IMPLICATIONS OF ENERGY CONSUMPTION ON ECONOMIC GROWTH IN KENYA.

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A RESEARCH PROJECT SUBMITTED TO THE DEPARTMENT OF ECONOMICS IN PARTIAL FULFILLMENT OF THE REQUIREMENT FOR THE REWARD OF THE DEGREE, BACHELOR OF SCIENCE IN ECONOMICS OF MAASAI MARA UNIVERSITY

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DECLARATION

This research project is my original work and has never been submitted for any degree award or any other award in any training institution.

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DEDICATION

I dedicate this scholarly piece of research project to my father Solomon, my friends Joseph and Emmanuel who availed their moral, material and scholarly support towards the running of this research project.

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ABSTRACT

The oil crisis of 1970's affected majorly developing countries which are largely oil importers, Kenya being one of them. In 2016, Kenya was ranked 75th in the world for oil consumption, accounting for about 0.1% of the world's total consumption of 97,103,871 barrels per day. Kenya's installed electricity capacity as of 2021 stood at 2,990 MW, a significant growth from 1,800MW in 2014, but still low for a country with a population of over 50 million. (World Bank). The Kenyan economy has been experiencing economic instability by being not able to absorb economic shocks, evident from the Ukraine-Russia civil war despite an increasing demand of oil consumption. Energy consumption in Kenya has been rising generally Kenya's energy consumption has been on the rise with a significant portion of energy mix comprising of petroleum and electricity. However, there is a limited understanding of the implication of this energy consumption on Kenya's economy. The study sought to investigate the implication of energy consumption on economic growth in Kenya between January 2006 and September 2022. Variables studied were petroleum, electricity and Gross Domestic Product. The study used an Ordinary Least Square (OLS) estimation technique to determine the relationship between the variables. Data went through a series of logarithmic transformation and differencing to make it stationary. Pre-estimation tests were carried out to ensure that data was stationary, normal and had no autocorrelation and multicollinearity. Regression results showed that generally economic growth and energy consumption have a positive relationship. The coefficient between petroleum consumption, electricity consumption and economic growth was positive. Electricity consumption show more elasticity on unit changes on GDP compared to Petroleum. Petroleum showed a statistical significance at 90% confidence level while electricity consumption was significant at 95% confidence level. More energy consumption means more output hence growth of the economy.

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LIST OF ACRONYMS AND ABBREVIATIONS

OPEC: Organization of petroleum exporting countries

GDP: Gross Domestic Product

KETRACO: Kenya Electricity Transmission Company

KPLC: Kenya power and lighting company

KNBS: Kenya National Bureau of Statistics

EREC: Electrification and Renewable Energy Corporation

HFO: Heavy fuel oil

NOCK: National Oil Corporation of Kenya

KenGen: Kenya Electricity Generating Company

IPPs: Independent Power Producers

IOCs: International oil companies

HDI: Human Development Index

BRICS: Brazil, Russia, India, China, and South Africa (is an acronym for five leading emerging economies)

WDI: World Development Indicator

MSMEs: Micro, Small and Medium Enterprises

EIA: Energy Information Administration

OLS: Ordinary least squares

ADF test: Augmented Dickey-Fuller test

ARDL: Autoregressive distributed lag model

NARDL model: Nonlinear autoregressive distributed lag model

VAR: Vector autoregressive

CS-ARDL model: Cross-sectional augmented autoregressive distributed lag model

CS-DL model: Cross-sectional augmented distributed lag model

C.GDP%: Percentage change in GDP

C. Petroleum%: Percentage change in Petroleum

C. Electricity%: Percentage change in Electricity

d3dlogpet: Third differencing of log of petroleum

d3dlogelect: Third differencing of log of electricity

d3dlogngdp: Third differencing of log of GDP

CHAPTER ONE

1.0 Introduction

The chapter describes the background of the study, statement of the problem, objectives of the problem, the research questions, significance of the study, the scope of the study, justification, limitation of the study, delimitation of the study and the ethical issues used in the research.

1.1 Background of the study

Energy as in input in production has been of great concern to economists in particular in realizing the growth of country's Gross Domestic Product (GDP). Oil prices especially in developing economy countries have shown a great impact on both external and internal economic environment of such countries, evident among the sub-Saharan countries. Energy prices have an inflationary effect on the economy thus reducing real wages. Reduction in real wages directly affect savings leading to less money to invest hence reduction in the growth of an economy ultimately. It goes without contradiction that most countries with oil deposits, except a few, are highly developed. This therefore shows that energy generally has an impact on the growth of an economy, whether directly or indirectly. However, energy in traditional production theories has been disregarded as an important input in production as it does not enter the production function directly. Instead, the focus their effort on land, labor, capital and entrepreneurship (Wikipedia, 2023).

It is evident that the oil crisis of 1970's affected majorly developing countries which are largely oil importers, Kenya being one of them. Since then, oil got more attention. Scholars started modelling energy-economy interactions in developing economies. Organization of petroleum exporting countries (OPEC) estimates that developing economies consume only about one-sixth of the world oil. Despite the insignificant share, they are badly affected by price movements in the world markets because of their dependence on imported oil and low investments in alternative sources of energy. Energy has taken a significant place alongside labor, capital and land as key factors of production. Therefore, energy policy in development strategies is essential (OPEC).

Kenya's oil consumption has been on the rise over the years. In 2016, Kenya was ranked 75th in the world for oil consumption, accounting for about 0.1% of the world's total consumption of 97,103,871 barrels per day. Kenya registered a consumption of over two million metric tons of light diesel oil in 2020. This comprised nearly half of the total domestic consumption of petroleum products that year. Additionally, Kenya consumes nearly 1.4 million metric tons of gasoline. The country has over the years been importing substantial amounts of crude oil and natural gas. Kenya is an increasingly promising player in the booming East Africa oil and gas market. The multiple onshore discoveries announced by Tullow Oil since 2012 have led exploration and production companies' optimism about the country's potential. A total of 63 oil exploration blocks have been announced, of which 37 are licensed to international oil companies (IOCs) and one to the National Oil Corporation of Kenya (NOCK). A total of 78 wells have been drilled so far, with 10 showing oil discoveries and two with natural gas flows. Tullow estimates current crude oil recoverable reserves at approximately 750 million barrels. The company has allocated $100 million for pre-development spending in Kenya, in addition to $125 million for exploration and appraisal spending with a potential for another $75 million (World Bank).

Kenya's installed electricity capacity as of 2021 stood at 2,990 MW (KPLC), a significant growth from 1,800MW in 2014, but still low for a country with a population of over 50 million. The Government of Kenya (GOK) has pursued efforts that increase power demand and supply and lower the cost of electricity by injecting cheaper renewable energy sources such as geothermal, wind, solar, and the addition of natural gas into the energy mix while weaning off the more expensive heavy fuel oil (HFO) plants. It is expected that generation will reach 5,000MW by the year 2030, with the bulk of it coming from geothermal, natural gas (imports), wind, and solar. Around a third of Kenya's installed capacity is owned and operated by independent power producers (IPPs) across several plants, including small-scale hydro plants, geothermal, biomass, wind, solar, and heavy fuel oil plants. The remaining capacity is owned and operated by Kenya Electricity Generating Company (KenGen), which is 70% government-owned (Kenya Ministry of Energy)

Kenya experiences approximately 16% system loss of generated power due to aging transmission and distribution networks. To address this, Kenya Electricity Transmission Company (KETRACO) is constructing 4,500 kilometers of new power lines, more than doubling the transmission network and introducing Kenya's first high-voltage 400kV and 500kV DC lines, as well as three major regional interconnectors to Ethiopia, Uganda, and Tanzania. Beyond these lines, KETRACO is planning a further 4,200 kilometers of lines to expand and strengthen the grid. (KPLC)

1.2 Statement of the problem

The Kenyan GDP has been experiencing fluctuations over the years. Although the GDP has risen with reference to 1964 when Kenya got independence, the rise in GDP has not been steady and other countries like China and India who were initially at the same bar have shown a significant improvement in their GDP compared to Kenya. The Kenyan economy has been experiencing economic instability by being not able to absorb economic shocks, evident in Ukraine-Russian civil war. Kenya's energy consumption has been on the rise with a significant portion of energy mix comprising of petroleum and electricity. Oil consumption in Kenya has been rising generally but fluctuations are evident in oil consumption. The oil revenue realized remain constant over the years then boomed in 2018 and levelled up in 2019 and 2020. Consumption of electricity has also been increasing generally over the years. However, there is a limited understanding of the implication of this energy consumption on Kenya's economy. This study aims to explore the impacts of energy consumption on economic growth as well as identify potential policy measures to be taken to realize more growth of the Kenyan economy.

1.3 Objectives of the study

1.3.1 The general objective

To ascertain the implication of energy consumption on economic growth in Kenya.

1.3.2 Specific objectives

To determine the impact of petroleum fuels consumed on economic growth.

To find out the impact of consumption of electricity on the growth of the economy.

1.4 Research hypotheses

H0: Petroleum fuels consumed do not have an impact on economic growth

H1: Petroleum fuels consumed have an impact on economic growth.

H0: Electricity consumption do not influence economic growth.

H1: Electricity consumption influence economic growth

1.5 Significance of the study

This research study is of paramount importance in macro economy. Price over the years has been a common denominator of the energy sector in that, more focus has been put to prices of energy as opposed to units of the energy that is consumed. This research will therefore expand the knowledge and shift attention to focus on units of the energy consumption in efforts to influence economic growth. It will spur more rigorous research to be done concerning connectedness between price and units of energy consumed in an economy and their relation to economic growth and the extent to which both affect the growth of the economy. This research study will help the authorities to formulate policies to channel efforts to manage energy consumption in line to cost and benefits approach to achieve the growth of the economy.

1.6 The scope of the study

The study focused on aggregate energy consumption the Kenyan economy as a whole. The energy sector was targeted majorly by the research. The research topic spanned for the period between January 2006 and September 2022 since this was the period that the research project would find relevance.

1.7 Justification

Previous researchers have made efforts to determine how energy consumption and its relationship to economic growth of a country. However, most researchers have not been able to link electricity and petroleum consumption jointly in determining how both influence economic growth. Researchers have also been using aggregate electricity consumption as opposed to electricity that is used specifically in productive purposes. Still, per capita energy consumption in their research work is also evident and this might have influenced their findings. Energy consumption per capita does not really reflect a clear picture of the real energy consumption because if population level rises while consumption level remains constant, energy consumption per capita falls hence inefficient. This research project will bridge the knowledge gaps of the previous researchers.

1.8 Limitation of the study

The study encompassed the use of secondary data which are majorly found in the internet. Inefficient secondary data was evident especially from sources that did not have official documentations.

1.9 Delimitation of the study

To address the limitations of the project, the researcher used primarily data that was posted on official documents such as official release of KNBS publications to obtain reliable results.

1.10 Assumption of the study

The study had the following assumptions:

i. Energy consumption is directly proportional to production units of goods.
ii. There are minimal or no energy losses.
iii. A large portion of energy is used in production purposes.

1.11 Ethical issues of the study

Data in research is essential in making conclusions. In secondary research data manipulation by the primary researcher is usually possible. Therefore, the researcher cross-examined data that would be used in the research project to establish consistency of the data used. The researcher also validated the credibility of the source of secondary data used and avoid data from unrecognized sources and or institutions. Again, the researcher did not manipulate data obtained from the secondary sources to suite his preference to influence the findings ultimately.

CHAPTER TWO

LITERATURE REVIEW

2.0 Introduction

The chapter describes the theoretical literature, empirical literature, analysis of existing literature, the research gap, theoretical framework and the conceptual framework.

2.1 Theoretical literature

2.1.1 Endogenous Growth Theory.

It is also referred to as New Growth Theory (NGT). This is a fresh take on the drivers behind economic prosperity and growth. Endogenous growth theory maintains that economic growth is primarily the result of internal forces, rather than external ones. It argues that improvements in productivity can be tied directly to faster innovation and more investments in human capital from governments and private sector institutions. The endogenous growth model states that the economic growth of any nation is an outcome of internal factors like human capital, knowledge, and innovation. This principle stresses internal factors and not exogenous forces. This school of thought believes that governments and private sector enterprises should work on endogenous elements contributing to research_and_development. This will lead to technological advancement and a rise in productivity in the long run (Romer, 1990).

The origin of endogenous growth theory can be traced back to the 1980s. Economists back then opposed Solow Swan's neo-classical growth model. The neo-classical model disregarded the impact of exogenous forces on economic development. The exogenous growth model highlighted the role of physical_capital investments and infrastructure (exogenous factors) in causing a gap between developed nations and under-developed nations. (Author)

According to Romer (1990), aggregate output is dependent on the quantities of capital, labor and technology which is treated as an endogenous factor, appearing in the production function as an input. Capital accumulation is actualized by technical knowledge acquired through research and development and other knowledge creating processes. He argues that whereas intra-firm production exhibits constant returns to scale, there occurs external increasing returns to scale since benefits of technological improvements from research and development are not only limited to the undertaking firm but also other firms in the industry through copying the new methods and ways of doing things. Similarly, human capital investment results in not only an improvement in labor and capital productivity but also economy-wide worker productivity.

Romer (1990) concludes that technological growth works to offset diminishing returns to capital that exhibits growth so that the investment are directly influences the growth rate. One of the biggest criticisms aimed at the endogenous growth theory is that it is impossible to validate with empirical evidence.

2.1.2 Solow growth model

According to Solow (1956), the rate of growth depends on the growth rate of capital stock, labor supply and exogenously determined technological progress (A) and (AL) effective labor with technological progress so associated referred to as labor augmenting or Harold neutral. The assumption of the production function relates to capital and effective labor exhibiting constant returns to scale in output, but with the declining marginal product of capital. Incremental output due to an incremental capital and labor can be obtained as the sum of the products of marginal physical products of labor (MPL) and capital (MPK) with the respective increases in capital and labor.

Solow (1956) acknowledges that savings, labor and depreciation are responsible for the accumulation of capital stock and the subsequent growth in output such that while higher rates of savings would increase transitory output, depreciation and population growth would act to restrain. The implication of this being a steady state level of the economy where savings would equal depreciation irrespective of starting level of capital in the economy. Solow (1956) therefore asserts that an increase in growth of an economy can only be brought about by technological progress, by continually shifting the production function and hence raising the effectiveness of the productivity of labor. The shortcomings of the Solow model however are centered on its inability to explain origin and factors influencing technological progress.

2.2 Empirical literature

2.2.1 Impacts of petroleum fuels consumption on economic growth.

Rahman et al (2018) studied the relationship between oil consumption and economic growth in Bangladesh using annual data ranging from 1980 to 2015. GDP was the dependent variable, oil consumption being the explanatory variable. All variables were co-integrated and Granger Causality test results showed that a unidirectional causality was running from oil consumption to economic growth, which went hand to hand with the growth hypothesis.

Harun & Pata (2016) investigated the causality link between economic growth and oil consumption using annual data over the years of 1974-2014 by using causality tests and the Engle-Granger and Gregory-Hansen co-integration models for the Turkish economy. Individual oil consumption levels were the explanatory variables while economic growth was the explained variable in the model. Empirical findings supported the view that there is no long term co-integration between the level of economic growth and oil consumption level. However, the UVAR, TYVAR and Hsiao's Granger causality tests in the short term showed that a positive one-way causality was going from the oil consumption level to the economic growth rate, and oil consumption level stimulates economic growth rate.

Yousaf (2022) analyzed the relationship of fossil energy consumption with economic development in the case of BRICS countries between 1990 and 2019. Coal, oil and natural gas were used as independent variables and Human Development Index as dependent variable. Fully modified ordinary least squares is used with the quadratic function of coal, oil, and gas consumption to assess the size-based effect across time. This study showed that coal and natural gas consumption follows the inverted U-shaped relationship with HDI, while coal consumption showed a negative relationship with Human Development Index (HDI).

Oduro et al (2020) carried out a study to investigate the impact of crude oil consumption and oil price on the growth of the Ghanaian economy. The variables used were oil prices and yearly consumption units as independent and economic growth as the dependent variable. It proceeded with annual time series data (1980-2016) sourced from World Development Indicator (WDI) and Energy Information Administration (EIA). All variables used in the study were integrated of order one as suggested by the Augmented Dickey-Fuller (ADF) test. Further, the Johansen Cointegration test suggested the existence of cointegration among the variables. The study used the OLS estimation procedure. The study found a positive and statistically significant relationship between oil price and economic growth in the long run. On the other hand, an inverse relationship was found between crude oil consumption and economic growth in the long run.

Buabeng et al (2022) examined the effect of oil revenue on economic growth of Ghana using bounds test approach to co-integration within the framework of autoregressive distributed lag model (ARDL) as estimation strategy. Oil revenue was used as the independent variable and economic growth as the dependent variable. The ARDL estimates suggested that an increase in oil revenue generated a significant increase in economic growth of Ghana, implying that oil revenue boost economic growth. Supplementary finding of the study revealed that non-oil revenue, capital and foreign direct investment (FDI) affect economic growth of Ghana positively while interest rate exert a negative effect on economic growth of Ghana.

Dzulfikri et al (2022) examined the asymmetry effect of oil consumption, unemployment, and broadband technology on economic growth in Indonesia. Oil consumption, unemployment rate and broadband technology were independent variables while economic growth was the dependent variable. Data on these attributes were annually collected from 2000 to 2019. The effect test result using the nonlinear autoregressive distributed lag (NARDL) model showed that oil consumption and unemployment affect economic growth asymmetrically in the long and short term. Meanwhile, broadband technology only affect economic growth in the long term, and the effect was positive.

Erwin et al (2022) examined the relationship between coal consumptions, electricity consumptions, and oil consumptions on MSMEs and contributors of exports of goods and services in Indonesia. Coal, electricity and oil consumption were explanatory variables while MSMEs exports were the dependent variable. Coal consumptions and oil consumptions triggered a positive increase in MSMEs and contributors to exports of goods and services. From another scope, electricity consumption had empirical evidence that affected the contribution of exports of goods and services through MSMEs.

Koengkan and Matheus (2017) investigated the nexus between consumption of biofuels and economic growth in Brazil during the period of 1990 to 2015. Consumption levels were used as explanatory variable and economic growth as the dependent variable. The vector autoregressive (VAR) was applied. The preliminary tests proved the presence of multicollinearity and the existence of unit root in the variables. The results of VAR model indicated the existence of a bidirectional relationship between consumption of biofuels and economic growth, consumption of oil and economic growth, and consumption of biofuels and oil.

Simone et al (2020) studied the energy-economic growth nexus with a new approach with the introduction of globalization index, in ten Latin American and the Caribbean countries from 1971-2014. Variables used include energy consumption as explanatory variable and economic growth and globalization (dummy) as the dependent variables. The Autoregressive Distributed Lag (ARDL) and the Granger causality Wald test were used as a methodology. The empirical results pointed to the existence of a bidirectional relationship between economic growth and consumption of renewable energy, a unidirectional relationship from consumption of fossil to economic growth, and a bidirectional relationship between globalization and consumption of renewable energy.

Kamah et al (2021) carried a study on revisiting energy consumption-economic growth. Energy consumption was the independent variable and economic growth as the dependent variable. The study applied cross-sectional augmented autoregressive distributed lag (CS-ARDL) and cross-sectional augmented distributed lag (CS-DL) models to examine the long-term impact of energy consumption on economic growth. The empirical results revealed that energy consumption has a positive and significant long-run effect on economic growth and that cross-sectional dependence, slope endogeneity and heterogeneity are issues that should be on the watch when dealing with panel data of developing and developed countries' analysis. Furthermore, the outcomes indicated that the impact of energy consumption on economic growth is stronger in less developed countries than in advanced economies.

2.2.2 Impacts of consumption of electricity on the growth of the economy.

Bildirici and Melike (2013) estimated the causality relationship between electricity consumption and economic growth by Markov Switching VAR (MS-VAR) method for some emerging countries: Argentina, China, India, Brazil, Mexico, Turkey and South Africa. Variables used for the study included electricity units consumed and economic growth. The results from MS-VAR models show that in first, second and third regime, electricity consumption is the Granger cause of the economic growth and economic growth is the Granger cause of the electricity consumption. In sum, we found some evidence of bidirectional Granger causality between the electricity consumption and the economic growth.

Koengkan and Matheus (2017) analyzed the nexus between hydroelectricity consumption and economic growth in seven Latin American countries in the period from 1966 to 2015, using an auto-regressive distributive lag (ARDL) methodology. Hydroelectricity was used as the independent variable while economic growth was the dependent variable. The results suggested the existence of feedback hypothesis in short-run, where the hydroelectricity consumption and economic growth are interrelated.

Magdalena et al (2023) investigated the relationship between geothermal energy consumption, economic growth, and foreign direct investments in countries where geothermal energy production is possible. Geothermal energy units and foreign direct investment were the explanatory variables and economic growth the explained variable. The results obtained showed a one-way causality from economic growth to geothermal energy and one-way causality from geo-thermal energy consumption to foreign direct investments. The results obtained individually based on countries indicate that one-way causality from foreign direct investment to geothermal energy consumption was found for Mexico and Portugal, and one-way causality from geothermal energy consumption to economic growth for Italy and Mexico. On the other hand, it is understood that causality is determined for Germany, Japan, and the USA from economic growth to geothermal energy consumption. No significant results were found for Turkey and New Zealand, and it is understood that the macroeconomic structures of these countries are not affected by geothermal energy.

José et al (2022) studied the interactions between renewable energy consumption, economic growth and globalization: Fresh evidence from the Mercosur countries. Variables of the study included renewable energy consumption, economic growth and globalization. Data for five Mercosur countries between 1980 and 2014 and the panel vector auto regression (PVAR) methodology were used. The results from PVAR model regression and panel Granger causality Wald pointed to bidirectional causality between renewable and fossil fuel consumption and economic growth. The results also suggested that the Mercosur countries are dependent on fossil fuels. Moreover, the results also indicated that the globalization process has a positive indirect influence on renewable energy consumption.

Erwin et al (2022) examined the relationship between coal consumptions, electricity consumptions, and oil consumptions on MSMEs and contributors of exports of goods and services in Indonesia. Coal, electricity and oil consumption were explanatory variables while MSMEs exports were the dependent variable. Coal consumptions and oil consumptions triggered a positive increase in MSMEs and contributors to exports of goods and services. From another scope, electricity consumption had empirical evidence that affected the contribution of exports of goods and services through MSMEs.

2.3 Analysis of existing literature

Rahman et al (2018) studied the relationship between oil consumption and economic growth in Bangladesh. From the findings the study did not show the degree of causality between oil consumption and economic growth. The study did not also show the long term and short term effects of oil consumption on economic growth. That is also the case in the study of Harun & Pata (2016) where the study did not encompass other external factors that affected the Turkish economy which might have contributed to the differences in the short-term and the long term findings. The study by Yousaf (2022) used inferior variables to with regard to the negligible degree of economic contribution of the variables (coal and natural gas) and this might have influenced the findings. So is the study by Erwin et al (2022. Oduro et al (2020) and Buabeng et al (2022) carried their study in countries that have fossil fuel deposits and did not give sufficient conclusions because not all countries have fossil fuel deposits. The results might have been influenced by tariffs imposed on exportation of the oil as opposed to the contribution of the oil to productive purposes of the country. Dzulfikri et al (2022) brought the impact of broadband technology in the study. The findings might have been influenced by the technology and not by consumption of oil. Still, with introduction of technology, the short-term effect will differ from the long-term effect of oil consumption to the economy because technology is only variable in the long-term. Globalization, which is introduced in the study by Simone et al (2020) as a variable is not an indicator of economic growth but economic development instead. This means that, with globalization, the study was limited to industrialized countries because the less-developed countries do not factor in the impact of globalization because the economy is still struggling to pick up.

The study by Bildirici and Melike (2013) concentrated industrialised countries which are more or less technologically fit. The study did not also factor out incidences of energy losses and energy that is not used for domestic consumption which would otherwise translate to economic growth. Koengkan and Matheus (2017) and Magdalena et al (2023) limited their research to a single source of electricity. That is, hydroelectricity and geothermal power respectively. This might fail to explain the contribution of other sources of electricity which would otherwise influence the findings of the study. Again, Magdalena et al (2023) factored in foreign direct investment (FDI) which might have caused the economy to grow and not electricity consumption. José et al (2022) other than introducing globalization as a variable, the study did not determine the long-term and short-term effects of levels of electricity consumption on economic growth.

2.4 Research gap

Most of the research done by previous researchers were tailed towards specific variables and specific countries, most of them being developed country-economies if not oil exporters. Still, researchers have not studied the combination of electricity and petroleum consumption jointly. External economic shocks that are not related to energy consumption have not been coded into the studies and this can influence the findings of the studies. Most researchers have been focusing on effects of energy prices as opposed to consumption and most did not examine instances of energy losses. Therefore, this study has therefore sufficiently merged the knowledge gaps to generate a comprehensive conclusion on energy consumption and economic growth.

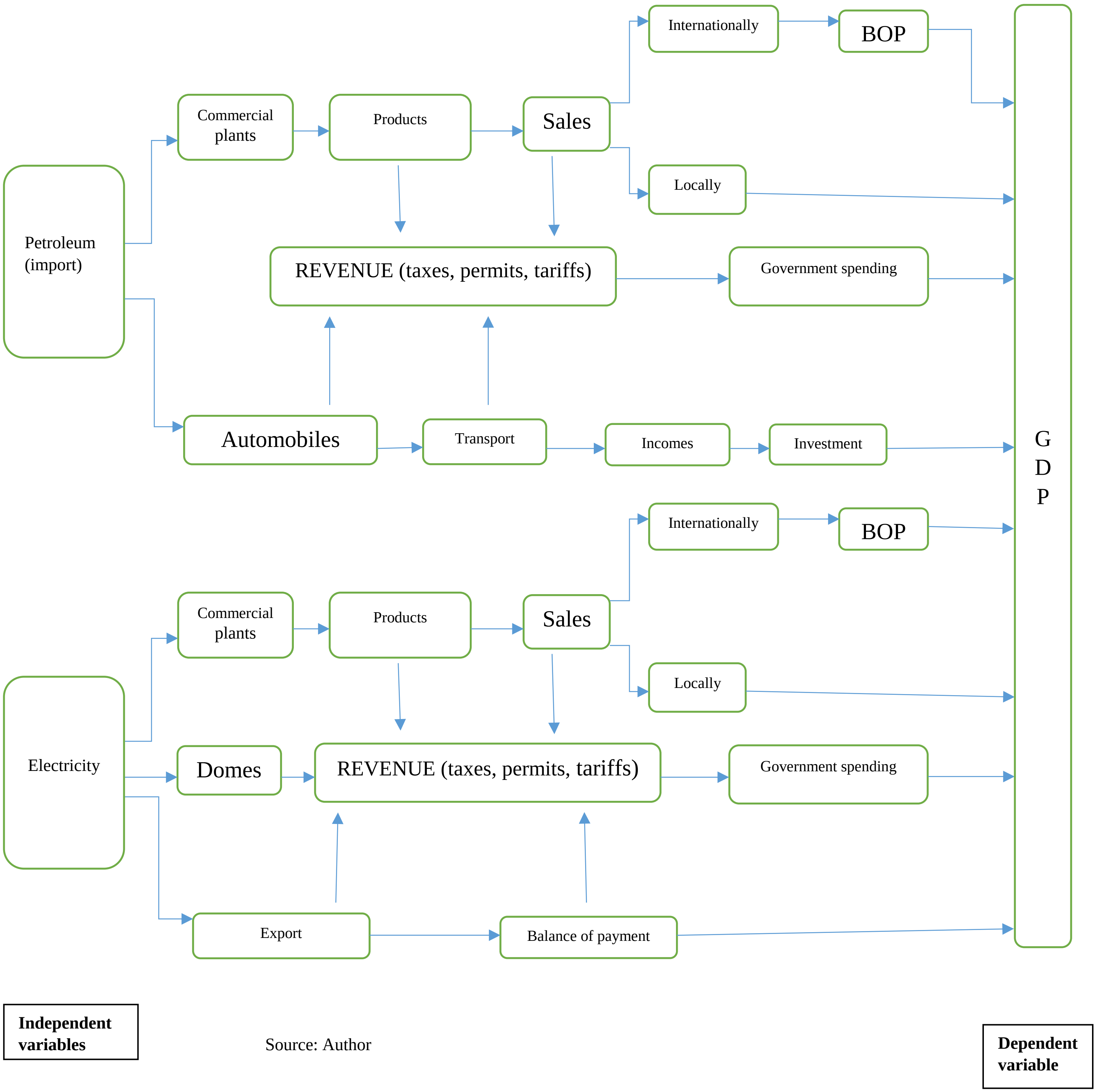
2.5 Theoretical framework

From the endogenous growth theory, output of a country can only be improved by internal factors of the economy as opposed to external factors. This implies that and increase or a decrease in consumption of energy in an economy, supposed that the energy margins were used for productive purposes then the economy will suffer or gain as a result. The Solow growth model exhibits a perfect relationship between inputs (labor and capital) and output. Energy in production is an essential input in production and hence a change in the level of energy consumed will influence the level of output realized affecting the level of economic growth.

2.6 Conceptual framework

Conceptual frame work is a diagrammatic representation of variables in a study, their operational definition and how they interact in the study. It shows how the independent variables influence the dependent variable of the study. The following conceptual framework shows factors

Figure 2. 1 Conceptual framework



Source: Author

CHAPTER THREE

METHODOLOGY

3.1 Introduction

This section accords a description of the research design used, theoretical model, empirical model, diagnostic tests and data analysis.

3.2 Research design

The study was non-experimental. This is because in this study, the researcher neither deliberately manipulated variables nor was the setting controlled. The researcher collected data without making changes or introducing treatments.

3.3 Theoretical model

The main concern of this research was to ascertain the implication of energy consumption on economic growth in Kenya. The analysis can be presented as a framework of a simple neoclassical production function. In this framework, it was assumed that output is determined by a Cobb-Douglas production function of the form;

$$Y_t = A_t L K_t \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \text{(3.3.1)}$$

Where Y_t is aggregate output, A_t is efficiency in production at time t, L is Labor and K_t refers to other physical capital of the country.

A modified Cobb-Douglas production function can be used to analyze the relationship between energy consumption and economic growth. The modified production function can be expressed as follows;

$$Y_t = L K_t E_t P_t \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \text{(3.3.2)}$$

Where Y_t is aggregate output at time t, A_t is efficiency in production at time t, L is Labor, K_t is other physical capital of the country, E_t is electricity endowment at time t and P_t is petroleum fuel available at time t.

The basic concept of growth implies periodical changes in output from periodical changes in inputs (Banister 2000). That is, Y, A, L, K, P and E change overtime.

3.4 Empirical Model

To attain the objective of establishing the implications of energy consumption on economic growth, the study used the model below.

Model 3.1:

$$y = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \varepsilon \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots 3.4.1$$

Where:

Y= Gross domestic product

X_1= Petroleum fuel consumption

X_2= Electricity consumption

Equation 3.4 showed that national output is a function of petroleum consumption and electricity consumption. It was used to determine whether energy consumption causes economic growth.

3.5 Definition and Measurement of Variables.

Table 3. 1 Definition and Measurement of Variables

Variable	Definition	Measurement
Economic growth	Refers to an increase in the amount of goods and services produced per head of the population over a period of time, usually a year.	Economic growth will be measured in annual change in real gross domestic product (GDP) in billions of US dollars.
Electricity	Is a form of energy resulting from the existence of charged particles, either statically as an accumulation of charge or dynamically as electric current	Electricity will be measured in annual change in electricity units expressed in million kilowatts per hour (kWh).
Petroleum	Is a liquid mixture of hydrocarbons which is resent in suitable rock strata and can be extracted and refined to produce fuels including petrol, paraffin and diesel oil.	Petroleum will be measured in yearly change in petroleum consumption expressed in a thousand metric tons(MT)

3.6 Data Type and Source

The research used secondary data from various published journals majorly Kenya national Bureau of Statistics (KNBS), Kenya Power and Lighting Company (KPLC) and Energy and Petroleum Regulatory Authority (EPRA). Key reference material for the data were statistical releases on major economic indicators in the Kenyan economy from 2006 to 2022.

3.7 Diagnostic Test

Diagnostic tests were executed to inspect the consistency and efficiency of the coefficient estimates and determine the adequacy of the data collected.

3.7.1 Stationarity Test

Stationarity was tested to circumvent spurious results; unit root was tested using the augmented dickey fuller (ADF) technique. This test was appropriate in exploring the extended character of the variables.

3.7.2 Normality Test

This test was carried out to verify if the error terms were normally distributed. The study evaluated whether the residuals exhibited normal distribution through skewness and kurtosis tests.

3.7.3 Autocorrelation

The Breusch-Godfrey LM test was applied to test the presence of serial correlation omitted from the model structure. Considering the Durbin-Watson test is plausible in non-stochastic regressions, the Breusch-Godfrey test was considered better.

3.7.4 Multicollinearity

It is the case where the independent variables in a model are highly correlated, and if present, the statistical inference made about the data may not be reliable. The study will use the variance inflation factor (VIF) method to identify the correlation between the independent variables and the soundness of the relationship.

3.8 Data Analysis

Data was collected from published materials and journal in KNBS portal. The data was entered into a Microsoft excel to give way to analysis of the data. Data was analyzed with help of Stata.

3.8.1 F-test

The researcher carried out an f-statistic test where the dependent variable (economic growth) was regressed on predicting variables of petroleum and electricity consumption. The model was tested at a significance level desired by the researcher (5% and 10%) and 2 degrees of freedom. If the significance value lie below the desired p-value, the model was considered significant. Otherwise the model would be insignificant. The researcher then determined the overall impact of petroleum and electricity consumption on economic growth by examining the coefficient of determination (R^2) to study the proportion of the variation in economic growth predictable to from petroleum and electricity consumption.

3.8.2 Individual parameter t-test

Additionally, coefficients were further assessed to ascertain the influence of each of the independent variables. The hypotheses were stated as follows.

i. H_0: Petroleum fuels consumed do not have an impact on economic growth

   H_1: Petroleum fuels consumed have an impact on economic growth.

ii. H_0: Electricity consumption do not influence economic growth.

   H_1: Electricity consumption influence economic growth.

From the empirical model,

$$\hat{y} = \hat{\beta}_0 + \hat{\beta}_1 x_1 + \hat{\beta}_2 x_2$$

The first hypothesis was stated as:

H_0: $\beta_1 = 0$

H_1: $\beta_1 \neq 0$

The researcher determined the value of β_1 and t-statistic at a p-value of 0.05. The researcher used a two-tailed critical t-statistic of 2. If the t-statistic lie in the acceptance region, the researcher would not reject the null hypothesis. Otherwise, the researcher rejected the null hypothesis. By rejecting the null hypothesis, it implied that petroleum consumption has an impact on economic growth. Otherwise it would imply that petroleum consumption does not have an impact on economic growth.

The second hypothesis was stated as:

H_0: $\beta_2 = 0$

H_1: $\beta_2 \neq 0$

The researcher determined the value of β_2 and t-statistic at a p-value of 0.05. The researcher used a two-tailed critical t-statistic of 2. If the t-statistic lie in the acceptance region, the researcher did not reject the null hypothesis. Otherwise, the researcher rejected the null hypothesis. By rejecting the null hypothesis, it implied that electricity consumption has an impact on economic growth. Otherwise it would imply that electricity consumption has no impact on economic growth.

CHAPTER FOUR

RESULTS AND DISCUSSION

4.0 introduction

This chapter presents the empirical approach undertaken to qualify the interactions between the variables under study while presenting and interpreting the findings.

4.1 Descriptive statistics

Descriptive summary of the variables shown in Table 4.1 indicate that all variables were normally distributed as their skewness coefficients have absolute values that are less than 1. Better still, tests show that all variables exhibited a kurtosis values of 4 and below. The data is therefore shows a normal distribution.

Table 4.1 Descriptive statistics

Descriptive Statistics

Variables	Obs	Mean	Std. Dev.	Min	Max	p1	p99	Skew.	Kurt.
d3dlogngdp	13	-.007	.042	-.101	.076	-.101	.076	-.268	4.055
d3dlogelect	13	0	.057	-.116	.072	-.116	.072	-.458	2.395
d3dlogpet	13	-.013	.244	-.338	.47	-.338	.47	.436	2.233

Source: output from Stata

4.2 Stationary test

To make study variables stationary, the researcher transformed the original data as a percentage change of the previous year, found the logarithmic transformation of the percentage changes. The researcher then differenced the logarithmic transformation to achieve stationarity. The researcher performed Augmented Dickey-Fuller test for log difference of percentage change in GDP and the output was as shown in table 4.2 below.

Table 4. 2 Augmented Dickey-Fuller test, log difference of percentage change in GDP.

Dickey-Fuller test for unit root Number of obs = 12

	Test Statistic	1% Critical Value	5% Critical Value	10% Critical Value
		---------- Interpolated Dickey-Fuller ---------		
Z(t)	-5.579	-3.750	-3.000	-2.630

MacKinnon approximate p-value for Z (t) = 0.0000

Source: output from Stata

From table 4.2 above, the p-value of the test statistic (p-value for z (t) = 0.000) was less than 0.05. Moreover, the absolute value of the test statistic was greater than the absolute value of the critical value at 5% significance level (5.579 >3.000). Therefore, we reject the null hypothesis and conclude that the differenced log transformation of GDP was stationary.

The researcher performed Augmented Dickey-Fuller test for log difference of the percentage change in petroleum to ascertain for the stationarity of the variable. The results were as shown in table 4.3 below.

Table 4. 3 Augmented Dickey-Fuller test, log difference of percentage change in petroleum.

Augmented Dickey-Fuller test for unit root Number of obs = 12

	Test Statistic	1% Critical Value	5% Critical Value	10% Critical Value
		---------- Interpolated Dickey-Fuller ---------		
Z(t)	-4.338	-3.750	-3.000	-2.630

MacKinnon approximate p-value for Z (t) = 0.0004

Source: output from Stata

The table above shows the output generated after performing Augmented Dickey-Fuller test for log difference of percentage change in petroleum. From the table, the p-value of the test statistic (p-value for z (t) =0.0004) was less than 0.05. The absolute value of the test statistic (4.338) was greater than the absolute critical value at 5% significance level (3.000). Therefore, we reject the null hypothesis and conclude that log difference of percentage change in petroleum was stationary.

To test stationarity of log difference of percentage change in electricity (variable), the researcher performed Augmented Dickey Fuller test and the output was as shown on table 4.4 below.

Table 4. 4 Augmented Dickey-Fuller test, log difference of percentage change in electricity

Augmented Dickey-Fuller test for unit root   Number of obs   = 12

	Test Statistic	1% Critical Value	5% Critical Value	10% Critical Value
		---------- Interpolated Dickey-Fuller ---------		
Z(t)	-4.721	-3.750	-3.000	-2.630

MacKinnon approximate p-value for Z (t) = 0.0001

Source: output from Stata

From table 4.4 above, the p-value of the test statistic (p-value for z (t) = 0.001) was less than 0.05. Moreover, the absolute value of the test statistic (4.721) was greater than the absolute value of the critical value at 5% significance level (3.000). Therefore, we reject the null hypothesis and conclude that the differenced log transformation of electricity was stationary.

4.3 The model

After ascertaining that the variables of the model were stationary, the researcher regressed the variables to fit the model. The resulting model was as shown below;

$$\hat{y} = -0.06 + 0.075x_1 + 0.509x_2$$

From the fitted model above, a unit (billion US dollar) change in gross domestic product (y), petroleum increases by 0.075 units (million metric tons) holding all the other factors constant. It was also evident that holding all the other factors constant, a unit (billion US dollar) increase in Gross domestic product, electricity increases by 0.509 units (million kWh).

4.4 Normality test

The researcher tested for the normality of the residuals of the fitted model. He used skewness-kurtosis test after predicting residuals of the model and results were as shown in table 4.5 below.

Table 4. 5 Skewness/Kurtosis test for normality

Skewness/Kurtosis tests for Normality

------ joint ------

Variable	Obs	Pr(Skewness)	Pr(Kurtosis)	adj_chi2(2)	Prob>chi2
resid	13	0.681	0.420	0.890	0.640

Source: Stata output

From the table, the probability of skewness (0.681) was greater than 0.05 implying that skewness was asymptotically normal. Similarly, pr (kurtosis) indicates that kurtosis was asymptotically distributed (p-value of kurtosis = 0.420). Finally, chi (2) is 0.640 which is greater than 0.05 implying its significance at 5% significance level. Consequently, the null hypothesis could not be rejected. Therefore, according to the skewness test for normality, residuals showed normal distribution.

4.5 Autocorrelation

To verify for serial correlation, the study carried out Breusch-Godfrey LM test and the output was as shown on table 4.6 below. From the table, the probability of chi 2 is greater than 5% therefore the null hypothesis of no serial autocorrelation was not rejected.

Table 4. 6 Breusch-Godfrey LM test for autocorrelation

Breusch-Godfrey LM test for autocorrelation chi2	df	Prob>Chi2
3.469	1	0.063

H0: no serial correlation

Source: output from Stata

4.6 Multicollinearity

To verify if the data used in the research study had incidences of multicollinearity, the study utilized variance inflation factor (VIF) method to identify the correlation between the independent variables and the soundness of the relationship. Table 4.7 shows results obtained. The rule of the thumb is that a VIF value above ten indicate a high degree of multicollinearity. From the output below, all the VIF values are below ten and close to unitary indicating that there was no multicollinearity.

Table 4. 7 Variance inflation factor for multicollinearity

Variance inflation factor

	VIF	1/VIF
d3dlogelect	1.046	.956
d3dlogpet	1.046	.956
Mean VIF	1.046	.

Source: output from Stata

4.7 Test for Regression

The adequacy of the regression model was tested using the F-test at 95% confidence level. The results of the test were as shown in table 4.8

Table 4. 8 F-Test

Linear regression

Mean dependent var	-0.007	SD dependent var	0.042
R-squared	0.551	Number of obs	13
F-test	6.143	Prob > F	0.018
Akaike crit. (AIC)	-51.278	Bayesian crit. (BIC)	-49.583

**** p<.01, ** p<.05, * p<.1*

Source: output from Stata

The results shown in table 4.8 showed that the regression model was adequate at 95% confidence level (F=6.143, P=0.018). This showed that at least one of the independent variable had a significant effect on the dependent variable.

The individual parameter t-test was carried out to ascertain the independent variable that had a significant effect on the dependent. The results for the test was as shown in table 4.9

Table 4. 9 Individual Parameter t-test

d3dlogngdp	Coef.	St.Err.	t-value	p-value	[95% Conf	Interval]	Sig
d3dlogpet	.075	.037	2.03	.07	-.007	.157	*
d3dlogelect	.509	.158	3.22	.009	.157	.861	***
Constant	-.006	.008	-0.65	.529	-.024	.013	

Source: output from Stata

The results shown in table 4.9 showed that electricity (d3dlogelect), at 95% confidence level, the p-value was below 5% and the t-statistic was above 2 (P=0.009, t=3.22). Therefore the researcher rejected the null hypothesis at 95% confidence level and concluded that electricity consumption has statistically significant impact on the level of economic growth. Petroleum (d3dlogpet) at 95% confidence level, the p-value was above 5% and the t-statistic was 2 (P=0.007, t=2.03). Therefore the null hypothesis was not rejected and concluded that at 95% confidence level, petroleum consumption has no statistically significant impact on the level of economic growth.

4.8 Discussion

4.8.1 Impacts of petroleum fuels consumption on economic growth.

From the study findings, we have found that the level of petroleum consumption has a positive relationship on the level of economic growth. It was also evident that apart from the positive relationship, at 10% significance level, petroleum consumption had a statistical significance to the level of growth of the economy. This study confirms the findings of studies done by past researchers. Studies by Rahman et al (2018) on the relationship between oil consumption and economic growth in Bangladesh and studies by Harun and Pata (2016) investigating the causality link between economic growth and oil consumption in the Turkish economy found a positive one way causality going from oil consumption level to the economic growth rate which is a confirmation of the findings of this study. Still, Oduro et al (2020) on a study to investigate the impact of crude oil consumption and oil price on the growth of the Ghanaian economy found a positive and statistically significant relationship between oil price and economic growth in the long run. The findings confirm findings by studies by Buabeng et al (2022), Dzulfikri et al (2022), Erwin et al (2022), Koengkan and Matheus (2017), Simone et al (2020), Kamah et al (2021) just to mention some but a few.

Basically, petroleum is the engine of the economy as it runs through almost all sectors of the economy as it aids in production, processing, manufacturing, extraction of natural resources including minerals. In simple terms, it facilitates form utility of goods. Transportation of goods and people is also essential in an economy. Factors of production and final goods need to be transported to the final consumer (market) for ease of accessibility. This is called place utility and most of vessels used in transportation of factors of production are operated using petroleum. This makes petroleum very essential in any economy (KNBS, 2021).

4.7.2 Impacts of electricity consumption on the growth of the economy.

From the study, electricity consumption had a positive relationship on the level of economic growth. It was also true to say that, at 5% significance level according to the study, electricity consumption had a statistical significance to the growth of the economy. The positive relationship between electricity consumption and economic growth confirm the findings of studies by Bildirici and Melike (2013) on the causality relationship between electricity consumption and economic growth, Koengkan and Matheus (2017) on the nexus between hydroelectricity consumption and economic growth in seven Latin American countries. Still, Magdalena et al (2023) obtained the same results in the study on the relationship between geothermal energy consumption, economic growth, and foreign direct investments.

The significance of electricity consumption on economic growth depends on the level of technology and industrialization. The Kenya economy is Agricultural-based, though not entirely. Most industrial plants use electricity in their operations and the output is what reflects on economic growth. Kenya also exports electricity to her neighboring states such as Ethiopia, Uganda and Tanzania. Kenya is also ranked as the country that has the largest wind power plant in Africa. Generally, electricity in Kenya is used in a wide range as compared to petroleum. However, industrial revolution is still at primitive levels. Otherwise, more output would be realized even more. (KNBS, 2020)

CHAPTER FIVE

CONCLUSIONS AND POLICY IMPLICATIONS

5.1 Introduction

This chapter provides a summary of the findings, conclusions, policy recommendation and areas of further studies arising from the research project on the implication of energy consumption on economic growth in Kenya.

5.2 Summary

There are several studies that have determined the relationship between energy consumption and economic growth in various countries, develop and less developed. These studies have indicated that there is generally a positive relationship between energy consumption and economic growth. This study analyzed the implication of energy consumption on economic growth in Kenya by analyzing the regression Gross Domestic Product in Kenya against petroleum and electricity consumption for the period between January 2006 and September 2022.

Ordinary Least Square estimation was applied to determine the effect of energy consumption on economic growth. The results showed that electricity at 95% confidence level was statistically significant to influence the rate of economic growth Petroleum at 10% significant level was also statistically significant. Generally, electricity consumption and Petroleum consumption had a positive relationship with the rate of economic growth.

5.3 Conclusion

5.3.1 Impacts of petroleum fuels consumption on economic growth.

There is a positive relationship between petroleum consumption and economic growth in Kenya according to the findings of this study. The elasticity of Economic growth in Kenya to petroleum consumption is 0.075. This implies that with an incline in consumption of petroleum in Kenya there will be growth of the economy (A. C. Kimani, 2018).This is because many economic activities regarding production of goods, processing, manufacturing and transportation use petroleum fuels. Petroleum is used as a fuel for cars, buses, trucks, and motorcycles. In addition, petroleum is used to power airplanes and ships. Petroleum is used as a backup fuel in Kenya's electricity generation mix. During periods of high demand, petroleum-fired power-plants are used to supplement the power generated from hydro, geothermal, and wind sources. Petroleum products are used in the production and distribution of fertilizers, pesticides, and other agricultural inputs. Petroleum is also used to power irrigation pumps and farm machinery. Petroleum products are used in the manufacturing of plastics, chemicals, and other industrial products. Therefore, more petroleum consumption implies more production, more sales and growth as a result. (Ministry of Petroleum and Mining, "Kenya Petroleum 2020 Status Report," December 2020)

5.3.2 Impacts of electricity consumption on the growth of the economy.

The study, among a number of other studies show a positive relationship electricity consumption and economic growth. In this study, the elasticity of economic growth to electricity was 0.509. With an incline in consumption of electricity in Kenya, there will be significant growth of the economy (Magdalena et al, 2023). Electricity is essential in economic activities such as manufacturing, Agriculture, mining and services. Electricity is used to power machines and equipment in industries such as food processing, textile manufacturing, and construction materials. In Agriculture, electricity is used for irrigation pumps, greenhouse lighting, and processing of agricultural products such as tea, coffee, and horticulture. Electric trains in the Standard Gauge Railway (SGR) and the recently launched electric buses in Nairobi, which provide efficient, reliable, and environmentally friendly transport. Moreover, electricity is essential for construction activities such as powering tools and equipment used in building and infrastructure development. Electricity is also critical for service industries such as banking, hospitality, healthcare, and telecommunications, which require reliable and continuous power supply to operate efficiently. Mining activities such as drilling, excavation, and processing of minerals also require electricity. More electricity consumption therefore translates to more rates of economic growth. (Kenya National Bureau of Statistics, "2019 Economic Survey", 2020)

5.4 Policy recommendations

5.4.1 Impacts of petroleum fuels consumption on economic growth.

The findings of the study recommends various policy options to realize economic growth through petroleum nexus. The government should optimize petroleum import tariffs and other non-tariff barriers to reduce petroleum prices in Kenya. It should incentivize petroleum importation to reduce petroleum pump prices. Competition is also an essential mechanism to regulate prizes in the free market. It should therefore empower private firms in the energy sector that are overshadowed by large monopolies. The Government of Kenya should indirectly encourage consumption of petroleum by reducing import levies on petroleum-based automobiles such as motor vehicles and machinery to encourage transportation, more processing, manufacturing hence more output. The government should form and initiate trade and regional blocks with countries that export petroleum such as Nigeria and the Arabian countries to enjoy tax reductions resulting from the good relations. Additionally, the private players in petroleum mini-sector should collude to enjoy the economies of scale in importation.

5.4.2 Impacts of electricity consumption on the growth of the economy.

The government should optimize export charges per unit of electricity exported to encourage more countries in the East African region import electricity from Kenya. More private participants such as Kengen, KETRACO and EREC should be incentivized to venture into production and supply of electricity by issuing permits and licenses to increase competition, which is a mechanism of price stabilization. Levies on production of electricity should be optimized in that both the government and the production farm benefits. The government can also venture into production of electricity from other sources such as nuclear energy which are relatively expensive to the private sectors to cushion sources such as hydro-electricity during the dry seasons to stabilize prices as well as increase power output. It should also provide a feasible fiscal environment for development, expansion and growth of local industries revolving around processing, manufacturing, tanning and value-addition which are the major users of electricity in Kenya. Good regional relations both bilateral and multilateral is of paramount importance usually by encouraging trans-boundary trade in exchange of electricity.

5.5 Areas for Further Research

5.5.1 Impacts of petroleum fuels consumption on economic growth.

There are various areas that require further studies in line with petroleum consumption and economic growth. Researchers should:

i. Study on the effect of petroleum in developing economies, especially in Sub-Saharan Africa (SSA).
ii. Investigate the effects of each petroleum product such as kerosene, petrol, diesel and bitumen as opposed to investigating aggregately under one umbrella as petroleum.

5.5.2 Impacts of electricity consumption on the growth of the economy.

Researchers should:

i. Study on the effect of electricity in developing economies, especially in Sub-Saharan Africa (SSA).

ii. Investigate the effects of each electricity source independently as a variable such as hydro-electricity, geo-thermal, solar energy, nuclear, wind energy and many more in Sub-Saharan Africa.

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APPENDIX: DATA SET

Year	C.GDP%	C. Petroleum%	C. Electricity%	d3dlogpet	d3dlogelect	d3dlogngdp
2006	_	_	_	_	_	_
2007	106.8507	111.1914515	107.4887449	_	_	_
2008	100.2323	91.42134094	103.2791909	_	_	_
2009	103.3069	111.7768667	100.272997	_	_	_
2010	108.0585	99.60501567	110.0536616	-0.3097032	0.048727998	-0.03448334
2011	105.1211	112.3254862	104.4618529	0.2396429	-0.11631661	-0.03790662
2012	104.5687	122.234893	101.2286994	-0.117748	0.072059977	0.041179493
2013	103.7978	83.64301105	103.9836241	-0.1860022	0.016322657	-0.01060622
2014	105.0201	106.1512575	113.0074064	0.4697435	-0.0008347	0.009223211
2015	104.9677	114.6109303	112.1376276	-0.3384556	-0.06397817	-0.01359886
2016	104.2135	117.2770317	104.106727	0.0468806	0.010580475	0.002386072
2017	103.838	93.66436054	104.0857257	-0.0843116	0.061101998	0.004478985
2018	105.6479	106.4131273	102.7673202	0.2606849	-0.03763351	0.007508189
2019	105.1142	98.36509741	102.5041474	-0.2426344	0.009871092	-0.01877626
2020	99.7498	90.03694808	99.11617528	0.0853089	-0.01790586	-0.01084584
2021	107.5174	111.8623773	108.8251815	0.1369496	0.068665077	0.075865952
2022	104.2356	101.5281083	104.6738856	-0.1326835	-0.05518177	-0.10134511

SOURCE: KNBS, WORLD BANK