EFFECT OF ENERGY PRICE LIBERALIZATION ON ECONOMIC GROWTH IN KENYA (1980 – 2014)

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A RESEARCH PROJECT SUBMITTED TO THE DEPARTMENT OF ECONOMETRICS AND STATISTICS IN THE SCHOOL OF ECONOMICS IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE AWARD OF THE DEGREE OF MASTER IN ECONOMICS (ECONOMETRICS) OF KENYATTA UNIVERSITY.

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DECLARATION

This project is my original work and has not been presented for a degree in any university or any other award.

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DEDICATION

I dedicate this research work to all who are dear to me.

ACKNOWLEDGEMENT

I thank God for keeping me healthy throughout the process of doing this research work. I also thank God for helping me to pursue my Masters of Economics (Econometrics) studies. I'm grateful to my family for always being there for me. I'm grateful to my late parents for taking me to school and for making sure that I never stay at home because of school fees.

I appreciate all my lecturers and all my friends for the guidance, understanding and moral support they gave me. I sincerely thank my supervisors, Dr. Susan Okeri and Dr. Joseph Muniu for taking their time to make sure this study became a success. Their recommendations, criticisms, feedbacks and suggestions helped shape this study. I also appreciate Mr. Jacob Nato for his comments, encouragements and for always putting a smile on my face whenever I felt that I was stuck with this study.

ABSTRACT

The main purpose of this study was to determine the effect of energy price liberalization on economic growth in Kenya. Energy sector is an important component of economy, and just like other goods and services, energy price affects its demand, supply and use. The use of energy is embedded in the production function that leads to economic growth. In Kenya, the energy sector contributes about 9.49 percent of GDP with the petroleum sector, electricity sector and fuel wood sector contributing 8.4 percent, 0.6 percent and 0.49 percent respectively. Kenya has initiated a number of reforms to stabilize and promote fair price and efficiency of energy in the economy. Kenya introduced several economic reforms such as energy sector reform of energy price liberalization to promote its economic growth by stabilizing supply and prices of energy and by creating a competitive energy market. Despite implementing these reforms, the Kenyan economy has not experienced double digit rate of economic growth (Ministry of Planning and National Development, 2007). The objectives of the study were to investigate the effects of energy price liberalization on economic growth in Kenya and to find out whether there was a significant difference in stability of energy price during the period of liberalization of energy price and the period of no liberalization of energy price. The study used secondary data covering a period of 35 years from 1980 to 2014. The study extracted data from the Kenya's Statistical Abstracts of 1980 to 2014. The study used several methods of diagnostic tests such as Augmented Dickey Fuller unit root test, Phillips-Perron unit root test, Ramsey test, Jarque-Berra test and Durbin Watson test. Phillips-Perron unit root test and Durbin Watson test were used to assure robust model estimation. Stability tests found that there was significant difference in the stability of energy price before and after the liberalization of the energy price. OLS regression estimates indicated that energy price liberalization had a negative effect on economic growth in Kenya. The coefficient value of the dummy variable was -0.1607 with a probability value of 0.0367 and suggested that energy price liberalization was significant in explaining economic growth in Kenya. The study recommended reevaluation of energy sector reform of energy price liberalization and also encouraged implementation of reforms in other sectors of the economy.

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ACRONYMS AND ABBREVIATIONS

ERC: Energy Regulatory Commission.

GDP: Gross Domestic Product.

IEA: International Energy Agency.

KENGEN: Kenya Electricity Generating Company Ltd.

KNBS: Kenya National Bureau of Statistics.

KPLC: Kenya Power and Lightning Company.

NCAER: National Council of Applied Economic Research.

OLS: Ordinary Least Squares.

OPERATIONAL DEFINITION OF TERMS

Energy: refers to a source of power, such as petroleum and electricity.

Liberalization: refers to the lessening of government regulations and control to encourage exchange and participation in the economy.

Liberalization of the market: refers to the relaxation of government control in the market by allowing market forces to operate freely.

Liberalization of price: refers to a situation where the market price freely change in line with market situations.

CHAPTER ONE

INTRODUCTION

1.1 Background

The rise in energy prices has increased concerns about the long run economic growth of countries around the world. In the past two decades, high energy prices have had a negative impact on economic developments (Costantini & Martini, 2010). The rise in oil prices experienced around the world in the year 1973 to 1980, 1988 to 1989 and 2003 to 2008 were followed by economic recessions. In China, Sweden and USA, an increase in energy price and energy use per GDP had resulted in a decrease in the economic growth and investment share (Gbadebo & Chinedu, 2009).

In Kenya, the energy sector contributes about 9.49 percent of GDP with the petroleum sector, electricity sector and fuel wood sector contributing 8.4 percent, 0.6 percent and 0.49 percent respectively (Ministry of Energy, 2012). Over the years, one of the major issues in the Kenya's energy sector is the enforcement of infringement of the fair trade practices, pricing and the consumer protection by various regulatory agencies. The Energy Regulatory Commission (ERC) and the Competition Authority implemented the 2006 Energy Act and the 2009 Competition Act to promote competition and stabilize the market variables in the energy market (Ministry of Energy, 2012).

Kenya's Energy Regulatory Board introduced energy price liberalization in piecemeal until in 2002 when the energy price liberalization covered the whole energy sector. Following operationalization of Energy Act 2006, the Energy Regulatory Board changed to Energy Regulatory Commission in July 2007. The energy price liberalization reform was implemented with an aim of regulating the energy sector, enhancing competition, efficiency, choice and

stability in the energy market and promoting the growth and development of energy sector and Kenya's economy (Ministry of Energy, 2012).

1.1.1 Liberalization of Energy Market

The notion of liberalization has changed the operations in the legal and economic framework of the energy market in the world. The European Union liberalized the gas market to reduce monopolies, create competition, and enhance stability in the gas market. Economists have argued that increasing liberalization of the market, especially in the energy market, gives consumers more choice while enabling the producers to perform optimally (United Nations Economic Commission for Europe, 2012). It is however noted that the process of liberalizing the energy market, especially with concerns for energy price, is a long and hard process due to the existence of vested interest on both supplier's and consumer's side and other economic variables which may be an obstacle to its success (Hamilton, 2009). Balancing these objectives has made it necessary for there to be a minimum energy market regulation and oversight for existence of efficiency in the energy market.

Arguments made are that liberalization of the energy market is more effective in the long run no matter the type of market. This is so because most market mechanisms are flexible in the long run and the impact of such liberalization is rarely felt in the short run. Despite these shortfalls, liberalization helps develop and grow markets and thus the economy through enhancement of reliability, adequacy and market performance (United Nations Economic Commission for Europe, 2012).

1.1.2 Liberalization in Kenya's Energy Sector

The Kenyan government introduced liberalization in the energy sector in piecemeal with the first one in 1990 targeting the petroleum sector, the second one in 1996 targeting the electricity sector and the third one in 2002 that targeted the whole energy sector. The main reason for liberalizing the energy sector was to stabilize the prices in the energy market, to increase accessibility and to increase competition (Ministry of Energy, 2003). The Ministry of Energy elaborated that with increased competition and stabilization of liberalized energy prices and supply in the energy market, the economy would grow because of the increase in investment that would be made in the energy sector and the availability of energy for production of goods and services. The Kenyan government also argued that liberalization of energy prices would lead to the availability of clean energy that would increase efficiency in the production process (World Bank, 2010).

The Kenyan government is a major player in the electricity subsector with more than 77 percent shares in Kenya Electricity Generating Company (KENGEN). Despite this, power tariffs have always been so high in both the liberalized and non-liberalized segments of the market. According to Kenya Power and Lightning Company (KPLC) Annual Report of 2011, the price of electricity has been on the rise from Ksh 5.92/Kwh in 2003 to Ksh 8.13/Kwh in 2008 to Ksh 10.1/Kwh in 2011 (Ministry of Energy, 2012).

In the oil and petroleum subsector, the oil companies and their oligopolistic nature usually do not pass cost reductions, from price falls in the international market, to consumers. This has made the petroleum products to always be expensive. The Energy Regulatory Commission has attributed this to several factors among them being the weakening of the Kenya Shillings against the US dollar and the fact that Kenya is an importer of crude oil (Ministry of Energy, 2012).

A study by Kenya Institute for Public Policy Research and Analysis (KIPPRA), found that the high cost of energy is among the biggest bottlenecks to economic activities in Kenya. It argued that this and other socioeconomic factors have caused Kenya to lose a large portion of foreign direct investment and its competitiveness as an economy. The KIPPRA's study estimated that the cost of energy in Kenya is four times higher than in South Africa and three times higher than in China. It also concluded that the problem of high cost increases due to the unreliability of energy supply. This has caused companies in Kenya to lose more than nine percent of their production (Kenya Institute for Public Policy Research and Analysis, 2005).

1.1.3 Liberalization of Energy Prices and Kenya's Economic Growth

Kenya's economic growth rate has experienced random dips and peaks since early 1980s to 2014. Within this period, the growth rate of the Kenyan economy has been below the double digit level with the highest economic growth rate being 8.4 percent in 2010. The lowest economic growth rate was -0.8 percent and was experienced in 1992 (Ministry of Planning and National Development, 2007).

Liberalization of energy prices in Kenya began in the early 1990s, when the government involved itself in the supply and pricing of energy. Liberalization of energy prices mostly affected the petroleum sector and electricity sector which have the highest energy sector contribution to the GDP at 8.4 percent and 0.6 percent respectively. In the Kenyan economy, the manufacturing sector is the largest consumer of electricity, the second largest consumer of petroleum products and the third largest consumer of energy. The rise in the price of petrol, in 2010 and 2011, coupled with the unsustainable supply of diesel threatened the operations of many companies and the living standard of their employees. The economic growth during this period reduced from 8.41 percent in 2010 to 6.12 percent in 2011. The unreliable supply of

electricity and its fluctuating and high non-liberalized price, especially during dry seasons, have also caused the firms to incur huge losses in production, inefficiency of operations and damage of equipment from power surges. This hinders the growth of the manufacturing sector and thus hinders the growth of the economy (Moraa, 2008).

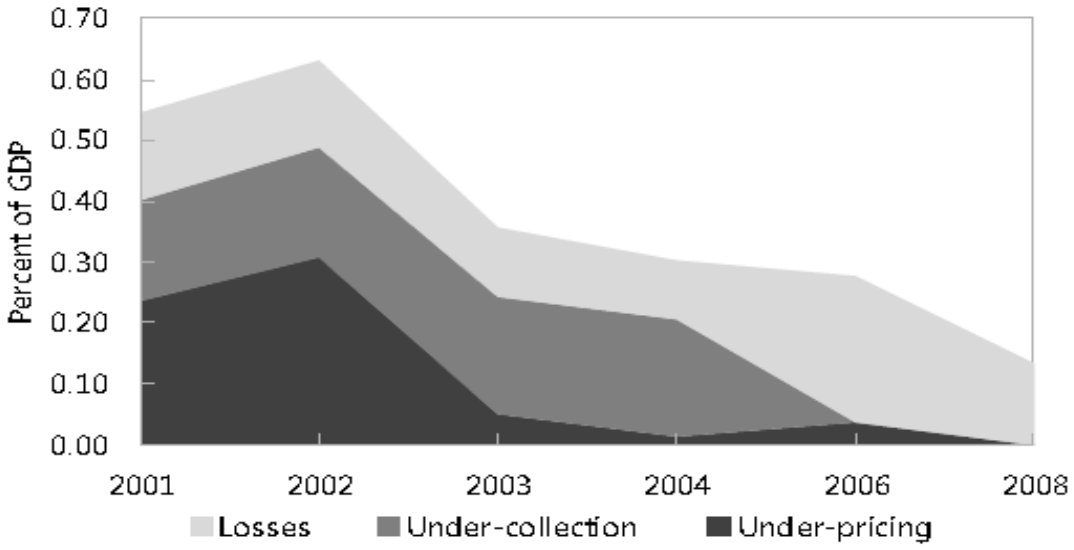

Figure 1.1: Hidden costs in the power sector as a percentage of GDP (2001 – 2008).
Source: World Bank (2010).

In the electricity subsector, the electricity price liberalization has allowed tariffs to increase in line with costs from Kshs. 4.9 per kWh in 2000 to Kshs. 10.5 per kWh in 2006 to Kshs. 13.3 per kWh in 2010. According to the World Bank (2010), the tariff reform measures of energy price liberalization have led to a significant decrease in the hidden costs in the power sector in Kenya from 0.6 percent of the GDP in 2002 to almost zero in 2008. Consequently, Kenya's economic growth increased from 0.6 percent in 2000 to 6.33 percent in 2006 to 8.41 percent in 2010. Figure 1.1 shows how the hidden costs in the power sector fell significantly over the last decades due to electricity price liberalization.

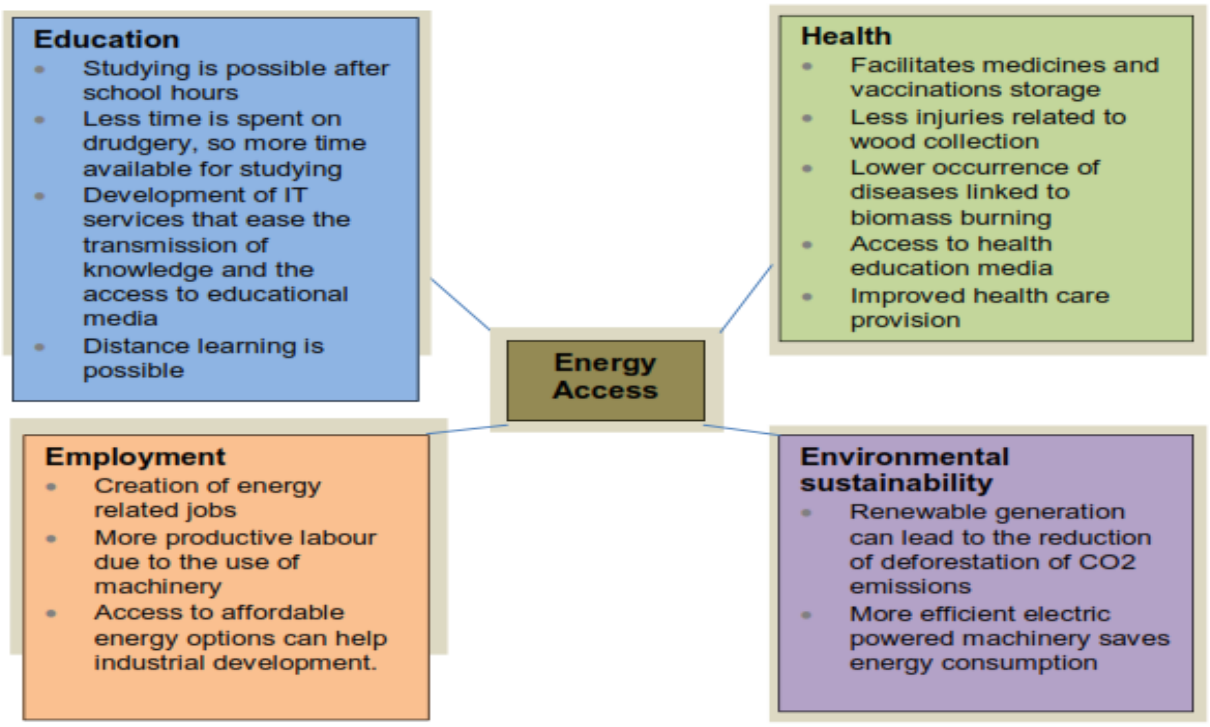

Figure 1.2: The impact of energy price liberalization on economic development goals in Kenya. Source: World Bank (2010).

World Bank (2010) report about electricity expansion in Kenya concluded that liberalization of energy price has led to increased energy access which has enabled Kenya to meet its economic and social development goals. Figure 1.2 summarizes some of the economic development goals that have improved due to the liberalization of energy price in the past decade i.e. between the year 2000 and 2010. It shows that liberalization of energy price increased energy access which resulted in improvement of economic development in terms of improved level of education, health, employment and environmental sustainability.

1.1.4 Energy Sources in Kenya

There are several sources of energy in Kenya. These sources include petroleum (diesel, petrol, gas and kerosene), electricity (wind, hydropower, solar and geothermal), biomass (charcoal,

wood and biogas) and others such as coal. Electricity and petroleum are the most used energy source in commercial agencies and urban areas while the use of biomass are most in rural areas (Ministry of Energy, 2003). Like most developing countries, the supply of energy in Kenya does not meet the demand for energy.

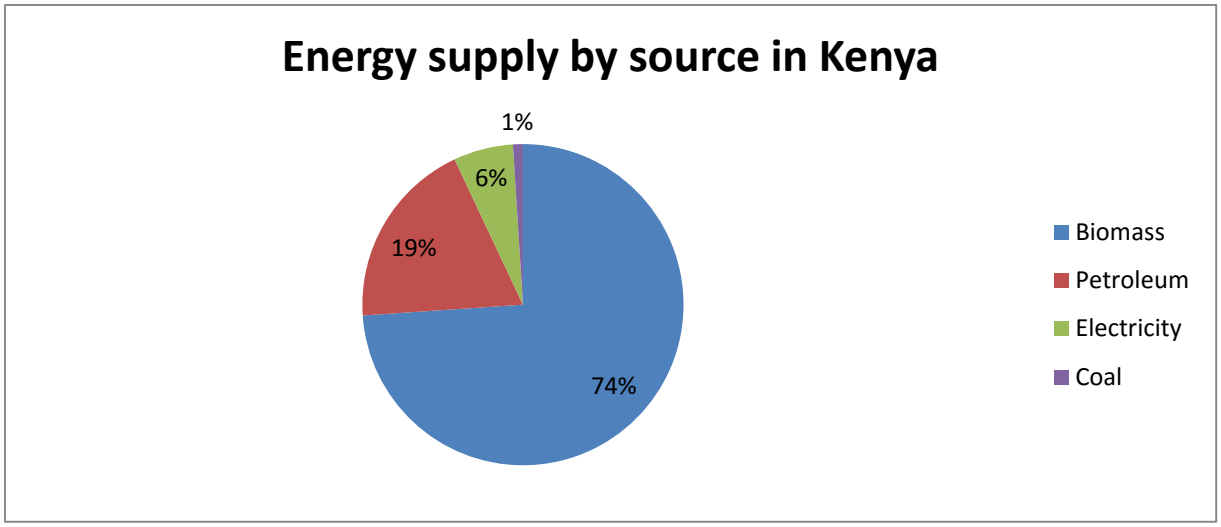

Figure 1.3: Energy supply by source in Kenya as of 2012

Source: Ministry of Energy (2012).

Figure 1.3 shows that 74 percent, 19 percent, 6 percent and 1 percent of energy supply by source in Kenya comes from biomass, petroleum, electricity and coal respectively as of 2012. However, commercial consumers such as industries and companies mainly use electricity (Ministry of Energy, 2012). Figure 1.4 shows the projected production of electricity in Kenya.

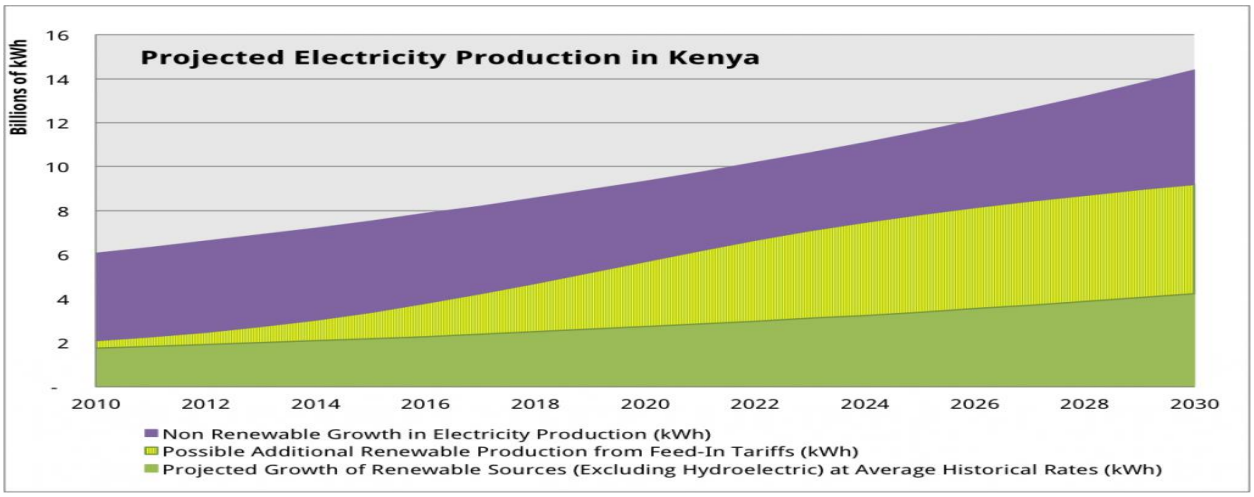

Figure 1.4: Projected electricity production in Kenya

Source: Ministry of Energy (2012).

1.1.5 Energy Consumption in Kenya

The challenges facing energy consumption and demand in Kenya include the reliance on crude oil importation, energy prices (both liberalized and non-liberalized), limited renewable energy, overstretched distribution network and diminishing resources. These challenges affect both the use of energy and the supply of energy within the country. In 2002, the estimated total biomass resource demand was 35 million metric tons against a supply of 15 million metric tons (Ministry of Energy, 2003).

The Kenya's Vision 2030 comprises of three key pillars, namely the economic, political and social pillars. The economic pillar aims to achieve an average economic growth rate of at least ten percent per annum and sustain that level of economic growth until 2030. The pillar also aims at the creation of the clean, secure and cheap energy (Ministry of Planning and National Development, 2007).

The development projects proposed in Kenya's Vision 2030 will increase the demand of energy in Kenya (Ministry of Planning and National Development, 2007). Currently, the price of energy is higher in Kenya compared to its competitors such as South Africa, Ethiopia and Nigeria. Kenya must therefore produce more energy at a lower cost and increase the energy consumption efficiency in order to be more competitive (World Bank, 2010). In the Vision 2030, the Kenyan government has committed to continue with institutional reforms in the energy sector that include provision of a strong regulatory framework (such as liberalization of energy prices), separation of generation from distribution and encouraging more private investors to invest in power generation (Ministry of Planning and National Development, 2007).

In line with Kenya's Vision 2030, the Kenyan government has embarked on the search for new sources of energy through exploitation of geothermal power, renewable energy sources and coal among others and improvement of energy production in the already existing energy plants. This has resulted in building of plants such as Olkaria II power plant in Olkaria, discovery of oil in Ngamia I in Turkana County, construction of wind power farms in Ngong Hills and the building of a coal power plant in Lamu County. The Kenyan government is also doing research and development on the feasibility of building a nuclear power plant (Ministry of Planning and National Development, 2007). All these developments aim to stabilize the liberalized energy prices and supply of energy. The Ministry of Energy argued that energy price liberalization is a stimulus for development of the energy generating projects by the government and the private sector.

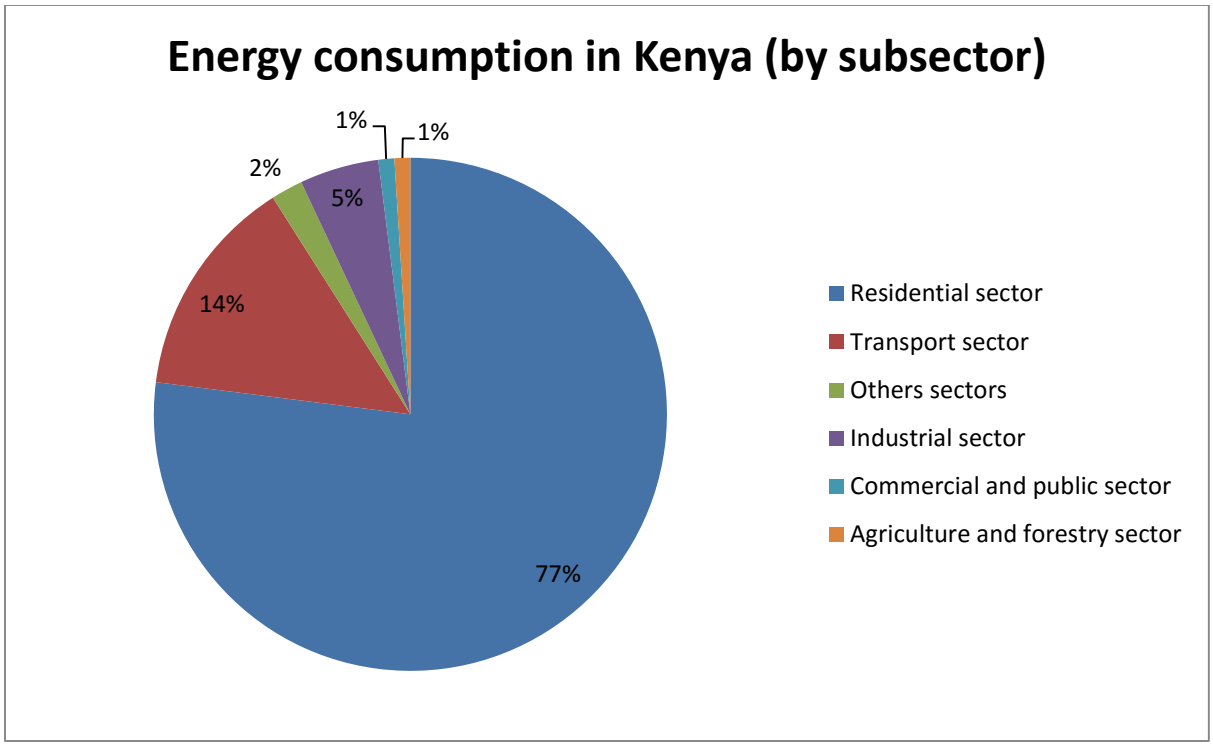

Figure 1.5: Energy consumption in Kenya (by subsector) in 2013.

Source: Kenya National Bureau of Statistics (2014).

As shown in Figure 1.5, the demand side consists of several subsectors that consume energy. These subsectors include the public, transport, residential, forestry, agriculture and commercial subsectors. Among these subsectors, the residential subsector is the largest consumer of energy.

1.2 The Statement of the Problem

The Kenyan government aims at improving its economic growth level and sustaining it at a double digit rate. In line with the Kenya's Vision 2030, it has aimed at having an economic growth rate of above 10 percent and maintaining it through to the year 2030 (Ministry of Planning and National Development, 2007). To meet this economic growth expectation, the Kenyan government has introduced measures among them being energy reform of energy price liberalization.

However, despite the Kenyan government's effort in carrying out reforms in different sectors such as the implementation the energy reform measure of energy price liberalization in 2002, the economy has not experienced double digit economic growth rate. Moreover, the level of economic growth has decreased and the rate of economic growth has slowed to 5.1 percent, 3.3 percent and 4.5 percent in the years 2004, 2009 and 2012 respectively (Kenya National Bureau of Statistics, 2013). The government has acknowledged not meeting its economic growth objectives of double digit economic growth rate, but it still pegs them on the developments in the energy sector, stability in supply and prices of energy and favorable liberalized energy prices that results from energy price liberalization. The Kenyan energy sector contributes about 9.49 percent to GDP with the petroleum sector, electricity sector and fuel wood sector contributing 8.4 percent, 0.6 percent and 0.49 percent respectively (Ministry of Energy, 2003).

Should the energy price liberalization policy not meet its economic objectives, then double digit economic growth rate in Kenya will be difficult to achieve. Need therefore arose to investigate why, despite the Kenyan government's reform in the energy sector through energy price liberalization, economic growth rate is still below the double digit level. In response to this problem, the study proposed to investigate the impact of energy price liberalization on economic growth in Kenya.

Most literatures available on economic development and energy have looked at how economic development affects energy instead of how energy and energy price affects economic growth (Toman & Jemelkova, 2003; Jorgenson, 1984). This study stressed that economic growth levels and economic growth effects of energy prices have to be carefully distinguished. Aghion and Howitt (2009) argued that mainstream economic models used to describe the economic growth process do not include energy and energy price as some of the factors that could affect economic

growth. Although some of these literatures have considered the effects of oil prices on economic activities (Hamilton, 2009; Gbadebo & Chinedu, 2009), they have ignored to investigate whether these prices are liberalized or not. Liberalization of energy prices in developing economies like Kenya is not a common phenomenon because markets in developing countries are not mature and well developed. Most researches (Solow, 1956; Kraft & Kraft, 1978; Jorgenson, 1984; Ghali & El-Sakka, 2004) have looked at the relationship between energy and economic growth in the perfect competitive markets while some researches like Costantini and Martini (2010), Gbadebo and Chinedu (2009) in Nigeria, Oh and Lee (2004) in Korea, Hondroyiannis, Lolos and Papapetrou (2002) in Greece and Lee and Chang (2008) in Asian economies have majored in the level of energy consumption and economic growth. In Europe, the United Nations Economic Commission for Europe (2012) had studied the impact of liberalization of natural gas markets. They have never considered the liberalized energy price as an important variable, as was used in this study.

The main purpose of this study was to determine the effect of energy price liberalization on economic growth in Kenya. The study divided the study period into two periods that is the period of energy price liberalization and the period of no energy price liberalization to find out the effects of non-liberalized and liberalized energy prices on economic growth in the two periods. The period of no energy price liberalization was from 1980 to 2001 and from 2011 to 2014 while the period of energy price liberalization was from 2002 to 2010. The study utilized quantitative econometric analysis, such as OLS regression and stability analysis to evaluate and identify the relationship that existed between the main variables. Other appropriate econometric methods of testing that are used included diagnostic techniques and stationary tests. This study added to the existing literature by exploring deep into the role of the liberalized energy price on economic

growth and identifying both theoretically and empirically the economic growth impact of these liberalized energy prices.

1.3 Research Questions

The study addressed the following research questions;

(i) What are the effects of energy price liberalization on economic growth in Kenya?

(ii) Is there a significant difference in stability of energy price during the period of liberalization of energy price and the period of no liberalization of energy price?

1.4 Objective of the Study

The main objective of the study was to determine the effect of energy price liberalization on economic growth in Kenya.

The specific objectives of the study were;

(i) To investigate the effects of energy price liberalization on economic growth in Kenya.

(ii) To investigate out whether there is a significant difference in stability of energy price during the period of liberalization of energy price and the period of no liberalization of energy price.

1.5 Scope of the Study

The study was done in Kenya and involved the use of data on economic growth rate and the energy price index of Kenya. The data were collected for the thirty five years period between 1980 and 2014 which was completely available and long and sufficient for this study. The thirty five year period was divided into two periods such that the period of no energy price liberalization was from 1980 to 2001 and from 2011 to 2014 and the period of energy price liberalization was from 2002 to 2010.

1.6 Significance of the Study

This study explored the effect of energy price liberalization on economic growth in Kenya. By doing this, it provided more empirical evidence on the energy price liberalization and economic growth literature especially in relation to Kenya. By checking this effect, it also provided more information on the magnitude of the relationship that exists between energy price liberalization and economic growth in Kenya. The findings got from this study will be important to stakeholders in the energy sector and interested investors. Policy makers will also find this study important to them in formulating and reviewing existing energy price liberalization and economic growth policies. The estimates got from this study will be important in identifying constraints that affect different components of the economy on the energy pricing side and on the economic growth side. This study extended the knowledge frontier and will stimulate further studies in this area. Given that energy is a fundamental component of Kenya's Vision 2030, the findings of this study was important in assessing the effectiveness of energy price liberalization policies that have been implemented by stakeholders in the energy sector.

1.7 Organization of the Study

This study is presented in five chapters. Chapter one is the introduction of the background of the study, statement of the problem, research questions, research objectives, significance of the study and organization of the study. Chapter two is the review of relevant literature that is both theoretical and empirical literature. Chapter three is the methodology that presented the methodology adopted by this study, the empirical model, the data collection method and the data analysis method. Chapter four is the presentation and discussion of the empirical findings. Chapter five is the summary, conclusions and recommendations of the study.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

This chapter presents a review of the theoretical and empirical literature. It reviews existing literature that relates to the topic of this study. Towards the end of this chapter is an overview of the literature review.

2.2 Theoretical Literature

Energy prices and economic growth are macroeconomic factors that characterizes all economies. This section presents the various theories that help explain the relationship that exist between energy price and economic growth and the theoretical basis of this study.

2.2.1 Theory of Production

This section is a review of the role of energy price in the supply and consumption of energy. It links energy to production where it also analyses the role of energy in production and thus in the increasing level of production used in the growth of the economy (economic growth). It however notes that the connection between production and economic growth and the role of energy and energy price is more complex. The mainstream theory of economic growth is reviewed, especially because of its limitation in considering energy and other factors as components of production.

Over the years, both the classical and neoclassical economists did not consider energy as one of the factors of production. However, modern day economists have found that energy is a key factor of production. This argument concurs with economist like Alam (2006) who through his

‘Economic Growth with Energy’ work found that not only is energy a factor of production but it also boosts the growth of an economy.

2.2.1.1 Energy in Production

One of the key concepts in production economics is reproducibility. The factors of production are inputs to the producers; some of these inputs are manufactured while others are non-reproducible. Mainstream economists argue that land, labor and capital are the main factors of production while other inputs such as energy (fuel) are intermediate inputs. According to Stern (1999), prices are paid to owners of the main inputs for providing their services directly or indirectly through the intermediate inputs.

This notion has brought about less focus on intermediate inputs such as energy and more focus on main inputs and their role in the economic growth process. Energy inputs are mainly in the form of oil, gas and electricity whose role is fairly convoluted in the mainstream theory of growth. Stern (1999) claimed that ecological economists have emphasized more on the role of energy and its availability in production economics and economic growth process. He also concludes that at the macro-level, all economic activities require energy directly or indirectly.

2.2.2 Theories of Demand and Supply

The demand for energy has been on the increase since the year 1900 due to the growth of the economy and population (Toman, & Jemelkova, 2003). Most increase in the demand for energy is experienced in the developing countries. Toman and Jemelkova (2003) noted that while the demand for energy increases exponentially, the supply of energy increases geometrically thereby resulting into a continuous shortage in the energy market. The study, however argued that unlike

other goods, energy is a special good that is simultaneously produced and consumed and is not stored in most cases.

NCAER's showed that the demand for energy grows at a slower rate than the gross domestic product in the initial stages of economic development then declines over time. The study also found that there was a decrease in demand for energy due to improved efficiency at the higher levels of economic development. The study acknowledged that the increase in supply of energy caused a relatively small drop in energy prices, which then increased the levels of consumption, especially in the household level (National Council of Applied Economic Research, 1960).

2.2.3 The Mainstream Theory of Growth

Over the years, there has been bias on the role of energy in economic growth in the mainstream production and growth theory. Solow's model of economic growth does not include any resources at all (Solow, 1956). However, studies by Toman *et al*. (1994) and Kamien and Schwartz (1982) extended this model to include the renewable resources, nonrenewable resources and waste assimilation services. It is important to note that their extended models were found to have greater application in environmental sustainability than in macroeconomics.

2.2.3.1 The Neoclassical Growth Model

The economic growth models analyze the changes in the economy over time as the quality and the amount of different inputs in the process of production change. In the Solow's model, a combination of manufactured capital and constant sized labor produces the output, which equates to the national income (Solow, 1956). The assumption of the neoclassical model is that as the capital employed rises, the output increases but at a decreasing rate.

The neoclassical growth theory shows that technological progress is the only cause of continuing economic growth. When there is an increase in the level of technological knowledge, the functional relationship between the productive outputs and inputs change. With this, more and better output is produced using the same quantity of inputs. The basic growth model concludes that increase in technical knowledge increases economic growth by making the rise in the rate of return to capital to be more than the diminishing return to capital.

2.2.3.2 Growth Model with Natural Resources

According to reviewed literature on resources and economic growth, neoclassical economists have placed more emphasis on conditions that enables continuing economic growth. They argued that both institutional and technical conditions determine whether continued economic growth was possible or not. The institutional conditions refer to factors such as system of property rights, market structure and value towards future generation.

Stiglitz (1974) showed that economic growth was achievable when there is finite and non-renewable natural resources which have zero extraction cost and no non-depreciating capital. The study, however, clarified that using the same model under perfect competition would lead to depletion of natural resources and the social welfare and consumption would eventually fall to zero. In another study, Dasgupta and Heal (1979) showed that the economy would collapse and the natural resources would be depleted if a constant discount rate is applied.

2.2.3.3 Endogenous Growth Model

The endogenous growth model uses endogenous factors to explain the long-run growth rate of an economy. It stresses on the technical progress resulting from human capital stock, size of capital

stock and rate of investment. The endogenous growth model outlines that output per capita grows even in the absence of exogenous technical progress.

Romer's model of Endogenous Technical Change assumes that economic growth comes from technological change. In the model, human capital and existing stock of knowledge produce new knowledge or ideas. The new knowledge or ideas enter the production process through three ways. First, human capital, available producer durables and labor produce final products in the final sector. Second, a new design increases productivity by increasing the total knowledge stock. Third, a new design produces a new intermediate input when used in the intermediate goods sector.

Van and Yetkiner (2003) adjusted the Romer model to include the energy consumption. They found that economic growth rate negatively depends on the real energy prices. They concluded that in a situation of increasing energy prices, reutilizing energy tax incomes in the form of research and development is required for both output growth and energy efficiency growth.

The policy implication of endogenous growth model is important to developing and developed economies. The model depicts that the economic growth rate due to factors such as capital and energy cannot be the same in all economies. The other implication is that economies with greater human capital stock and more investment on research and development will have faster economic growth rate. This explains why economic growth rate of developing economies is likely to be lower than that of developed countries. The endogenous growth model also implied that the contribution of factors such as capital and energy to economic growth may be larger than the levels suggested by Solow residual model. This also implies that when a firm invests in

research and development or education, the positive effect is felt not only by the firm but by other firms and the whole economy through spillover effects.

2.3 Empirical Literature

The quantitative relationships that exist between energy price and economic growth is varied in different studies. This section presents the empirical studies and analysis on the relationship between economic growth and energy price.

From the neoclassical view of the production function, several factors affect the link between economic growth and energy either positively or negatively over time. The relationship between aggregate output and energy is affected by; the technological change, shifts in the composition of the outputs, substitution between other inputs and energy and shifts in the composition of the energy inputs. In his study of the theory of wages, Hicks (1932) analyzed the impact of prices of factors of production on production. The study concluded that "a change in the relative prices of the factors of production is itself a spur to invention and to the invention of a particular kind directed to economizing the use of a factor which has become relatively expensive."

In the study of whether the use of energy causes economic growth, Kraft and Kraft (1978) and Yu and Hwang (1984) used Granger (1969) causality test. Although their results were inconclusive, there was indication of causality relationship between economic growth and energy. The causality from energy to gross domestic product was significant at 10 percent level for economies such as South Korea and Japan.

In a study done by Yu and Choi (1985) in the Philippines, they found that there is a strong and positive relationship between economic growth and energy price. They argued that the relationship that existed was unidirectional where energy price was an independent variable

while the economic growth was a dependent variable. Asafu-Adjaye (2000) also found the same causal effect in his study carried out in Indonesia and Singapore.

Abosedra and Baghestani (1991) and Akarca and Long (1980) studied the causal relationship between economic growth and energy. The two studies used the related test (Sims, 1972) to test whether energy use caused growth in the economy. They found that the causality from energy to economic growth was significant in both developed and developing countries.

Among the different macroeconomic indicators of sustainability, one of the commonly used is the energy / real GDP ratio that is the E/GDP ratio (also known as the total energy use to total economic activity). A study using this ratio on many industrial nations has shown that it has declined over the past sixty years (Kaufmann, 1992). Some energy analysts and economists have interpreted this to mean that there is a relatively weak relationship between economic growth and energy. However, other biophysical economists have disputed this by arguing that the E/GDP ratio ignores other variables such as energy price and energy quality. The effects of change in other variables such as energy price on the E/GDP ratio can be estimated using Cleveland *et al.* (1984) and Gever *et al.* (1986) equation.

While using the E/GDP ratio on a study done in the United Kingdom, Japan, Germany and France, Kaufmann (1992) found that the signs on the regression coefficient of natural gas, oil and electricity are negative, indicating that the natural gas, oil and electricity does more work and as a result generate more economic output.

Popp (2002) studied induced innovation and energy prices. Using the inference on prediction of "induced innovation", the study proposed that a rise in energy prices caused a decrease in energy use which in turn hindered additional innovation for economic growth. The study, however,

noted that this induced innovation coupled with reduced energy use can increase a firm's competitiveness.

In a study done on developing countries for the period 1981 to 2000, the findings were that by including energy in the production function, energy played a fundamental role in the economic growth of those countries compared to other variables that exists in the production function. The IEA concluded that a reduction in energy use causes a slowdown in the economic growth while the vice versa is true (International Energy Agency, 2004).

In a study of world energy prospects and challenges, Birol (2007) compared the demand of energy with growth of economies. The study found that the increase in demand for energy helped increase the global economic growth. The study also found that price of energy affected the consumption of energy and the demand of energy. The study concluded that the use or consumption of energy led to economic growth.

Wolde-Rufael (2009) analyzed the relationship between energy and economic growth in 17 African countries from 1971 to 2004. The study concluded that labor, capital and energy influenced economic growth within the 17 African countries. The study however stressed that while labor and capital are the most important factors of economic growth, energy is just a contributing factor of economic growth.

Odhiambo (2010) used data between 1972 and 2006 to investigate the relationship between energy consumption, energy prices and economic growth in Kenya, South Africa and Democratic Republic of Congo. The study found that energy prices influenced economic growth in Kenya and South Africa. The study also found that the use of energy influenced the prices of energy in Democratic Republic of Congo.

Menyah and Wolde-Rufael (2010) investigated the link between economic growth and energy consumption in South Africa from 1965 to 2006. The study found that there was a causal relationship from energy consumption to economic growth. The study also found that an increase in consumption of energy led to an increase in economic growth.

Wanjiku (2011) studied the impact of petroleum consumption on economic growth in Kenya between 1980 and 2009. The study used Granger causality test and found that there was uni-directional causality between petroleum consumption and economic growth. The main finding of the error-correction model were that petroleum consumption had a positive impact on economic growth. The study concluded that petroleum consumption stimulates economic growth of Kenya.

Fowowe (2012) analyzed the effect of energy consumption on economic growth of 14 sub-Saharan African countries, including Kenya, from 1971 to 2004. The study found that, for all the countries, changes in economic growth impacted the demand for energy. The main finding of the study was that energy consumption had a positive effect on economic growth of all the 14 countries.

Dogan (2014) examined the relationship between economic growth and energy consumption in Kenya, Benin, Congo and Zimbabwe from 1971 to 2011. The study found that there is no causal relationship between energy consumption and economic growth in Zimbabwe, Benin and Congo. The study also found that in Kenya, the causal relationship was unidirectional from energy consumption to economic growth and that consumption of energy has an impact of economic growth.

2.4 Overview of Literature

The reviewed literature showed a link between energy price and economic growth. It also showed that energy use affects economic growth of a country. The theoretical literature showed that apart from energy, there are other factors that affect the economic growth of a country. It also showed that different features of energy, such as energy quality, energy price and energy efficiency determined how energy affects economic growth. Most of the literatures reviewed are for developed countries showing that few studies on the relationship of energy price and economic growth are for developing countries like Kenya. The literature, however, does not show the exact relationship between energy price and economic growth. It also considers the prices of each type of energy and not energy price as a whole as was used in this study. The reviewed literature does not consider whether the energy price is liberalized or not as was used in this study. From this, the study showed a basis to investigate the impact of energy price liberalization on the growth of the Kenyan economy.

CHAPTER THREE

METHODOLOGY

3.1 Introduction

This chapter discusses the methodology applied in this study to investigate the impact of energy price liberalization on economic growth in Kenya. It presents the theoretical framework that guided the study and the models estimated in order to provide answers to the research questions and fulfill the research objectives. The chapter also presents the descriptions and measurements of variables, type of data used and their sources, and data analysis techniques employed.

3.2 Research Design

This study adopted a quantitative research design. It used the quantitative data on the different levels of energy prices and the gross domestic product at several periods. The study collected quantitative data from KNBS databases and publications on the relevant variables used in this study for the period of thirty five years between 1980 and 2014. The study used econometric models and other quantitative techniques to analyze the data and determine the impact of energy price liberalization on economic growth in Kenya.

3.3 Theoretical Framework

This study investigates the impact of energy price liberalization on economic growth in Kenya. It adopted the neoclassical growth model. As shown in the literature review, energy is an important factor in economic growth of any economy such as Kenya. The literature reviewed showed that energy use and supply is affected by the energy prices that prevail in the market among other determinants.

The derived production function of the neoclassical growth theory (Solow, 1956) is shown as:

$$Y = f(A, K, L) \text{ ………………………………….. (1)}$$

Where Y is aggregate real output, K is capital stock, L is labor, A is technology or technological progress.

Technology (A) is factor productivity that is endogenous and related to energy. Most forms of technology require energy to power it (Stiglitz, 1974). According to the law of thermodynamics, “no production process can be driven without conversion of energy”. Using this justification, the neoclassical growth model is now a function of technology, labor, capital and energy. Energy is treated as an exogenous variable and if it is made as a component of production technology, the model in equation (1) becomes;

$$Y = f(A, K, L, E) \text{ ………………………………….. (2)}$$

Where E is energy.

The final output Y is assembled from various intermediate goods x_i where i is the index of the variety of goods and mx is the total output of m firms in the economy (Hicks, 1932). These intermediate goods are manufactured using labor and energy as the primary inputs. The price of x goods is given by the mark-up over marginal cost shown as:

$$P_x = \frac{(V_{LX} \bullet \mathrm{w} + V_{EX} \bullet P_E)}{\beta} \text{ …………………….. (3)}$$

Where V’s are the Leontief input factors, P_x is the price of good x, P_E is the price of energy, β is marginal cost, w is wage for labor, $_{LX}$ and $_{EX}$ are respectively index for labor and energy used in production of good x.

To grow the economy, new goods x need to be produced by investing on new capital (Solow, 1956). This reveals the channels through which energy and energy price affects economic growth.

Equation (2) can be written in terms of a Cobb Douglass function of the form:

$$Y = A^{\beta_0} E^{\beta_1} K^{\beta_2} L^{\beta_3} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots.. (4)$$

$$\beta_0 > 0, \beta_1 > 0, \beta_2 > 0, \beta_3 > 0$$

Where E, K, L and A are energy, capital, labor and technology respectively. β's are parameters of the model and are also elasticities or shares of various inputs in the production.

Applying a logarithmic transformation to linearize equation (4), the econometric equation is written as:

$$Ln\, Y = \beta_0 Ln\, A + \beta_1 Ln\, E + \beta_2 Ln\, K + \beta_3 Ln\, L + \varepsilon \ldots\ldots\ldots (5)$$

Where Ɛ is the random error in the model.

Popp (2002) argued that the technology can be captured by the trend effect because of lack of exact data on it and also because it is not directly and easily measurable. Applying this justification in this study and letting Y to stand for Ln Y, E to stand for Ln E, K to stand for Ln K and L to stand for Ln L, equation (5) is rewritten as:

$$Y = \beta_0 + \beta_1 E + \beta_2 K + \beta_3 L + \varepsilon \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (6)$$

The study used the expression for interior solutions to the unconstrained producer spending optimization problem (Asafu-Adjaye, 2000) to get the real prices:

$$Y = \beta_0 + \beta_1 E_p + \beta_2 k + \beta_3 w + \varepsilon \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots.. (7)$$

Where GDP is the gross domestic product and a representation of the theoretical output Y, Ep is energy price, k is capital price, w is labor price, β_0 is the trend effect, β_1, β_2 and β_3 are parameters of the model.

3.4 The Empirical Models

To derive the empirical model, the study considered equation (7) as a starting point. The study preferred to use the price indices instead of real prices because the price indices are weighted

based on their importance to the economy unlike real prices which do not consider the weights (Kaufmann, 1992). Applying Laspeyres index calculation on each variable of equation (7) to get;

$$GDP_r = \beta_0 + \beta_1 E_{pi} + \beta_2 k_i + \beta_3 w_i + \varepsilon \ldots\ldots\ldots\ldots\ldots\ldots\ldots (8)$$

Where GDPr is GDP growth rate, E_{pi} is energy price index, k_i is capital price index, w_i is labor price index, β_0 is trend effect and β_1, β_2 and β_3 are coefficients.

The period of the study was divided into two that is (i) the period of no implementation of energy price liberalization (1980 to 2001 and 2011 to 2014) and (ii) the period of implementation of energy price liberalization (2002 to 2010). A dummy variable (D) was used to factor these periods in equation (8). The empirical model is expressed as;

$$GDP_r = \beta_0 + \beta_1 E_{pi} + \beta_2 k_i + \beta_3 w_i + \beta_4 D_i + \varepsilon \ldots\ldots\ldots\ldots\ldots\ldots\ldots (9)$$

Where β_4 is a regression coefficient of the dummy variable D_i and

$$D_i = \begin{cases} 1 & \text{for the period of energy price liberalization} \\ 0 & \text{for the period of no energy price liberalization} \end{cases}$$

To investigate the effects of energy price liberalization on economic growth in Kenya, the study used Ordinary Least Square (OLS) method assuming a well behaved error term (ε). The study used OLS method because it provides super consistent estimates of the autoregressive coefficient. To study the magnitude of the effects of energy price liberalization on economic growth, the study used regression model estimation which gives energy price liberalization coefficient. To find out whether there was a significant difference in stability of energy price before and after liberalization of energy price, the study used dummy variable and used t-test to test its significance.

3.5 Definition, Measurement of Variables and Hypotheses

GDP growth rate (GDPr): This is the increase in the capacity to produce final goods and services from a given period to another period. It was measured in percentage. The GDP growth rate tracks and provides a standard measure for economic growth (Sims, 1972).

Energy price index (E_{pi}): This is a macroeconomic indicator used to monitor energy price movements. The energy price index is stated as the 'fuel and power price index' in the Kenya's Statistical Abstract. It was measured in percentage. The Kenya's energy price index consists of the prices of petroleum, electricity, biomass and coal. The energy price index is a weighted index, which means that each type of energy in the energy price index basket is assigned a weight based on its own importance in the economy and the amount of money spent on it. KNBS assigns the "weight" according to their relative importance in the economy, with petroleum and electricity given more importance than biomass and coal. Use of the energy price index was preferred because it is a weighted aggregate change in the retail prices paid by consumers for a given 'basket' of energy. The study expected energy price to have a negative relationship with economic growth because an increase in energy price, especially in a developing economy, leads to a decrease in energy consumption, which dampens the productivity levels and economic growth (Oh & Lee, 2004).

Capital price index (k_i): This is a macroeconomic indicator used to monitor capital price movements. It was measured in percentage. It monitors the cost of capital. The commercial bank real interest rate of obtaining loans was used as the proxy variable for the cost of capital (Toman & Jemelkova, 2003). The study expected capital price to have a negative impact on economic growth (GDP) because as Solow (1956) argued, an increase in the cost of new capital and

manufactured capital causes the rate of return to capital to be less than the diminishing return to capital and thus reduces its use and economic growth.

Labor price index (w_i): This is a macroeconomic indicator used to monitor labor price movements. It was measured in percentage. It was derived from the annual average real wage earnings per employee expressed in Kenya shillings. The study expected labor price to impact negatively on GDP because increasing labor price increases production costs and reduces economic growth (Stern, 1999).

Dummy variable (D_i): This represents the period of energy price liberalization and the period of no energy price liberalization. It was measured as 1 for the period of energy price liberalization (2002 to 2010) and as 0 for the period of no energy price liberalization (1980 to 2001 and 2011 to 2014) (Popp, 2002).

3.6 Study Area

The study was done for the case of Kenya. Kenya is a country found on the eastern side of Africa and borders Tanzania, Uganda, South Sudan, Ethiopia and Somalia. Kenya is a developing country that has a population of approximately 45 million people and that made it a suitable area to carry out this study.

3.7 Target Population

The study targeted the Kenyan population. Even though the study did not involve getting data directly from the individuals in Kenya, it got its aggregated information from secondary sources. Doing this study in Kenya was significant because the inferences from it may be applied on the whole East Africa given that it is the country with the largest economy in East Africa.

3.8 Data Type, Variable and Source

The study used secondary data. The data was derived from publications that contained the variables of interest. The data on economic growth rate and the energy price index was obtained from Kenya's Statistical Abstracts. The data was for the period between 1980 and 2014 which is completely available. The period between 1980 and 2014 was long and sufficient for this study and was chosen due to the availability of data.

Table 3.1: Variables and data source

Variable	**Description**	**Source**
GDPr	GDP growth rate	KNBS
E_{pi}	Energy price index	KNBS
k_i	Capital price index	KNBS
w_i	Labor price index	KNBS
D_i	Dummy variable	

3.9 Research Instruments

The main research instrument used in this study is the data collection sheet. The study structured the data collection sheet to capture all the required data. The data collection sheet was selected for use because this study mainly used secondary data.

3.10 Data Analysis

The study used quantitative data analysis techniques. The data analysis was done to answer each of the research questions of this study. The study used the unit root test i.e. the Augmented Dickey Fuller test to test the time series properties on the collected data (Granger, 1969). OLS regression was used to find the effects of energy price liberalization on economic growth in Kenya.

CHAPTER FOUR

EMPIRICAL FINDINGS

4.1 Introduction

This chapter presents the findings of the study. First, it discusses the trend and characteristics of the time series variables of the study over the study period. It also presents the results of stationarity tests, diagnostic test and the results of the empirical model. Finally the chapter explains the effect of energy price liberalization on economic growth in Kenya.

4.2 Trend and Characteristics of the Time Series Variables

This section shows the trend and characteristics of the variables included in the empirical model. It discusses the movement of the variables over the study period.

Table 4.1: Descriptive statistics of the variables

Variable	Observation	Mean	Std dev.	Minimum	Maximum
GDP growth rate	35	3.7277	2.3393	-0.7995	8.4057
Energy price index	35	12.5207	6.6135	-3.8000	33.9000
Capital price index	35	18.6558	8.4115	10.5833	36.2400
Labor price index	35	1.3143	8.6024	-22.1000	19.7000

Source: Author's calculations.

Table 4.1 presents the descriptive statistics of the variables. The study used 35 observation of each variable. GDP growth rate had a mean of 3.7277, standard deviation of 2.3393 and minimum and maximum of -0.7995 and 8.4057 in 1992 and 2010 respectively. Energy price index had a mean of 12.5207 and standard deviation of 6.6135. Capital price index had a mean

and standard deviation of 18.6558 and 8.4115 respectively. Labor price index had a mean, standard deviation, minimum and maximum of 1.3143, 8.6024, -22.1000 and 19.7000 respectively.

4.2.1 Trend and Characteristics of GDP Growth Rate

Figure 4.1 shows that the trend in the GDP growth rate of Kenya has been fluctuating with several dips and peaks. Throughout the period of study, the lowest GDP growth rate experienced was negative 0.8 percent in the year 1992 while the highest GDP growth rate experienced was 8.4 percent in the year 2010. The dips and peaks of the GDP growth rate show cyclical movements. The trend also showed that during the period of study, the GDP growth rate of Kenya had not reached double digit levels.

Figure 4.1: Trend in GDP Growth Rate

Source: Kenya Statistical Abstracts

The economic growth rate of Kenya had experienced sharp declines in 1992, 1997, 2002 and 2008. The sharp declines can be attributed to the poor performance of the economy around the

period where there is a steady increase in energy prices. In theory, the increase in energy prices increases the cost of production and as a result dampens economic growth.

4.2.2 Trend and Characteristics of Energy Price Index

Figure 4.2 shows the trend of energy price index. The energy price index shows a cyclical movement but generally downward sloping. Between the year 1986 and 1994, the energy price index experienced positive gains followed by a drastic drop from 29 percent in 1995 to 2 percent in 1996. After the year 1996, the energy price index experienced an almost systematic increase and decrease all through to 2014. The lowest energy price index was negative 4 percent in 2010.

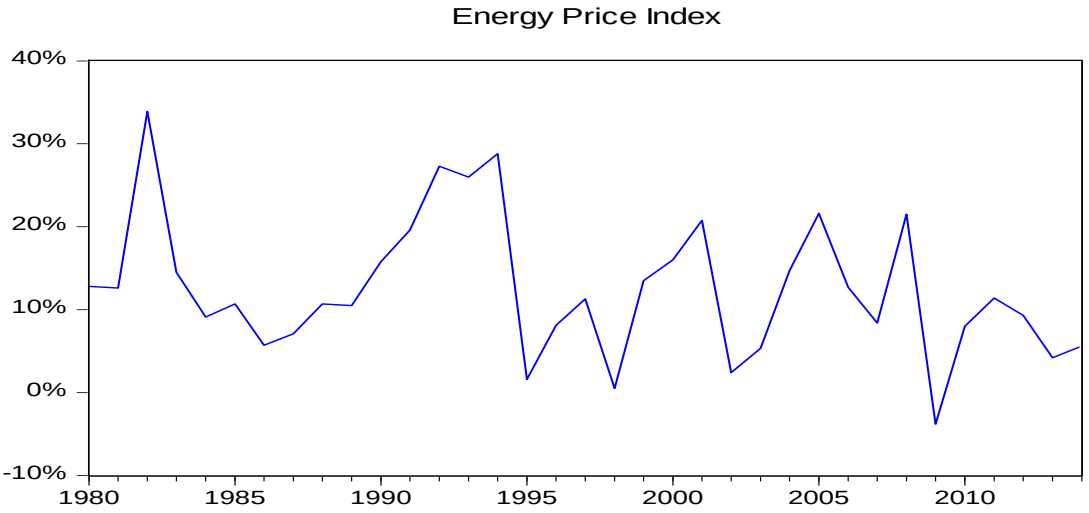

Figure 4.2: Trend in Energy Price Index

Source: Kenya Statistical Abstracts

The Kenya's energy price index experienced steady increases between 1986 and 1994, 2002 and 2005 and 2007 and 2008. Given that petroleum has the most weight in the Kenya's energy price index, these steady increases can be attributed to the numerous increases in oil prices experienced around the world in the same period from 1987 to 1990 and from 2003 to 2008. This can also be attributed to the piecemeal liberalization of energy price in Kenya's energy sector

that targeted the petroleum subsector. The decrease in energy prices can also be attributed to increase in economic activities and economic growth as seen in 2010 which had the lowest energy price index of negative 4 percent and highest economic growth rate of 8.4 percent.

4.2.3 Trend and Characteristics of Capital Price Index

Figure 4.3 shows that the capital price index experienced a steady increase from 1980 to 1994 followed by a steady decline from 1994 to 2004. Between 2004 and 2014, the capital price index experienced slightly steady increase. The lowest capital price index during the study period was 10.6 percent in 1980 while the highest capital price index was 36.2 percent in 1994. The trend can be attributed to level of economic growth rate and energy price index in the economy. When the economic growth rate is low and energy price index is high, the capital price index increases for example in 1982 and 1994.

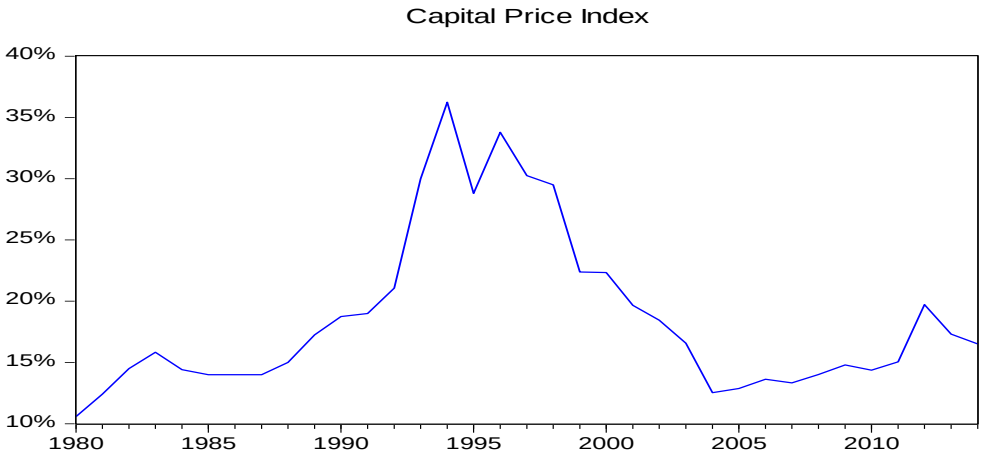

Figure 4.3: Trend in Capital Price Index

Source: Kenya Statistical Abstracts

4.2.4 Trend and Characteristics of Labor Price Index

The Kenya's labor price index experienced numerous consecutive fluctuations during the period of study. However, between 1991 and 1993 the labor price index experienced a drastic decline,

while between 1993 and 1995 the labor price index experienced a drastic increase. During the study period, the labor price index was lowest at negative 22 percent and highest at 20 percent in 1993 and 1995 respectively as seen in Figure 4.4. The fluctuations in labor price index can be attributed to fluctuations in level of economic growth where labor price index is high when economic growth rate is high.

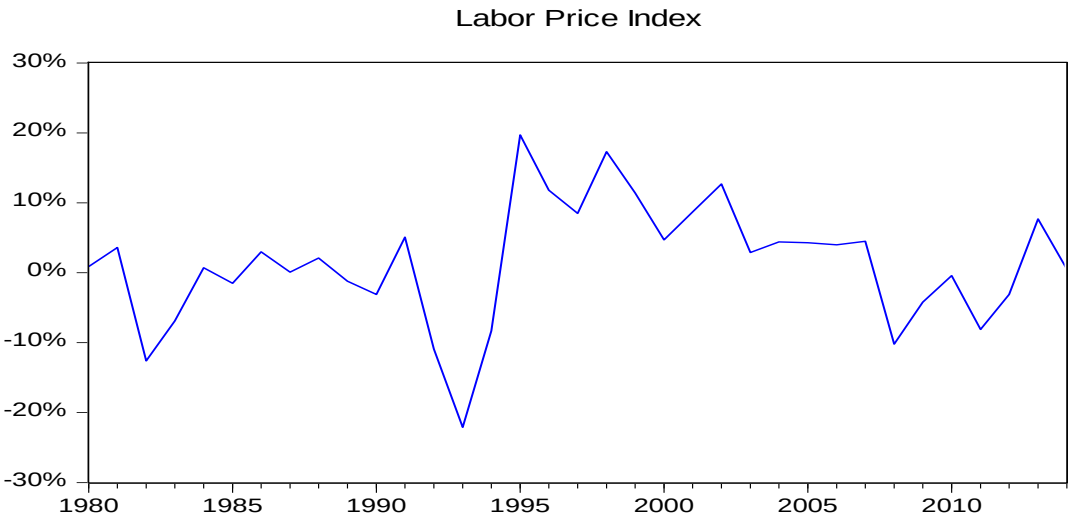

Figure 4.4: Trend in Labor Price Index

Source: Kenya Statistical Abstracts

4.3 Correlation Analysis Results

Table 4.2 presents the results of the correlation analysis. The correlation analysis on the variables was to find out the degree of association among the variables. It also provides a check on whether the multicollinearity problem existed in the data (Gujarati & Porter, 2009). The correlation coefficients showed the direction of relationship and the strength of the relationship between two variables in the model. The correlation coefficient rule is that the closer to one the coefficient is in absolute terms, the stronger is the association between two variables (Damodar & Dawn, 2009).

Table 4.2: Correlation coefficients among the variables

	GDPr	E_{pi}	k_i	w_i
GDPr	1			
E_{pi}	-0.4120	1		
k_i	-0.4008	0.1120	1	
w_i	0.2331	-0.5883	0.1616	1

Source: Author's calculations.

Again, the GDPr is the GDP growth rate, E_{pi} is the energy price index, k_i is capital price index, and w_i is labor price index.

The results showed that GDP growth rate and energy price index, GDP growth rate and capital price index and energy price index and labor price index are negatively correlated. This result is consistent with results from other researchers such as Oh and Lee (2004), Toman and Jemelkova (2003) and Solow (1956). On the other hand, GDP growth rate and labor price index, energy price index and capital price index and labor price index and capital price index are positively correlated. While using Pearson correlation coefficient in a study done in Sri Lanka, Morimoto and Hope (2001) found the same results thereby concluding that energy price and economic growth are highly and negatively correlated.

The correlation coefficient showed that there was a weak correlation between GDP growth rate and energy price index, GDP growth rate and capital price index, GDP growth rate and labor price index, energy price index and labor price index and capital price index and labor price index. There was a moderate correlation between energy price index and labor price index. The

low correlation levels in the results showed that there was no multicollinearity problem in the data (Damodar & Dawn, 2009).

4.4 Stationarity Test Results

To examine whether the series were stationary or not, the study conducted Augmented Dickey Fuller (ADF) unit root test and Phillips-Perron (PP) unit root test on the variables of the empirical model at levels with intercept and with intercept and trend. The study used Phillips-Perron test because of structural change and ADF test ensures that the errors are white-noise by including the appropriate number of lags (Damodar & Dawn, 2009).

Table 4.3: Unit root test results

Variables			Unit Root Test					
			ADF Test			PP Test		
			τ-statistic	Critical value (5%)	Stationarity status	τ-statistic	Critical value (5%)	Stationarity status
GDP Growth rate	Levels	Intercept	-3.4668	-2.9511	Stationary	-3.4668	-2.9511	Stationary
		Intercept and Trend	-3.6684	-3.5485	Stationary	-3.7334	-3.5485	Stationary
Energy Price Index	Levels	Intercept	-4.4418	-2.9511	Stationary	-4.4418	-2.9511	Stationary
		Intercept and Trend	-4.7311	-3.5485	Stationary	-4.7343	-3.5485	Stationary
Capital Price Index	Levels	Intercept	-2.9511	-1.6812	Stationary	-2.9511	-1.8296	Stationary
		Intercept and Trend	-3.5485	-1.6482	Stationary	-3.5485	-1.7629	Stationary
Labor Price Index	Levels	Intercept	-3.6511	-34285	Stationary	-3.6512	-3.4385	Stationary
		Intercept and Trend	-3.5485	-3.4257	Stationary	-3.5485	-3.5052	Stationary

Source: Author's calculations.

Table 4.3 presents the results of the unit root tests. The results showed that GDP growth rate, energy price index, capital price index and labor price index were stationary at levels for both

with intercept and with intercept and trend. The results showed that there may exist a short run relationship among the variables.

4.5 Diagnostic Test

The model was estimated and subjected to various diagnostic tests. Table 4.4 shows that the model passed most diagnostic tests. Ramsey test was done for model misspecification and the results showed a probability value of 0.0348 which indicate no significant evidence of model misspecification. Normality analysis done on the data using the Jarque-Bera test resulted in a Jarque-Bera statistic of 0.8 with a probability of 0.6 and estimated that the data was normal. The model did not show the presence of homoscedasticity when tested using the Engle test for first order autoregressive heteroscedasticity (ARCH (1)). The Durbin Watson statistic observed was approximately 1.8 and confirmed that the model is free from autocorrelation.

Table 4.4: Diagnostic test results

Diagnostic test	Value
Jarque-Bera	0.8 (0.6)
Durbin Watson	1.8
Ramsey (RESET)	7.1 (0.0348)
ARCH(1)	0.29 (0.83)

Source: Author's calculation

Figures in parentheses represent probabilities

4.6 Effects of Energy Price Liberalization on Economic Growth

The model of the study had five variables namely GDP growth rate, energy price index, capital price index, labor price index and the dummy variable representing the period of energy price liberalization and the period of no liberalization of energy price. GDP growth rate was the

dependent variable while the energy price index, capital price index and labor price index were the explanatory variable.

The first objective of the study was to find the effects of energy price liberalization on economic growth in Kenya. The study used ordinary least squares regression to estimate the coefficients of the variables of the model. Table 4.5 presented the results of the ordinary least square regression.

Table 4.5: Results of regression model estimation

Variable	Coefficient	Standard error	t-Statistic	Probability
Constant (Intercept)	7.400814	1.3465	5.4963	0.0000
Energy price index	-0.083701	0.0544	-3.4015	0.0134
Capital price index	-0.140831	0.0605	-2.3297	0.0267
Labor price index	0.033129	0.0533	0.6210	0.5393
Dummy	-0.160697	0.8743	-3.1702	0.0367
R-squared	0.31			
Adjusted R-squared	0.21			
F statistic	3.32			
Probability of F statistic	0.02			
Durbin-Watson	1.8			
Number of observations	35			

Source: Author's calculation

The value of the R-squared and Adjusted R-squared of the model were 0.31 and 0.21 respectively. The R-squared value of 0.31 showed that the model explained approximately 31 percent of variability in the response. The Adjusted R-squared value of 0.21 showed that the model explained approximately 21 percent of the variation in the GDP growth rate. The value of the F-statistic and the probability value of the F-statistic were 3.32 and 0.02 respectively. The

probability value of the F-statistic which was 0.02 showed that the model was statistically significant.

The study found that the coefficient of energy price index was negative 0.0837 with a corresponding t-value of negative 3.4015 and a probability value of 0.0134 implying that the coefficient is significant. The coefficient of energy price index suggested that energy price was negatively related to economic growth. The coefficient also showed that a one unit increase in energy price would decrease the economic growth by 0.0837 units. The probability value of 0.0134 showed that amongst the independent variables of the study, energy price index was the most significant in explaining GDP growth rate. The result agreed with the expectation of this study that energy price would have a negative relationship with economic growth. The result was consistent with Bernanke's (2006a) findings that stressed that an increase in energy prices slows down economic growth. The result was also in support of conclusions drawn by Van and Yetkiner (2003) who found that energy prices had a negative and significant effect on economic growth in the long run. The result also concurred with that of Asafu-Adjaye (2000) who found that increased energy prices dampens economic growth in developing countries.

The study used dummy variable to differentiate whether the energy price is liberalized or not liberalized. The coefficient of the dummy variable was negative 0.1607 with a t-value of negative 3.1702 and a probability value of 0.0367. The dummy variable took the value of 0 or 1 to indicate energy price being not liberalized and liberalized respectively. The probability value of 0.0367 suggested that energy price liberalization was significant in explaining economic growth in Kenya. The dummy variable was found to be negatively related to economic growth and the coefficient of the dummy variable suggested that energy price liberalization resulted in a decrease in economic growth in Kenya. The result was attributed to the fact that oil and

petroleum subsector made the largest weight in the energy price index and the oligopolistic nature of players in the oil and petroleum subsector that usually do not pass cost reductions, from price falls in the international market, to consumers. The result showed that energy price liberalization had significant negative effects on economic growth in Kenya. The finding is in contrast to World Bank (2010) findings which indicated that liberalization of electricity prices promoted economic activities which in turn increased economic growth. The finding also disagreed with that of United Nations Economic Commission for Europe (2012) who found that liberalization of natural gas market in the European region led to improved energy efficiency and security and increased economic growth.

The coefficient of the capital price index was negative 0.1408 with a t-value of negative 2.3297 and a probability value of 0.0267. The probability value of 0.0267 showed that capital price index was significant in explaining GDP growth rate. The coefficient was negative, suggesting a negative relationship between capital price index and economic growth rate. This confirmed the expectation of the study, which was that capital price was negatively related to economic growth in Kenya. The finding also supports Solow's (1956) findings that an increase in capital price dampened economic growth of an economy. The result concurs with Aghion and Howitt (2009) who concluded that there is a negative relationship between capital price and economic growth.

The coefficient of labor price index showed the effect of labor price on economic growth. The labor price index had a coefficient of 0.0331 with a t-value of 0.6201 and a probability value of 0.5393. The probability value of 0.5393 showed that labor price index was not significant in explaining the GDP growth rate.

4.7 Stability of Energy Price

The second objective of the study was to examine whether there was a significant difference in stability of energy price during the period of liberalization of energy price and the period of no liberalization of the energy price. The study used the dummy variables to solve the problem of loss of degrees of freedom that are caused by loss of observation when data is split (Damodar & Dawn, 2009). The study did not therefore carry out the Chow test directly, but instead interpreted the coefficients, probability value and the t-statistics of the dummy variable in the regression results (Hamilton, 1994).

Table 4.5 presented the results of the regression analysis of the model with the dummy variable. The coefficient of the dummy variable was negative 0.1607 and significant. The dummy variable had a t-statistic value of negative 3.1702 and a probability value of 0.0367 suggesting that there was structural break in the energy price during the period of energy price liberalization and during the period of no energy price liberalization. The probability value of 0.0367 also suggests that the dummy variable is significant in the model.

At 5 percent significance level, the study found that there was significant difference in the stability of energy price during the period of liberalization of energy price and the period of no liberalization of energy price. This can be attributed to the fact that petroleum has the largest weight in the Kenya's energy price index and also because Kenya is a net importer of crude oil. It is also attributed to the fact that international oil and petroleum product prices affect energy prices nationally in Kenya. The result do not concur with that of Stern (1999) who found energy costs to be stable in the long run.

CHAPTER FIVE

SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.1 Introduction

This chapter summarizes the study and makes conclusions based on the results of the study. This chapter also presents the policy implications of the findings and suggests areas for further research.

5.2 Summary

Energy is an important component in promoting growth of any economy such as Kenya. The way energy affects economic growth of an economy depends on several factors among them being the type of economy, the quality of energy, the type of energy and the price of energy. Energy being a normal good, its price affects its demand and consumption and in turn affects growth of an economy. Kenya implemented the energy sector reform of energy price liberalization as one of the measures that will enable it to reach and sustain double digit economic growth rate as envisioned in Kenya's Vision 2030.

The study focused on the effect of energy price liberalization on economic growth of Kenya. By doing this, the study had two specific objectives to fulfill. The first objective of the study was to find the effects of energy price liberalization on economic growth in Kenya. The second objective was to investigate whether there was significant difference in the stability of energy price before and after the liberalization of energy prices. By answering the specific objectives, the study was able to answer the main objective of the study, which was to determine the effect of energy price liberalization on economic growth in Kenya.

The study acknowledged that energy and in particular energy price was not the only factor that affected the economic growth of a country. The study, therefore, included other variable that is labor and capital as is in the neoclassical growth theory (Solow, 1956; Stiglitz, 1974; Van & Yetliner, 2003). The study also took into account the different periods under which energy price liberalization policy was implemented and used the dummy variable to account for this in the model of the study. The study collected the data for these variables, over a 35 year period, from the Statistical Abstracts of Kenya. The study period used was from 1980 to 2014 and was deemed sufficient for the study.

The study used ordinary least squares regression and found that energy price liberalization had a significant negative effect on economic growth of Kenya. In the thirty five year span from 1980 to 2014, several events affected energy price including world oil crisis of 1980, energy reforms of 1994 to 2002 and oil glut of 1986 and 2014. The study found that at 5 percent significance level, there was no stability in the energy price throughout the study period. The study also found that there was significant difference in the stability of energy price during the period of liberalization of energy price and the period of no liberalization of energy price. Energy price index and capital price index were found to be negatively related to GDP growth rate while labor price index was found to be positively related to GDP growth rate. The findings indicated that energy price liberalization had significant negative effects on economic growth in Kenya.

5.3 Conclusions

The probability values showed that amongst the independent variables, energy price index was the most significant. The coefficient of the energy price index was negative 0.0837 indicating the negative relationship between energy price and economic growth. The dummy variable had a coefficient of negative 0.1607 which led to a conclusion that energy price liberalization had a

negative relationship with economic growth and it had significant effect on economic growth. The conclusion was that energy price liberalization had a significant negative effect on economic growth of Kenya.

5.4 Policy Implications

The results of the study had important policy implications. First, the results showed that energy price liberalization had a significant negative effect on economic growth. This is important to stakeholders such as ERC and investors in the energy sector in formulating and reviewing existing economic growth and energy price liberalization policies. The coefficients of the energy price index and dummy variable are also important in identifying constraints that affect economic growth on the energy pricing side. Given that energy reforms were among the issues that the Kenyan government in the Ministry of Energy and Petroleum had included in Vision 2030, the results of this study are very important in assessing the effectiveness of the implemented energy price liberalization policies.

5.5 Recommendations

The study found that there may exist a short run relationship among the variables. From this, the study recommends that the government should set a period that is long enough in order to evaluate the impact of different energy policies that it implements. The study also recommends that other studies be done on different energy subsectors, such as petroleum subsector and electricity subsector, so as to compare the results and also to know the energy subsector on which price liberalization policies have best impacts on economic growth.

The study found that energy price liberalization had a significant negative impact on economic growth in Kenya. The study, therefore, recommends that the Kenyan government should

reevaluate implementation of the energy sector reform of energy price liberalization. The study also recommends that the Kenyan government should encourage reforms in other sectors of the economy because of the fact that the GDP growth rate did not reach double digit rate throughout the study period.

Most forms of technology require energy to power it. The study recommends that a similar study be done using the same methodology, but with technology as an additional variable. This would help explain how energy and energy price effects on technology affects economic growth of the country. The study also recommends that government should develop other energy sources such as nuclear energy, then do a similar study.

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