THE DETERMINANTS OF LIGHT DIESEL PRICES IN KENYA

By

PATRICK KIBURI KILEMI

A research paper submitted to the School of Economics in partial fulfillment of the requirements of the award of a Masters of Arts Degree in economics of the University of Nairobi

November, 2008

DECLARATION

This research paper is my original work and has not been presented for any degree award in any other university.

Signed ..... Date 02/12/2008

KILEMI PATRICK KIBURI

This research paper has been presented for examination with our approval as university supervisors

Signed ..... Date 03/12/2008

Dr Nelson H.W. Wawire

Signed ..... Date Dec 2, 2008

Prof. Peter Kimuyu

DEDICATION

To my wife Dr Lydia Nkirote and my children Mutuma and Nkatha.

ACKNOWLEDGMENTS

I wish to thank the University of Nairobi, School of Economics for the opportunity to pursue a master's degree in economics. Many thanks to the staff and the administration for the support and enabling environment accorded to pursue this degree.

Special thanks to my supervisors Dr Nelson N.W. Wawire and Prof. Peter Kimuyu to whom I am truly indebted. Your guidance in developing the research problem and support with reading references is appreciated. Your patience with my limitations and encouragement to pursue grey area of research is graciously acknowledged. Your generosity with academic knowledge is truly evident in the quality of this research paper. Thank you.

To Dr Sichei, for getting out of his way many times to bail me out on econometric modeling and supporting my study with many resoureeful materials. To Jane Kibiru, my classmate for mastering e-views early and generously sharing the knowledge with me. To my other classmates, you were of great academic support, importantly, you were friends, and we were like a family. In particular, Grace, Helen, Kirgit Kittony, Tich, Lomuto, Kibe, Korir, Kinoti, Magati, Beth, Owango, Steve and Eunice, thank you for your support. Team work made obviously very challenging tasks look simple and fun to solve.

To my family for supporting me through out the course period and understanding the many days I spent away and missed many family occasions. I truly hope that you will later find this effort worthwhile.

The author takes full responsibility for any errors, omissions or misrepresentations in this paper.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

OPERATIONAL DEFINATION OF TERMS

Barrel: Refers to a measure of quantities of crude oil traded between countries and constitutes of 159 litres of crude oil or refined fuel and 91 kg of gas.

Biomass fuel: Refers to organic traditional sources of energy mostly firewood and charcoal.

Black Products: Refers to by products of the refinery process and includes products like fuel oil, industrial diesel and lubricants.

Economic Profits: Refers to super normal profits enjoyed by oligopolistic and monopolists in a restricted market.

Super normal profits: Also called economic rent or abnormal profits or excess profits charged above the opportunity cost of labour and capital in an oligopolistic or monopolistic market.

Competitive market: A market place with many buyers and sellers with free entry and free movement of goods and services.

Fuel cycle: Refers to total petroleum products development cycle that includes exploration, identification and assessment, production or extraction, separation or improvement, conversion, transformation and refinement, storage, transportation, distribution and use.

Hospitality: Refers to an arrangement between oil marketers who have loading facilities to allow small oil marketers to use their facility at a charge.

Independent oil companies: Refers to oil marketing companies with less than five percent market share, independent of the multinational influence with mostly

domestic shareholding.

Jatropha: Refers to a plant known to produce biofuel.

Majors: Oil marketing companies with more than five percent market share.

White products: Refers to diesel, ketrol, kerosene & aviation gas, products derived from crude oil through the refinery process.

70:30 rule: A energy requirement that all the oil marketers at least process 30 percent of their share at the Mombasa refinery.

E-10: Refers to ethanol-gasoline blend with a 10 percent ethanol for every litre of gasoline.

Herfindahl-Hirshman Index (HHI) measures the level of concentration in an industry and is generated from the summation of squares of market shares for all the firms participating in that industry.

ABBREVIATIONS AND ACRONYMS

AGO:	Automotive gas oil/ Automotive diesel/Light diesel
ADB:	Africa development bank.
COMESA:	Common markets for East and Southern Africa
ECM:	Error correction model
FOB:	Free on board
IEA:	International energy agency
IMC:	Industry managed cost
KOT	Kipevu oil terminal
KOSF:	Kipevu oil storage facility
KPRL:	Kenya petroleum refinery limited
KPC:	Kenya pipeline company limited
LPG:	Liquidified petroleum gas
MOE:	Ministry of Energy
MJT:	Mombasa joint depot
NOCK:	National oil corporation of Kenya
NJD:	Nairobi joint depot
SEK:	Swendish Kroner
PDL:	Petroleum development levy
PLATTS:	A global provider of energy information who tracks daily crude oil cost movements and gives monthly averages for use as base costs in pricing.

ABSTRACT

This study was motivated by the important role diesel energy plays in the modern economy and the persistent increase in pump prices over the past decade. Automotive diesel is a quintessential commodity in the modern economy playing a critical role as input product in transport and many other productive processes and therefore a causal factor for economic growth. Increases in the price of automotive diesel poses inflationary pressure to the economy whose effects to the productive segments of the economy is negative. Frequents draughts, lack of alternative sources of energy in Kenya, constrained foreign exchange earnings and the oligopolistic nature of petroleum market have made petroleum prices a stable topic in every day discussions. Diesel continues to be a major source of commercial energy in Kenya given the lack of potential economically viable substitutes with no known crude oil reserves and the high costs involved in exploration, extraction and refinery.

This study sought to answer the important questions of what actually determines the pump price of diesel and how this pump prices reacts to changes in primary input components of crude oil, foreign exchange and taxes The study used an error correction model in analyzing changes in diesel pump prices given dynamism in the input components and the ensuing price making mechanism. The study established a strong relationship between cost of inputs and pump prices of diesel and a strong price adjustment process as measured by the error correction term. These findings are important because they lay bare the specific vulnerability the country faces in terms of dependence on imported crude oil and the market inefficiencies which don't encourage price competitions and therefore, the findings forms a strong foundation for the development of appropriate policies in management and regulation of petroleum pricing in the country.

CHAPTER ONE

INTRODUCTION

1.1 Background to the study

1.1.1 Overview of global oil industry

World wide escalation of petroleum prices has often been under public scrutiny since expenditure on petroleum is significantly visible in the consumer's budget (Imitira 2005). This has led to speculation as to their causes including the view that multinational oil companies manipulate prices in an oligopolistic market to earn economic profits (Bhaskara *et al*, 2005). Changes in the forces of demand and supply has lead to a consistence increase in the cost of crude oil. It is a known fact that crude oil cost constitutes an important component of the petroleum cost. The consistent rise of crude oil price has lead to a global outcry that oil was getting very expensive.

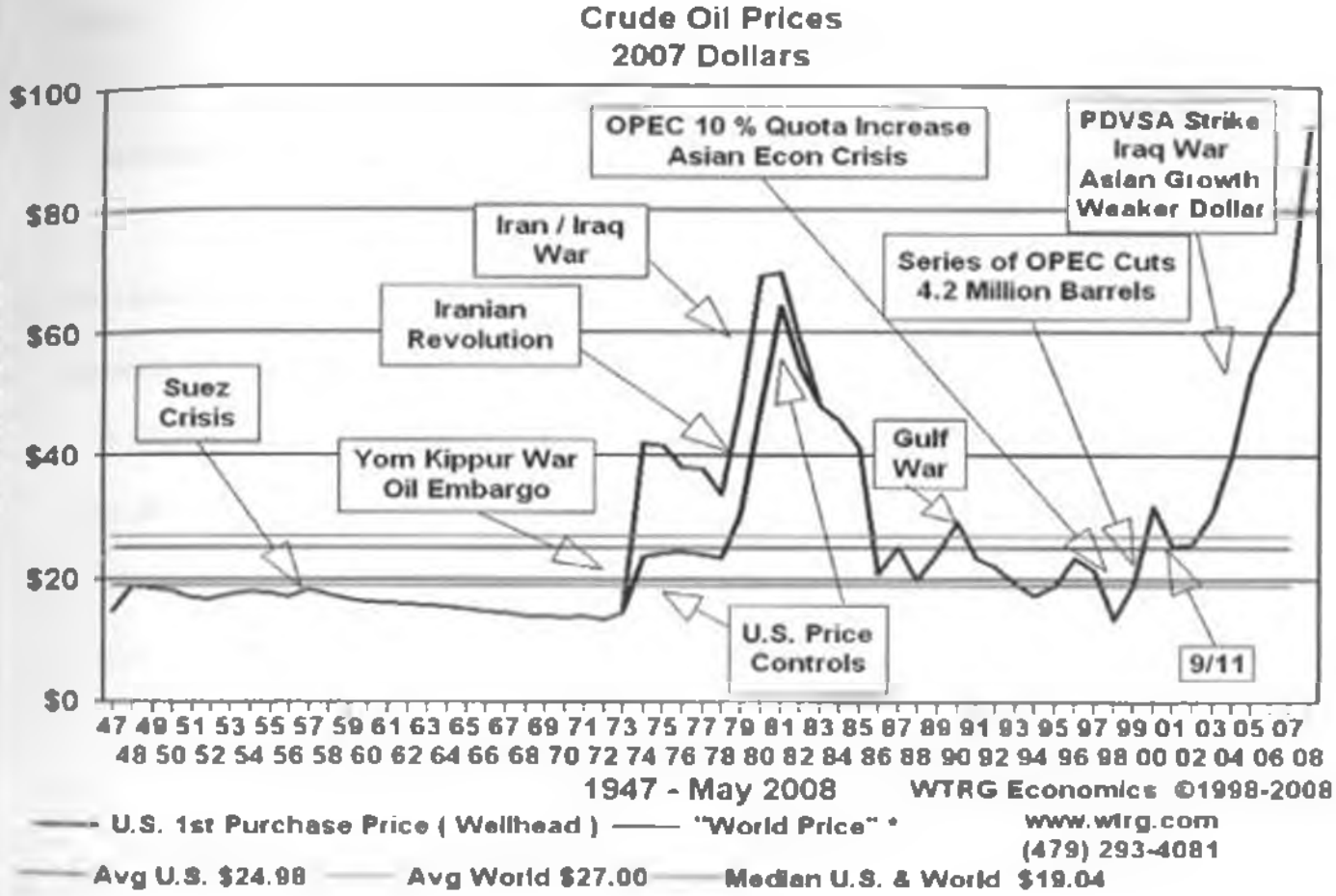
The demand for oil has been stretched by the growth of the economies of China and India, with the automobile industry growing by 25 percent in 2005 and 50 percent in 2006 in China alone (Hearts and Mind, 2007). This demand pull in China and India combined with increasing demand in the United States of America has led to increased competition for crude oil. The situation has been worsened by witnessed growth in the global economy with substantial demand coming from the developing countries.

Supply constraints explain the failure of the oil industry to respond to increased demand due to costs and time required to explore, drill, refine and transport. The new

environmental requirements have made it almost impossible to put up a new refinery (Hearts and Mind, 2007)

Global political instability has contributed to geopolitical tensions which have resulted in global production disruptions with big effects to the cost of a barrel. The Iraq invasion, the Nigerian abductions, the Venezuelan stand off and the Iran nuclear ambitions are recent indicators of how unstable the global market (Hearts and mind, 2007).

Fig 1.1 Trend of world crude oil prices from 1947-2006



Source: Reuter's website, 2008 www.reuters.com, 09.8.2008

The global trend of crude oil prices in the last three decades demonstrates a delicate balance between demand and supply. Fig 1.1 above shows that world highest crude oil spikes have been as a result of supply disruption, a direct result of geopolitical conflicts with the Arab- Israel conflict of early 1970's being the first post second world war conflict

to greatly affect the global crude oil supplies. The Iranian revolution of 1979 and the Iraq-Iraq war of 1981 show record new crude oil price highs of 65 dollars per barrel. The Gulf war of the early 1990's, the Asian financial crisis and the September 11 incident in the United States started the current price rally that has seen the world procure a barrel at 150 dollars in May 2008, a record by any measure. From the graph above, it can be appreciated that the global price of crude oil has over time increased unabated and that geopolitics has contributed to the biggest spikes recorded so far.

Price liberalization in many African countries was faced with similar problems. Consumers generally perceived higher prices as detrimental to their interest and hence higher prices with liberalization faced public resistance. This was worse in countries with high inflation rates. In addition, lack of competitive environment and deregulation meant benefiting a few oil companies rather than the consumers, (Karekezi, *et al* 1996). Little (1993) hypothesized that petroleum end use prices would go down in a competitive market environment free of exogenous factors as long as a country was not going through an inflationary period.

1.1.2 The Kenya petroleum market and industry structure

Petroleum in Kenya is a major source of commercial energy and has over the years accounted for over 80 percent of the country commercial energy requirements (Mecheo *et al.* 2003). The Transport, Manufacturing, Agriculture and the Power generation sectors are all dependent on petroleum products. Senga *et al* (1980), while reviewing the trends in Kenya for petroleum consumption established that the Transport industry consumes 70 percent of the petroleum products used in the country. This trend has been maintained with

the transport sector being the dominant consumer of petroleum products. Petroleum products are the most important source of commercial energy in Sub Saharan Africa accounting for 72 percent as of 1990 requirements with coal electricity and gas meeting the rest of the demand (Schloss, 1992).

The overall petroleum policy of the government of Kenya is to ensure a secure, reliable and least cost supply of petroleum products to the domestic economy. Consistent with this policy and in tandem with other reforms in other sectors of the economy, the petroleum industry was liberalized in 1994 allowing marketers to determine distribution and their pricing strategies. The government partially retained control of the supply side by operating an open tender system ran by the Ministry of Energy where every month, all licensed oil marketers submit bids for the supply of the industry for the incoming month. It has also set in the 70-30 rule where all marketers are supposed to process at least 70 percent of there requirements through the Mombasa refinery to support the local liquidified petroleum gas(LPG) market and sustain the Refinery which was considered inefficient but important to the Mombasa economy (Indetie, 2002).

Deregulation was aimed at enhancing operational efficiencies and offer better prices to the market by introducing competitiveness in the oil marketing. The elimination of the market distortions attracted new investments in the petroleum marketing with independents invading and disturbing the long held status quo of dominance by multi nationals. Nyoike and Okech, (1996) noted that the post deregulation period was characterized by significant price increases which the marketers blamed on higher offshore costs, depreciation in

exchange rates and inflation, yet they were slow in reducing the prices when the world crude oil price declined.

Republic of Kenya (2007) government through the Ministry of Energy, puts Kenya inland market total domestic consumption for 2006 at three billion, three hundred and fifty five million, six hundred and forty thousand (3,355,648,000) litres. Of this consumption, 56 percent was white products, being Gasoline, diesel and Kerosene. Diesel constitutes of 60 percent of the white products with growth of the segment being powered by the transport industry. The black products consist of fuel oil, industrial diesel and lubricants which are mostly by products of the refinery process and the high percentage is a reflection of the refinery inefficiency which has a very low barrel-product conversation rate. These black products are subjected to very low taxes because they are considered industrial inputs and this might explain why the white product shoulder a high tax burden because they are considered important for luxury consumption. The table below shows segmented automotive diesel consumption in Kenya in 2006.

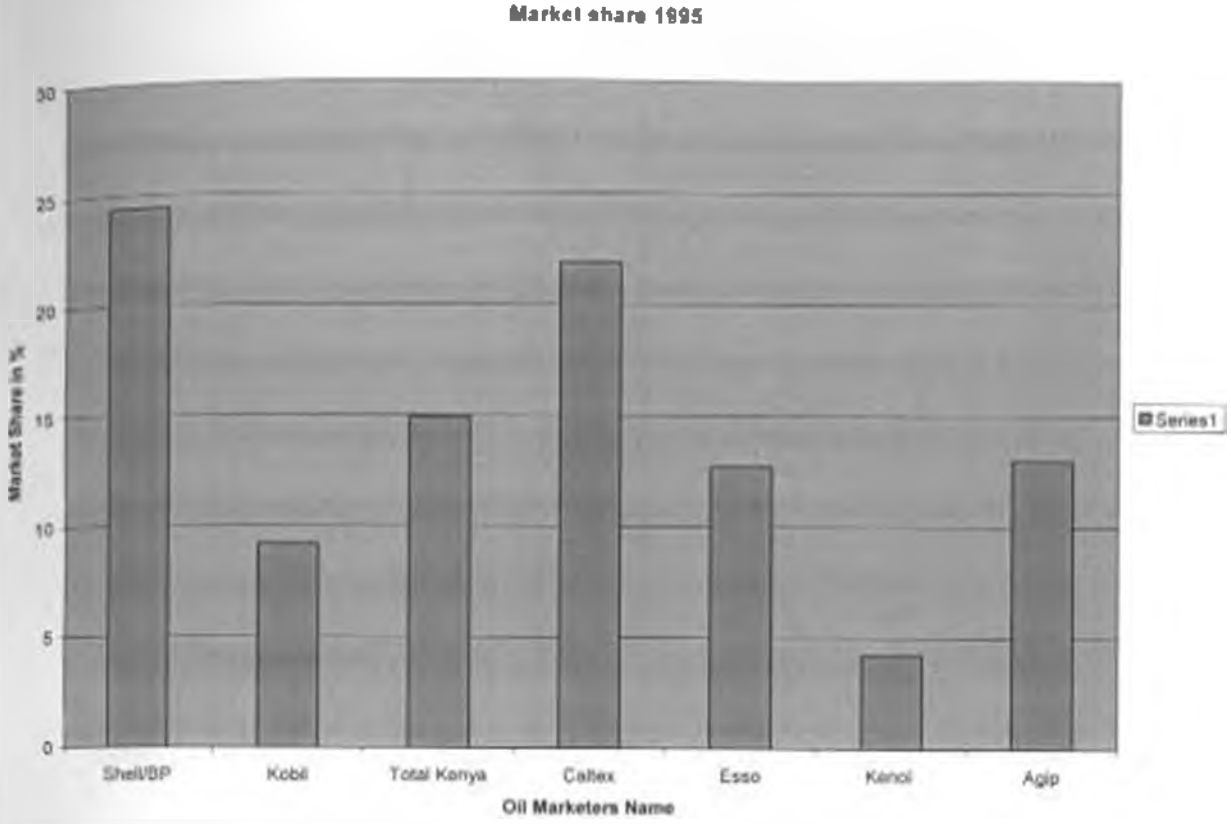
Table 1.1 Automotive diesel use in Kenya per sector in 2006

SECTOR PRODUCT	Automotive diesel in thousands of litres	% of total use
[illegible]	165.84	[illegible]
[illegible]	165,177.61	52.09
[illegible]	286,155.16	26.38
[illegible]	21,332.59	1.96
Rail	23,521.61	2.17
[illegible]	49,879.67	4.52
Others	5,059.15	0.51
[illegible]	18,271.09	1.68
[illegible]	9,143.91	0.49
[illegible]	2,487.[illegible]	0.21
[illegible]	19,918.[illegible]	1.83
[illegible]	10,448.87	0.98
[illegible]	6,451.60	0.59
Military	7,869.31	0.72
Other commercial [illegible]	51,511.99	4.74
Total Inland sales	**1,885,673.29**	**81.41**
Bunkers (International and Local)	1,425.00	0.11
Export markets	246,406.81	18.48
GRAND TOTAL	**1,333,505.10**	**100.00**

Source: Republic of Kenya, 2007. Ministry of Energy.

From table 1.1 above, it can be appreciated that most of diesel used in the country is pumped through the retail networks (52 percent), independents 26.4 percent and direct road transporters purchase at 5.5 percent. Its however worth while noting that transport takes almost all the products pumps through the retail and reseller channels hence making it the biggest consumer of automotive light diesel in the country. Prior to liberalization in 1996, a few multinational oil marketers controlled the Kenyan oil industry with market shares as shown in figure 1.2 below.

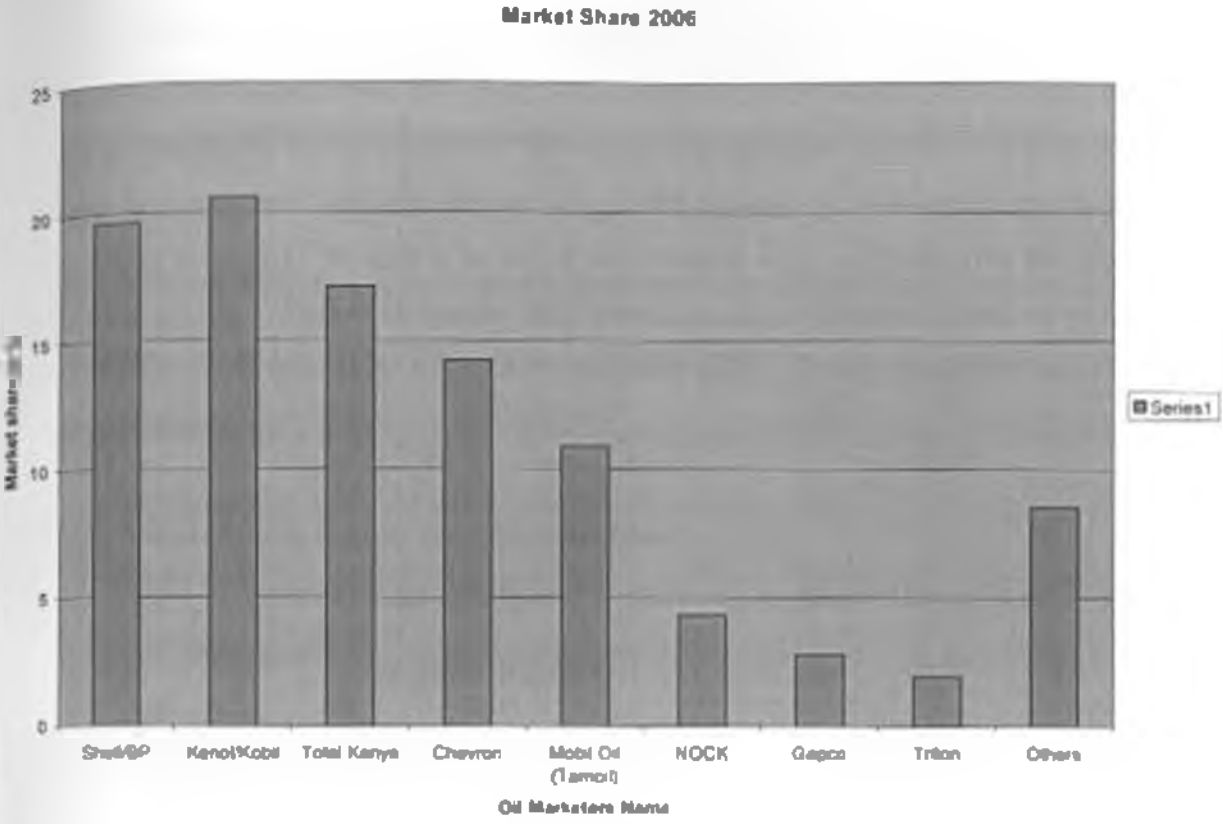
Fig 1.2 Market shares in Kenya before price deregulation in 1995



Source: Karekezi *et al*, 1999

From figure 1.2, it is noted that before liberalization in 1996, petroleum marketing was dominated by multinationals with Shell, BP, Total, Caltex, Esso, Kenol Kobil and Agip with more than 95 percent of the market. It was hoped that the post liberalization period would attract new investment in the petroleum marketing sector and emergence of competition and new entrants was hypothesized. Post liberalizations, the market has evolved with many small independents entering the petroleum industry and the long held status quo destabilized as shown with the markets shares in figure 1.3 below.

Fig 1.3 Market shares in Kenya post deregulation in 2006



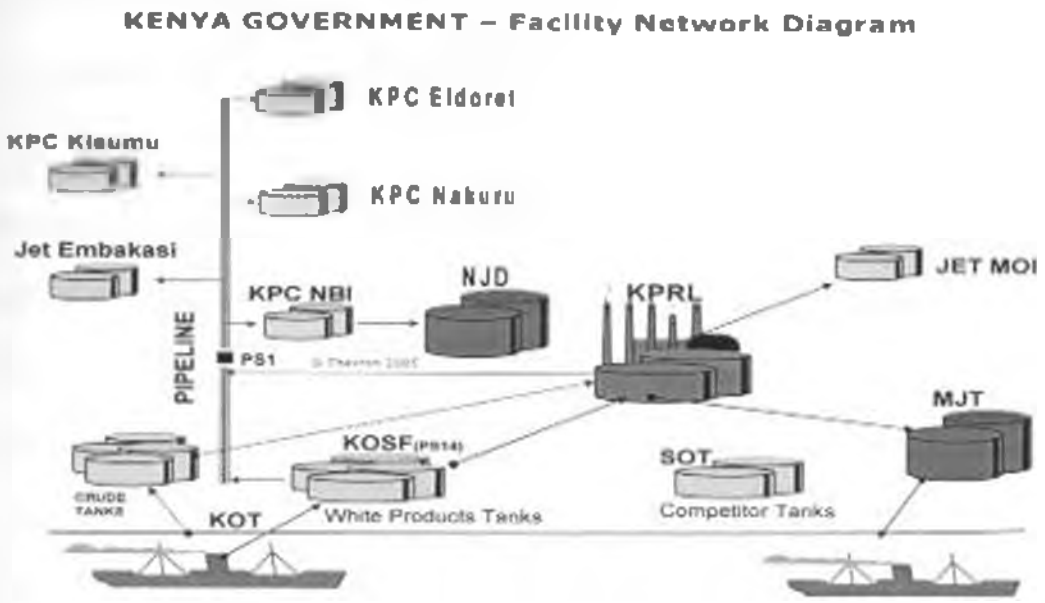
Source Petroleum Institute of East Africa (PIEA), website 2007. www piea co.org. 25.04.2007

Figure 1.3 shows how the market has evolved in the last ten years of post liberalization. The exit of Esso (Mobil), Agip and lately BP indicates non attractiveness of the Kenyan market due to depressed margins. However, the emergence of Kenol-Kobil as the market leader can easily be picked as the high light of the last decade. Its significant to note that National Oil, Gapco Triton and others, have a combined share of 17.57 percent, a significant share considering they had a near zero market share ten years ago.

1.1.3 Petroleum storage and distribution infrastructure in Kenya

The product supply structure for the petroleum industry in Kenya is shown by the figure below. In the figure, two scenarios are shown, one in which crude oil is imported for refining at the Kenya petroleum refinery in Mombasa and the other in which refined petroleum products are imported for sale in the country. In both cases, the imported material progresses through a series of value-added steps on its way to the ultimate consumer. Fig 1.4 below shows the main petroleum distribution infrastructure in Kenya with the port on Mombasa, the refinery and the pipeline playing the anchor joints in the supply chain.

Fig 1.4 petroleum Supply Structure in Kenya.



Source: Chevron Kenya ltd, 2005.

Both refined and crude petroleum products are received at the Kipevu Oil Terminal (KOT) from where they are respectively pumped to Kipevu Oil Storage Facility and KPRL for storage and refining. The refined products are then transported via the Kenya pipeline system to respective company depots for local distribution, or to the export

market through the Kenya Pipeline managed storage depots in Kisumu, Eldoret and Nakuru. The Kenya Pipeline Company (KPC), a wholly Government owned company, manages a 14 inch 450 KM pipeline from Mombasa to Nairobi. The company also manages another 446 KM long pipeline comprising an 8-inch Nairobi to Kisumu segment and a 6-inch Nakuru-Eldoret branch (PIEA 2006). The pipeline tariffs for all products except jet fuel in Nairobi and Mombasa international airports are Ksh.1.53/M^3 to Nairobi, 2.105/M^3 to Nakuru, 2.706/M^3 to Eldoret and 2.703/M^3 in Kisumu. From the storage depots, petroleum products are then transported by road tankers to bulk consumers, domestic retail stations and export destinations. Plans are however underway to extend the oil pipeline from Eldoret to Kampala in order to serve the export market more efficiently (KPC, 2007)

Crude oil and refined petroleum products are mainly imported from Middle East through a monthly-centralized tender system organized by the oil industry but coordinated by the Ministry of Energy. Despite entry of new petroleum traders after liberalization, their participation in the tender process has been very low due to prohibitive costs. To deliver an economic crude oil cargo of about 80,000 Metric Tones at the prevailing international crude oil price of about US$ 100 per barrel would require about US$75 Million. New entrants in the industry who are mainly small are unable to raise this kind of money and offer any meaningful competition in crude oil supply. This business segment has therefore remained with the well-entrenched firms. As a result, of the 32 crude oil tenders awarded in the period 2004/2005, 19 (59.4 percent) were won by Kobil, 6 (18.8 percent) by Shell, 4 (12.5 percent) by Total, 2 (6.3 percent) by Caltex

and 1 (3.1 percent) by Triton. Similarly, over the period 2002-2005, large oil companies accounted for about 82 percent of total refined products cargo deliveries while the combined independent operators account for only about 18 percent. In 2006 and 2007, there have been changes with the entry of some high worth players namely Triton, Addax and Gulf Energy.

Kenya's downstream oil distribution infrastructure mainly comprises storage depots, loading facilities, transportation trucks and retail dispensing stations. Asset ownership in this market segment is also heavily skewed in favour of the large operators as shown by table 1.2 below.

Table 1.2 Ownership of storage depots and loading facilities in Kenya

Location	Category	Name	Ownership
Mombasa	Depot	Mombasa	Kenya Pipeline Company
		[illegible]	MOI-Kobil, Chevron, Total
		Mombasa	Shell, Oilibya and Tocaffey
Nairobi	Depot	Nairobi Joint Depot	Kenol Kobil, Total & Chevron
		Nairobi Joint Depot	Kenya Pipeline Company
	Loading Facilities	Nairobi Joint Depot	Kenol Kobil, Total & Chevron
		Nairobi	Shell, Oilibya and Oilcom
		National Oil Corporation	National Oil Corporation
Sagana	Depot	Sagana Depot	Kenol Kobil
Nakuru	Depot	Nakuru	Kenya Pipeline Company
		Nakuru	Kenol Kobil
	Loading Facilities	Nakuru Loading Facility	Kenya Pipeline Company
Eldoret	Depot	Eldoret	Kenya Pipeline Company
		Kisumu	Kenol Kobil
	Loading Facilities	Eldoret Loading Facility	Kenya Pipeline Company
Kisumu	Depot	Kisumu	Kenya Pipeline Company
		Kisumu	Kenol Kobil
	Loading Facilities	Kisumu Loading Facility	Kenya Pipeline Company

Source: Republic of Kenya, Ministry of Energy, 2005.

It is apparent from table 1.2 above that the major oil companies and the Government through the KPC and the National Oil Corporation (NOCK) predominantly control the entire network of storage depots and loading facilities. Ownership, geographical distribution and access to these facilities are considered a critical bottleneck to entry and effective competition in Kenya's petroleum industry. In Western Kenya,where KPC manages efficient common-user loading facilities, competition at the retail level has been vibrant and market share profiles have substantially changed over the last four years (Imitira (2005). This is because the loading facilities have leveled the playing field by allowing all the firms easy access to their products at standardized charges. However, Nairobi and Mombasa markets, which respectively comprise about 60 percent and 20 percent of the entire petroleum market in Kenya, are still rigid due to inadequacy or absence of efficient loading arms. On the other hand, ownership of the retail network in the country has over time since liberalization evened out with the major oil companies and new entrants splitting the ownership on an almost 50:50 basis as shown below;

Table 1.3: Ownership and Distribution of Retail Outlets (2005)

Region	New Entrants		Majors		Total
	No	%	No.	%	No.
Central	59	41.5	83	58.5	142
Nairobi	123	39.9	185	60.1	308
Coast	63	49.9	65	50.8	128
Rift Valley	170	56.9	129	43.1	299
Eastern/N Eastern	53	43.4	69	56.6	122
Western	30	57.7	22	42.3	52
Nyanza	62	60.8	40	39.2	109
Total	560	48 6	593	51.4	1,153

Source: Republic of Kenya, Ministry of Energy, 2005.

Table 1.3 could however be misleading if the statistics are seen as a reflection of the level of competition in the industry. Most of the retail stations owned by the independent dealers are located in non strategic rural market or low traffic roads in urban economically underprivileged locations while those operated or leased out by the major companies are located in up market areas, major towns and cities and along major roads and highways.

Prior to deregulation, petroleum product prices in Kenya were set by a government-oil industry committee comprising of representatives from the Ministries of Finance, Energy, Trade and oil company representatives. After liberalization, this committee was disbanded and now the respective oil marketing companies set prices. The landed cost in Mombasa includes all off-shore costs such as free on board (FOB) crude oil price,

freight and premium, insurance premium, war risk premium, letter of credit, pre-shipment inspection fees, wharfage and ocean losses. Other costs such as refining and storage charges, refinery usage, industry managed costs (IMC), company profit margin and taxes and levies are included to arrive at the wholesale price in Mombasa. Inclusion of pipeline and rail transport tariff from Mombasa generates landed costs in other towns (Nairobi, Nakuru, Eldoret and Kisumu), while a town delivery cost by road tankers and a dealer margin are included to arrive at the retail pump price in Ksh/litre. Table A 3 and A 4 demonstrates the price build-up method for Automotive Diesel in the country. The most common strategy by the oil marketer is to adopt the ex refinery pricing when international prices are going down and platts when international prices are going up to cater for replacement. This by a large extent explains why price drops are slow and increases are fast as articulated by Bacon (1991) rockets and feathers phenomena.

1.2 The statement of the problem

It has been noted in the background that oil is a quintessential commodity in the modern economy with its most important role as a liquid fuel for transportation. Energy is a critical input in many productive processes and therefore a causal factor for economic growth The sharp increase in the price of petroleum prices has presented a unique challenge to the net oil importers in the developing world with the prospects of slowing down economic progress (ADB, 2006). In the Kenyan case, the problem has been worsened by frequent droughts which have stifled hydro power generation capacity and increased the countries dependence on oil for power generation

Various explanations have been given to justify the pricing regime witnessed in Kenya. There is suspicion of price asymmetry between the crude oil prices and the pump prices which explains the rigidity of prices coming down when the crude oil prices are downward bound

Imitira (2005). The other argument is incompleteness of foreign exchange pass through which the slowness of any benefits trickling to the pump price can be explained. The third argument has been lack of competition and cartel like actions by the multinationals. Kimuyu (1988) noted that to the extent that the oil industry is oligopolistic and the power sector is monopolistic, then the commercial energy market in Kenya is imperfect. The fourth argument has been petroleum prices are taxed at various levels and thus the pump price is a reflection of the exorbitant taxation regime applied by the Government.

The high price of light diesel which is predominantly used in the transport and the industrial sectors presents a problem of cost inflation as a result of high energy price. The African Development Bank (ADB) projected a rise of inflation of 1.3 percent and 2.6 percent in the net oil importing countries in 2005 and 2006 respectively, as a result of the high oil prices (ADB, 2006).

The short- run demand for light diesel is inelastic and therefore shift in consumption would be expected to pay for high energy bills (Imitira, 2005). This reduction in consumption stifles aggregate demand and in effect slows national productivity. This in effect reduces the speed and intensity of national investment. Reduction in consumption and investment slows down economic growth.

The high cost of light diesel reduces the profitability of the transport and the industrial sectors thereby reducing the public revenue tax base. The reduction in government revenue exerts a heavy toll on the budget and is worsened by reduced employments as a result of thinner profits in the diesel consuming sectors. Thus the high cost of diesel has a double effect of eroding government revenue and reducing general employment in the country. The high diesel prices causes a higher transport cost which increase commuting costs especially for an agriculture dependent country like Kenya, it becomes expensive to get products from the farms to the market, therefore eroding their profits and stifling agricultural production. The high transport cost distorts agriculture marketing by widening disconnect between supply and demand.

All alternative sources of energy pursued by the government are diesel dependent with Independent Power Producers, Geothermal and Cogeneration, all needing massive supplies of diesel for them to run. The price of diesel therefore becomes an important component in the energy pricing in the country. The price of diesel is kept relatively low by the government in view of its importance to the economy in comparison to gasoline by applying discriminatory fiscal regime. The importance of light diesel in the economy will continue to grow with the expansion of industrial and transport sectors of the economy . and this is not likely to change because at the present and in the near future, there exist no feasible substitutes to this fuel (Sasia, 1987). Advanced exploratory techniques in crude oil search, geothermal potential in the rift valley basin and global biofuel research may, however, change this opinion.

This research aimed at evaluating the price making mechanism of light diesel in the country with a view of deducing optimal pricing policy given the dynamism of the cost components. The research sought to answer the following research questions:

a) What are the determinants of automotive diesel prices in Kenya?

b) Do domestic prices of automotive diesel relate to changes in crude oil, exchange rates and taxes?

1.3 The objectives of the Study

This research sought to establish the determinants of automotive light diesel prices in Kenya with a view of establishing price build up mechanism of diesel in the country. The specific objectives of the study were:

a) To establish the determinants of automotive diesel prices in Kenya

b) To examine the relationship between domestic prices of automotive diesel prices and changes in the price of crude oil, foreign exchange rates and government taxes.

c) Suggest appropriate policy recommendations on the management and regulation of the petroleum pricing in the country.

1.4 Justification and significance of study

This study contributes to existing literature on pricing under different market structures. In particular, existing literature focuses on gasoline, the premium products in the first world, while this study analyses pricing of diesel, an input product in many productive processes This research will helps policy makers in the energy sector to formulate appropriate pricing policies not only in petroleum marketing but also in petroleum dependent segments like transport, power and manufacturing.

The study of diesel pricing was justified by the following facts; that although the industrial revolution was initially powered by coal, since its discovery in Pennsylvania in 1869, oil has gained increasing prominence in terms of its share of the world primary energy supply accounting to 37 percent share in 2001 (IEA, 2005). Energy is the most important part of international trade with oil alone being the most important item in world trade. In Kenya, oil import bill is the biggest consumers of foreign exchange hence a critical component of the balance of payments matrix.

Senga *et al* (1980) stated that Kenya will continue to rely on petroleum products as a source of commercial energy because of lack of potential economically viable substitutes, limited potential for production of electricity energy and the use of thermal power which is dependent on petroleum products. The hydro power potential is exhausted, the country has no known crude oil reserves and the only frontiers left for expansion are thermal and power generation by the independent power producers.

These energy sources require massive supplies of automotive diesel and therefore diesel prices play a significant role in power pricing in the country. This study assists power economist in their planning and pricing of power given the inconsistence rain patterns in the country.

In Kenya, the tourism industry, Transport, Manufacturing and Agro business are diesel dependent either for transport, source of energy or as raw materials. According to Stern and Cleverland (2004), energy is a critical input in many productive processes and therefore a causal factor for economic growth. Economic growth stimulates consumption of fuel by house holds and hence it's a complete circle linking demand and supply. The IMF estimates a sustained increase of crude prices by 10 percent would lead to a loss of 1.5 percent to 3 percent of the GDP in net oil importing countries of sub Saharan Africa (IEA, 2004) . High diesel prices are therefore a challenge to the government stated objective of achieving high economic growth rates and therefore this study assists planners in mitigating this challenge.

Overall, this study assists government planners, oil marketers, petroleum consumers and the general public in understanding downstream diesel pricing and assist in evaluating market performance of the oil industry and developing an optimal pricing and marketing policy.

1.5 Scope and organization of the study

This research paper has used Nairobi retail automotive prices as anchor price because Nairobi constitutes more than 60 percent of the oil market in Kenya and automotive diesel again constitute more than 60 percent of the white products used. The study analyzed quarterly time series data from 1996 to 2006, restricting the study to the post deregulation period.

The first chapter of the study introduced the local oil market and industry, linking its performance with the global oil market and its challenges. It illustrated the oil market infrastructure and demonstrated the importance of petroleum as a source of commercial energy in Kenya. The second chapter introduced pricing in economic theory, discussed relevant literature in price making mechanism, reviews empirical studies taken in the petroleum pricing, highlighting their strengths and weaknesses and indicated gaps to be filled by future research. The third chapter details the theoretical framework, introduces the methodology, specifies the model, and states the working hypothesis, data sources and the estimation technique. Chapter four presents empirical findings, analysis and discussions of the results. Chapter five presents policy implications and recommendations deduced from the study results usable by the government in pursuit of stable energy policy.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

This chapter presents a review of literature on the determinants of automotive light diesel prices in the world. It highlights studies carried out in both developed and developing countries as well as different views and policies suggested and adopted in the areas of the energy sector especially pricing of petroleum products.

2.2 Theoretical literature review

The theoretical underpinning of this study was epitomized by Kimuyu, (1988) when it was noted that to the extent that the oil industry is oligopolistic and the power sector is monopolistic, then the commercial energy market in Kenya is imperfect.

One of the important determinants of how society resources are used is how the markets are organized. In a perfect competition, the polar case which seldom occurs, economic theory assumes there are many buyers and sellers, dealing with a homogeneous product with free mobility of resources. Prices in a perfectly competitive market equal the marginal cost of the product. In a monopolist market, there is only one seller which is not the case in Kenya petroleum market. A close resemblance would be a monopolistic competitive market where there are many sellers with differentiated products In Kenya branding of petroleum products is a new phenomenon with consumer perception transfixed at the homogeneity of the products.

In an oligopolistic market, the key characteristic is interdependence, actual or perceived between firms. Nyoike and Oketch (1999) stated that oligopolistic market becomes a cartel if there exist arrangement amongst at least a few larger sellers. Economic theory associates oligopolistic markets with a number of pricing behaviors which includes price leadership. The market leader announces prices and the rest of the market follow suit almost immediately. Shell, Total, Chevron and Kenol have played this role interchangeably since deregulation of the petroleum industry.

The multiplicity and predictive limitations of oligopoly pricing theories are well documented and appreciated. Grant (1982) argued that competition between two sellers will result in a monopoly price, a competitive price, a determinate price intermediate between them, a perpetually oscillating price, and no price at all because the problem is impossible. This range of predictions corresponds to the range of pricing behavior prevalent in the manufacturing industry. The major limitation is that no single theory is robust enough to capture all the pricing behaviors' observable both across different industries and in the same industry over time.

To circumvent the inherent weaknesses of oligopoly theory, industrial economists have evolved a less formal approach to the analysis of oligopoly pricing based upon plausible assumptions on corporate motivations and behavior, and the observation of patterns of pricing behaviour in a number of industries. This approach is analytically informal in that it does not seek to develop an empirical model of oligopoly pricing

such as the Cournot model, but focuses on the factors that influence the extent of collusion and competition in a given market.

The extent to which oligopoly price exceeds the long-run competitive price in a given market is a function of the ability of firms to have a synchronized product pricing policy. However, certain factors should prevail for this to happen. These include similarity of collusion motivations, recognition of interdependence by firms, and the ability to achieve and successfully maintain matched prices above the competitive level.

The incentive to avoid competition is the latent potential to rake in monopoly windfall. According to Grant (1982), the ability to extract monopoly premiums is however dependent on the price elasticity of demand, extent and intensity of entry barriers in an industry and the similarity of cost structure and technology between firms in that industry. Similarity of costs and technology between firms makes collusive pricing practices attractive. Similarly, the extent to which firms appreciate the gains of matched pricing depends on the apparent interdependence of their pricing-output decisions. This insight is in turn a function of seller concentration levels and the cross-price elasticity of demand between the outputs of the colluding firms. Cross-price elasticity of demand is usually high where product differentiation is difficult to accomplish, as is the case with petroleum products. Grant (1982) further argued that successful pricing synchronization in an industry is primarily a communication issue. Ease of communication among firms is premised on the number of firms in the industry, and

history of past collaboration and communication in the industry. Finally, the ability to raise and maintain prices above the competitive level by oligopoly firms depends on their ability to frustrate competitive initiatives from within and without.

Competition from new firms is usually subdued through entry barriers. Prices in collusive oligopoly cannot exceed the long-run perfectly competitive price by more than the enormity of entry barriers in that industry. On the other hand, competition from the colluding firms would be triggered by the incentive for each firm to undermine the oligopoly price in order to expand its market share and increase profitability. If this strategy is pursued by all firms, the results in lower profits. Colluding firms will pursue this pricing behaviour if there are large buyers in the industry that induce the offer of large discounts, or a fall in short-run marginal costs relative to the average cost and industry price. The tender prices for the independent power producers (IPP's) therefore, offer the best competitive pricing of petroleum products in Kenya

In general, due to the desire by colluding firms to adjust prices to reflect different circumstances in different sectors of the market and avoid competitive price-cutting where possible, price competition among oligopoly firms mainly take the form of credits and rebate (Grant, 1982). In addition, the balance of forces for coordination and competition in oligopoly is unlikely to generate a stable equilibrium price in the long run. The tendency to retaliate against competition from any firms results in a process of cumulative price-cutting, which could degenerate into a price war. Since both the incentive to gain sales by undercutting the oligopoly price and the potential for

retaliation against competition are dependent upon cross price elasticity of demand, it is feasible that the oligopoly price will be unstable if the product is homogeneous.

Imitira (2005) noted that petroleum costs represent a small share of total motoring costs (including servicing, maintenance, parking charges and purchase costs of automobiles) and due to absence of substitutes, the price elasticity of demand for petroleum products is usually very low. However, due to the relative homogeneity of petroleum products as a result of widespread adoption of international quality standards, and limited scope for product differentiation, the cross-price elasticity of demand for petroleum products is very high. Low price elasticity and high cross-elasticity of demand generally discourage price undercutting as a means of increasing sales and provides a conducive environment for collusive pricing in the petroleum industry.

In addition, the forward and vertical integration in the petroleum industry in Kenya constitute a significant entry barrier. Most of the petroleum products in Kenya are sold through company managed or leased-out retail stations owned by the major firms. Usually, these stations are located on high-traffic (hence relatively more expensive) locations such as major roads, highways and cities relative to the independent stations that are situated in peripheral locations where sales volumes are low. This implies that the prime petroleum markets in Kenya are foreclosed from new entrants. Moreover, the petroleum industry is highly vertically integrated and the domineering grip of the product supply chain by the majors restricts products supply to the new entrants. Due to inadequacy or absence of efficient common user loading facilities in Nairobi and

Mombasa respectively, new entrants in these petroleum market have had to rely on hospitality from the major oil firms. Mostly this hospitality is often denied or granted at premiums that diminish any possibility of price undercutting at the retail level.

2.3 Empirical literature review

A thorough understanding of the pricing mechanism of any fuel requires knowledge of the fuel cycle which begins at the source of energy and goes towards the end use (Delucia and Associates, 1990). It includes exploration, identification and assessment, production or extraction, separation or improvement, conversion, transformation and refinement, storage, transportation, distribution and use. Costs incurred at different stages are considered in the final pricing.

Bacon (1991), in reference to gasoline price movements in Britain from 1965 to 1990 likened gasoline price rises to rockets and price falls to feathers and made an early attempt to test price asymmetry statistically, using biweekly data from June 1982 to January 1990. Bacon used an adjustment model where it was assumed that traders at the various levels of the oil distribution chain set their target prices to closely reflect their costs and a profit margin. The difference between the prices they actually receive at a given time and their target prices provide them with incentives to adjust their prices towards their preferred level. The speed of this price adjustment can then be measured to determine whether price changes occur asymmetrically.

Bacon concluded that all petroleum price changes in Britain were eventually fully passed on to the consumer (amount symmetry), but noted a high prevalence of pattern asymmetry. However, the asymmetry was so short lived that British gasoline market could still be considered a highly competitive market. In addition, the author argued that price asymmetry is difficult to define and model, but is doable, and that short frequency data sets yielded more binding conclusions.

Karrenbrock, (1991), distinguished three types of possible price asymmetries, namely pattern, amount and combination asymmetry. Pattern asymmetry means that an increase in price is passed through from an upstream price, i.e. wholesale to retail price, faster than a decrease in price is passed through. Amount asymmetry on the other hand estimates whether upstream price increases or decreases are eventually reflected at the downstream level regardless of the timing involved. Finally, the study defined combination asymmetry to reflect both pattern and amount asymmetries.

Unlike Bacon, Karrenbrock used a partitioning model on monthly wholesale price data from January 1983 to December 1990. The model found pattern asymmetry as wholesale price increases were initially passed through to the retail level much faster than wholesale price decreases. But there was no amount asymmetry from wholesale price to retail price because all wholesale price increases or decreases were completely reflected at the retail level within two months after the shock. The study found that if wholesale gasoline prices rose by 10 cents per gallon in one month, retail gasoline prices would rise by 6.8 cents in the same month and 3.5 cents in the following month.

Conversely, if wholesale gasoline prices reduced by 10 cents per gallon in one month, retail prices would reduce by only 3 cents in the same month but will fall by 6.9 cents in the following month. The study concluded that in spite of the asymmetric price movements, the total lag length for complete retail price pass through was about the same (2 months) whether wholesale prices were rising or falling.

Ndungu (1996) Concluded that exchange rates and domestic price level are important variables in the macro economic stability of a country. The conclusions were derived from an exchange rate pass through study for Kenya using quarterly time series data from 1970 to 1993. The study concluded that inflation and exchange rates drove each other. Examination of asymmetric gasoline price movements requires a careful analysis at many possible markets.

Nyoike *et al* (1994), did not establish any evidence of cartel in the petroleum sub sector in Kenya. In providing evidence for existence of oligopoly market in the country, they noted that significant control of service stations is held by eight firms, an observation valid even in 2007 with Shell and Kenol controlling more than 40 percent of the market share. Total, Chevron and Oil libya combined controls up to 40 percent of the market share, meaning the five largest oil marketing companies have over 80 percent of the market share. An herfindahl Hirsman index (IIII) done by the for 1994 and 1995 market shares indicated an index of 1.780 and 1.720 respectively, market concentration indexes associated with oligopolistic competition. Nyoike *et al* noted the existences of vertical integration as witnessed locally and internationally in the

petroleum sub sector. The following fiscal and non fiscal barriers to entry were noted; capital intensiveness which characterizes investment in the sector, non provision of hospitality services by majors to independents, Requirements for line fill quantities, requirement for crude oil processing agreement with Kenya refinery and seventy percent crude oil processing at the refinery to support the local liquidified petroleum gas.

Borenstein *et al.* (1997) undertook a detailed analysis of numerous levels of gasoline prices. They constructed a partial adjustment model to examine weekly or biweekly gasoline prices at the national level from March 1986 to December 1992 and used their model to examine various relationships in the gasoline market chain. They searched for asymmetric price movements between crude oil to spot gasoline prices, crude oil to retail prices, spot gasoline to terminal prices, crude oil to terminal prices and terminal to retail prices. They encountered price asymmetry at the level of crude oil prices to spot gasoline prices, and from wholesale gasoline price changes to retail price changes. They attributed some of the asymmetry to inventory adjustment lags and market power of some firms.

The authors modeled an empirical test for the common belief that retail gasoline prices adjusted more quickly to increases than to decreases in crude oil prices. To estimate the rate at which gasoline prices adjust to crude oil price changes, the study assumed a simple linear long-run relationship between retail gasoline price and crude oil prices such that:

$$R = \alpha + \alpha_1 C + \varepsilon$$

Where:

R is the retail gasoline price

C is the crude oil price

ε is the error term

The study recognized that retail price adjustments to crude oil price shocks were not instantaneous but assumed that the adjustments function was time-invariant during the sample period and was independent of the absolute magnitude of the crude oil price change.

Defining $\Delta C_t = C_t - C_{t-1}$, and

$\Delta R_t = R_t - R_{t-1}$

The adjustment was modeled as:

$$\Delta R_t^1 = \beta_0 \Delta C_t \qquad (2.1)$$

$$\Delta R_{t+1}^1 = \beta_1 \Delta C_t$$

$$\Delta R_{t+n}^1 = \beta_n \Delta C_t$$

Where the subscript on ΔR indicated that it was solely the change resulting from period t change in crude oil price, and n is the number of periods it takes for retail prices to completely adjust to the period t change in crude oil prices. Under these assumptions, the total change in retail gasoline price in any period t will depend on the crude oil price changes in the previous n periods:

$$\Delta R_t = \Delta R_t^{1} + \Delta R_t^{1-1} + \Delta R_t^{1-n}$$

$$\Delta R_t = \sum \beta_i \Delta C_{t-i} \quad \text{..... (2.2)}$$

Equation (2) above however imposes symmetric response assumption to increases and decreases in crude oil price changes. Recognizing that the adjustment process could be different for increases than for decreases (pattern asymmetry), the model instead assumes that:

$$\Delta R_t^{1} = \beta_0^{+} \Delta C_{t-i}$$

$$\Delta R_{t-1}^{1} = \beta_1^{+} \Delta C_{t-i} \quad \text{..... (2.3)}$$

$$\Delta R_{t-n}^{1} = \beta_n^{+} \Delta C_{t-i}$$

If $\Delta C_t > 0$, and

$$\Delta R_t^{1} = \beta_0 \Delta C_{t-i}$$

$$\Delta R_{t-1}^{1} = \beta_1 \Delta C_{t-i} \quad \text{..... (2.4)}$$

$$\Delta R_{t-n}^{1} = \beta_n^{-} \Delta C_{t-i}$$

If $\Delta C_t < 0$

Defining $\Delta C_t^{+} = \text{Max}\{ \Delta C_t, 0\}$ and $\Delta C_t^{-} = \text{Min}\{ \Delta C_t, 0\}$, ...(2.5)

the simple empirical model for adjustment of retail gasoline prices to crude oil changes allowing for the possibility of asymmetric adjustments becomes:

$$\Delta R_t = \sum_{i=0}^{n}(B_i^{+}\Delta C_{t-i}^{+} + B_i^{-}\Delta C_{t-i}) + \varepsilon_t \qquad (2.6)$$

Where ε_t is assumed to be normally distributed.

However, a number of issues need to be resolved before estimating equation (2.6) above. These issues arise in the estimation of all downstream price transmissions and result in a model specification more general than (2.5). The lag structure for instance imposes certain constraints on the adjustment path, allowing it to be even non-monotonic. It also allows an inter-temporal independence, which contrasts with the standard partial adjustment model. If the long-run relationship is assumed to be $R = \alpha_0 + \alpha_1 C + \varepsilon_t$, then an estimated partial adjustment model (PAM) is such that:

$$R_t - R_{t-1} = \mu(\alpha_0 + \alpha_1 C_{t-1} - R_{t-1}) + \varepsilon_t \qquad (2.7)$$

Borenstein *et al.* (1997), stated that eventually there was a complete transmission of crude oil price shocks to wholesale prices, but the process takes several weeks. The authors however argued that since wholesale prices are formed in competitive and well-organized markets, the lags in the adjustment process were peculiar. A change in crude oil price changes the opportunity cost of the primary input, and under most standard models of firm behaviour, should lead to an instantaneous and smooth change in the equilibrium price.

Consider for instance a competitive firm that realizes that the upstream costs have gone up by an amount likely to trigger a retail price increase in the long run. If the firm was operating in a perfectly competitive market where the marginal cost is equal to price (MC = P), the marginal cost is now greater than price (MC > P) and in accordance with the theory of the firm, the firm has a motivation to scale down its production or supply. Since all firms in the industry have similar motivations, the retail price of gasoline will therefore adjust immediately to reflect the changes in crude oil prices.

Bacon (1991) tested for asymmetry in adjustment rate by introducing a quadratic term in the adjustment process:

$$R_t - R_{t-1} = \psi_1 (\alpha_0 + \alpha_1 C_{t-1} - R_{t-1}) + \psi_2 (\alpha_0 + \alpha_1 C_{t-1} - R_{t-1})^2 + \varepsilon_t \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (2.8)$$

so that the test for $\psi_2 = 0$ is the test for whether adjustments to increases and decreases in crude oil prices occur equally quickly. The PAM however imposes equal proportional adjustment towards the new equilibrium in all periods after a shock in crude oil price. In addition, the quadratic term as used by Bacon imposes a structure on the asymmetry implying that the asymmetry becomes proportionally larger as the difference between the current retail price and the long-run equilibrium price increases. The main advantage of the PAM over the lag adjustment model in (2.6) above is that the PAM takes account of the long-run relationship between the prices of upstream and downstream goods, and the tendency to reverse towards that relationship. To correct

this, equation (2.6) is estimated with an error correction term, which is a one period lagged residual from the relationship $R_t = \alpha_0 + \alpha_1 C_t$. The model then becomes:

$$R_t - R_{t-1} = \sum_{l=0}^{n}(\beta_l^{+}\Delta C_{t-l}^{+} + \beta_l^{-}\Delta C_{t-l}^{-}) + \gamma_l(R_{t-1} - \alpha_0 - \alpha_1 C_t) + \varepsilon_t \quad \text{.....(2.9)}$$

A concern for the above model is the possibility of endogeneity of upstream prices. Crude oil prices could be correlated with the error term in equation (2.9) if unobserved determinants of the retail price were also correlated with crude oil price.

Borenstein and Shepard (2000) argued that if supply adjustment costs are high, firms usually prefer to absorb upstream cost shocks over multiple periods in order to reduce the impact of the shocks on their cash flow. Because adjusting levels of production is costly, economic agents stagger the adjustment over time. A slump in crude oil price for instance implies a long-run increase in the supply of gasoline. However, due to supply adjustment costs that are directly proportional to the absolute size of adjustment per period, firms opt to absorb the shocks gradually, ultimately attaining the full quantity adjustment commensurate with the cost decline. The other explanation enumerated in the study stems from a large literature on industrial organizations and microeconomics and focuses on the difference between market clearing prices and spot transaction prices. The concern in these models is why changes in spot transaction prices do not strictly correlate with changes in market clearing prices, and various

reasons have been given to explain this behavior such as menu costs that make changing transaction prices costly, information imperfections and demand inelasticity. Major weakness of the Borenstein *et al* model is the specification and estimation of the price adjustment equation. They have used fixed time lag structure in their dynamic short run equation which is not consistent with the underlying data generating process.

Asplund *et al*, (2000) on their part analyzed the passthrough of costs to retail petroleum prices in the Swedish gasoline market. They used daily data to examine price responses in the Swedish gasoline market to changes in the Rotterdam Spot price, exchange rate and taxes. The authors argued that the relationship between prices and costs in the Swedish gasoline market portray a pattern regarded as typical for many products; the price remains fixed for some period of time, and when adjusted is in the direction motivated by the underlying cost. The study emphasized that for a fuller understanding of price adjustments, it was necessary to examine the data sets where the sample frequency at least matches that of price adjustments. In addition, data with shorter frequencies generated more credible results. The study tests various symmetries such as downward and upward flexibility of prices, symmetry in response to exchange rates, spot market prices and taxes.

The study used data on retail prices of leaded premium gasoline in Sweden for the period January 1980 to December 1996. The authors argued that the gasoline market in Sweden was vertically integrated where gasoline was sold almost exclusively through

branded stations, and therefore retail prices are determined by the list prices of the retail chains (firms). The study focused on the retail price list of Shell, which through out the period was either the largest or second largest firm with a market share ranging between 17 percent and 21 percent. The behaviour of shell's retail segment was therefore assumed to closely reflect those of other firms in the industry. The general form of the model estimated was:

$$\Delta RP = f(\Delta SP, \Delta E, \Delta MC, WAGE, TAX)$$

Where:

RP is the retail list price of one litre of premium leaded gasoline (excluding VAT);

SP is the Rotterdam Spot market price of gasoline in US$;

E is the exchange rate of Swedish Kroner to US dollar (SEK/US$);

MC is the marginal cost of gasoline which is also denoted SP*E; and,

ΔWAGE is an index of nominal wage rate.

Using monthly data, the study estimated the long-run relationship between retail prices and costs, i.e. Retail price (RP) and explanatory variables Marginal cost (MC), Tax and Nominal wage rate (WAGE) and produced the following results:

$$RP = 22.9 + 0.902*MC + 0.658*TAX + 2.01*WAGE + \mu$$

(6.29) (0.03) (0.03) (0.12)

DW=0.63 Adj. R^2 = 0.988

Where figures in brackets are the standard errors.

A non-negative relationship between recent cost changes and price adjustment was expected. However, sometimes the price moves in one direction when the marginal cost moves in another (unexpected sign) due to omitted variables or hedging opportunities and inventory situation. The study argued that the explanation for the large number of wrong signs was a gradual adjustment pattern. If the firm for some reason wished to avoid large price changes, this may result in occasional violation of the monotone relationship between cost changes and price adjustment.

To capture the probability that price adjustments partly reflect previous changes in costs, lagged variables were included in the subsequent econometric analysis and estimated the relationship between all the price adjustments and the preceding changes in marginal cost and taxes. The coefficient for change of marginal cost was found to be greater (0.28) for price rises than for price cuts (0.19), indicating presence of pattern asymmetry in price adjustment.

Imitira (2005) motivated mainly by the unrelenting agitation for reintroduction of price controls in the petroleum market in Kenya premised on the view that gasoline retail prices do not respond to the market fundamentals. The study undertook a price passthrough analysis to ascertain presence of amount asymmetry (whether upstream cost changes are not fully transmitted to the retail levels and pattern asymmetry (whether crude oil price increases are transmitted faster and more efficiently than crude oil price decreases). The study found no evidence of amount asymmetry but pattern

asymmetry was found to be prevalent. Indeed retail gasoline prices in Nairobi rise faster than they fall.

Ye *et al*, (2005) documented that petroleum products change hands severally on the supply chain from the point of production to the ultimate consumer. Each firm participating in the supply and marketing chain incurs some costs and wishes to make some mark-up; hence petroleum price usually increases with each intermediate sale. Consequently, any change in price at any intermediate point of sale is expected to affect prices at each successive sale. This process is called pass-through in economic literature.

Bhaskara *et al* (2005) tested asymmetric relationship between crude oil and gasoline prices in Fiji and confirms asymmetry in price adjustments with respect to crude prices. By using two models, the Granger two steps and LSE Hendry Approaches, the study derives identical findings testifying presence of asymmentry.

Kiptui (2006) assessed the extent to which exchange rate affect consumer's prices in Kenya. Using two different approaches, the unrestricted VAR and the Johansen framework of multivariate cointegration, he show that a 10 percent increase in exchange rates leads to 4 percent increase in consumer prices. This study confirmed a significant effect of import prices on inflation in Kenya at a pass through of 0.7 of import prices to consumer prices.

2.4 Overview of literature

From the above literature, it was appreciated that a petroleum pricing had received a fair amount of research with interest being restricted on the relationship between crude oil and gasoline prices, the dominant product in the United States and Europe. From Bacon's pioneer work in 1991 to Bhaskara *et al* (2005) Fiji research, empirical test have shown resistant of marketers to adjust prices downwards while extreme alacrity have been shown to the opposite giving credence to Bacon's Rockets and Feathers hypothesis.

In Kenya, literature available is limited to Imitira (2005) analyzing asymmetry or lack of it in relationship between crude oil prices and Nairobi gasoline prices. Indeed the study findings indicated no amount asymmetry but showed pattern asymmetry was prevalent. This study will incorporate other input cost components of tax and foreign exchange to determine the price making mechanism in automotive diesel.

This study adopted the Bhaskara *et al* (2005) approach of testing relationship between gasoline prices and cost components because of two reasons: One, the study incorporated the relationship between the cost variables of crude oil , taxes, foreign exchange and refinery cost. Two, Fiji as a developing country represented a close resemblance to the Kenyan macro economy because it's dependent on imported oil, limited foreign exchange and use of fiscal policy in petroleum to attain redistribution of wealth as in all developing countries

CHAPTER THREE

METHODOLOGY

3.1. Introduction

This chapter presents the methodology employed to examine and estimate a model which explain the determinants of automotive diesel prices in Kenya. The econometric model for the study is first outlined followed by a specification of a model to be estimated. The variables used in the study are explained, including the sources of data and diagnostic analyses that were done.

3.2 The Econometric Model

This study adopted the Bhaskara *et al* (2005) model and used it on the Kenyan data.

Bhaskara *et al* (2005) specified the general model for gasoline piece to be;

$$rp = f(pc, er, tx, rc) \quad \text{.....(3.1)}$$

Where;

rp = Retail price

pc = Price of crude oil

er = Exchange rate

tx = Taxes

rc = Refinery costs

By using price of crude and exchange rates as the predominant factors, the model is reduced to;

$$rp = f(pc, er) + e \quad \text{.....(3.2)}$$

Where e captures all the other variables excluded from the reduced model

Bhaskara *et al*, (2005) used Engel - Granger two step procedures to estimate 3.1 above. In Granger two step procedures, the first OLS was used to estimate relationship between PG and PC' and E. The second stage, one period lagged values of residuals (Z) of the OLS equation were used to estimate the following error correction model when price adjustment was symmetric.

$$\Delta rp_t = \sum_{i=1}^{n} \beta_{ri} \Delta rp_{t-i} + \sum_{i=0}^{k} \beta_{ci} \Delta pc_{t-i} + \sum_{i=0}^{j} \beta_{ei} \Delta er_{t-i} + \theta Z_{t-1} + \epsilon_t \quad \ldots\ldots\ldots\ldots\ldots (3.3)$$

Estimate parameter θ indicates speed of adjustment of prices.

The asymmetric equation was derived in a straight forward way from equation (3.2) above.

$$\Delta rp_t = \sum_{i=0}^{n1} \beta_{ci}^{+} \Delta pc_{t-i}^{+} \sum_{i=1}^{n2} \beta_{ri}^{+} \Delta rp_{t-i}^{+} + \theta^{+} Z_{t-1} \sum_{i=0}^{k1} \beta_{ci} \Delta pc_{t-i} \sum_{i=1}^{n1} \beta_{ri} \Delta rp_{t-1} + \theta^{-} Z_{t-1} + \varepsilon_{it} \ldots\ldots (3.4)$$

Superscript + stands for coefficients and variables when there was an increase in price of crude oil and superscript – when there was a decrease or no change.

3.3 Model specification

Drawing from equation (3.2) above, the automotive diesel retail price (rp) is a function of crude oil (pc), exchange rates (er), government taxes (tx), freight (fi), refinery cost (rc), distribution cost (dc) and marketer margin (mm).

The general model for diesel price in Kenya was then expressed as:

$$rp_d = f(pc, er, tx, fi, rc, dc, mm) \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (3.5)$$

The first OLS was used to estimate the relationship between price of retail price (rp) and crude oil (pc), exchange rates(er), government taxes (tx), freight (fi), refinery cost (rc), distribution cost (dc) and marketer margin(mm).

The following OLS equation was estimated, assuming a linear symmetric relationship and crude oil cost, foreign exchange and tax as the predominant factors, *fi*,*rc*,*dc*, and *mm* are captured through the error term (ε).

$$rp_d = \alpha + \lambda pc + \delta er + \phi tx + \varepsilon \quad \text{..... (3.6)}$$

In the second stage, using the one period lagged value of the residuals (Z) of the OLS equation, the following error correction term was estimated.

$$\Delta rp_t = \alpha + \beta_p \Delta rp_{t-1} + \beta_{pc} \Delta pc_{t-1} + \beta_{er} \Delta er_{t-1} + \beta_{tx} tx_{t-1} - \theta Z_{t-1} + \varepsilon_t \quad \text{.....(3.7)}$$

Equation 3.5 and 3.6 above were the estimate equations of this study and were used to test the relationship between light diesel prices and input cost variables and speed of adjustment incase of disturbance in any of the variables in the short run and in the long run.

3.4 Definition and measurement of variables

Retail price of diesel (rp_d) - The pump price of diesel in Nairobi and was measured in shillings per litre.

Crude oil cost (*pc*) - This was the cost of procuring a barrel of crude in the international market free on board and was measured in dollars per barrel.

Exchange rate (*er*)- This was the exchange rate of Kenya shillings to the US Dollar and was measured in shillings per dollar.

Tax rate (*tx*) - These were all fiscal payments loaded in pump prices per litre and includes import duties, excise, levies and value added taxes and were be measured in shillings per litre.

Freight and insurance (*fi*) - These were cost of transporting products from source to the port of Mombasa and insurance while at high seas. They were measured in dollars per metric tone.

Refinery cost (*rc*) - These are product processing cost at refinery and were measured in dollars per metric tone.

Distributions costs (*dc*) - These are the cost of transferring product from the refinery to the service stations and were measured in shillings per litre.

Marketers Margin (*mm*) was the profit made by oil marketers and was measured in shillings per litre.

Change in retail price of diesel (Δrp) was measured by differencing the retail price at the previous period (rp_{t-1}) from the retail price in the current period (rp_t).

Change of crude oil cost (Δpc) was measured in dollars per barrel, by differencing the crude cost at the previous period (pc_{t-1}) from the crude cost in the current period (pc_t).

Change in foreign exchange rate (Δer) was measured in Kenya shilling to the US dollar.and was measured by differencing the exchange rate at the previous period (er_{t-1}) from the exchange rate in the current period (er_t).

Change in tax rates (Δtx) – This was measured by differencing the tax rate at the previous period (tx_{t-1}) from the tax rate in the current period (tx_t).

3.5 Estimation techniques

Equation (3.6) and (3.7) was estimated using ordinary least squares (OLS) estimation method. Before carrying out estimation, diagnostic tests were conducted on the time series variables. A specification associated with error correction model (ECM) was applied. This involved testing stationarity and the order of cointegration of each variable using the Augmented Dickey Fuller unit root tests (ADF). This is because time series data exhibits non-stationary characteristics. The ADF test assumed that the data generating process was autoregressive. An autoregressive process is one that considers only one period such that observation at time t depends only on the observation at time t_{-1}. Either way, there may be autocorrelation in the error term which biases the test. To overcome this problem, the study used (ADF) test.

3.5.1 Unit root tests for stationarity of data

Time series data may exhibit a trend of unit root(s) over time. If the mean and variance do not vary systematically over time, then it becomes a stationary series. A stationary stochastic process implies that the underlying stochastic process that generated the series was invariant with time.

Economic time series with the presence of unit roots may be trended to remove the non-stationarity trend in it. It requires differencing to ensure that any autocorrelation is removed and the error term is white noise. This was done to the series before the regressions was ran

3.5.2 Cointegration analysis

Granger (1987) argued that a linear combination of two or more non-stationary series may yield a stationary series. If such a linear combination exists, then the non-stationary series are said to be cointegrated. This means that the non-stationary series move closely together over time, and the difference between them is stable. This will result in a linear combination known as co integrating equation, and it may be interpreted as a long-run relationship between the variables.

The study performed tests for cointegration using the Augmented Dickey-Fuller (ADF) in testing stationarity of the variables. The results showed that all the variables were non stationary and integrated of order one. This meant that all the variables had to be differenced once to render them stationary. After establishing the order of integration, the study further checked whether the non-stationary variables were cointegrated. This was aimed at further establishing whether there existed a long run relationship amongst non stationary variables. This was done by generating residuals from the long-run equation of the non-stationary variables, which were then tested for stationarity using the ADF test. The result showed that the test statistics were lesser than the critical values implying that there was no unit root hence the model used for estimation incorporated error correction term to capture long run relationship.

3.5.3 Diagnostic tests

A battery of tests was carried out to indicate the model inadequacy or failure. For example, in the case of the linear regression model estimated by OLS, a series of diagnostic tests were used to indicate whether any of the assumptions required for OLS to be the best linear unbiased estimator (BLUE) appeared to be violated. These assumptions included a serially uncorrelated and homoscedastic error term, absence of correlation between the error term and the regressors and correct specification of the model. This study carried out various diagnostic tests such as autocorrelation residuals, the white test for heteroscedastic errors and normality test for the distribution of residuals.

3.6 Data type and sources

The data consisted of annual observations of the variables that included monthly crude oil cost, retail prices of automotive diesel, government taxes and monthly dollar-shilling exchange rates as captured and published by the Kenya Bureau of Statistics (KBS).

3.6 Data analysis

Descriptive statistics of all the variables were analyzed and the trends in the data are presented. This was followed by the first ordinary linear regression in order to establish the long run relationship between automotive diesel and its determinants. The second stage involved using the lagged variables of the residuals of the first regression to estimate the error correction model. The error correction model was used to examine the relationship in the short-term between diesel prices and changes in crude oil prices, exchange rates and government taxes. The regressions were carried out using the E-views econometric software.

CHAPTER FOUR

EMPIRICAL FINDINGS

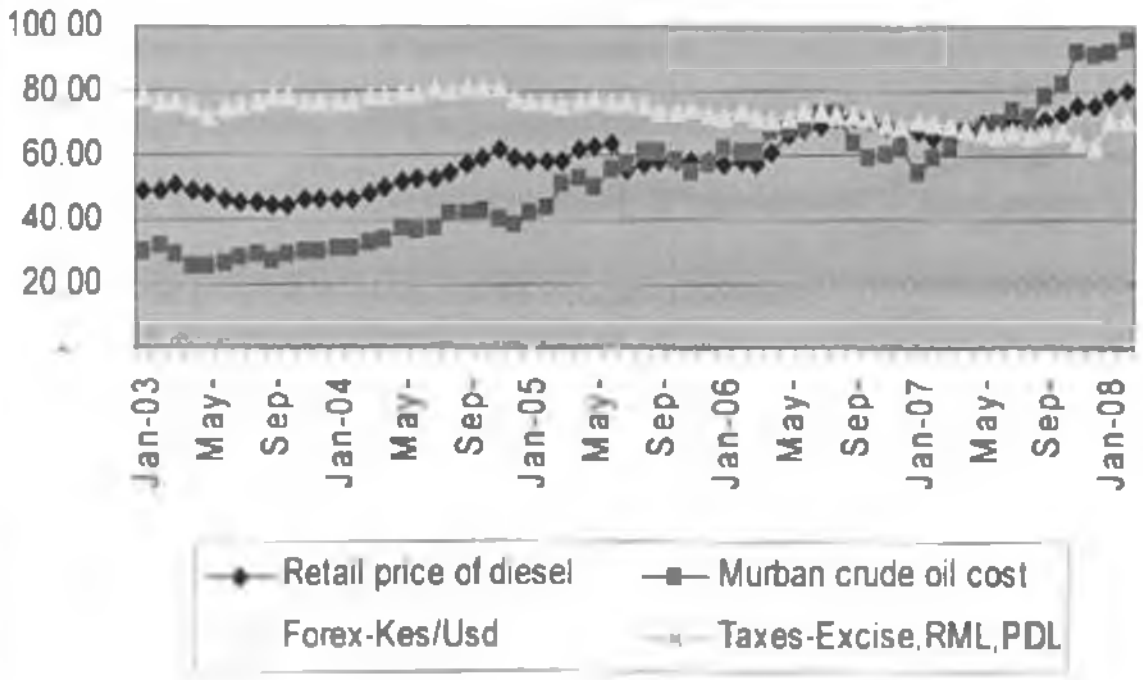
4.1 Introduction

This chapter presents the empirical results of the study and their analysis. The chapter commences with the trending of the variables and the descriptive statistics, which give indications of normality of the time series data. Diagnostic test results, regressions results and discussions are presented.

4.2 Trends in the variables.

It is important to analyze how the various variables have trended over time to give an indication of the direction and magnitude of their relationship. Fig 4.1 below shows the trends of crude oil prices, exchange rates, retail prices of diesel and taxes for the period under study, 2003-2007.

Fig 4.1 Trends of crude and retail prices, exchange rates and tax



From the trend graph 4.1 above, it can be deduced that foreign exchange has oscillated between the 60-80 marks for the last five years. This can be attributed to stable macro economic environment, and more so, the monetary policy pursued by the central bank. Moreover, Foreign exchange inflows have been boosted by a vibrant tourism sector and stability in the traditional earners of agriculture export in horticulture, tea and coffee. Remittances from Kenyans living in diaspora have also contributed to this stability. Ironically, Import of crude oil has been the single largest consumer of foreign exchange and increases in the cost of the barrel have put unprecedented pressure on the Kenya shilling.

The cost of Murban crude has consistently increased over the period under study from a low of slightly above 40 US dollars per barrel to 82 dollars per barrel in December 2007. By April 2008, the cost of crude hit a record high of 147 dollars per barrel, setting off a global outcry that the cost of energy could bring down many economies. Many explanations have been given to explain this price rocketing scenario, but the market forces of demand and supply gives a fundamental explanation as to why. The positive growth of global economies experienced in the last decade has put a lot of pressure on oil supply with India and China alone showing unsatisfiable demand for oil. Geopolitical tensions and the cartel behavior of the OPEC have not helped in any way. Rapid industrialization in the developing world and immense motorization world over has made global demand for oil outstrip supply. The high cost of explore , find, drill and refine process has made it difficulty for producers to respond to escalating global demand as demonstrated by consistent crude oil cost increases in Graph 4.1 above.

As would be expected, the retail price of diesel move close with the crude oil prices. This is because crude oil is the primary input in the diesel production. Higher foreign exchange rates means that the domestic diesel is acquired at a higher cost. Government taxes are directly added to the price and increases in taxes show immediate increase in price as witnessed in 2006. Diesel taxes have been stable over the years, with a slight increase in 2006 and 2008. All these increases are passed to the market price.

4.3 Descriptive statistics

Table 4.1 below gives the summary statistics of the main variables that have been included in the model. The descriptive statistics include the mean, median, standard deviation, minimum, and maximum of each variable.

Table 4.1 Descriptive statistics of the variables.

Sample 2003 01 2008 03				
	Price of crude oil	Exchange rates	Retail price of diesel	Taxes on Diesel
Mean	52 630	73 847	59 767	17 367
Median	55 200	74 335	58 460	16 505
Maximum	95 100	81 270	80 310	19 705
Minimum	25 000	62 541	44 100	15.919
Std Dev	19 127	4 399	9 741	1.644
Skewness	0 303	-0 421	0 109	0 690
Kurtosis	2 210	2 549	1 947	1 573
Jarque-Bera	2.558	2.359	2 992	10 178
Probability	0 278	0 307	0 224	0 006
Observations	62	62	62	62

The results showed that the Price of crude oil had a minimum value of Kshs 25 and a maximum value of Kshs 95.10 with a mean of Kshs 52.63 and a median of Kshs 55.20. The price of crude oil has a standard deviation of 19.127, an indication of wide disparities and skewness of 0.303, kurtosis of 2.210 and a probability 0.278. These statistics attest to the

erratic nature of international crude oil prices, mainly due to the fragile balance between supply and demand.

Exchange rates have a maximum of 81.270 and a minimum of 62.541, with a mean of 73.847 and a median of 74.335. Exchange rates have a standard deviation of 4.399, more stable than crude oil price, with a skewness of -0.421, kurtosis 2.549 and a probability of 0.307. Movements in foreign exchange rates were attributed to imbalances of payments position.

Retail price of diesel has a maximum value of 80.31 and a minimum value of 44.10, a mean of 59.767 and a median of 58.46. Retail price has a standard deviation of 9.741 as a result of the price disparities. The skewness is 0.109 and kurtosis of 1.947 with a probability of 0.224. These numbers can be explained by the many adjustments done on the retail prices of diesel as a result of changes in the international prices of diesel. Tax has a maximum value of 19.705 and a minimum of 15.919, a mean of 17.367 and a median of 16.505. The standard deviation of tax is 1.644, an indication of the minimal variations noted over the study period. The kurtosis is given by 1.573, skewness is 0.69 and has a probability of 0.006. From the close relationship between crude oil and retails prices of diesel, it was safe to attribute these changes to changes in the international in the cost of crude.

4.4 Correlation matrix

Correlation matrix is an important indicator of the linear association between explanatory variables and help in determining the strength of association of the variables in the model.

Though descriptive statistics directed on which of the equation was more able to yield better results and highlighted on possible problems to encounter, there was need to enhance the statistics by more insightful quantitative analysis such as the correlation matrix. The correlation matrix was an important indicator that tested the association between the explanatory variables. The matrix also helped to determine the strength of the variables in the model, that is, which variable best explained the relationship between retail price of diesel and its determinants. The correlation matrix is presented in the following table 4.2

Table 4.2 Correlation matrix

	Price of crude oil	Exchange rates	Retail price of diesel	Taxes
Price of crude oil	1.000			
Exchange rates	-0.760	1.000		
Retail price of diesel	0.924	-0.698	1.000	
Taxes	0.782	-0.787	0.8710	1.000

From the table above, it can be deduced that there is a positive correlation between retail prices and crude oil prices, crude oil prices and taxes, Taxes and retail prices have a high correlation coefficient which could cause autocorrelation and this is because retail prices of diesel are inclusive of the taxes. There is negative correlation between exchange rates and taxes, exchange rates and retail prices, and exchange rates and crude oil price

4.5 Time series properties of data

Empirical analysis of time series data presents a problem of non stationarity which leads to a spurious regression results which no inferences can be made (Gujarati, 1999). To

overcome this problem, stationarity test of the variables was carried out. The study used Augmented Dickey Fuller tests for stationarity or non stationarity of time series data by running a unit roots test. Figures A1 to A8 in appendix 4 showed that crude oil, retail price of diesel, exchange rates and tax rates were non stationary at levels and were all stationary at first difference. However, a more rigorous stationarity test analysis for unit roots using Augmented Dickey Fuller test (ADF) was used and the table 4.3 below shows the results.

Table 4.3 Unit roots test

Variable	No of lags	Critical values at 1%	Critical values at 5%	ADI	Order of integration
Retail price of diesel	1	-3.542	-2.910	-4.374	I(1)
International price of crude	1	-3.544	-2.911	-5.350	I(1)
Exchange rates	1	-3.542	-2.910	-8.832	I(1)
Tax rates	1	-3.542	-2.910	-5.529	I(1)

From the table above, no variable was stationary at levels. They were all stationary after first differencing. Further tests were carried out to verify if the non stationary data were cointegrated. Cointegration concept implies that if there is a long run relationship between two or more non stationary variables, deviations from this path is stationary. The Engle-Granger two step procedures were used to generate residuals for the long run equation of the non stationary variables. These were used to test unit roots for the error correction model using the Augmented Dickey fuller test (ADF). The results of the cointegrating regression are shown in table A6 in Appendix 4.

The coefficient of determination is 0.926, meaning over 92 percent of the variations in the retail price of diesel can be explained by changes in the price of crude oil cost, foreign

exchange rate and taxes on diesel. The Akaike information criterion (AIC) suggested the presence of trend in the cointegrating relationships using tests of the endogenous and exogenous variables.

The critical values at 1 percent, 5 percent are respectively -2.5689 and -1.9394035. The ADF test statistic is -4.384548 which was greater in absolute terms to the critical values at 1 and 5 percent, implying the residuals are stationary, therefore the residuals were used as the error correction term and an error correction formulation was adopted.

4.6 Diagnostic Test results

The following diagnostic tests were performed on the model to evaluate the validity of the model. They include LM autocorrelation test, ARCH (Autoregressive conditional heteroscedasticity) to detect heteroscedasticity, the Jacque bera test for normality of the residuals, Ramsey RESET test for the specification of the regression and the CUSUM test for stability over time of the coefficients of the regression model. The results are presented in table 4.4 below. The parameters are stable and the model could be used for estimation at 5 percent confidence level

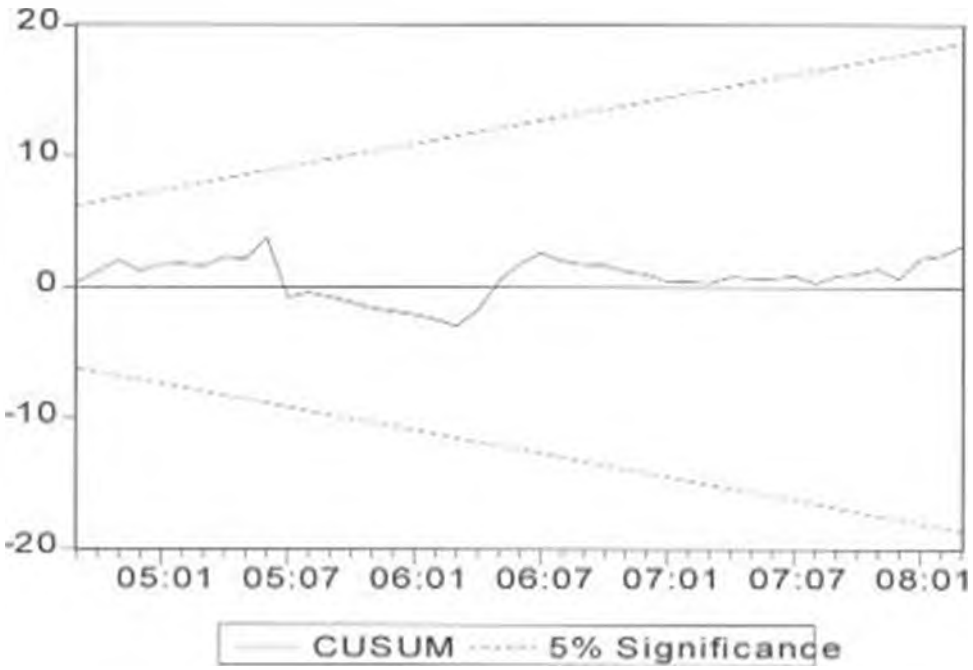
Table 4.4 Diagnostic test of the ECM model

Test	F - statistic	Probabilities
White Heteroskedasticity Test	1.200	0.314
Ramsey RESET test	0.316	0.730
ARCH ResidualTest.	0.550	0.461
LM Test	6.960	0.011

The Ramsey RESET test for model specification, the ARCH test and White heteroskedasticity test for constant variance of the residuals, and the LM test for serial correlation of the residuals suggested a good fit from the Jarque bera test, homoscedasticity and non autocorrelation.

Figure 4.2 below shows the CUSUM test graph done at 5 percent level and was used to test the stability over time of the coefficients of the regression model over time. From the graph, there were no major structural breaks in the data and therefore the diagnostic results were satisfactory.

Fig 4.2 Cusum at 5 percent significance



From the results above, it is revealed that the parameters are stable and the model can be used for forecasting at 5 percent interval.

4.7 Regression results, Interpretation and Discussion

From the above analysis, cointegration was accepted and the error correction model was selected as the preferred model and re-specification of the estimation equation was done to include the error correction term. The error correction term captured the long run relationship and reflected attempts to correct deviations from long run equilibrium. Its coefficient was interpreted as the speed of the adjustment. The results obtained from the second regression, including the lagged residuals of the first OLS are represented by table 4.5 below.

Table 4.5 Error correction model results.

Variable	Coefficient	t-Statistic
Constant	0.345	1.411
Lagged retail price	0.235	1.785
Lagged price of crude change	0.076	1.008
Lagged rate of tax change	0.056	0.099
Lagged rate of foreign exchange	0.018	0.121
Lagged residual	-0.289	-2.875
R-squared		0.239
Adjusted R-squared		0.170
Durbin-Watson stat		2.192
Akaike info criterion		4.061
Schwarz criterion		4.268
F-statistic		3.451
Prob (F-statistic)		0.009

All variables had the expected signs. From table 4.5 above, the previous period price of diesel had a positive sign in the short run, with a one unit change in previous period prices of diesel leading to 0.23 changes in the current prices. This implies that current prices have a memory of the previous price and one may infer that cost transfers are not complete in their first period. These findings are consistent with Boreinstein (1997), Bacon (1991) and Bhaskhara (2005).

Changes of crude oil prices on retail prices of diesel were positively related with a one unit change in crude oil resulting to a 0.07 unit change in the retail price of diesel in the short run. In the long run however, a one unit increase in the price of crude will lead to 0.36 unit increase in the retail price of diesel as shown on table A6 of the long run cointegration results. This shows that month to month, complete transfer of increases in the prices of crude oil is not complete and probably is spread over the consequent periods. The findings are consistent with Boreinstein (1997), Bacon (1991) and Bhaskhara (2005), Imitira (2006) and Asplaund (2000).

Tax and retail price of diesel are positively related with a one unit change in taxes leading to 0.056 unit change in the price of retail diesel in the short run. In the long run, a one unit change in taxes leads to 2.96 unit change in retail price of diesel, indicating a significant pass through of taxes to the pump price over and above the actual increase. This shows that marketers take advantage of increases of taxes to pass through other cost to the pump price

Foreign exchange is positively related to the price of retail diesel with a one unit increase in the rate of foreign exchange leading to 0.018 unit change in the retail price of diesel in the short run. In the long run, a one unit change in the rate of foreign exchange will lead to a 0.52 unit change in the retail price of diesel.

From table 4.5, the adjusted R^2 is 17 percent implying crude oil prices, foreign exchange rates and level of taxation, significantly influence the retail price of automotive diesel. This means that 17 percent of the changes in the retail price of diesel can be explained by changes in the lagged retail prices of diesel in the previous period, crude oil price, foreign exchange rate and taxes on diesel. The F- statistic was 3.451 and statistically significant at five percent, implying if combined together, crude oil prices, foreign exchange rates and taxes, explain the retail price of automotive diesel strongly.

The error correction coefficient had the expected sign, i.e negative with a value of 0.289. The negative sign confirms the model will converge to the long run equilibrium and the speed of adjustment is represented by the value 0.289. From the study, 28.90 percents of the shocks are adjusted within the first month. This confirms the hypothesis of transmission of cost to the retail prices of diesel.

The t-statistic are 1.411, 1.785, 1.008, 0.099 and 0.121 for constant, lagged variable of retail price, crude price, tax rate and foreign exchange respectively meaning the variables are significant for the model. The F-statistic measures the overall significance of the regression used and the value 3.451 shows that the equation has the validity in fitting the data.

The probability of 0.009 shows that out of 100 variables, there is a chance that 9 will be zero, therefore rejecting null hypothesis that all the regression coefficients are zero.

Durbin Watson statistic is 2.192, which is closer to 2, confirming that there is no serial correlation between the coefficients. The akaike information criterion has a value of 4.061, satisfying the criterion for a measure of goodness of fit of an estimate statistical model, same as the Schwarz criterion with a low value of 4.268.

From the above analysis, it was established that pump price of diesel is determined not only by the current price, but also the previous periods prices of crude oil, exchange rates and prevailing taxation regime. The relationship between the pump prices is positively related to crude oil, tax and foreign exchange. The price adjustment process is at less than 30 percent per period, implying minimal competition between the oil marketers in terms of pricing, a dominant characteristic in an oligopolistic market.

High diesel prices present negative welfare implications because of its high importance in manufacturing and transport sectors. The high petroleum prices causes cascading effects to the productive sectors of the economy because it is a critical input in the productive process.

Kenya depends fully on imports for its petroleum needs. Out of the white products consumed in the country, 56 percent is automotive diesel. The high import bill presents a balance of payment challenges to the country and makes the local prices highly dependent on international crude oil cost. With the transport sector being the biggest consumer of diesel in the country, the on going mechanization of agriculture and lack of alternative

power generations mean more diesel powered generators will be required further constraining the demand of diesel in the country.

The revenue the government collects from petroleum products is very significant. Taxation policies in place affect the pump price and this is cascaded to the other productive sectors dependent on diesel. Government of Kenya uses taxation to influence demand and supply with a strict licensing and regulation procedures in place to control and encourage local participation in the petroleum industry.

The government of Kenya policy of deregulation is highly dependent on the macro economic stability with low inflation rates and stable foreign exchange rates. Deregulation without a framework to encourage competition will only lead to substitution from state monopoly to oligopolistic competition as affirmed by Imitiru (2006) and Nyioke *et al* (1994) Herfindhal-Hirshman index results.

In conclusion, government plays a significant role in the importation, processing and distribution with a 50 percent ownership of the refinery and 100 percent ownership of the pipeline. Importantly, it is the government responsibility to maintain a conducive macroeconomic environment where competition thrives, inflation is low and foreign exchange rates are stable.

CHAPTER FIVE

SUMMARY, CONCLUSIONS AND POLICY IMPLICATIONS

5. 1 Summary

Persistent increases in pump prices have led to increases in the cost of living and inflationary pressure in the Kenyan economy. This study was motivated by lack of current specific literature on the determinants of diesel prices in Kenya. There was need to establish the relationship between the pump prices of diesel and the input cost components of crude oil, tax and foreign exchange. The study had three specific objectives, establish the determinants of the light diesel prices in Kenya, examine the relationship between the retail prices and crude oil price, foreign exchange rates and taxes on Diesel and make appropriate policy recommendations.

The study provides evidence of empirical relationship between the pump prices of automotive diesel and the price of crude oil, foreign exchange rates and taxes on diesel. The study used monthly data for a period of 62 months for the period between January 2003 and March 2008. The data was sourced from the Kenya national bureau of statistics leading economic indicators published monthly. The study used Angle Granger two step error correction methodology as adopted by Bhaskara in his study of Fiji gasoline prices. Unit root tests were performed with the objective of ensuring non spurious results.

5.2 Conclusions

The results from the study showed that retail prices of automotive light diesel was significantly influenced by the previous periods prices, international crude oil prices, government taxes on diesel and foreign exchange of the US dollar to the Kenya shilling. The short term model showed that the speed of adjustment in the case of changes in the price of crude oil, foreign exchange rates and taxes, was significant with a convergence tendency to the long-run equilibrium.

From the results, the influence of crude oil on local prices was found to be positive and significant. It was found that changes in the foreign exchange rates and taxation rates significantly changed the retail price of automotive diesel.

5.3 Policy implications

The results of this study lead to the following policy recommendations that would enhance petroleum policy planning, price monitoring and evaluation and petroleum market development.

Because crude oil is traded in the international market, its demand is such that it cannot influence, in any way, the initial price. The Kenya government should therefore look at internal factors playing as escalator variables in the crude price determination. Low inflation and stable exchange are important in price determination mechanism which helps in reducing price fluctuations and create conducive environment for undertaking long term

investment in petroleum industry. The regional integration initiative of the East African Community or even COMESA can be used as a vehicle to jointly source and procure crude oil such that they create a critical volume base whose joint demand is able to attract discounted prices thereby mitigating the escalating world crude oil prices.

The government of Kenya should review the law governing competition in the country. The current law has not been effective in controlling and encouraging competitive conditions in the petroleum sector. There is an urgent call for repeal of the law to set up institutional framework to monitor and encourage entry, investment and competition in the petroleum sector. In particular detection of anti competition laws, restrictive business practices and outright monopoly practices should be defined such that litigation and penalty process are efficient and practical. It is time a national energy policy document is produced to set the guidelines for development and regulation of the petroleum sector. The government should implement policies that make it easier for investors to enter the petroleum industry by removing existing entry barriers like minimum processing quantities, dead stock quantities, 70-30 rule and eliminate expensive hospitality charges by owners of loading facilities in Mombasa and Nairobi. Importantly, the national oil corporation should further be strengthened to be an active participant not only in the marketing but also in availing joint loading facilities to the smaller local oil marketers.

Other than using taxation to increase its revenue, the government should further pursue the equity objective by shifting the lower income groups from biomass fuel to kerosene and LPG by encouraging investment in the petroleum sector in the rural areas. The government

should extend tax incentive to the oil marketers to venture into rural areas of the country. This is because as stated in section 1.1.3 of this study, most of the investment is concentered in urban areas and as such little or no competition is encountered in those areas creating equivalents of geographical monopolies where only one supplier exists. To this end, prudent use of the Petroleum Development Levy (PDL), which was introduced in 1991, should be seen to perpetuate development in the petroleum sector especially in distribution and marketing of the petroleum products.

The government should pursue local search for petroleum substitutes to crude oil imports with increased investment, not only to crude oil explorations, but also blend options with ethanol – gasoline blend ratios of 9:1, globally called the E-10; offering the sugar cane producing farmers expanded markets and supporting agro-industries. This will release significant foreign exchange earning for competing use. Brazil, a developing economy like Kenya has recorded enormous success in this Ethanol field. Further more, with the limited potential for hydro-power, alternate sources of power should be pursued. Coal has been known world over as a cheap source of power and the government should increase funding towards its exploration. Further more, the government should support investments in the biofuel global initiative and take advantage of the country's potential to grow Jatropha, an important producer of biofuel.

5.4 Limitations of the study and areas of further research

The study used published data by Kenya Bureau of Statistics which may have contained weaknesses of price averaging and collection defects. The study only used the variables crude oil, foreign exchange and taxes, as the possible determinants of pump prices while in actual world, many other variables play a role in the price making mechanism.

A study incorporating all the major products diesel, gasoline, kerosene and fuel oil would be ideal as the cost allocation at refinery level determines the input cost presented to the market. Inclusion of symmetry and asymmetry characteristics would shed more light in the local feathers and rockets scenario.

References

Africa Development Bank Group, (2006), High oil prices and the African Economy; Concept paper prepared for the AGM, Burkina Faso

Asplund M., R Eriksson and R. Friberg (2000), "Price Adjustments by a Gasoline Retail Chain," *Scandinavian Journal of Economics, 102(1), 101-121*

Bacon R.W., (1991), Rockets and Feathers: The Asymmetric Speed of Adjustment of U K Retail Gasoline Prices to Cost Changes, *Energy Economics, XIII 211-218*

Bhaskara B. R., and Gyaneshwar R.(2005), Crude Oil and Gasoline Prices in Fiji: Is the relationship Asymmetric? The University of South Pacific, *EconWPA microeconomic series no 0510004*

Borenstein S., A. C. Cameron and R. Gilbert (1997), Do Gasoline Prices Respond Asymmetrically to Crude Oil Price Changes? *Quarterly Journal of Economics, 112. 305-339*

Borenstein, S. and Shepard, A. (2000), Sticky Prices, Inventories and Market Power in Wholesale Gasoline Markets, National Bureau of Economic Research, Working Paper No. 037

DeLucia and associates, Inc., (1990), Energy Pricing, An issue of importance for Sector and non sector specialist; Perspectives, Discussion, and Policy reform cases. Office of Energy, Bureau of Science and Technology, USAID

Energy Information Administration of the United States (EIA), 2005, Energy balances of the OECD Countries and the non OECD Countries.

Grant R M., (1982), Pricing Behaviour in UK Wholesale Market for Petrol: A Structure Conduct Analysis, *The Journal of Industrial Economics, Vol 30 No.3, 271-292*

Gujarati, D., (1999), Essentials of Econometrics, New Delhi, McGraw Hill International, Second Edition.

Engle, R.F and Granger C.W.J (1987), Co-Integration and error correction Representation, estimation and testing, *Econometrica*, 55, 251-76

Hearts and Mind (2006); What drives the price of gasoline, Chevron global marketing publications, 3rd Quarter issue, 2006.pp 5-9.

Karrenbrock, J.D (1991), The behaviour of Retail Gasoline Prices: Symmetric or Not? *Federal Reserve Bank of St Luis 73, 19-29*

Karekezi Stephen et al (1996), Petroleum marketing in Africa: Issues in pricing, taxation and investment, *AFREPREN*

Kimuyu, P.K (1988), Demand for Commercial Energy in Kenya;1963-1985, A structural investigation, PHD Thesis, University of Nairobi.

Kiptui, L.K (2006); Exchange rates pass through to domestic prices in Kenya, 1972-2004 MA thesis, University of Nairobi

International Energy Agency, (IEA) (2004), Analysis of the Impact of High Oil Prices on the Global Economy. May 2004

International Monetary Fund, (IMF) 2000, The impact of Higher Oil Prices on the Global Economy, IMF research department, December 2000.

Imitira, K. J (2006) Sticky Prices and Market Power in Gasoline Market in Nairobi MA thesis, University of Nairobi

Indetie , L , (2002) "Emergence of Independent Petroleum Dealers in Kenya Institute of Public Analysis and Research, (IPAR) Special Report Series.

Little A D., (1993), Petroleum Market Structure and Pricing Study for Kenya

Mecheo, J, Omiti, J, (2002) Petroleum Market Structure and Pricing following Deregulation. Institute of Policy Analysis and Research, (IPAR), Discussion Papers.

Ndungu, N, (1996); Price and exchange rate dynamics in Kenya, empirical investigations 1970-1993. AERC Research papers series, No 58

Republic of Kenya, (2003-2008), Leading economic indicators, various issues. Government printers.

Republic of Kenya, (2003-2008) Economic surveys, various issues. Government printers.

Stern, D.I; Cleverland, C. J (2004) Energy and Economic Growth Rensselaer Working Papers in Economics 0410.

Okech B.A and P M Nyoike, (1996), Finance and Markets in the petroleum Sub sector: Conceptual and policy issues. AFREPREM working paper No 146 Nairobi

Senga, W; Manundu, H W; Manundu M (1980) Assessment of commercial energy supply and demand in Kenya; Institute of development studies, University of Nairobi

Schloss, M (1992) Does petroleum trade matter? Policies to secure and rationalize oil supplies in sub Saharan Africa, World Bank report

Ye M., J. Zyren, J. Shore, and M. Hurdette, (2005), "Regional Comparisons, Spatial Aggregation, And Asymmetry of Price Pass-through in U.S. Gasoline Markets." *Atlantic Economic Journal, 33, 179-192*

APPENDICES

Appendix 1: Refined data used in the research

Table A1 Data used in the study

	Period	Retail price of Diesel	Murban crude oil [illegible]	Forex Kes/Usd	Taxes: Excise, RML, PDL
1	Jan-03	40.89	29.80	77.74	15.919
2	Feb-03	42.20	31.70	76.60	15.919
3	Mar-03	50.02	29.10	76.66	15.919
4	Apr-03	49.62	25.00	74.90	15.919
5	May-03	44.61	26.00	71.61	15.919
6	Jun-03	44.20	26.80	74.17	15.919
7	Jul-03	45.80	27.76	76.43	15.919
8	Aug-03	46.31	[illegible]	[illegible]	15.919
9	Sep-03	44.71	26.90	76.42	15.919
10	Oct-03	44.10	28.10	77.77	15.919
11	Nov-03	46.66	28.60	76.36	15.919
12	Dec-03	[illegible]	[illegible]	76.14	15.919
13	Jan-04	46.62	31.06	76.47	15.919
14	Feb-04	40.00	[illegible]	76.46	15.919
15	Mar-04	40.20	33.16	77.70	15.919
16	Apr-04	[illegible]	[illegible]	76.36	15.919
17	May-04	51.49	37.05	78.37	15.919
18	Jun-04	[illegible]	[illegible]	79.61	15.919
19	Jul-04	52.37	37.30	[illegible]	[illegible]
20	Aug-04	[illegible]	41.66	[illegible]	[illegible]
21	Sep-04	57.17	41.30	81.11	[illegible]
22	Oct-04	[illegible]	[illegible]	81.27	[illegible]
23	Nov-04	61.07	[illegible]	81.24	16.606
24	Dec-04	[illegible]	[illegible]	77.34	[illegible]
25	Jan-05	60.36	43.10	[illegible]	16.606
26	Feb-05	[illegible]	44.00	75.60	16.606
27	Mar-05	[illegible]	50.96	75.01	16.606
28	Apr-05	61.77	[illegible]	76.60	16.606
29	May-05	[illegible]	49.80	[illegible]	[illegible]
30	Jun-05	[illegible]	56.48	76.21	[illegible]
31	Jul-05	65.50	57.10	76.04	16.606
32	Aug-05	67.10	[illegible]	75.70	[illegible]
33	Sep-05	[illegible]	61.05	[illegible]	[illegible]
34	Oct-05	[illegible]	[illegible]	73.81	[illegible]
35	Nov-05	[illegible]	[illegible]	[illegible]	[illegible]
36	Dec-05	[illegible]	[illegible]	[illegible]	16.606
37	Jan-06	[illegible]	62.15	[illegible]	[illegible]
38	Feb-06	67.01	[illegible]	[illegible]	[illegible]
39	Mar-06	67.00	[illegible]	[illegible]	[illegible]
40	Apr-06	[illegible]	[illegible]	71.16	[illegible]
41	May-06	[illegible]	[illegible]	72.27	[illegible]
42	Jun-06	[illegible]	[illegible]	[illegible]	16.505
43	Jul-06	[illegible]	72.00	[illegible]	[illegible]
44	Aug-06	71.60	[illegible]	[illegible]	19.705
45	Sep-06	[illegible]	63.70	[illegible]	[illegible]
46	Oct-06	[illegible]	[illegible]	72.02	[illegible]
47	Nov-06	[illegible]	[illegible]	[illegible]	[illegible]
48	Dec-06	[illegible]	62.05	[illegible]	19.705
49	Jan-07	[illegible]	[illegible]	70.94	[illegible]
50	Feb-07	[illegible]	[illegible]	69.73	[illegible]
51	Mar-07	[illegible]	62.10	[illegible]	[illegible]
52	Apr-07	[illegible]	67.60	[illegible]	19.705
53	May-07	[illegible]	[illegible]	[illegible]	[illegible]
54	Jun-07	[illegible]	65.70	[illegible]	[illegible]
55	Jul-07	[illegible]	73.70	67.41	[illegible]
56	Aug-07	70.36	71.76	66.76	[illegible]
57	Sep-07	[illegible]	[illegible]	[illegible]	[illegible]
58	Oct-07	[illegible]	81.60	67.11	19.705
59	Nov-07	[illegible]	91.75	[illegible]	[illegible]
60	Dec-07	[illegible]	[illegible]	[illegible]	[illegible]
61	Jan-08	70.40	[illegible]	[illegible]	[illegible]
62	Feb-08	[illegible]	95.10	70.64	19.705
63	Mar-08	[illegible]		[illegible]	[illegible]

Notes

Taxes from 2003 consist of Excise of [illegible], RML of [illegible] and PDL of [illegible]

2004/2005 changed to ED of [illegible], RML of 5.80 and PDL of 0.40

[illegible] changed to ED of [illegible], RML of [illegible] and PDL of 0.40

Appendix 2: Market shares as at end of 2006

Table A2 Market Share 2006

COMPANY	Percentages
Shell/BP	19.61
Kobil	17.68
Total Kenya	17.12
Chevron	14.24
Mobil Oil (Tamoil)	10.89
NOCK	4.31
Kenol	2.87
Gapco	2.78
Triton	1.95
Bakri International	1.49
Oilcom	1.33
Petro	1.21
Metro Petroleum	1.07
Galana Oil	0.91
Dalbit Petroleum	0.67
Engen	0.67
Tecaflex	0.48
Global Petroleum	0.22
MGS International	0.18
Fossil	0.16
Hass Petroleum	0.07
Addax Kenya	0.04
Hashi Empex	0.01
Total	**100**

Source: Petroleum Institute of East Africa

Appendix 3: Price build up based on platts and ex Mombasa refinery.

Table A3 Sample price build up ex Mombasa

	Ex Mombasa weighted average cost				Replace cost Factoring current Bnd/Bbl			
	AGO	Unleaded PMS and Leaded PMS	Unleaded RMS and Leaded RMS	IK	AGO	Unleaded PMS and PMS	RMS	IK
Weighted Average Cost	**64.2200**	**52.0600**	**42.2400**	**58.2500**	**68.1800**	**58.5700**	**61.2200**	**68.7700**
Partial KPC Tariff - (A)	0.0001	0.0001	0.0030	0.1240	0.0001	0.0001	0.0030	0.1240
Partial Inland Transport - (B)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Operational Loss	0.1927	0.1562	0.1267	0.1748	0.1927	0.1562	0.1267	0.1748
Margin	**2.9931**	**4.0681**	**11.8095**	**4.2093**	**0.9659**	**1.1501**	**2.8295**	**4.5131**
Finance Cost	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Base Price	**67.4059**	**56.6764**	**54.1792**	**62.7586**	**67.4059**	**59.8764**	**54.1792**	**62.7586**
Freight Diff - (C)	3.1389	3.1389	3.1360	3.0150	3.1389	3.1389	3.1360	3.0150
Road Maint Levy	9.0000	9.0000	9.0000	0.0000	9.0000	5.3000	9.0000	0.0000
Customs Duty	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Delivery Charge	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Excise Duty	10.3950	19.8950	19.8950	7.2650	10.3950	19.8950	19.8950	7.2650
V A T	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Petroleum Dev Levy	0.4000	0.4000	0.4000	0.4000	0.4000	0.4000	0.4000	0.4000
Net Delivered	**90.3491**	**89.1165**	**86.7902**	**73.5736**	**90.3491**	**89.1165**	**86.7902**	**73.5736**

Table A4 Sample price build up ex Singapore basis platts

PRODUCT : AGO			
PRICING STRUCTURE BASIS MEAN OF PLATTS			
CURRENT MONTH	Jan	2007	
PREVIOUS MONTH	Dec	2007	
MEAN OF PLATTS Dec 2007	546.9474		
PREMIUM	25.0000		
CBK MEAN RATE KSHS / US$	69.6999		
LOCATION			
Supply Depot		Nairobi	
Distance from Depot (Kms)		48	
For the Month		US$ MT	KSHS MT
FOB Mean of Platts		546.9474	38,122.1647
Total Premium		36.8352	2,567.4009
			-
CIF (US$ / MT)		583.7826	40,689.5737
Marine Insurance (1.00366xCIFx.0770%)		0.4500	31.4250
War Risk (1.003xCIFx0.0275)		0.1610	11.2232
C#		584.3936	40,732.2218
Shore Landing @ 2.5 US$ MT + Vat		2.9000	202.1200
IDF Fees		16.1606	1,126.6947
KPA Fees (1.20%)		7.0054	488.2749
CIFLW		610.4594	42,549.3210
Ocean Loss (0.5% of CIFLW)		3.0523	212.7416
Administration Fees (0.5% of CIF)		2.9220	203.6611
Suspended Import Duty(@0.34 tr)		-	-
Inspection Fees US $6		0.0861	6.0000
Recertification Charges		0.1726	12.0287
VAT		0.0276	1.9246
landing charges		32.0284	2,232.1034
Total (USD MT)		616.7189	42,986.6731
Average exchange rate (selling CBK)		69.6999	4,858.0730
Kshs MT		42,984.6771	2,996,026.7358
Base cost Conversion factor	1.18	36,427.6924	2,539,048.7118
KOSF storage fees USD MT	2.32	0.1617	11.2707
Total cost Mombasa (Kshs MT) -B		36.5891	
Add; Import Duty		-	
Add; Excise Duty		10.3050	
Add; Petro. Dev Levy		0.4000	
Add; Road Maint. Levy		9.0000	
KPC Tariff - Nairobi		1.7740	
Add: local delivery		0.3600	
Total price		58.4280	

Appendix 4: Stationary test results for independent variables

Fig A1 Tax at levels

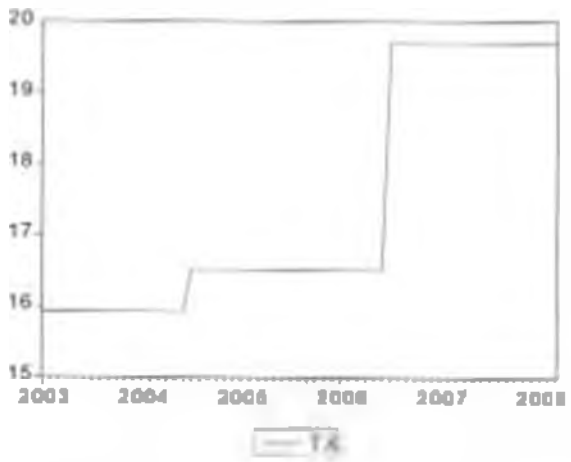


Fig A2 Tax at 1st difference

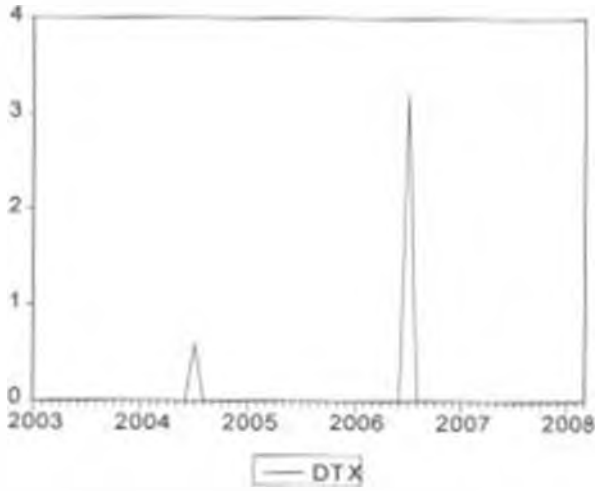


Fig A3 Time series of retail price at levels

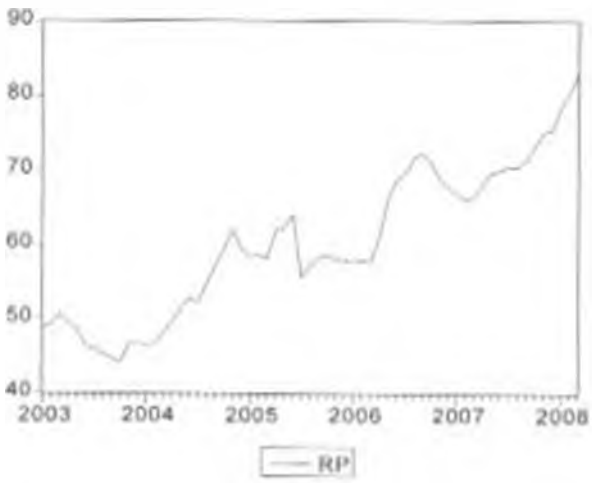


Fig A4 Retail price at 1st difference

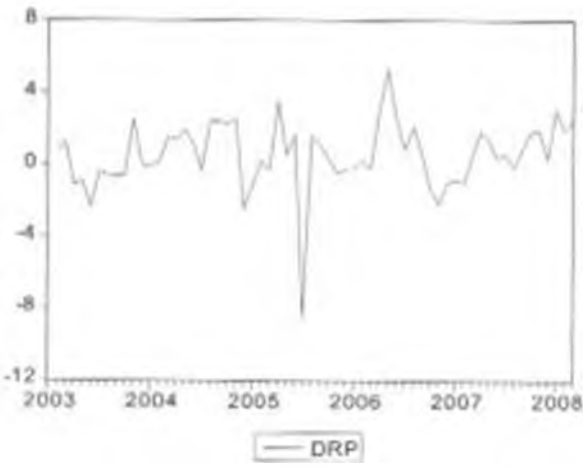


Fig A5 Crude oil at levels

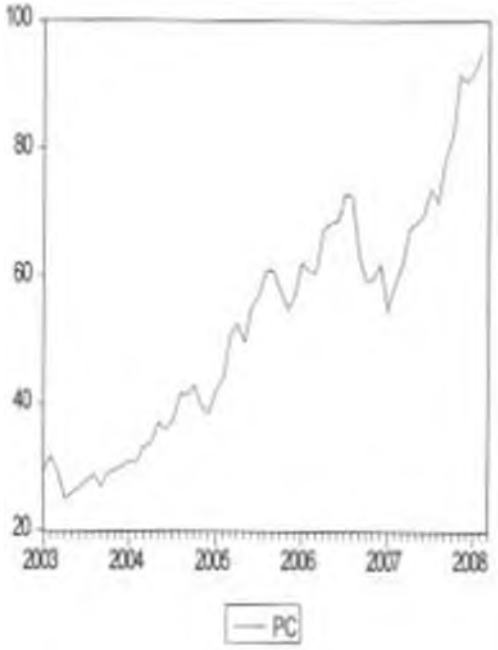


Fig A6 Crude oil at first difference

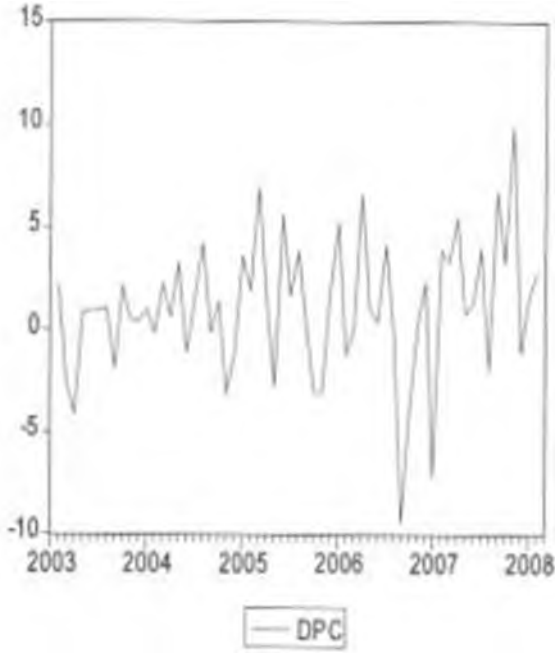


Fig A7 Exchange rates at levels

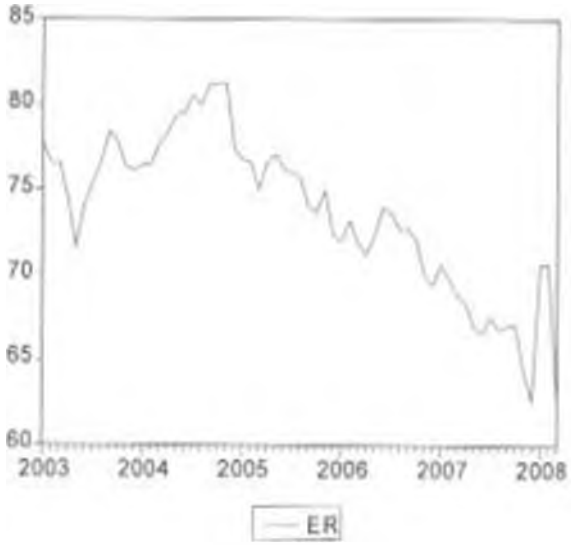
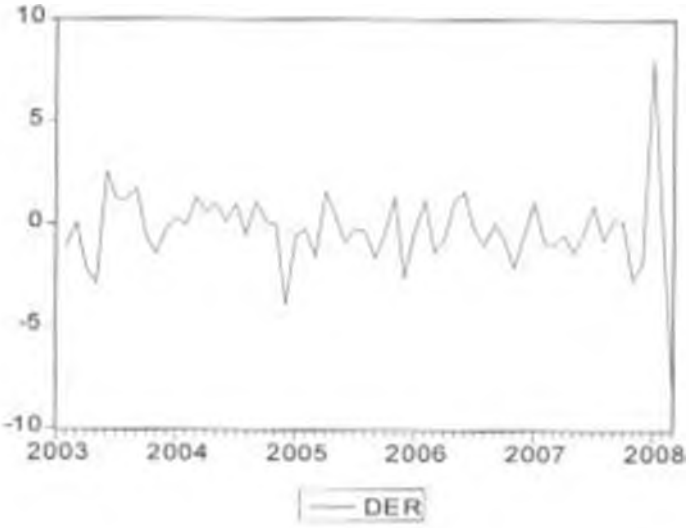


Fig A8 Exchange rates at first



Appendix 4: Results of the ADF on the ECM terms and cointegration regression

Table A5 Unit root test of the error correction terms

ADF Test Statistic	-4.385	1% Critical Value*	-3.541
		5% Critical Value	-2.910
		10% Critical Value	-2.592

Variable	Coefficient	Std. Error	t-Statistic	Prob.
RESID01(-1)	-0.528	0.120	-4.385	0.000
D(RESID01(-1))	0.218	0.129	1.685	0.098
C	0.004	0.278	0.014	0.989

R-squared	0.254	Mean dependent var	-0.003
Adjusted R-squared	0.228	S.D. dependent var	2.447
S.E. of regression	2.150	Akaike info criterion	4.418
Sum squared resid	263.601	Schwarz criterion	4.523
Log likelihood	-129.539	F-statistic	9.695
Durbin-Watson stat	1.956	Prob(F-statistic)	0.000

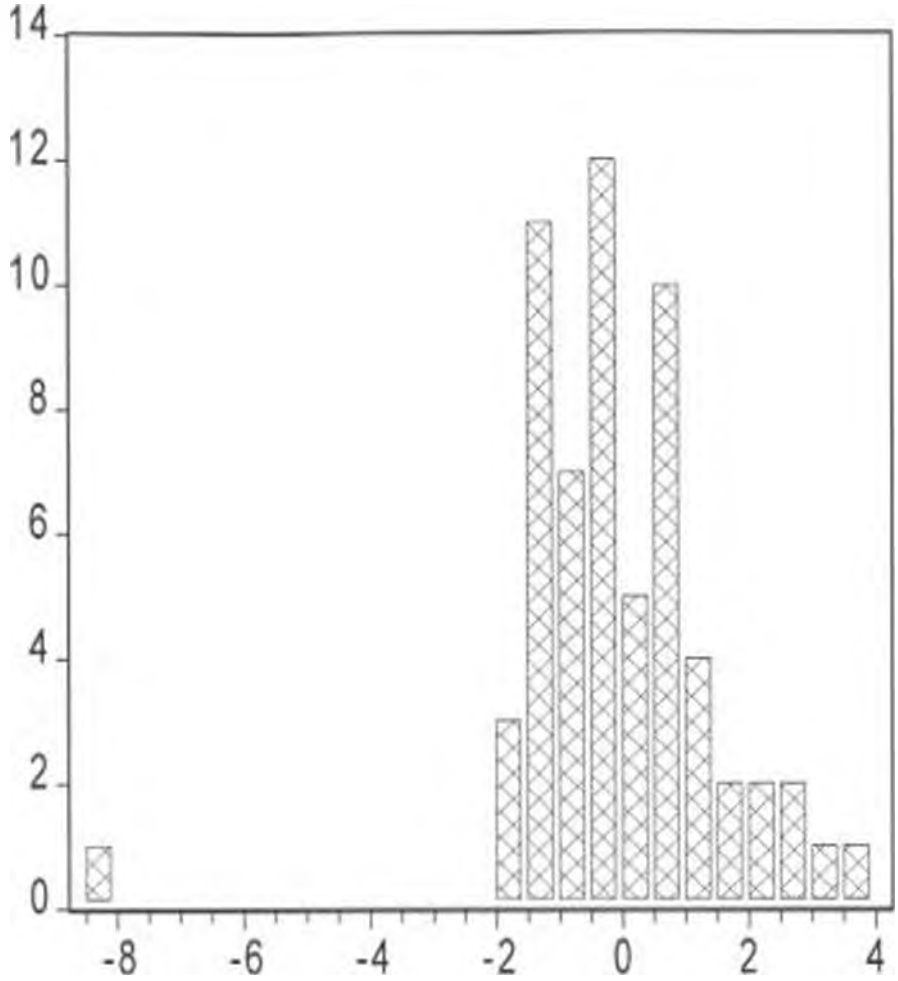
Table A 6: Cointegrating regression results.

Variable	Coefficient	t-Statistic	Prob.
Constant	-49.578	-3.423	0.001
Price of crude oil	0.3636	11.842	0.000
Exchange rates	0.525	3.888	0.000
Tax rates	2.961	7.861	0.000

R-squared	0.930	Mean dependent var	59.767
Adjusted R-squared	0.926	S.D. dependent var	9.741
S.E. of regression	2.651	Akaike info criterion	4.851
Sum squared resid	407.840	Schwarz criterion	4.988
Log likelihood	-146.370	F-statistic	255.043
Durbin-Watson stat	0.867	Prob(F-statistic)	0.000

Appendix 5: Normality test of the error correction model

Fig A9 Normality test.



Series: Residuals	
Sample 2003:03 2008:03	
Observations 61	
Mean	5.82E-17
Median	-0.150563
Maximum	3.646870
Minimum	-8.328233
Std. Dev.	1.684227
Skewness	-1.556674
Kurtosis	11.28573
Jarque-Bera	199.1299
Probability	0.000000