealth is transferred to foreign oil-producing countries. The major focus is not on whether the high oil prices in 2008 were a result of the OPECS strategy; instead, the cost components that accompany an increase in oil prices could explain why the United States and Sweden show a decline in growth when oil prices rise (González & Nabiyev, 2009).

The Real Business Cycle (RBC) theory provides a framework for understanding how business cycles arise from shocks to technology, productivity, or other real factors (Kydland & Prescott, 1982). In the context of fuel price fluctuations in Kenya, the RBC theory suggests that world oil price shocks can have a significant impact on the Kenyan economy through several channels (Maina, 2011; Mulugetta & Assefa, 2010). As a net importer of petroleum products, Kenya's fuel prices are directly linked to global oil prices (Mulugetta, 2009). When world oil prices rise, it becomes more expensive for Kenya to import fuel, which increases production costs for businesses across the economy (Coady, 2018). This increase in production costs can lead to lower output, higher prices, and reduced employment (Solow, 1974). World oil price shocks can also have an indirect impact on the Kenyan economy through demand and investment. When fuel prices rise, consumers have less disposable income to spend on other goods and services, which can lead to a decline in aggregate demand (Hamilton, 2003). Additionally, businesses may be less willing to invest in new equipment or expand their operations due to the increased uncertainty caused by volatile oil prices (Schneider & Schneider, 2003).Empirical studies have found that world oil price shocks have a significant impact on economic activity in Kenya. For instance, a 2011 study by Gachara Peter Maina found that a 10% increase in oil prices leads to a 0.5% decrease in real GDP in Kenya (Maina, 2011). Another study by Mulugetta and Assefa (2010) found that oil price shocks have a negative impact on both economic growth and employment in Kenya (Mulugetta & Assefa, 2010). The RBC theory suggests that policymakers can take several actions to mitigate the impact of world oil price shocks on the Kenyan economy (King’ong’o, 2022).

2.2.4 The Theory of Asymmetric Information

Akerlof (1970) as per his study research on quality uncertainty and the market mechanism developed this theory as he was trying to explain market failures. The theory stated that the

imbalance availability of information between market participants such as buyers and sellers could result in market failure, (Akerlof, 1970). According to economist market, failure referred to the uneven distribution of commodities and other services in a free-governed market where prices are controlled or determined by the law of supply and demand. Akerlof (1970) made a proposition that the car dealers didn't have the same information in the same market of operation, thus providing sellers with an opportunity to offer poor quality without reducing prices to cover for the product inferiority. According to Akerlof (1970), the term colloquial lemons was used in his study to refer to bad cars that are traded in the market. Therefore, the sellers of good cars would not be able to get better prices than average market prices of the products they offer to the market, (Jabbie, 2019). Market failure in this sense is where market participants are dissatisfied with the market situation and operations. This theory was relevant to this study in that, imbalanced information brings speculations of which at times oil importers use to exploit consumers depending on the kind of data they have secretly before the full directives from the regulatory authority are released.

Michael (1973) related asymmetric information to firms' awareness on employees' skills and ability. He argued that, new hires are not aware of availability of investment projects for any company in the market. Therefore, the employer should not be more certain on candidate's productive capabilities and full skills. In this note, Michael identified the information asymmetries that exist between employers and employees whereby the firm and the management should be at a position to have the same information for the prosperity of the organization, (Paiella, 2017). Stiglitz (1975), made a further argued that the theory asymmetric information was based on general equilibrium concepts that describe negative externalities that price out from the bottom of markets. For example, health insurance premiums would need to cover high-risk persons, i.e., those who work in hazardous workplaces, causing all premiums to rise and preventing low-risk individuals

from receiving cheaper preferred insurance services and premiums (Bergh, 2019). The two scientists did not investigate this notion on the basis of how imbalanced information impacts the pricing of specific commodities, as this could lead to illegal markets. Imbalanced information can lead to a situation in which some people benefit from lower insurance rates while others face greater costs. This may result in the formation of black markets in which individuals seek alternate, sometimes illegal, means of obtaining more affordable insurance solutions (Bergh, 2019).

Bachmeier and Griffin (2003) state that market participants must have the same information available and accessible to all without discrimination. Information is very essential in any economic set up for effective and efficient transactions. In this case, when one party is not fully supplied with information, he is at risk of incurring losses whereas other competitors are generating high profit value as they enjoy higher valuable transactions in expense of other competitors. In Kenya, fuels are imported in form of crude oil before refinery is done for distillation to different components (Radchenko, 2005). Most International trade are done in dollars whereby the value of a dollar can appreciate or depreciate at a given time. In the case that there is a prevailing appreciation in the value of a dollar, a number of importers will hold the crude oil until the value of a dollar goes up the sell at higher profit margin, (Akerlof, 1970). It realized, this theory is very relevant for this study since information on forex and dollar value affect fuel prices and therefore it can assisted meet the objective to determine the effect of currency exchange on fuel price fluctuation. This hypothesis indicates that in the context of Kenyan gasoline price swings, information asymmetry between consumers and fuel suppliers might influence how shocks, such as unexpected changes in global oil prices, affect the local fuel market. Consumers may not have real-time access to global oil prices or the factors that influence fuel price variations. As a result, individuals may be unaware of the underlying causes of unexpected fluctuations in

fuel costs, thus leading to misunderstanding and exploitation by fuel suppliers (Radchenko, 2005). This theory emphasizes the significance of transparency and information access in creating a fair and competitive gasoline market in Kenya.

According to Imitira (2007), when there is a shock in the price of oil on the global market, such as a sudden surge caused by geopolitical tensions or an interruption in supply, fuel suppliers may quickly modify their prices to reflect the shift. They might immediately pass on the increased costs to customers. This may result in an immediate increase in gas prices at the pump, which will have an impact on consumers' budgets who heavily rely on cars for transportation. The sudden price increase may also have an effect on sectors that depend heavily on oil, like airlines and shipping firms, potentially raising the cost of goods and services (Imitira, 2007). Due to information asymmetry, where consumers may not have complete information about the underlying reasons for fuel price increases or the extent of the increase, they may not immediately adjust their behavior in response. This means that consumers may not immediately reduce their fuel consumption or seek alternatives when prices rise. In cases where large fuel suppliers have significant market power, they could exploit this information asymmetry to their advantage. They might delay reducing fuel prices when global oil prices fall, causing consumers to pay higher prices for longer periods. This behavior can disadvantage consumers and result in increased costs for them. To address these issues of asymmetric information and potential market power, the Kenyan government may attempt to regulate fuel prices to protect consumers. This can involve the implementation of price caps or subsidies to limit the impact of fuel price fluctuations on consumers (Verleger, 2008). Price caps can set a limit on the maximum price that can be charged for fuel, ensuring that consumers are not subjected to excessive price increases. Subsidies, on the

other hand, can offset some of the costs of fuel for consumers, reducing the burden of price fluctuations on their wallets.

The Theory of Asymmetric Information posits that differing levels of information among market participants can lead to inefficiencies and market distortions (Akerlof, 1970). In the context of fuel prices in Kenya, this theory suggests that oil importers may possess superior knowledge of global oil prices compared to domestic fuel retailers, granting them an advantage in price negotiations (Awan & Ahmad, 2016). Additionally, the government may have a better understanding of fuel subsidy costs than other stakeholders, giving them an edge in determining subsidy levels (Ndungu & Olale, 2010). According to the Theory of Asymmetric Information, these information asymmetries can result in several undesirable outcomes, like Oil importers may leverage their superior knowledge of global oil prices to charge domestic fuel retailers higher prices. The lack of transparency in the fuel pricing process obscures the reasons behind fuel price fluctuations and facilitates collusive behavior among oil importers and fuel retailers. The government's inability to effectively target fuel subsidies to the neediest consumers stems from a lack of accurate information on subsidy costs. To mitigate the potential negative impacts of asymmetric information on the fuel market, the Kenyan government could implement various policies, like the government could increase transparency in the fuel pricing process by mandating oil importers and fuel retailers to disclose their costs and pricing methodologies (Grossman, 1981).

The government could foster competition in the fuel market by eliminating entry barriers and encouraging new market entrants (Stiglitz, 1975). The government could enhance its data collection efforts on fuel subsidy costs to better target subsidies to the neediest consumers. By implementing these policies, the Kenyan government could effectively reduce the adverse effects of asymmetric information on the fuel market, ensuring that consumers have access to affordable

fuel. Fuel price variations, according to Akerlof, (1970), might have broader economic repercussions in Kenya as well. When fuel prices increase, businesses face higher transportation and production costs. This can affect their profitability and potentially lead to price inflation in other sectors. Higher costs can also impact the overall affordability and competitiveness of goods and services, potentially impacting the economy as a whole. In summary, Verleger (2008) contends that, due to information asymmetry, customers may be unaware of fuel price rises, allowing larger suppliers to possibly exploit the situation. To protect consumers and mitigate the impact of fluctuating fuel prices, the Kenyan government may regulate fuel prices through measures such as price caps or subsidies. These fluctuations can also have broader economic implications by affecting business costs and potentially leading to price inflation in other sectors of the economy.

2.3 Empirical Review

2.3.1 Pipeline Transportation Cost Shocks and Fuel Price Fluctuation

According to USA researcher, Hernandez in his study published in (2015) to make a comparison of cost of transportation on truck transport compared to pipeline cost of transport of wastewater sludge. Both industrial domestic sludges produced by wastewater treatment facilities is considered biomass source for production of biodiesel whereby the transportation is very expressive to sludge. The main objective for this study was to determine the best mode of transport mode to use as a function of quantity shipped and transport distances to be covered. He pointed out that, in the currently situation, sludge was mostly transported by truck and pipeline. He estimated that both fixed and variable cost components are for different quantities to be transported. The estimation for transportation cost per gallon of biodiesel were observed to be deviating in the costs based on the distance traveled and quantity shipped. This result from the study recommended that biofuel

plants should have a better biomass transportation decision that would help reduce the price of biodiesel significantly in the market, (Hernande, 2015). This study provided a recommendation that it is cost effective to most organizations therefore, the US companies should relook on their transportation for profit maximization.

Wang (2015) from his study of optimization of oil transportation network in China by taking into account pipeline and shipping transport. This research first considered analyzing the risk factors for different modes of transportation for crude oil importation. Based on the least value of transportation cost and general risk, a model multi-objective programming was employed to optimize the transportation networks for crude oil importation and genetic algorithm and ant colony algorithm were established to help solve the problem. The final result showed that VLCC (very large crude carrier) was better off over long-distance geographical sea transportation, while pipeline transportation was more secured than sea transport, (Shiwoku, 2018). This study only checked on the security of the product leaving behind the cost accompanied with it, which would likely be transferred to the economy by charging high retail oil prices. A study by Olujobi, (2021), Nigeria is one of the leading oil producers in Africa but despite of the availability of these resources, the state still experiences shortages of premium motor spirit (PMS) and distribution to address the needs of product users.

According to the study by Mohammed (2014) to investigate the implications of price changes on oil and petroleum products distribution in Gwagwalada for the period of 12 years (2000-2012). Questionnaire were issued to obtain primary data for an area of ten wards around Gwagwalada area council that was the study area. The software package for social sciences (SPSS) was employed to help analyze the raw data obtained and assist in determining whether to reject or accept a problem item as being reflected. The results found out that, there was a statistically

significant impact of price changes of oil products distribution in Gwagwalada. This would significantly cause fluctuation to distribution of oil and petroleum products whereby price increment of PMS significantly leads to increased cost of distribution. The study provided a recommendation that the government should ensure availability of the products, ensure effective distribution channels to prevent disruption, scarcity, distribution, consistency as well as efficiency on price determination policy to fight corruption and market concept in the chain of petroleum product supply and distribution, (Sanni, 2014). This study was useful in the sense that it recommended to the authority to stabilize the economy, which should be borrowed as well to the Kenyan economy.

In Nigeria, Petroleum revenue plays a pivotal role in the budget, but it is being affected by pipeline vandalism. Pipeline vandalism caused massive ecological and socio-economic effects in Sub-Saharan countries. It causes environmental degradation and a loss of revenue. Azodo did study research in 2019 to carry out an investigation on the effect of crude oil vandalism on petroleum revenue using the ordinary least squares method and the Granger causality test. Revenue loss, repair costs, and clean up were to be determined in this study. The findings showed that pipeline vandalism could lead to a loss of revenue of 6% to 10%. This study provided a recommendation that an alternative source of transportation should be employed in transporting crude oil and petroleum products (Azodo, 2019). In this study, it was realized that pipeline systems were costly to install and maintain, so the government was required to facilitate other means for oil product transportation. One possible alternative means of transportation that was suggested in the study was the use of rail or truck transportation. This would not only reduce the risk of pipeline vandalism but also provide flexibility in reaching different locations (Azodo, 2019). Additionally,

the study emphasized the importance of implementing stricter security measures and penalties to deter pipeline vandalism and protect the revenue generated from oil and petroleum products.

Mungai (2016) aimed to determine the challenges affecting distribution of oil and petroleum products through pipeline in Kenya. The major objectives of this study were to identify the impact of pilferage on distribution of petroleum products in Kenya, to establish the impact of infrastructure in place on distribution of petroleum products and to determine impact of capacity on distribution of petroleum products in Kenya. The study employed descriptive case study design and used self-administered questionnaire as a tool to collect data. The questionnaire comprised of open and close-ended questions. He analyzed the data using descriptive statistics like means and percentages then presented in charts, graphs and tables. The result found out following, based on pilferage 100% agreed that it has an impact distribution of oil in Kenya, 41% respondents agreed with the idea that the road infrastructure have impacts on distribution of oil whereas 13% stated they did not think the road infrastructure did have an impact on distribution of oil. On capacity, 45% of the respondents agreed that it impacts distribution of oil in Kenya, 9% disagreed. On information technology, 37% stated that it does not have an impact on distribution of oil whereas 17% agreed that it does affect petroleum distribution. The study provided a recommendation that, some measures should be in place order to caution against pilferages, infrastructure to be well maintained and finally capacity to be increased, (Kebschull, 2017).

Tanui (2019) in his study to identify the factors influencing transport and distribution of oil products in Kenya. The main aim was to examine the extent to which strategic factors like infrastructure, technology information communication affects transport and distribution of petroleum products. The researcher employed descriptive research design. The population of study were sourced from security, safety, Information Technology Support, maintenance, operations and

senior management staff who were 234 staff members. The sample size was reduced to 148 respondents from the total population. The statistical analysis was under taken against the simples including; frequency distributions, correlation analysis, chi square and multiple linear regression analysis. From the analysis the research found out that, there was a positive influence of infrastructure and ICT on the transport and distribution of oil and petroleum products at KPC. The study therefore recommended that, strategic factors including infrastructure, security, ICT, and pipeline capacity should be considered by KPC to improve on the performance of transport and distribution of oil and petroleum products in Kenya (Tanui, 2019). The study done point out performance should be better off but did not consider the cost associated with it that will be transferred to oil prices in the economy.

2.3.2 Inflation Rate Shocks and Fuel Price Fluctuations

Inflation is the long-term rise in the prices of services and goods caused by currency depreciation. Even though inflation is a bad thing, it may be beneficial to entrepreneurs (Ibrahim & Maram. 2019). High inflation rate issues typically arise when an unanticipated increase happens. If earnings do not rise in tandem with inflation, everyone's purchasing power will be effectively diminished, resulting in a sluggish or lethargic economy. In addition, inflation is a quantitative measure of the rate at which an economy's average price level of a basket of selected goods and services rises over time. Inflation, which is frequently stated as a percentage, denotes a decline in the purchasing power of a country's currency (Ozdemir & Akgul, 2015). Inflation can be damaging to both individuals and corporations. When prices rise, customers may find themselves unable to buy necessary products and services, resulting in a drop in their overall standard of living. Furthermore, as the cost of production rises, businesses may struggle to sustain profitability, potentially leading to layoffs or closures. As a result, it is critical for governments and central

banks to closely monitor and regulate inflation in order to guarantee economic stability and citizens' well-being. Inflation can have a negative impact on many sectors of an economy. It can, for example, diminish the value of savings and investments, making it more difficult for individuals to prepare for the future.

Furthermore, high inflation rates can cause financial market uncertainty and instability, deterring investment and stifling economic progress (Ibrahim & Maram, 2019). Demand-pull Inflation happens when an economy's aggregate demand for goods and services rises faster than its productive capability. A central bank that rapidly raises the supply of money could be one source of shock to aggregate demand. Everyone understands that the national debt is a bad thing. However, did you realize that it can lead to significant inflation rates over time? If the national debt rises, the government has two options: raise taxes or print more money to pay it off. Businesses will raise their prices for goods and services if taxes are raised. As previously indicated, the latter will inevitably lead to an increase in inflation. Printing more money to pay off the debt may appear to be a simpler solution, but it might have serious implications. When there is an excess of money in the economy, the value of each individual unit falls, resulting in a drop in purchasing power. This loss of purchasing power eventually leads to higher costs for goods and services, causing inflation to grow even more. As a result, either hiking taxes or printing more money to pay down the national debt may contribute to high inflation rates over time (Ibrahim & Maram, 2019).

According to Lioudis (2022), crude oil is a substantial economic input, and an increase in oil prices contributes to inflation, which gauges the overall rate of price rises across the economy. Because it affects consumer purchasing power and firm profitability, inflation is an important indicator of an economy's health. Furthermore, increasing oil prices might raise production costs

for companies that rely heavily on oil, contributing to inflationary pressures. After the dramatic rise in oil prices in 1973, academics and politicians began to pay closer attention (Kilian & Murphy 2013). The rationale for this is that understanding the inflationary implications of an increase in oil prices can help politicians and central banks develop policies to limit inflation. Oil is one of the most essential sources of energy, and the effects of oil price variations are harmful for country economies. Oil price fluctuations affect both oil-importing and oil-exporting countries. Oil price fluctuations, particularly in non-oil-producing countries, can have a significant impact on economic factors such as consumer prices and core inflation.

Furthermore, it is widely believed that sudden and large changes in oil prices can trigger an increase in consumer prices and core inflation, resulting in an economic recession in oil-importing countries. The effects of rising oil prices on high inflation can be summarized in three ways: The first effect comes because oil accounts for a share of household consumption. This fraction includes processed products such as gasoline used for transportation and heating fuel, which fall within the consumer price index's household consumption basket. The second effect is reflected in consumer prices via producer prices. Firms and manufacturers pass on increases in energy prices to final product prices. As a result, the consumer price index suffers, which is an indirect effect. The third effect is that increased inflation and higher wages may be expected. Wage negotiations are taking place to compensate for the decline in real income. Production costs rise as oil prices rise, which was known as a second-round impact.

Based on the aforementioned facts, the Central Bank of the Republic of Turkey confirmed that oil price unpredictability is a risk factor for Turkey, which follows an inflation targeting regime (CBRT Monetary Policy Report 2012). Furthermore, it has been suggested that the appearance of oil supply concerns could lead to an increase in energy prices, exacerbating the

anticipation of inflation and finally necessitating action to avert it. As a result, this paper analyzes an agenda item and seeks to establish if shocks in oil and gasoline prices pose a danger to consumer price inflation and core inflation. Several experts have looked into the link between oil prices and inflation in Turkey (Ozdemir & Akgul, 2015). However, just a few studies have looked into whether the link is non-linear. Oil price and inflation series may display nonlinear behavior as a result of policy changes, energy crises, and other factors. As a result, if oil price and inflation data show structural regime shifts, a model with constant parameters, mean, and variance is likely to produce deceptive conclusions. Modeling the relationship between oil prices and inflation in a nonlinear framework is thus preferable. Nonlinear modeling captures potential nonlinearities and regime shifts in the link between oil prices and inflation, allowing for a more realistic description of its dynamics. Policymakers can better grasp the complicated interplay between oil prices and inflation in Turkey by including these elements, resulting in more informed decision-making and successful policy actions (Ozdemir & Akgul, 2015).

Several studies have been conducted on the relationship between oil prices and inflation using various econometric methodologies, nations, and sample periods. A'lvarez (2011) were among the studies that are important. These studies show that oil prices have an impact on inflation. Kahn and Hampton (1990) analyze whether increases in oil prices have an impact on the US economy and discover that, in the short run, higher oil prices can raise inflation and lower real GDP. Huntington (1998) studies the relationship between oil prices and inflation from a different angle and discovers that in the United States, consumer prices appear to respond asymptotically to energy price increases and drops. According to LeBlanc and Chinn (2004), increases in oil prices are anticipated to have only a minor impact on inflation in the United States, Japan, and Europe. However, increased oil prices might lead to lower consumption and investment in the long run as

businesses and consumers confront higher costs. Furthermore, LeBlanc and Chinn (2004) argue that the impact of rising oil prices on inflation may differ among countries due to disparities in energy reliance and economic architecture. Cunado and Perez de Gracia (2005) demonstrate that oil prices have persistent effects on inflation and asymmetric effects on GNP in European countries when a nonlinear relationship is taken into account.

Medina and Soto (2007) demonstrate, using a dynamic stochastic general equilibrium that a 13% increase in the real price of oil leads to a 0.4% increase in inflation in the Chilean economy. Using the Hodrick-Prescott technique, Ewing and Thompson (2007) study the cyclical co-movements of crude oil prices and consumer prices. Their findings confirm the notion that the price of oil is the most important factor influencing consumer pricing in the United States. Farzanegan and Markwardt (2009) use a VAR to examine the dynamic link between oil price shocks and main macroeconomic indicators in Iran. They discover that negative oil price shocks significantly raise inflation. In Kenya, the total year-on-year inflation rate was 7.3 percent in July 2023, according to the Consumer Price Index (CPI). Between July 2022 and July 2023, inflation was driven mostly by price increases in transportation (13.0%), food and non-alcoholic beverages (8.6%), and housing, water, electricity, gas, and other fuels (7.8%) (KNBS, 2023). The increase in transportation costs can be linked to a rise in fuel prices, which has a direct impact on the prices of goods and services. Furthermore, supply chain disruptions and worldwide market trends have led to the rise in food prices, making it more expensive for consumers. There are inherent inefficiencies in Kenya's oil supply chain because oil marketers do not always follow the norms and regulations established by the Ministry of Energy and the Energy Regulation Commission. As a result, production costs have risen, which are subsequently passed on to consumers (Musyoka et al., 2012).

When this occurs, the Consumer Price Index and inflation rapidly rise, implying a high cost of living. Furthermore, these inefficiencies contribute to gasoline shortages and distribution issues, causing consumers inconvenience and irritation. Furthermore, noncompliance with regulations reduces market competition, reducing consumer options and potentially leading to monopolistic practices (Musyoka et al., 2012). Rasche and Tatom (1977, 1981), Daby (1982), Burbige and Harrison (1984), Hamilton (1983, 1996), Mork (1989), Santini (1885), Gissen and Goodwin (1986), and Lee et al. (1995) provide tangible evidence that rising oil prices reduce output and increase the impact of oil price fluctuations on Kenya's Consumer Price Index. These studies have consistently shown that rising oil prices have a negative impact on Kenyan output levels. Furthermore, the impact of oil price fluctuations on the Consumer Price Index has been found to be significant, implying that changes in oil prices have a direct impact on the cost of products and services for Kenyan consumers. The rise in oil prices can exacerbate inflation, particularly in importing countries such as Kenya, (Musyoka et al., 2012).

As a result of the effect of fluctuating oil prices on inflation, consumers in Kenya may experience a higher cost of living. Due to these two combined consequences, tax revenues are decreased for the nation, increasing budget deficits. With regard to Kenya in particular, the short-term inelasticity of oil product pricing means that an increase in price will result in an increase in spending, which will cause changes in trade and currency rates. They exert pressure on the local currency, which causes it to decline. The local currency is impacted by depreciation, according to (Kamin & Rogers 2000). Even if depreciation boosts overall demand in oil-importing nations, prices may rise due to exchange rate pass-through, and lower output may result from increased input costs.

2.3.3 World Oil Prices Shocks and Fuel Price Fluctuations

Chadi (2017) did a research study to determine the dynamic impacts of world crude prices to shocks in pump fuel prices in United States. He used monthly data set posting pump fuel prices for 162 countries over period ranging between 2000 and 2014. The result showed that pump gasoline prices show positive direction to price shocks of crude oil but varies across depending on level of income as per the economic status of the state. It was observed that there was existence of variance across state groups as long as there were persistence impacts of world crude oil shocks in prices that is transferred to fuel pump prices. Further results showed that decline in world oil prices cause a small impact on pump prices of gasoline than increases of world oil prices. It was concluded that fuel prices go through deferent direction depending on the world crude oil prices (Chadi, 2017). This study was limited to gasoline only leaving behind other fuels like diesel thus provides gaps in energy and petroleum sector. In recent days, Asia recorded about 40% captured by the world oil trade of major transactions taking place in the region.

Maqbool (2019) did a research study to determine volatility of oil spillovers in the leading oil trading states on returns from crude oil. The study employed multivariate GARCH models with inclusion of BEKK-GARCH, ABEKK-GARCH, DCC-GARCH and ADCC-GARCH techniques of estimation using daily gathered data starting from September 2009 up to end of August 2018 for specified three states exporting oil (Saudi Arabia, Iraq and United Arab Emirates) and four nations oil importers (China, India, Japan and South Korea) for spot crude petroleum. The results showed that bidirectional spillover highly accepted for correlation of oil importers in two countries (Iraq and Saudi Arabia). The general results showed that all oil exporting and importing states had different significance level of correlation to oil but oil shock influences are more experienced by oil exporting states, (Maqbool, 2019).Hassel (2015) from Angola carried out a study to determine

the relationship existing on oil-prices and domestic satisfaction development in oil industry by making focus on the domestic variables. His study contended that, the focus on domestic variables at times neglect influence from the external environment that has ability and contribute with huge impact on content development. The notable external variable in this case was oil prices that reflected worldwide on demand and supply of oil and its profitability in the industry. This was carried out by checking at how reduction in oil prices leading to an impact in the macroeconomic environment of the states as well as how environment affect domestic investment.

The study found out that a reduction in oil-prices had greater impact on macroeconomic environment that prohibits Angola from developing satisfaction on the petroleum industry. The study conclude that it was of important to carry out research as it pointed out the impact of oil price fluctuations in Angola to help improve on oil development programs (Hassel, 2015). The study by Keramidas (2016) to determine the effect low petroleum prices in oil exporting states and also identify the effect of it to the economic stability. The study was to identify the main factors that results to low oil prices. The research used descriptive statistics to show how oil-exporting states are exposed to oil price changes in sub-Saharan countries whereby the GDP as well as revenue generated by the government were closely correlated with that of oil prices. In general, most of Sub-Saharan and North African states found to be of high risk as a result high exposure and are easily affected most. Macro-economic impacts resulted from fall in price by 60% was analyzed using GEM-E3 model that represented world oil market fluctuation over the period previous two years. From the study, the result found showed a drop in oil price had a different impact to export oil nations, (Keramidas, 2016).

A study by Mwangi (2015) on effect of world oil prices on stock prices to Kenyan economy by use of monthly data collected from 2003 to 2015. He deployed Johansen's multivariate co-

integration test and VECM-vector error correction model. First Johansen's co-integration test showed that the determinants were co-integrated to at most one vector whereby co-integration estimate showed that the oil prices having significant relationship to oil prices in Kenya for long run. On the other hand, VECM model showed that oil prices were having significant effects to oil prices in short-run. Finally, the study provided that world petroleum prices have negative impact to oil prices in the Kenyan economy in long run. The study recommended how to encounter world oil prices shock by the assistance impulse response as well as variance decomposition technique. From impulse response, the results provided that shocks in world oil price lead immediate reduction of oil prices. The final recommendation stated financial analysts, policymakers and shareholders to consider impact of world oil prices in pricing of oil products in the Kenyan economy (Mwangi, 2015). This brought sense that the petroleum sector needs be checked on properly to prevent price hikes.

Ang'u (2019) did research to determine the effects of world oil prices and the influence to energy sector in Kenya. The main objectives of the study were to determine whether oil is a curse or blessing to the economy, the relationship between oil and civil war and finally, to determine the impact of high oil prices to energy industry especially generation and pricing of electricity. The study employed correlation matrices for the information gathered between 1970 and 2016 from both global and local level. The findings from the analysis revealed that there was a relationship between higher petroleum prices and civil war with the intervention of foreign states and low oil prices with domestic civil wars. These findings demonstrated that civil conflicts could arise in cases where oil prices were low and that foreign states were bearing on oil related conflicts. Finally, electricity generated through conventional thermal and fuel cost component of power prices get affected highly by world. The renewable sources of electricity were found to be unaffected by the

world oil prices changes therefore recommended for as an alternative source of electricity, (Ang'u, 2019).

2.3.4 Currency Exchange Rates Shocks and Fuel Prices Fluctuations

With effect of corona virus pandemic affecting most economies in the world which led to rebate to whether pump petroleum prices have adjusted significantly or there should be an increase or decrease in international oil prices. The study was done by Klutsem (2021) to determine the rate by which the US dollars' exchange rates affect the prices of gasoline pump prices in Colombia and Ghana. The data was obtained between the periods of 2012 and 2019 and by the use of non-linear auto-regressive distributed lag model deployed to aid the analysis of data for interpretations. The results found showed that, exchange rate had significance because of fluctuations of premium gasoline pump prices in both Ghana and Colombia. However, adjustment on rates that would occur between positive and negative changes was found to be not significant, disregarding existence of price asymmetry. The study therefore recommended that the two countries should prioritize the formulation flexible exchange rate as a prevention to shocks from exchange rate that may affect retail fuel prices, (Klutsem 2021). This study provided an information that exchange rates should be looked at careful to prevent economic oil shocks.

Nouira (2018) assessed the effect of exchange rates and fluctuations in the oil price. This was done through an examination of the exchange rate and oil market in some of the MENA states like Saudi Arabia, Qatar, and Jordan. The study used time series data that covered the period between 2001 and 2017 and deployed the tests for asymmetric non-causality and non-causality-in-variance of Hafner and Herwartz (2006) to aid in determining the existence of volatility spillover between exchange rate returns and oil prices. This study revealed that if prices were increased in Saudi Arabia, it would bring about differences in exchange rates as well. In addition,

the result showed the existence of significant volatility spillovers among oil markets and rate exchanges in specified MENA nations. Therefore, the study recommended that the results be shared among investors and policymakers for consideration (Nouira, 2018). These findings have important implications for investors and policymakers in the MENA region. Understanding the spillover effects between exchange rates and oil prices can help them make informed decisions regarding investment strategies and economic policies. Additionally, sharing these results can foster collaboration and knowledge-sharing among different stakeholders, leading to more effective measures to mitigate the impact of volatility spillovers on exchange rates.

Daggash (2017) did a research study to evaluate the impact of rate of exchange on stock prices in both Nigeria and South Africa. The main objective of the study was to ascertain the impact of exchange rates to performance of stock in the two mentioned countries. Determining the impact of exchange returns and price of crude oil of the two states showed that returns on rate of exchange were having a positive impact in Nigerian economy therefore, confirmed to be agreeing with hypothesis stock flow for Nigeria but refusing the same hypothesis to South Africa. The study deployed VAR granger causality that identified short run rates fluctuation of naira to be the major significant factor influencing performance oil stock prices in Nigeria. In Johannesburg South Africa, results showed that prices are influenced by short run difference in rates of exchange. The paper provided conclusions and recommendations for the two countries by providing that, policies should be established to stabilize exchange, (Daggash, 2017). Musibau (2015) investigated the relationship existing between rate of exchange and oil prices in Nigeria for the period between 1997 and 2012. The main objective of the study was to explore the differential impact of negative and positive rate of exchange on shocks experienced in oil prices. The research deployed time series and structural approach to analyze data that were gathered. The findings revealed the

responses to both negative and positive shocks in oil prices. With positive price shocks rate of exchange were depreciating whereas with negative shock in oil price exchange rates were appreciating (Musibau, 2015)

Omagwa (2017) carried out a research study on retail oil pricing and price regulations in Kenyan oil sector. The main objective of this paper was to identify the impact of international crude oil prices and rate of exchange on the retail prices of oil products in Kenya as well as to determine the relationship existing between oil retail prices on monthly basis and periods before and after introduction of oil price control. Descriptive longitudinal approach was deployed on secondary data gathered whereby simple correlation and multiple regression were use in analyzing data. Findings from the study revealed that**,** the two variables had significant impact on retail monthly oil prices. It was also realized that they were lesser explanatory power on monthly oil prices during the time after introduction price controls compared to that time before introduction for the oil products. The results further revealed that, the is positive correlation existing between monthly pump prices of diesel and super products for the time period before price control whereas after price control the was negative correlation for kerosene**.** The study concluded that the variables were key in determining retail oil prices and ERC should consider such in monthly oil price determination. Further, he recommended that those other factors should be considered other than the two variables in this study, (Omagwa, 2017). The other variables should be put into consideration as fuel prices will not be determined using one factor only.

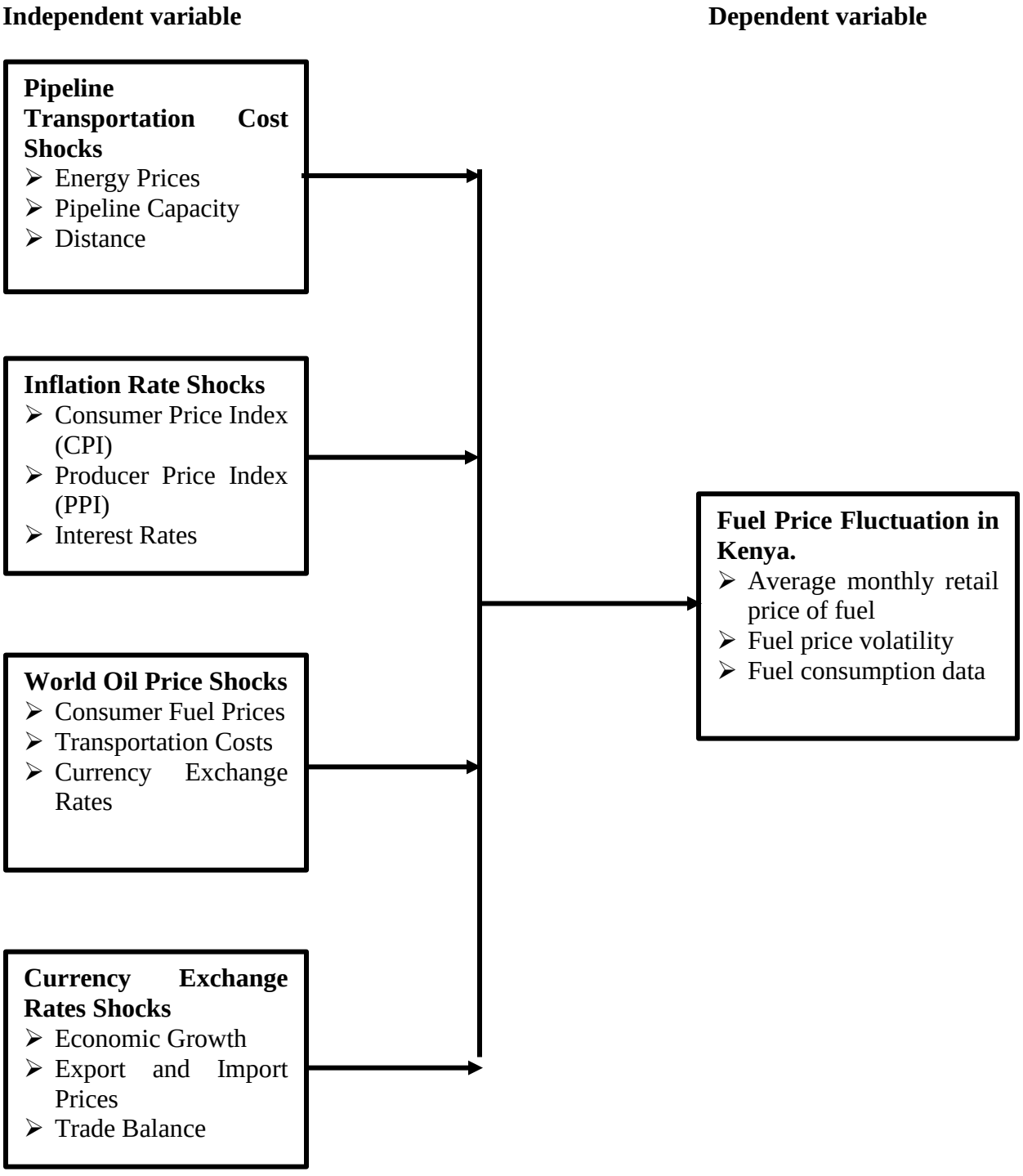
Maina (2015) carried out a research study to determine factors causing crude oil prices shocks in Kenya. The main objective of the study was to investigate channels that results shocks in oil prices into the economy. The study was specific on five variables to be focused on namely real exchange rate, money supply, inflation, international price of crude oil and real GDP growth.

A secondary data was obtained from 1991 to 2014 for analysis using Structural VAR methodology. By use of granger causality tests the result showed that there is no causality existing between prices of crude oil and other macroeconomic variables under the study. From the study, it was found that there was bi-directional causality between inflation and real rate of exchange in Kenya. On the other hander study found that there was unidirectional causality starting with inflation to GDP, then from GDP finally to real rate of exchange. In conclusion, the findings revealed that oil shocks were caused by the five variables in the Kenyan economy and specified that any change in exchange rate and inflation effect price of oil products as well. From the findings the study recommended that the government should stabilize exchange rates, implement policies and development of other energy sources (Maina, 2017). This study provided recommendation on energy without proving direction on fuel prices and the way forward.

2.4 Conceptual Framework.

FIGURE 1

Conceptual Framework.



Source: Author, (2023)

2.4.1 Operationalization of Variables

TABLE 1

Operationalization of Variables

Variable	Nature of Variable	Measure	Measurement Scale
Pipeline Transportation Cost Shocks	Independent Variable	Total Fuel Transport Cost per liter/Total Fuel Cost per liter	• Ratio
Inflation Rate Shocks	Independent Variable	Change in fuel price per liter / Initial fuel price per liter	• Ratio
World Oil Prices Shocks	Independent Variable	Change in Total Oil Prices per liter/ Change Total Fuel Cost per liter	• Ratio
Currency Exchange Rates Shocks	Independent Variable	Change in Exchange rates/Total Fuel Cost per liter	• Ratio
Fuel Price Fluctuation In Kenya.	Dependent Variable	Change in fuel price per liter /Base fuel price per liter	• Ratio

Source: Author, (2023)

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 Introduction

This section contained information on the methodology the researcher would employ in examining the pathway through which supply shocks caused fuel price fluctuations in Kenya. It entailed discussion on the research design adopted, the population the targeted, the expected sample size and the procedures that would be employed to arrive at the sample, the type of data used and the method used to collect the data as well as the data analysis techniques that was applied in analyzing the collected data.

3.2 Research Design

To investigate the pathways through which supply shocks cause fuel price fluctuations in Kenya, a descriptive research design was employed. This design involved quantitative collection method to provide a comprehensive understanding of the phenomenon. The quantitative aspect of the research involved analyzing historical data on fuel prices, supply shocks and other relevant economic indicators. This analysis helped identify patterns and correlations between supply shocks and fuel price fluctuations. Through quantitative data, a more holistic understanding of the phenomenon was achieved, enabling policymakers to make informed decisions and develop effective strategies to address any issues related to fuel prices in the country.

3.3 Population of Study

In statistics, the target population was described as a particular group about which data is sought. A population was precisely defined as the group of individuals, organizations, components, occasions, collections of things or households under investigation. Kenyan families and businesses that are a part of the fuel supply chain, such as fuel importers, distributors, retailers and consumers,

would be the study's target population. By focusing on this particular population, the study aimed to understand the numerous ways in which supply shocks affect fuel prices in Kenya and their effects on different stakeholders in the fuel sector. The Energy and Petroleum Regulatory Authority (EPRA) database was used to gather daily information on fuel prices, import quantities, and consumption trends. 96 observations were made during a time period of 8 years, from 2015 to 2022, using a time series data design.

3.4 Sampling Techniques

According to Mugenda and Mugenda (2003), for smaller populations, 10% of the population is sufficient to serve as the sample. A research sample can be divided into sub-group carefully to get the representative of the whole data of study McLeod (2014). The study adopted a census approach since petroleum prices were under regulation by one state regulatory authority.

3.5 Instrumentation

Secondary data was used to collect information from the respondents under study through published financial statements. The methodical strategy the researcher used to compile data for research referred to as the data gathering procedures Mofolo-Mbokane, (2011). The acquired data was the key to unlocking the information's hidden significance. Through the use of publicly accessible financial accounts, this study employed secondary data to collect information from the respondents. To study obtained information on inflation rate, transportation cost, exchange rates and global oil prices, the other sources of data including official publications. Authorities like the Central Bank of Kenya (CBK) and the KPC, who have helped the EPRA when necessary, by providing more information and advice, were engaged in this study for more clarification and data collection. Since the CBK is the custodian of information on interest rates that operate inside the Kenyan economy, its information was found crucial for this study. KPC would offer details on oil

pipeline transit from Kenya's coast to storage locations spread across the nation. The collected data were considered to be taken as factual and accurate.

3.6 Data Collection

This study relied heavily on desk research methodology. The process included secondary data sources like EPRA website, company brochures, annual financial reports and any other government directives where applicable. Additional information was obtained international publications like changes in world oil prices.

3.7 Data Analysis and Presentation

The data analysis process reviewed collected data, cleans it, converts it to suit user needs, displayed data to highlight helpful information, suggests conclusions and supports decision-making, (Etikan, 2016). The secondary data collected were checked for completeness in order to ensure that relevant data for each of the years were available. The data obtained were recorded in an excel sheet and later were uploaded into Stata version13 software for analysis. Diagnostic tests were done through test of assumption for residual autocorrelation, multicollinearity, stationarity, differencing, test for co-integration, granger causality test and impulse response test. The effect of pipeline transportation cost shocks on fuel price fluctuations in Kenya, the effect of inflation rate shocks on fuel price fluctuations in Kenya, the effect of world oil price shocks on fuel price fluctuations in Kenya and the effect of currency exchange rate shocks on fuel price fluctuations in Kenya were determined using time series data analysis.

3.7.1 Test for Residual Autocorrelation

It is also referred to as test for homoscedastic to ensure residuals were independently and normally distributed. This would ensure that there were equal or similar variances between the variables being tested i.e., the dependent and independent factors. Therefore, if it was found violated then it

would suggest that the model was unstable and cannot relied upon to make any economic decision. Autocorrelation was assumed to be existing when the residuals were not independent of each other and it was tested by the use of Shapiron-Wilk walk test. Autocorrelation is the degree of similarity between a given time series and a lagged version over successive time interval. Autocorrelation measured the relationship between current values of a variable as compared with the past values. Autocorrelation function was a tool used to find patterns in the data set. It provided the correlation between points separated by various time lags. The reference and decision were made with regard to the P-value. It was assumed that the residuals are not auto correlated, unless otherwise. If the test p-value was less than the significance level (P<5%), you could conclude the residuals were correlated whereas if the p-value was greater than the significance level (P>5%), it could be confirmed that residuals were not auto correlated.

3.7.2 Test for Multicollinearity.

Multicollinearity is the existence of high inter-correlation among independent variables in a multiple regression model. Multicollinearity could result into misleading output if not taken care of effectively such that the result could not be used by the analyst to understand or predict the variables in a statistic model. Presence of multicollinearity in a data set reduces the precision of the estimated coefficients thus weakens the statistical strength of the regression model. Therefore, the analyst would not trust the p-values of the independent variables subjected statistically significant decision making. Where there was existence of multicollinearity between the variables under study, the result obtained would be less reliable.

3.7.3 Test for stationarity

Stationary data refers to a time series data with constant mean and variance across the data set over time. On the other hand, data was considered non-stationary in case there was strong trend or

seasonality observed from the data set. When predicting the future, most time series models assumed independency from one point to another thus stationarity test was carried out to confirm statistical properties like mean, variance and autocorrelation were constant. This test tends to check on fluctuation between the variables under investigation over a period of time.

3.7.4 First differencing.

Differencing was carried out to transform the data set. First differencing was referred to as series of changes from one period to another. It helped to remove the series dependence on time, this at time referred to as temporal dependence and it also assisted in stabilizing the mean of time series data. Differencing was done by use of augmented dickey Fuller test since the data was found not to be stationary.

3.7.5 Test for Cointegration.

Cointegration was a method used to test the correlation between non-stationary time series in the long-run or under specified time period. Cointegration test was carried out to identify scenarios where non-stationary time series were integrated together in a way that they could not deviate from equilibrium in the long term. The test helped to identify the degree of sensitivity of variables under study over a specified period of time. This helped identify long-run parameters or the equilibrium for two or many variables.

3.7.6 Granger causality test

This was a statistical test for determining whether one-time series could be used in forecasting another. Granger causality was carried out to investigate the flow of information between time series and the variables. It helped to test pattern of correlation between empirical data. It eased variable forecasting in different time series.

3.7.7 Impulse response test.

An impulse response was referred to as reaction of a system in response to an external change in this case, we referred to economic shock. An impulse response of time series model was used to measure the changes in the future responses of variables under investigation whenever there could be an unpredicted economic change. This test helped to ensure the model was stable enough to accommodate any economic shocks.

The results obtained were presented on graphs, tables and figures from the software to show the significance of a variable on fuel prices in Kenya.

The tables provided other information that were relevant for further interpretation and to aid in conclusion and recommendations. VECM model was fitted in the form of:

$$Y_{t-1}= \beta_0+ \beta_1X_{1t-1}+ \beta_2X_{2t-1}+ \beta_3X_{3t-1}+ \beta_3X_{3t-1}+ \beta_4x_{4t-1}+ e$$

Where;

Y = Fuel price fluctuation.

β_0 = Constant

β_1 = Change in fuel price per unit with change in Transport cost shocks holding other variables constant.

X_1 = Transport cost shocks

β_2 = Change in fuel price per unit with change in rate of inflation holding other variables constant.

X_2 = Rate of inflation shocks

β_3 = Change in fuel price per unit with change world oil prices shocks holding other variables constant

X_3 = World oil prices shocks

β_4 = Change in fuel price per unit with change in exchange rates shocks holding other variables constant

X_4 = Exchange rates shocks

t-1 = The optimal lag.

e = Error term.

Analyzed data were presented in tables and figures.

CHAPTER FOUR

DATA ANALYSIS, INTERPRETATION AND DISCUSSION

4.1 Introduction

This chapter presented the results of data analysis detailed work. The data under consideration were first fed into excel thereafter transferred into STATA for analysis. The results obtained were presented using tables, graphs and descriptive statistics. The data under multiple diagnostics thereafter VEC model was fitted. The data used for analysis was as per Appendix A, data collected.

4.2 Descriptive Analysis

This summarize and described the main features of a dataset, such as its central tendency, variability and distribution. Table 2 below, presented results of descriptive statistics of the data in this project.

TABLE 2

Descriptive Table

Variable	Obs	Mean	Std. Dev.	Min	Max
Fuel price fluctuation	96	0.82736	0.77713	0.03565	4.43916
Inflation rate	96	1.24573	0.81509	0.10000	3.90000
Transport cost	96	0.08321	0.02134	0.02172	0.20340
World oil price	96	0.01243	0.03795	0.00010	0.20340
Exchange rate	96	0.10915	0.29674	0.00021	0.99190

Source: Author (2023).

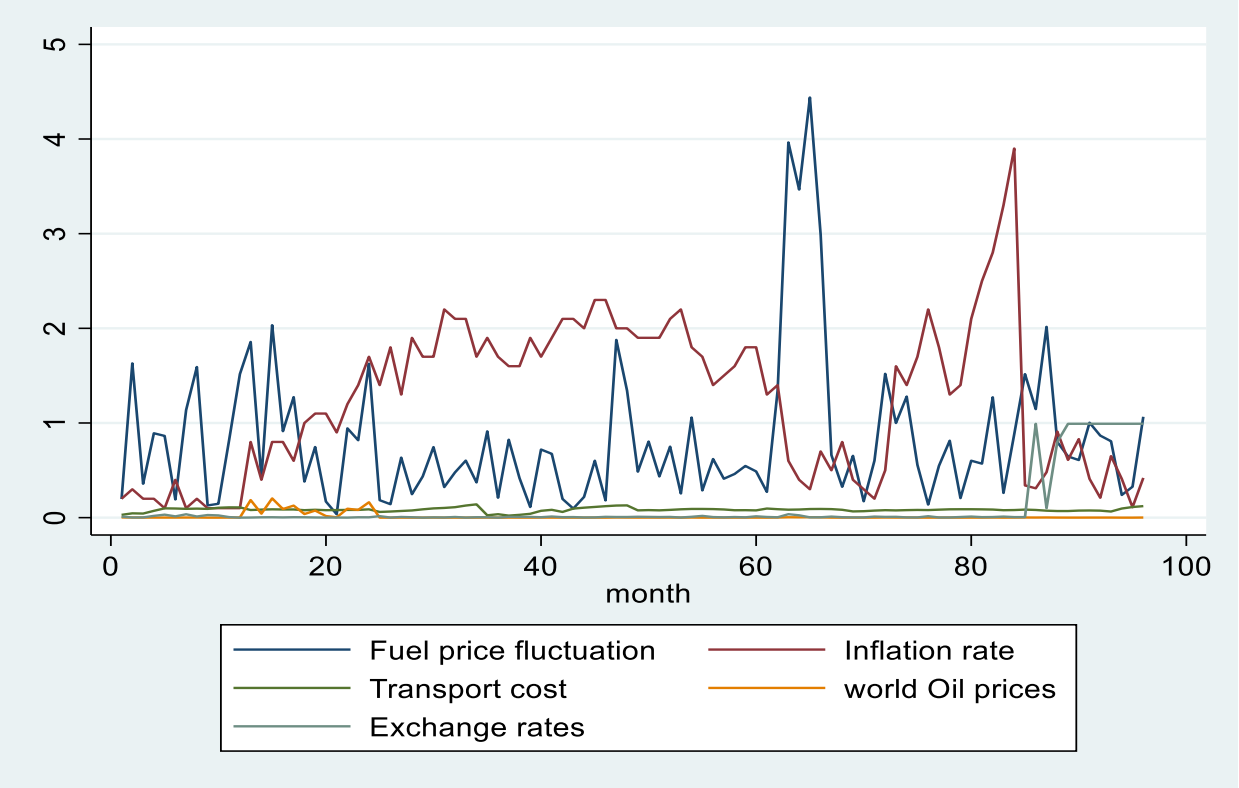
The analysis provided that the observation for all variables was 96 months the period of January 2015 to December 2022. The table above showed the statistics used to describe the characteristics of all variables. It showed that the fuel price fluctuation had a mean ratio of 0.82736, STD deviation of 0.77713 with a minimum ratio of 0.0.03565 and maximum change of 4.43916. Inflation rate had a mean ration change of 1.24573, an error of 0.81509 with a minimum inflation rate change of 0.10000 and a maximum change ratio of 3.90000. Also, it was found that cost of transport had a mean ratio of 0.08321, std. deviation of 0.02134 minimum change ratio of 0.02172 and maximum change ratio of 0.20340. Further the result revealed that world oil prices had a mean ratio of 0.01243, error ratio of 0.03795, minimum change ratio of 0.00010 and maximum change ratio of 0.20340. Lastly exchange rate had a mean ratio of 0.10915 standard deviation of .029674 with a minimum ratio change of 0.00021 and a maximum of 0.99190.

4.3 Test for stationarity.

This was done by generating trend plots for the four independent variables to test how random variable would change over period of time. It was found out that the variables were non-stationary since there were no spike from the trend plots. Stationarity could also be tested by carrying out unit root test in the time series data. A non-stationary data was referred to a data that have variances, means and covariance that would change over time as evidenced in the figure 2 below.

FIGURE 2

Trend Plot.



Source: Author, (2023)

4.4 First Differencing.

Data differencing was carried out to transform data to be stationary. This was done through dickie fuller test to ensure the data set for each variable were changed to be stationary. Data transformation was very important as it helped stabilize the mean variance for all the variables.

4.4.1 Test for stationarity after differencing.

After the differencing of variables were carried out, the data set could be used to fit a model which could be relied upon by any user in predicting fuel prices in Kenya. All the variables were stationary as could be read from the table below with p-values of 0.0000 ($p<0.5$) and could be confirmed from each table for every variable as per each table 3 to 7 below.

TABLE 3

Differenced fuel price fluctuation

Dickey-Fuller test for unit root			Number of obs =	94
Interpolated Dickey-Fuller				
	Test Statistic	1% Critical Value	5% Critical Value	10% Critical Value
Z(t)	-12.908	-3.518	-2.895	-2.582
MacKinnon approximate p-value for Z (t) = 0.0000				

Source: Author, (2023)

TABLE 4

Differenced inflation rate

Dickey-Fuller test for unit root			Number of obs =	94
Interpolated Dickey-Fuller				
	Test Statistic	1% Critical Value	5% Critical Value	10% Critical Value
Z(t)	-11.046	-3.518	-2.895	-2.582
MacKinnon approximate p-value for Z(t) = 0.0000				

Source: Author, (2023)

TABLE 5

Differenced transportation cost.

Dickey-Fuller test for unit root			Number of obs =	94
Interpolated Dickey-Fuller				
	Test statistic	1% Critical Value	5% Critical Value	10% Critical Value
Z(t)	-10.279	-3.518	-2.895	-2.582
MacKinnon approximate p-value for Z(t) = 0.0000				

Source: Author, (2023)

TABLE 6

Differenced world oil prices

Dickey-Fuller test for unit root		Number of obs =	94
Interpolated Dickey-Fuller			
	Test Statistic	1% Critical Value	5% Critical Value	10% Critical Value
Z(t)	-20.673	-3.518	-2.895	-2.582
MacKinnon approximate p-value for Z(t) = 0.0000				

Source: Author, (2023)

TABLE 7

Differenced exchange rates

Dickey-Fuller test for unit root		Number of obs =	94
Interpolated Dickey-Fuller			
	Test Statistic	1% Criticall Value	5% Critical Value	10% Critical Value
Z(t)	-19.290	-3.518	-2.895	-2.582
MacKinnon approximate p-value for Z(t) = 0.0000				

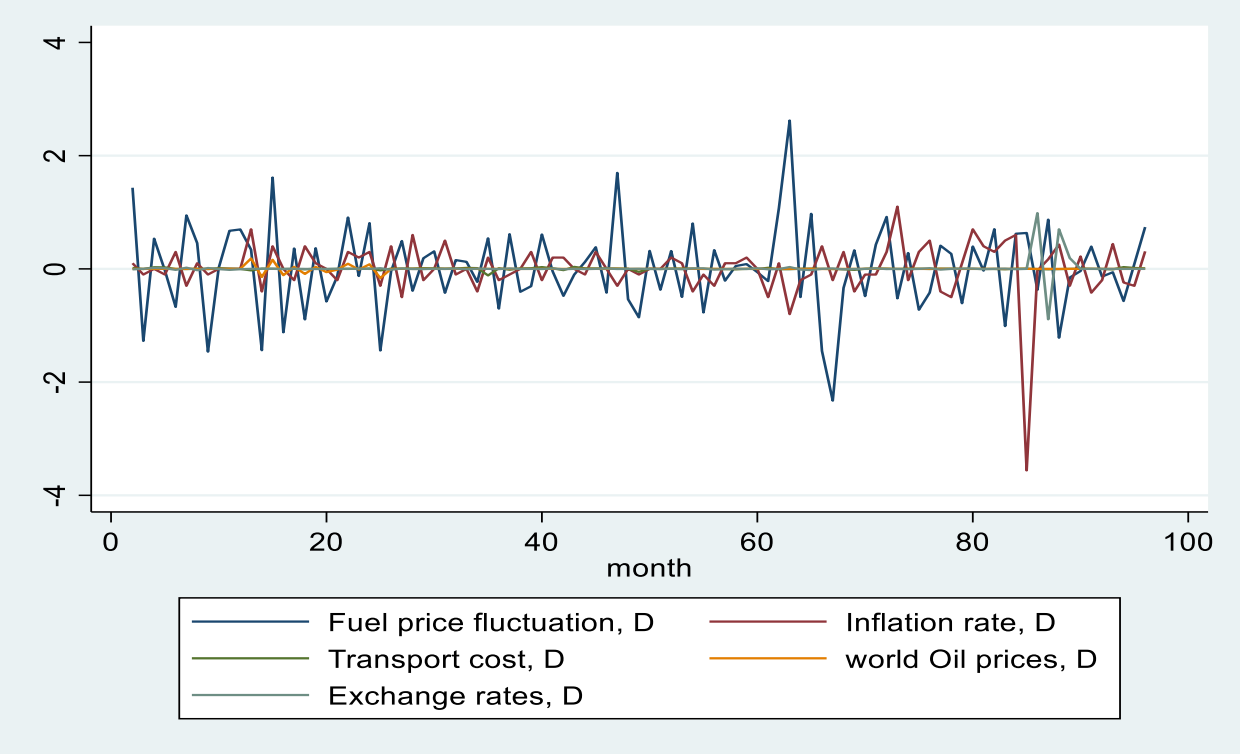
Source: Author, (2023)

4.4.2 Stationarity

After first differencing through dicky fuller test data was found to be stationarity as shown in the figure 3 below. The trend plot generated for each variable showed deterministic trends for the four variables. This was of importance since statistical tests, analytical tools and models generated from the differenced data set could be relied on as the economic variables data set had stabilized mean variance between the factors under study.

FIGURE 3

Trend Plot.



Source: Author, (2023)

4.4 Optimal Lag Selection.

The figure below presented results of the number of lags to be included in the model as provided by the various information criteria techniques. From the table, it was concluded that the optimal lag was lag 1 since it had higher number of a steric and also low number of AIC value (-7.42566). The implication of lag selection was to reduce residual correlation between the study variables.

TABLE 8

Lag Selection

Selection-order criteria
Sample: 5 - 96 Number of obs = 92

lag	LL	LR	df	p	FPE	AIC	HQIC	SBIC
0	299.149			1.1e-09	-6.39453	-6.33922	-6.25748	
1	371.58	144.86*	25	0.000	4.1e-10*	-7.42566*	-7.09377*	-6.60334*
2	385.186	27.21	25	0.345	5.3e-10	-7.17795	-6.56947	-5.67036
3	397.023	23.674	25	0.538	7.1e-10	-6.8918	-6.00674	4.69894

Source: Author, (2023)

4.5 Co-integration

Time series data were assumed to be co-integrated if they co-move towards long run equilibrium. The determination of stationary of the series was the first step before co-integration then Johansen methodology was adopted to test for co-integration thereafter appropriate model could be fitted for this case, the VEC model was considered since there was co-integration. As per the table below, it was confirmed that there was co-integration as it was evidenced by lack of a steric at lag zero.

TABLE 9

Test for cointegration.

Trend: constant				Number of obs =	94	
Sample: 3 - 96				Lags =	1	
rank	parms	LL	eigenvalue	SBIC	HQIC	AIC
0	5	82.921389		-1.52262	-1.603258	-1.657902
1	14	183.94093	0.88344	-3.236976	-3.462762	-3.615764
2	21	266.09992	0.82589	-4.646709	-4.985388	-5.214892
3	26	312.80449	0.62980	-5.398759	-5.818075	-6.102223
4	29	349.27929	0.53978	-6.029819*	-6.497518*	-6.814453
5	30	381.00843	0.49089	-6.656575	-7.140401	-7.468264

Source: Author, (2023).

4.6 Fitting VECM model

4.6.1 Model fitness statistic

The tables below provided an analysis on whether the model was safe to be used for reliance and prediction purposes. It provided an overall p-value of 0.0000 ($p<0.05$) which implied the model was statistically significant for economic shocks and variables analysis as show in table 10 below. The individual variables provided significance level in relation to fuel price fluctuation i.e., inflation rate shocks (0.0000), world oil price shocks (0.0.001) and exchange rate shocks (0.000) which were statistically significant ($p < 0.05$)., Transportation cost shocks (0.925) had been statistically significant since it the impacts are not hour to hour or monthly like the other variables but the effect is transmitted to fuel price changes as shown in table 11 below. Since data established that the equation p-value 0.000 ($p<0.05$) therefore it was concluded that the variable shocks were statistically significant in fuel price fluctuations as provided by table 10.

TABLE 10

Model fitness.

Cointegrating equations			
Equation	Parms	chi2	P>chi2
ce1	4	736.4356	0.0000

Source: Author, (2023).

TABLE 11

VECM Coefficients

Johansen normalization restriction imposed						
beta	Coef.	Std. Err.	z	P>|z|	[95%Conf.	Interval]
_ce1						
Fuel price fluctuation						
D1.	1					
Inflation rate						
D1.	5.536788	.4926804	11.24	0.000	4.571152	6.502424
Transport cost						
D1.	-1.315837	13.93195	-0.09	0.925	-28.62195	25.99028
World oil prices						
D1.	-20.32437	5.978216	-3.40	0.001	-32.04146	-8.607284
Exchange rates						
D1.	36.86426	1.501153	24.56	0.000	33.92205	39.80646
cons	-.4595614					

Source: Author, (2023).

4.6.2 Model coefficients.

The table 11 above, provided the fuel prices estimator for the various independent variables shocks which were considered to be the major fuel fluctuation determinants in the Kenyan economy. The world oil prices and transportation shocks were found to be having a positive effect while inflation

rates and exchange rates shocks were found to be having a negative effect on fuel prices where by a unit increase or decrease of an independent value of the variable would lead to increase or decrease in value of the dependent variable.

In was determined that there was a constant fuel price fluctuation ratio of 0.4595614 (45%) affecting fuel prices whenever the prices of other economic like transportation cost, inflation rates, world oil prices and foreign exchange rates were kept constant. The cost was to be incurred irrespective of any shocks experienced from the other variables. The VECM model was fitted as shown below.

$$\mathbf{Y_{t-1} = -0.459614 - 1.315837X_{1}t_{1} + 5.536788X_{2t1} - 20.32437X_{3t1} + 36.86426X_{4t1}}$$

4.7 Test for normal distribution.

The result provided that the time series data set for the variables were normally distributed across the period i.e., p-value 0.0000 ($p<0.05$) as shown in the table 12 below. Therefore, any economic decision made from data and the result were reliable for economic importance.

TABLE 12

Test for Normal Distribution

vecnorm

Jarque-Bera test

Equation	chi2	df	Prob > chi2
D2_fuelpricefluctuation	5.678	2	0.05848
D2_inflationrate	1581.839	2	0.00000
D2_transportcost	1527.477	2	0.00000
D2_worldoilprices	433.460	2	0.00000
D2_exchangerates	47.252	2	0.00000
ALL	3595.707	10	0.00000

Skewness test

Equation	Skewness	chi2	df	Prob > chi2
D2_fuelpricefluctuation	-.26502	1.077	1	0.29937
D2_inflationrate	-2.8758	126.811	1	0.00000
D2_transportcost	-3.1442	151.589	1	0.00000
D2_worldoilprices	0.94382	13.659	1	0.00022
D2_exchangerates	1.0386	16.540	1	0.00005
ALL		309.676	5	0.00000

Kurtosis test

Equation	Kurtosis	chi2	df	Prob > chi2
D2_fuelpricefluctuation	4.0956	4.601	1	0.03195
D2_inflationrate	22.483	1455.028	1	0.00000
D2_transportcost	21.945	1375.888	1	0.00000
D2_worldoilprices	13.465	419.801	1	0.00000
D2_exchangerates	5.8306	30.713	1	0.00000
ALL	3286.031	5	0.00000	

Source: Author, (2023).

4.8 Test for Residual autocorrelation

The analysis carried out provided that there was no residual correlation between the variables. This was established since the p-values ($p>0.05$) as provided in the table 13 below.

TABLE 13

Test for residual autocorrelation.

vecrmar

Lagrange-multiplier test

lag	chi2	df	Prob > chi2
1	26.5746	25	0.37746
2	30.8097	25	0.19540

Source: Author, (2023).

4.9 Summary of data analysis

4.9.1 Pipeline transport cost shocks and fuel price fluctuation.

The study found out that transportation shocks were having a slight impact on fuel price fluctuation with response to the economic condition. This was observed since transport changes were not felt on daily or monthly unlike the other factors that had daily or averagely monthly effect. Fuel price fluctuation was found to have a negative relationship with transportation shocks such that whenever there is a unit change in pipeline cost, fuel price would change by 1.315837 in respect to shocks experienced from the transport sector, which a positive increment in fuel prices. This was a result that the dealers needed to maximize their trading profits with changes in economic factors.

Dagmar (2010), provided an examination of price setting and investment dynamics in Indian economy in the petroleum sector. He observed that, there was a need to reduce the burden of rising petrol prices. Besides reduction of taxes the government looked into the issue of oil spillage during pipeline transportation as one of the factors affecting the stability of oil prices. This was put into consideration in terms of the state's capacity to have the right storage and distribution facilities to avoid oil losses. In this regard as per this study it was found to be in agreement that

pipeline cost i.e., transport cost, maintenance and oil spillage was a major factor of fuel price instability

4.9.2 Inflation rate shocks and fuel price fluctuation.

It was established that, inflation rate was a major factor affecting the cost of domestic and imported goods and services in the economy. Crude oil being one of the imported goods it was found to be highly affected changes in exchange rate thus would affect prices of goods and services including fuel prices. Inflation shocks will affect all oil products more in an open economy like Kenya where prices of commodities are determined by demand and supply. The study determined that inflation rate shocks had a negative relationship with fuel prices such that a percentage change in rate of inflation would lead to 5.536788 change in the value of the fuel price either upward or down wards depending on inflation rate,

According to research by Mwangi, (2013) and its findings on effects of inflation shocks and food items in Kenya. He noted that inflation shocks mostly affect food items but did not look into on how it affect fuel prices changes that was considered critical in this study. The study also did not come up with suggestions to balance between food item prices and prices of fuel to stabilize the economy. Jaewoo (2022) did research on effects of wages inflation on oil price shocks. He established that it varied depending on the states or structural of the economy that was realized to have been. The effects have declined over time in Europe and been. He further determined that wages were higher when prevailing level of inflation went up as well. He concluded that effect of oil price shocks on inflation expectations are consistent with the effects on wage rates. The study by Jaewoo study was more specific on wage rates leaving behind the general economic inflation thus form a gap this study.

4.9.3 World oil prices shocks and fuel price fluctuation.

The study established that there was positive relationship between world oil prices shocks and fuel price fluctuation in the Kenyan economy. It was determined that a unit change in the world oil prices would lead to 20.32437 change in the fuel prices in Kenya depending on either increase of decrease of world oil prices. Because fuel and petroleum products were refined mostly from imported crude oil this ware affected by economic shocks that were found to be having a greater impact on the fuel prices. When the world oil prices went up, the domestic fuel prices were up as well since purchase price was higher it was also realized inversely when the world oil prices decrease, the domestic fuel prices decreased as well and this was felt as a trend in the oil and fuel products industry.

Ntoiti, (2016) on his study of effect of regulatory components on volatility of petroleum prices in Kenya. The study observed that petroleum prices do not move in the same direction with the world oil prices. He further explained that the price payable by the consumers for petroleum product could differ significantly from the ex-refinery price due to excise and VAT which that was found to be hefty. This increased the oil purchase price as the total cash outflow required with inclusion of tax payable in importation of oil products. This study didn't bring it clear on the OPEC and their influence in the international oil industry. Further, this in Kenya the higher world oil prices the higher the fuel cost while the lower the world oil prices the lower the fuel cost in Kenya therefore this was in disagreement from Ntoiti's findings.

4.9.4 Exchange rates shocks and fuel price fluctuations.

The study established that in a real economic condition, currency exchange rates shocks had a negative relationship with fuel price fluctuations in Kenya. This was evident in the sense that a unit percentage change of exchange rates would lead to ratio change by 36.86426 in fuel prices

which could be either favorable or adverse depending on the decrease or increase in foreign currency rates. Kenyan's shilling was measured against US dollars which was more preferably mode of exchange in the international market. This was realized that when the value of US currency appreciated against shillings the crude oil prices went up this could make importation very expensive as the value of crude oil increased as well. In the case that the value of a dollar depreciated, importation become cheaper and this was reflected in fuel prices in the domestic market as well.

According to Omagwa, (2017) on his study to determine the effect of international crude oil prices and foreign exchange rate on monthly retail prices of four oil products in Kenya and also to establish the relationship existed in monthly oil retail prices during the period before and after introduction of price controls. The findings established that before introduction of price control measures, monthly international crude oil prices and exchange rates had effects on the product like; Super petrol and little of Kerosene prices. After the introduction of price measures, the two variables affected mostly more of diesel prices but had a little on of regular petrol prices. From this study it could be confirmed from this study that, exchange rates have a major influence in fuel prices fluctuation in the Kenyan economy

CHAPTER FIVE

SUMMARY, CONCLUSION, AND RECOMMENDATIONS

5.1 Introduction

The chapter offered a recap of the research, outlined the conclusions drawn from the study, and furnishes recommendations derived from the study's results. The summary of discoveries corresponds to the research questions explored.

5.2 Summary of Findings

It was determined that there was a constant ratio of 0.4595614 (46%) having a major impact on fuel prices whenever the prices of other economic factors like pipeline cost, taxes, world oil prices and foreign exchange rates remained unchanged. The cost was to be incurred irrespective of any favorable or adverse change experienced from the other variables.

5.2.1 Pipeline transport cost shocks and fuel price fluctuation.

The study revealed a slight correlation between transportation disruptions and fuel price fluctuations in response to economic conditions, with a positive relationship between pipeline costs and fuel price increases. It further established that, transportation cost charged on transportation of fuel products should be catered for when determining the sales value of the fuel products as it’s a major contributing factor of fuel price instability. The transport charges were found to be ever varying with response to the economic condition. Fuel price fluctuation was found to have a negative relationship with pipeline cost such a change in a unit change of pipeline cost leads to a change in fuel price by a ratio of 1.32.

5.2.2 Inflation rate shocks and fuel price fluctuation.

The study established that there ware constant price changes of good and services across the world. This affected the prices of both exports and import therefore it recorded that crude oil being one

of the imported items such shocks like inflation contributed to higher charges recorded on imported oil. The study found that inflation rate had a negative relationship with fuel prices such that a unit change in the inflation rate would result into change on of the fuel price by a ratio of 5.54 depending on upward or down wards movement of rates.

5.2.3 World Oil Prices Shocks and Fuel Price Fluctuation.

It was established that there was positive relationship between world oil prices and fuel price fluctuation. The study determined that a unit change in the value of world oil prices would impact the fuel prices value by a ratio of 20.32 depending on the increase or decrease of world oil prices. This was reached since fuel products were refined mostly from imported crude oil therefore, alteration of world oil prices cut across into domestic economy with the impact felt on fuel charges after refinery. On that note, when the prices went up, the domestic fuel prices went up and inversely felt when the prices decrease as observed from this study.

5.2.4 Exchange rates shocks and fuel price fluctuations.

This study determined that exchange rate shocks had a negative relationship with fuel price fluctuations in the Kenyan economy. This was established in the sense that a unit change of exchange rates would result into a change in fuel prices by the ratio of 36.86 that could be either favorable or adverse depending on the change of the rates. Kenyan currency was measured against US dollars which was found to be more preferred unit of trade in the international market. The study therefore found out that, when the value of US currency appreciated against Kenya shillings, the crude oil prices would go up thus, importation becomes very expensive as the value of crude would increase as well. In the case that the value of a dollar depreciated, importation become less expensive and this would be reflected with low fuel prices in the domestic market.

5.3 Conclusion

5.3.1 Pipeline transport cost shocks and fuel price fluctuation.

Several studies have provided valuable insights into the transportation and distribution of oil and petroleum products. Hernandez, (2015) compared the costs of transporting wastewater sludge using trucks and pipelines, emphasizing that these costs depended on distance and shipment volume. The study underscored the importance of improved transportation decisions for biofuel plants to lower biodiesel prices. Wang (2015) focused on optimizing oil transportation networks in China, evaluating risk factors and cost reduction strategies for pipeline and shipping transport. While pipeline transport was deemed more secure, cost considerations were left unexplored. Mohammed (2014) delved into the impact of price fluctuations on oil distribution in Gwagwalada, Nigeria, highlighting how price changes affected distribution costs and suggesting measures for efficient product availability. Azodo (2019) investigated crude oil vandalism's toll on petroleum revenue in Sub-Saharan countries, advocating for alternative transport methods, such as rail or truck, to mitigate vandalism risks. Mungai (2016) identified challenges in Kenya's oil product distribution, including pilferage, infrastructure, and capacity issues, offering recommendations to address these challenges. Tanui (2019) examined the factors influencing oil product transport and distribution in Kenya, emphasizing the positive impact of infrastructure and information technology and urging their enhancement.

Additionally, one study revealed a slight correlation between transportation disruptions and fuel price fluctuations in response to economic conditions, with a positive relationship between pipeline costs and fuel price increases. Dagmar (2010) explored price setting and investment dynamics in India's petroleum sector, emphasizing the need to consider factors like transport costs, maintenance, and pipeline spillage to alleviate the burden of rising petrol prices. These findings

collectively contribute to a deeper understanding of the complexities surrounding oil and petroleum product transportation and distribution.

5.3.2 Inflation rate shocks and fuel price fluctuation.

Inflation, a long-term price rise caused by currency depreciation could harm individuals and businesses, reducing purchasing power and causing economic instability Maram, (2019). High inflation often results from unexpected price increases, requiring vigilant government monitoring and regulation for economic stability Ozdemir & Akgul (2015). Oil prices significantly impacted inflation, with rising oil prices increasing production costs and inflation Lioudis, (2022). Oil price fluctuations affect both oil-importing and oil-exporting countries, impacting consumer prices and core inflation. Nonlinear modeling offers a realistic understanding of the oil-inflation relationship, aiding informed policymaking Ozdemir & Akgul, (2015). Numerous studies confirm that rising oil prices can lead to inflation in different countries (Kahn and Hampton, 1990; LeBlanc and Chinn, 2004; Farzanegan and Markwardt, 2009). In Kenya, inflation was driven by increased prices in transportation, food and housing due to factors like rising fuel prices and supply chain disruptions KNBS, (2023). Inefficient oil supply chains in Kenya contribute to higher production costs, resulting in inflation and a higher cost of living Musyoka, (2012). Fluctuating oil prices negatively impact Kenya's output and Consumer Price Index, exacerbating inflation. Inflation shocks affect fuel prices in Kenya, with a positive relationship between inflation rate shocks and fuel price changes Mwangi, (2013). While inflation shocks primarily affect food items, their impact on fuel prices and balancing measures in Kenya's economy warrant further consideration Mwangi, (2013).

In summary, these findings underscored the intricate connection between inflation and oil prices, particularly in Kenya, emphasizing the need for a comprehensive understanding to inform

effective economic policymaking. Understanding the relationship between inflation and oil prices is crucial for policymakers in Kenya to develop effective economic strategies. By analyzing the impact of inflation shocks on fuel prices, policymakers could implement measures to mitigate any adverse effects on the economy. Additionally, a comprehensive understanding of this connection could help in formulating policies that ensure stability and balance in Kenya's economy amidst fluctuations in oil prices.

5.3.3 World Oil Prices Shocks and Fuel Price Fluctuation.

Chadi's (2017) research delved into the dynamic impact of global crude oil prices on pump fuel prices in the United States. To achieve this, the study analyzed a dataset spanning from 2000 to 2014, consisting of monthly pump fuel price data for 162 countries. The study unveiled several key findings. Firstly, it identified a positive relationship between pump gasoline prices and crude oil price shocks. In simple terms, when crude oil prices surged, pump gasoline prices followed suit. Nevertheless, the extent of this increase was not uniform, varying according to the economic status of each state. Furthermore, Chadi's research shed light on the income-level variance in the impact of crude oil price shocks. It revealed that the influence of these shocks on pump gasoline prices differed significantly among states, hinging on their respective income levels. This finding indicated that wealthier states experienced distinct price dynamics compared to their less affluent counterparts. The study also highlighted the persistence of the impact of world crude oil price shocks on pump fuel prices. This persistence signified that changes in crude oil prices continued to exert an influence on fuel prices over an extended period. An interesting observation made in the study was the asymmetry in price movements. It noted that a decline in world oil prices had a lesser impact on pump fuel prices compared to the effect of increases in world oil prices. This asymmetry suggested a nuanced relationship between these variables.

In summary, Chadi's research underscored the influence of global crude oil prices on fuel prices in the United States, with variations based on the economic status of individual states. Additionally, the research revealed that the impact of crude oil price shocks persisted over time and that price movements displayed an asymmetric pattern. However, it is important to acknowledge that Chadi's study was limited to gasoline and did not encompass other fuels like diesel, leaving gaps in our understanding of the broader dynamics within the energy and petroleum sector. Furthermore, the study underscored the significance of the Asian region in global oil trade, with a substantial portion of major transactions occurring in this part of the world. In addition to Chadi's work, there were other studies conducted by researchers such as Maqbool, Hassel, Keramidas, Mwangi, and Ang'u, which provided further insights into the multifaceted effects of world oil prices on various aspects of different economies. These studies explored the impact on oil-exporting and oil-importing nations, stock prices, economic stability, and the energy sector, collectively enhancing our comprehension of the intricate relationship between global oil prices and diverse economic variables.

5.3.4 Exchange rates shocks and fuel price fluctuations.

The studies discussed in this text focused on the relationship between exchange rates, oil prices and their impacts on various aspects of different economies. Klutsem (2021) conducted a study examining the influence of exchange rates on gasoline pump prices in Colombia and Ghana. The findings revealed that exchange rates significantly affected premium gasoline pump prices in both countries. To address this, the study recommended the implementation of flexible exchange rate policies to mitigate the impact of exchange rate fluctuations on retail fuel prices. Nouira (2018) investigated the relationship between exchange rates and oil prices in MENA countries, specifically Saudi Arabia, Qatar and Jordan. The study discovered significant volatility spillovers

between oil markets and exchange rates in these nations. As a recommendation, the study suggested sharing these results with investors and policymakers to inform their decision-making processes. Daggash (2017) assessed the impact of exchange rates on stock prices in Nigeria and South Africa.

The study found that exchange rate returns had a positive impact on the Nigerian stock market but not on South Africa's. To address this, the study recommended the establishment of policies aimed at stabilizing exchange rates. Musibau (2015) investigated the differential impact of negative and positive exchange rate shocks on oil prices in Nigeria. The findings indicated that positive oil price shocks led to exchange rate depreciation, while negative shocks led to appreciation. This highlighted the differing responses of exchange rates to oil price shocks in Nigeria. Omagwa (2017) explored the impact of international crude oil prices and exchange rates on retail oil prices in Kenya. The study showed that both variables significantly affected monthly oil prices, with a more substantial influence observed before the introduction of price controls. The recommendation was to consider these factors when determining monthly oil prices. Maina (2015) conducted research to identify the factors causing crude oil price shocks in Kenya. The findings revealed no causality between crude oil prices and other macroeconomic variables.

However, various causal relationships were found among other economic factors. As a result, the study recommended measures to stabilize exchange rates and the development of alternative energy sources. In summary, these studies collectively emphasize the intricate interplay between exchange rates, oil prices and their repercussions on diverse aspects of economies. They offer valuable insights that can inform the decisions of policymakers and investors, aiding them in managing economic challenges related to these variables. By understanding the complex relationship between exchange rates, oil prices and their impact on economies, policymakers and

investors can make informed decisions to mitigate potential economic challenges. For instance, implementing measures to stabilize exchange rates can help reduce volatility and promote economic stability. Additionally, investing in alternative energy sources can help countries reduce their dependence on oil and mitigate the effects of fluctuating oil prices. These studies highlight the importance of proactive measures to address the interconnected nature of these factors and pave the way for sustainable economic growth.

5.4 Recommendations.

The study recommended that fuel prices should be charged the same all over the country irrespective of the distance covered in transportation of product. It's the work of the government through the regulator (EPRA) to ensure fuel prices are favorable and available to the common citizen without much struggle.

Further, recommendations were made to conduct comprehensive cost analyses for various oil transportation modes, including pipelines, trucks and ships considering factors like distance, volume, safety and sustainability. Research recommended to the government to explore pipeline risks and environmental security technologies. In addition, the government should find alternative way to control inflation from imported commodities thus prohibiting of such impact into domestic market. The study further recommended to the government to enter into contractual agreement with OPEC nations on oil deals for steady supply of crude oil at a favorable price. Such contracts would forward contracts that lock the future oil purchase prices. Evaluating the effectiveness of measures to mitigate the impact of inflation shocks on fuel prices and the broader economy was as well found to be important. It was found to be very necessary and important to stabilize exchange rate against foreign currency to stabilize domestic currency. Thus, could stabilize value of dollar since most intercountry trades were carried out using US dollar hence, the price of an item

depended on the value of the currency that were mostly affected by exchange rates. Therefore, it was recommended that central bank should ensure exchange rates are stable to prevent transferring negative impact to fuel prices.

5.5 Arears for further research.

This study majorly concentrated on effects of supply shocks on fuel price fluctuation in the Kenyan in the economy as the major objective. The study delt on effect of pipeline cost, inflation rate, world oil and foreign exchange rates influence on fuel prices. This did not fully exhaust the fuel industry leaving some areas for study. Therefore, further research can be done on the effect of political instability to fuel prices as it was observed that during election period fuel prices tend to go up. In addition to that, further research can be carried out to investigate effect of pandemic breakout on fuel prices as this was observed during covid-19 when fuel prices kept on changing on monthly basis with great margin.

5.6 Limitations of the Study

A significant limitation in studying the causal link between supply shocks and fuel price fluctuations in Kenya is the reliability and availability of historical data. This constraint can impact the precision and validity of findings since historical data on supply shocks, fuel prices, and relevant variables may not always be easily accessible, accurate, or complete. The data limitation is crucial because it affects the study's ability to establish a clear causal connection between supply shocks and fuel price shifts. While correlations between these factors may exist, establishing causation requires robust data that can account for other influencing factors.

Furthermore, data related to external factors like global oil prices, geopolitical events, and currency exchange rates may also be limited or subject to delays. These factors significantly affect fuel prices and should ideally be included in the analysis. However, data inadequacies can hinder

an accurate assessment of their impact. To mitigate this limitation, researchers may employ rigorous data collection methods, explore alternative data sources, and use advanced statistical techniques. Transparently acknowledging these data-related challenges in the study's conclusions is crucial to maintain credibility and transparency while recognizing the inherent limitations imposed by data constraints.

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APPENDICES

Appendix A: Data collection sheet

Year	Month	Fuel price fluctuation	Inflation rate	Transport cost	world Oil prices	Exchange rates
	1	0.19697	0.20000	0.02967	0.00224	0.01011
	2	1.63023	0.30000	0.04570	0.00163	0.00143
	3	0.35773	0.20000	0.04319	0.00036	0.00260
	4	0.89154	0.20000	0.07181	0.00089	0.01865
	5	0.86375	0.10000	0.09852	0.00086	0.03158
2015	6	0.19197	0.40000	0.09674	0.00090	0.01365
	7	1.13685	0.10000	0.09318	0.00114	0.03573
	8	1.59183	0.20000	0.09555	0.00159	0.01220
	9	0.12913	0.10000	0.09258	0.00013	0.02777
	10	0.14693	0.10000	0.10445	0.00015	0.02371
	11	0.81985	0.10000	0.10861	0.00082	0.00594
	12	1.51705	0.10000	0.10801	0.00152	0.00026
	13	1.85671	0.80000	0.08099	0.18570	0.00115
	14	0.41974	0.40000	0.08514	0.04200	0.00372
2016	15	2.03352	0.80000	0.08790	0.20340	0.00439
	16	0.91323	0.80000	0.08606	0.09130	0.00253
	17	1.27362	0.60000	0.08652	0.12740	0.00490
	18	0.38093	1.00000	0.07915	0.03810	0.00410

	19	0.74649	1.10000	0.08329	0.07460	0.00185
	20	0.16995	1.10000	0.07915	0.01700	0.00077
	21	0.03565	0.90000	0.08007	0.00360	0.00137
	22	0.94361	1.20000	0.08191	0.09440	0.00051
	23	0.81761	1.40000	0.08191	0.08180	0.00419
	24	1.62616	1.70000	0.08790	0.16260	0.00377
	25	0.18434	1.40000	0.06046	0.00018	0.01581
	26	0.14182	1.80000	0.06484	0.00014	0.00130
	27	0.63477	1.30000	0.07039	0.00064	0.00733
	28	0.24754	1.90000	0.07623	0.00025	0.00459
	29	0.43520	1.70000	0.08791	0.00044	0.00061
2017	30	0.74564	1.70000	0.09755	0.00075	0.00320
	31	0.32272	2.20000	0.10251	0.00032	0.00192
	32	0.47839	2.10000	0.11040	0.00048	0.00739
	33	0.60272	2.10000	0.12763	0.00060	0.00101
	34	0.37205	1.70000	0.14077	0.00037	0.00433
	35	0.91224	1.90000	0.02482	0.00091	0.00425
	36	0.21025	1.70000	0.03651	0.00021	0.00021
	37	0.82366	1.60000	0.02172	0.00082	0.00847
2018	38	0.41824	1.60000	0.02947	0.00042	0.00723
	39	0.11188	1.90000	0.04081	0.00011	0.00757
	40	0.71996	1.70000	0.07232	0.00072	0.00482

	41	0.67452	1.90000	0.08246	0.00068	0.01200
	42	0.19747	2.10000	0.06050	0.00020	0.00508
	43	0.09586	2.10000	0.09570	0.00010	0.00635
	44	0.21880	2.00000	0.10537	0.00022	0.00236
	45	0.60214	2.30000	0.11313	0.00060	0.00308
	46	0.18179	2.30000	0.12124	0.00018	0.00883
	47	1.87801	2.00000	0.12780	0.00188	0.00685
	48	1.34146	2.00000	0.12947	0.00134	0.00681
	49	0.48554	1.90000	0.07691	0.00049	0.00939
	50	0.80417	1.90000	0.07966	0.00080	0.00797
	51	0.43514	1.90000	0.07738	0.00044	0.00663
	52	0.75090	2.10000	0.08228	0.00075	0.00780
	53	0.25518	2.20000	0.08826	0.00026	0.00178
2019	54	1.05791	1.80000	0.09201	0.00106	0.00930
	55	0.28782	1.70000	0.09201	0.00029	0.01868
	56	0.61971	1.40000	0.09040	0.00062	0.00633
	57	0.41096	1.50000	0.08671	0.00041	0.00324
	58	0.46136	1.60000	0.07846	0.00046	0.00654
	59	0.54653	1.80000	0.07913	0.00055	0.00387
	60	0.48841	1.80000	0.07678	0.00049	0.01430
2020	61	0.27151	1.30000	0.09627	0.00027	0.00742
	62	1.34350	1.40000	0.08955	0.00134	0.00395

	63	3.96439	0.60000	0.08392	0.00396	0.03674
	64	3.46584	0.40000	0.08582	0.00347	0.02482
	65	4.43916	0.30000	0.09136	0.00444	0.00324
	66	2.98881	0.70000	0.09209	0.00299	0.00394
	67	0.66143	0.50000	0.09027	0.00066	0.01112
	68	0.32565	0.80000	0.08301	0.00033	0.00466
	69	0.65378	0.40000	0.06566	0.00065	0.00266
	70	0.17241	0.30000	0.06820	0.00017	0.00297
	71	0.60150	0.20000	0.07474	0.00060	0.01135
	72	1.52009	0.50000	0.07910	0.00152	0.00801
	73	0.99938	1.60000	0.07638	0.00100	0.00891
	74	1.27985	1.40000	0.07935	0.00128	0.00312
	75	0.55739	1.70000	0.08163	0.00056	0.00262
	76	0.13787	2.20000	0.07997	0.00014	0.01523
	77	0.54805	1.80000	0.08451	0.00055	0.00235
202	78	0.81325	1.30000	0.08828	0.00081	0.00241
1	79	0.20613	1.40000	0.08863	0.00021	0.00704
	80	0.60180	2.10000	0.08854	0.00060	0.01163
	81	0.57064	2.50000	0.08775	0.00057	0.00559
	82	1.27198	2.80000	0.08556	0.00127	0.00660
	83	0.26078	3.30000	0.07883	0.00026	0.01145
	84	0.88213	3.90000	0.08058	0.00088	0.00581

	85	1.51640	0.34000	0.08516	0.00152	0.00600
	86	1.14633	0.31000	0.08125	0.00115	0.99120
	87	2.01625	0.48000	0.07363	0.00202	0.10000
	88	0.79982	0.91000	0.06992	0.00080	0.80000
	89	0.64694	0.61000	0.07011	0.00065	0.99140
202	90	0.60854	0.83000	0.07478	0.00061	0.99150
2	91	1.00342	0.41000	0.07592	0.00100	0.99150
	92	0.86696	0.21000	0.07401	0.00087	0.99160
	93	0.80754	0.65000	0.06477	0.00081	0.99170
	94	0.23917	0.41000	0.09621	0.00024	0.99170
	95	0.32658	0.11000	0.11240	0.00033	0.99180
	96	1.06546	0.42000	0.12183	0.00107	0.99190

Source: Author 2023.