THE IMPACT OF CRUDE OIL PRICKS ON PETROLEUM PUMP PRICES IN KENYA: A CASE STUDY OF NAIROBI

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DECLARATION

This project paper is my original work and to the best of my knowledge has not been presented for the award of any degree in any other university. / /

signed . . . r ^ y ^ ^ :

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APPROVAL

This research paper has been submitted with our approval as University Supervisors

Signed

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DEDICATION

I dedicate this work to my wife Jacinta Mwelu Wafula, daughter Barbra Namaemba Wafula, and son Ben Wepukhulu Wafula who is named after my late father Mzee Benard Wepukhulu Mukhwaya.

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ABSTRACT

This study attempts to identify the key factors that determine petroleum pump prices in Nairobi which accounts for half of Kenya's total consumption. The study examines the time series data of crude oil prices both domestic and international and a number of other covariates, including exchange rate, lagged price of crude oil and gross domestic product. Based on the possibility of existence of co integration between pump and international crude oil prices, both domestic pump and international crude oil prices were modeled in first difference with an error correction term added to reflect the long-term relationship. The study concludes that the two sets of prices follow long term trends.

CHAPTER ONE

1.0 Introduction

The energy sector, composed mainly of electricity, biomass energy, and petroleum products - is one of the key sectors that drive the Kenyan economy. Wide access to modern, reliable, and cost-effective energy is both a guarantee of the dynamism and growth of the private sector, and a key to basic social services for poor Kenyans. The Kenya government has been very pro-active in the sector sincc the last Consultative Group (CG) meeting in 2003.

In Kenya, energy resources comprise both commercial and non-commercial ones. Commercial energy mainly comprises of petroleum products and electricity, while non-commercial energy comprises of biomass, and to a lesser extent solar energy, wind power and biogas. Petroleum fuel accounts for about 21% of the total primary energy consumption (UNEP, 2006; Mwakubo ct al., 2007) and it is also the major source of modern energy. Kenya docs not have a domestic source of oil; hence it relies on imported petroleum for its local consumption. Bccause of this, crude oil and imported refined petroleum products are Kenya's major imports

In Kenya, like in many other countries, commercial energy is mainly used by the transport and industrial sectors. These sectors have been growing very fast and as a conscquence, their demand for

commercial energy has been rising. However, their energy needs have primarily been met by petroleum.

The Kenyan economy has been undergoing reforms since the early 1990s with a view to improving the overall macro-economic performance, by increasing incomes, creating employment opportunities, reducing the incidence of poverty and enhancing the performance and productivity of public investments. These reforms have included abolition of commodity price controls, allowing the market forces of demand and supply to determine prices and allocation of resources, liberalization of foreign exchange and interest rate regimes, privatisation of the Government stake in non-strategic public institutions, reducing Government participation in activities of a commercial nature, rationalization of Government revenue and expenditure through budgetary reforms, civil service reforms, restructuring of the tax system and debt management programmes.

Consistent with these reforms in other productive sectors of the economy, the Government has, during the same period been undertaking reforms in the commercial segment of the energy sector (Electricity and Petroleum). Reforms in the petroleum industry solidified with deregulation in October 1994. These reforms were aimed at entrenching the operational efficiency of the industry by eliminating market distortions that existed, and attracting private investments into the petroleum industry.

Such reforms included liberalization of distribution and pricing of petroleum products in the country and partial liberalization of petroleum supply, abolition of the "White Oil Rule" that required oil marketing firms in the country to, as closely as possible, service their domestic product supply obligations by processing crude oil at the refinery, abolition of National Oil Corporation of Kenya's (NOCK'S) 30% crude oil supply quota, liberalization of the oil transportation modes and the attendant transportation tariffs and legalization of minimum operation stocks for motor petroleum and liquefied petroleum gas (LPG). In addition, a suspended duty of Kshs. 0.45 per litre on all imported refined petroleum products was introduced to cushion the Kenya Petroleum Refineries Limited (KPRL) from competition from more efficient refineries in the Gulf region during the transition period.

Since liberalization, the oil industry has attracted a substantial number of independent petroleum traders engaged in importation, exportation, distribution and wholesaling of petroleum products in the country. However, it has been observed that the post deregulation retail prices of petroleum products have not closely followed the changes in international oil prices. Consequently, it has been argued variously that oil companies arc quick to adjust retail petroleum prices upwards when international oil prices are rising and slow to lower prices when oil prices fall. This implies that retail petroleum prices arc sticky downwards which generates non

trivial economic efficiency and asymmetrical cost concerns on the downstream petroleum market.

In particular, when the international crude oil prices were rising during 2007 and 2008, oil marketing companies quickly passed on these increased costs to consumers, but took inordinately long to pass on cost reduction benefits to consumers when international oil prices were on a downward spiral in the last quarter of 2008. For instance, the load port price of Murban crude oil dropped from a record high of U$ 137.35 per barrel in July 2008 to US$ 42.10 per barrel in December 2008 while the pump price of super petrol dropped from Ksh. 110.00 per litre to Ksh.78.00 per litre over the same period (Ministry of Energy-ministerial statement dated May 13, 2008).

This behaviour by the oil marketing companies generated a lot of public concerns on the overall economic efficiency and rationale of unfettered market mechanisms in the retail petroleum market in Kenya and literally re-kindled agitations for re-introduction of price controls.

In October 2008, the Minister for Energy asked the Energy Regulatory Commission (ERC) to develop a formula for regulating downstream petroleum prices for his consideration (Ministry of energy). Consequently, on 14th November 2008, ERC published Draft Retail Price of Petroleum Products Regulations in the Kenya

Gazette and invited comments from the public and other interested parties. In addition, the Energy' Regulatory Commission developed a concept paper enumerating the pelrolcum supply chain logistics and their cost implications on downstream retail prices (ERC-Commission paper of petroleum pricing). Upon review of the comments by the stakeholders, the areas of concern identified included recovery of actual incurred costs, return on investments, margins, financing costs and inventory delays.

1.1 Liberalization of the Petroleum Oil Industry in Kenya

Prior to liberalization in October 1994, a significant feature of Kenya's oil industry was the relatively high level of government's direct participation, and a correspondingly low level of private sector involvement. Seven marketing and distribution companies were responsible for procuring and importing their own oil. The National Oil Corporation of Kenya was mandated to supply 30% of the crude oil requirement into the country. The Kenya Petroleum Refineries Limited, Kenya Pipeline Company Limited, National Oil Corporation of Kenya and Kenya Railways Corporation represented the government's presence in the petroleum industry.

The Kenya Petroleum Refineries Limited is owned on a 50:50 equity basis between the government and three shippers, namely, Shell, British Petroleum and Chevron. The Kenya Pipeline Company Limited, Kenya Railways Corporation and private transporters are

involved in transportation of petroleum products from Mombasa to other parts of the country and neighbouring countries. Prior to 1994, the government, in consultation with the oil marketers, set consumer prices for petroleum products in the country. However, since October 1994, the procurement, distribution and pricing of petroleum products have been liberalized with a view to enhancing operational efficiency of the industry and also attracting private capital (Republic of Kenya, 2004).

The petroleum industry was liberalised in October 1994 as part of the Structural Adjustment Program (SAP) for the energy sector. This was expected to bring about a realignment of the market structure, and to facilitate competition by removing behavioral and structural barriers to entry. However, heavy government participation in the Kenya Petroleum Refineries Limited (KPRL) meant that all product requirements for local consumption would first have to originate from the refinery and any shortfalls would then be catered for by imports to be made by specific firms through an industry tender system. In this way, the country was expected to benefit from the lowest prices on the international market with consumers benefitting from product availability and stable and competitive pricing in a free market.

Following liberalization, the first set of independent petroleum dealers to be registered were small-scale international importers who were targeting the export market in the Great Lakes region. It

took about a year after liberalisation for the first independent retail outlet to emerge. The Independent Petroleum Dealers Association was formed and registered in January 2000 to help members consolidate their operations in order to take advantage of the resulting economies of scale. The other key objectives of this association included joint product procurement, training in product handling, safety and environmental protection, representation at industry forums, creating awareness on legal rights, and enhancing knowledge about the petroleum industry.

1.2 Petroleum Consumption and GDP Growth

Petroleum is Kenya's major source of commercial energy and has, over the years, accounted for about 80% of the country's commercial energy requirements (Republic of Kenya 2004) on average, demand for oil in Kenya is relatively small due to the country's underdeveloped economy, which is heavily dependent on labour intensive and rain-fed agricultural systems. The domestic demand for various petroleum fuels on average stands at 3.1 million tons per year, all of which is imported from the Gulf region, cither as crude oil for processing at the Kenya Petroleum Refineries Limited or as refined petroleum products.

Kenya experienced relatively high economic growth immediately after independence. Gross Domestic Product grew at an average rate of 6.2% per year in real terms between 1964 and 1972. This

rapid growth was mainly due to favourable conditions on the international markets where export and import prices were stable. However, the emergence of instability on some of these markets, especially the supply disruptions and subsequent increased cost of energy, plus declining prices of agricultural products, affected the level of economic activity. This reduced the growth in GDP to an average of about 4.4% per year in real terms between 1972 and 1981.

Kenya's modern sector is however, heavily dependent on petroleum oil and the sector accounted for over 70% of total commercial energy consumed in the economy between 1968 and 1985. For example, before the first oil crisis in the late 1973, when the price of crude oil was declining in real terms, consumption growth of petroleum products was quite high, averaging 6% per year for the period 1968 to 1972, while GDP grew at an annual average rate of about 4.6% in real terms. This gave a GDP elasticity of 1.3. In 1973, GDP grew at 4.8%. But with a rise in oil price during the period 1973-74 of about 22%, GDP growth fell by half in 1974. The low growth in GDP continued until 1977 when it increased to 8.8% following the coffee *boom\ which was 'a shock' to incomes'. In the same year, 1977. petroleum consumption grew at 10.9%.

The second oil price shock of the late 1979 ended the effects of the coffee boom by reducing the growth in GDP to 3.3% in 1980. Meanwhile, petroleum consumption growth declined to 1.4%. Before

1973, oil was available at affordable costs, and rapid growth in petroleum products did not pose any balance of payments problem. The oil account was virtually in balance in exports and imports.

On the price hikes occasioned by the oil crises, the 1979-83 development plan (Republic of Kenya, 1985) asserted that: - "...one consequence of these trends will be that the pattern of further development will differ substantially from that preceding 1973....This high dependence on foreign energy sources and the role energy plays in all economic activities necessitates high priority being accorded to comprehensive planning of development in the energy sector."

1.3 Government Policy on Energy

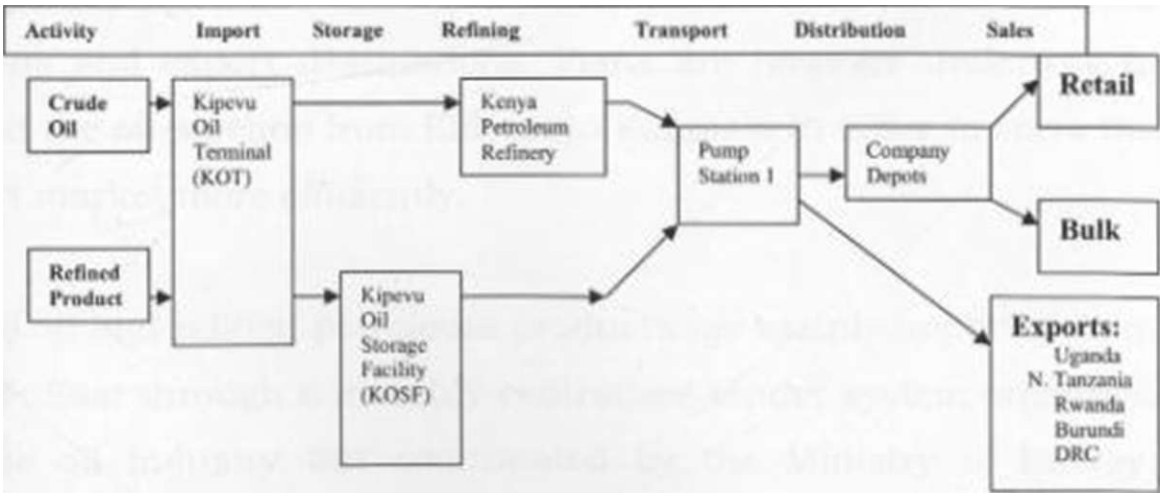
The first attempt at a policy paper on energy was made in 1987, to among other things; mitigate the adverse effects of oil importation on the domestic cconomy and balance of payments, provide a framework for a consistent policy on energy to ensure security of supply, and ensure efficient but affordable pricing and accelerated development of indigenous resources including the search for domestic fossil fuels particularly the hydrocarbons. New challenges associated with liberalization of the economy in the 1990s, including deteriorating balance of payments, economic stagnation, rising population, rising poverty, electricity rationing and outages, dwindling official development assistance and the recently observed

phenomenon of climate variability callcd for a new energy sector development strategy based on prudent integrated policies consistent with broader government policies on socio-economic development. However, despite these efforts, pump prices have consistently continued to vary from time to time.

1.4 Structure of the Petroleum Industry in Kenya

The product supply structure for the petroleum industry in Kenya is shown in Table 1. From the table, two scenarios are evident; one in which crude oil is imported for refining at the KPRL 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.

Tabic 1: Structure of the Petroleum Industry in Kenya



Source: MOE

Both refined and crude petroleum products are received at the Kipevu Oil Terminal (KOT) from where they arc pumped to Kipevu Oil Storage Facility and KPRL for storage and refining. The refined products are then transported via the Kenya pipeline system at a fee to respective company depots for local distribution, and to the export market through the Kenya Pipeline managed storage depots in Kisumu, Eldoret and Nakuru.

The Kenya Pipeline Company (KPC), a wholly owned Government company, manages a 14 inch 450 KM pipeline from Mombasa to Nairobi and another 446 KM long 8 inch and 6-inch pipeline system from Nairobi to Kisumu and Eldoret via Nakuru respectively. The pipeline tariffs for all products except jet fuel in Nairobi and Mombasa international airports are Kshs. 1.77/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 arc however underway to extend the oil pipeline from Eldoret to Kampala in order to serve the export market more efficiently.

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 cost implications.

To deliver an economic crude oil cargo of about 80,000 Metric Tones at an international crude oil price of about US$ 70 per barrel requires about US$48.3 Million. Initially Independents in the industry that arc mainly small were unable to raise this kind of money and could not therefore offer any meaningful competition in crude oil supply. However this trend has since changed and many of the independent traders arc winning tenders to supply both crude and refined petroleum product imports. They arc however, constrained by lack of storage and loading facilities.

This business segment is therefore dominated by well-entrenched firms. Out of the 20 crude oil tenders awarded in the period 2008 for instance, 8 (40%) were won by Kenya oil Company. 8 (40.0%) by Gulf Energy, 2 (10%) by Chevron Kenya Limited and 2 (10%) by Triton Petroleum Limited. Similarly, over the same period out of 44 refined oil tenders i.e. premium super petrol (PMS) , Automotive gas oil (AGO) and dual purpose kerosene (DPK) 1(2%) were won by Chevron Kenya Limited, 6 (14.0%) by Gulf Energy, 2 (5%) by Kenya Oil Company Limited, 10 (23%) by Gapco Kenya Limited, 12 (28%) by Addax Kenya Limited, 6 (14%) by Kenya Shell, 2 (5%) by Galana Oil Limited, 3 (7%) by Triton Petroleum Limited and 1 (2%) by National Oil Corporation of Kenya. This implies that large oil companies accounted for about 21% of total refined product cargo

deliveries while the combined independent operators accounted for 79% of the total refined imports (MOE petroleum consumption data 2008)

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 Tables 4 and 5.

Table 2: Ownership of Storage Depots and Loading Facilities

Location	Category	Name	Ownership
Mombasa	Depot	Mombasa	Kenya Pipeline. Company
Nairobi	Depot	Nairobi Joint Depot (NJD)	Kcnol Kobil, Total 81 Chevron
		Nairobi Joint Depot (NJD)	Kenya Pipeline Company
	Loading Facilities	Nairobi Joint Depot	Kcnol Kobil, Total fit Chevron
		National Oil Corporation	National Oil Corporation
Sagaiia	Depot	Sagana Depot	Kenol Kobil
Nakuru	Depot	Nakuru	Kenya Pipeline Company
		Nakuru	Kcnol Kobil
	Loading Facilities	Nakuru Loading Facility	Kenya Pipeline Company
Eldorct	Depot	Eldoret	Kenya Pipeline Company
		Kisumu	Kcnol 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: Ministry of Energy (MoE)

It is apparent from Table 2 that the major oil companies and the Government through the Kenya Pipeline Company and the National Oil Corporation 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 three years. 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 comprise about 60% and 20% respectively of the entire petroleum market in Kenya, are still rigid due to inadequacy or absence of efficient loading arms which facilitate loading on to tankers or rail wagons. 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 Independents splitting the ownership on close to a 50 to 50 basis as shown in Table 3.

Table 3: Ownership and Distribution of Retail Outlets (2008)

Region	**Independents**		**Multinationals**		**Total**
	No	%	No.	%	No.
Central	67	45	83	55	150
Nairobi	81	27	220	73	301
Coast	72	43	94	57	166
Rift Valley	n o	44	140	56	250
Eastern/N Eastern	64	52	60	48	124
Western	27	52	25	48	52
Nyanza	26	39	40	61	66
Total	**447**	**40**	**662**	**60**	**1109**

Table 3 could however be misleading if the statistics arc 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 low-end market and mostly 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. Therefore the volumes moved and the market shares controlled by the Multinationals are substantially high as shown in Table 4.

Table 4: Petroleum Market Share Profile (2006-2008)

	Year 2007			Year 2008		
comply	Sales	Mkt Shore (%)	Company Sales	Mkt Share (%)	Company Sales	Mkt Share
Shcll/BP	776.939	17.72	Shell/HP 994.102	21.50	Shell/RP 878,111	19.72
gSww	533,143	12.67	Chevron 490,923	10.62	IChevron 461,877	10.37
fetal	615,446	14.04	Total 748.362	16.18	Total |564,013	12.67
Spv®	350.135	7.99	Oilibya 333.380	7.21	Oilibya |319,906	7.19
Kobil	711.574	16.23	Kobil 751.326	16.25	Kobil 629,591	14.14
fonol	107,457	2.45	Kcnol 156,138	3.38	Kcnol 368,929	8.29
{Subtotal	3,094,694	70.581	Sub-total 3,474,230	75.13	Subtotal 3,222,427	72.38
(independent Dealers	1.289.899	29.43	Independent Dealers 1.149.870	24.87	Independent Dealers 1,229,777	27.62
jGrand Total	4,384,593		Grand Total 4,624,100	100	Grand Total 4,452,203	100

(Source: Ministry of Energy)

Tabic 4 shows that entry of new players in the petroleum market after liberalization in 1994 (29 in 2006, 24 in 2007 and 27 in 2008) and the seemingly equal distribution of retail dispensing sites between the established firms and the new players, the total market share controlled by independent dealers has continued to decline at 29.43% in 2006, 24.87% in 2007 and 27.62% in 2008 relative to 70.58%, 75.13% and 72.38% market share controlled by the large firms over the same period.

1.4 Pricing of Petroleum Products

The history of oil pricing can be traced back to the late 1920s. During this period, the private companies were marketing imported product - mainly kerosene. No authority, either the Government or the companies, enforced any artificial controls on the priccs, which were allowed to float. This situation continued till the advent of the Second World War. During the war and post war periods (1939-1948), the oil companies maintained price pools for major products.

The first attempt to regulate oil prices was based on Valued Stock Account (VSA) procedure agreed to between the Government of India and Burmah Shell in 1948. The VSA was based on import parity formula with Ras Tanura as the basing point. According to this system, the basic selling prices of all the major petroleum products were determined as the sum of Free on Board (FOB) that is, Ras Tanura price, ocean freight, insurance, ocean loss, import

duty, interest and other charges, as well as 10% remuneration. (Petroleum Insight, 2008)

Burmah Shell as a market price leader maintained separate VSA's for each product. Other companies followed the prices fixed by Burmah Shell. At the end of each year, collections at provisional basic selling prices were set off against actual costs. The resultant surplus/deficit were then certified by auditors and advised to Government. The selling prices were adjusted accordingly to keep the account in balance.

Petroleum pricing and costing has recently become a tricky subject not only in Kenya but also in the other non-oil producing countries worldwide. In Kenya, the Energy Regulatory Commission (ERC) has published on a monthly basis, maximum pump prices of petroleum products in the country. The said prices are set on the basis of c.i.f. (cost insurance and freight), crude oil price, and transportation costs within the country, retailers' and wholesalers' margins and refining fee.

Hence, the prices of commercial energy sources are not left to be determined by market forces but rather administered by the government. This implies that, the exogenously determined price is given to consumers who can consume as much as they can at the given price.

Before deregulation of petroleum products, the Government controlled oil product prices under the aegis of the general price control order of the Restrictive Trade Practices, Monopolies and Price Control Act (Cap 50 Laws of Kenya). The Ministry of Finance in consultation with the Ministry of Energy developed price schedules that were circulated to the oil industry for implementation. However, before the oil shock of 1979, pump prices were set by the Government in consultation with the oil companies (Republic of Kenya, 2004).

Petroleum product prices were set by a government-oil industry committee comprising 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.

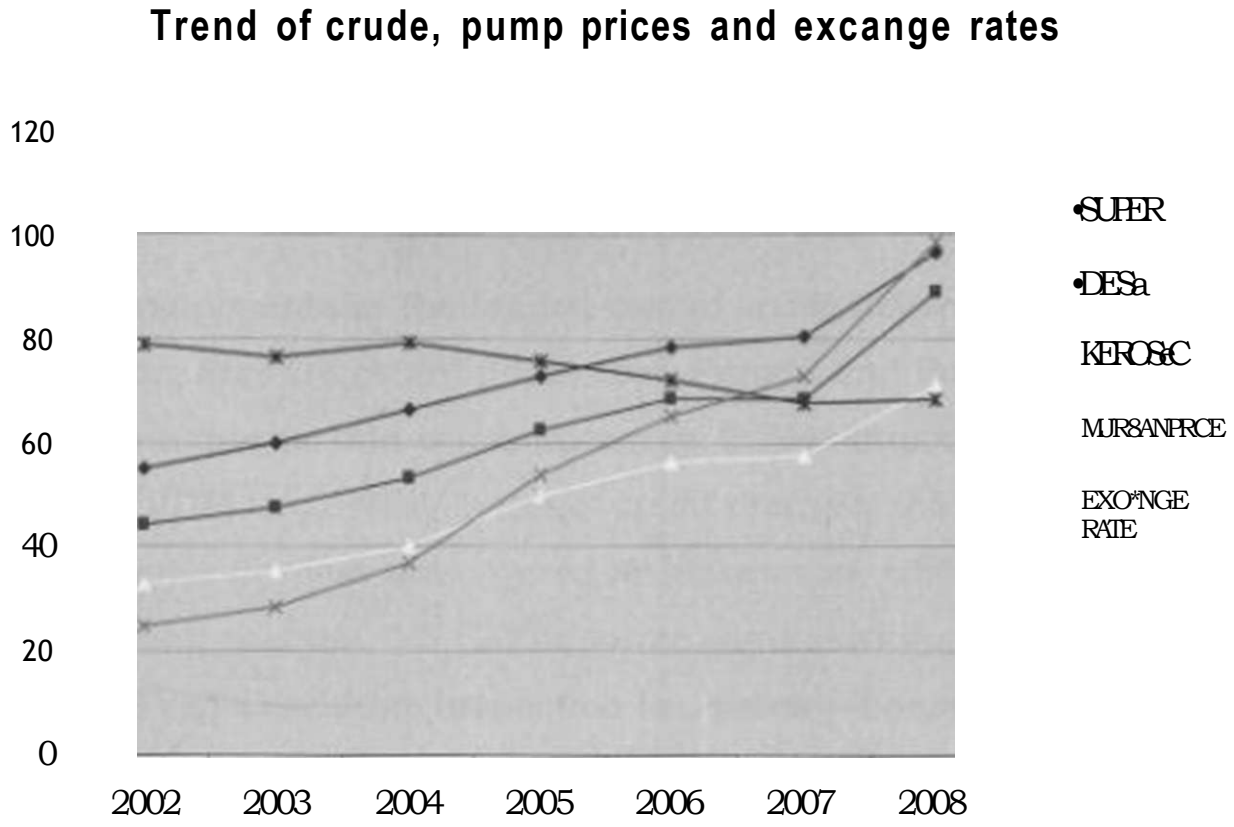
Inclusion of pipeline and rail transport tariff from Mombasa generates landed costs in other towns (Nairobi, Nakuru, Eldoret and Kisumu), while a town delivery cost by road tankers and a dealer margin are included to arrive at the retail pump price in Ksh/litre.

Appendix II demonstrates the price build-up method for petroleum products in the country.

1.5 Crude Oil Prices and Pump Prices

Figure 1 show the time series between Murban crude oil prices and Nairobi retail prices for diesel for the period January 2003 to December 2008. From the Figure, it is apparent that retail petroleum prices and crude oil prices trend very closely implying that crude oil pricc is an important variable in explaining changes in the petroleum retail price in Kenya. It should be noted that international prices for refined petroleum products are available on a daily basis in such publications as Piatt's and Reuters for the major trading markets. For imports into Kenya the relevant prices are those in the Arabian Gulf (AG) and the Mediterranean Sea (MED). Quotations for trading are based on the mean prices for 3-5 days around the bill of lading (B/L) day as FOB price plus a freight and premium component.

pjgure **1: Time Series between Murban Crude Oil Prices, ^change Rate and Nairobi Retail Pump Prices**



Source: Own Computation

1.6 Costing of Crude Oil

Crude oil is traded openly in the international markets. Kenya's crude imports are made up of about 90% Murban crude from Abu Dhabi, marketed by the Abu Dhabi National Oil Company (ADNOC). Early each month ADNOC sets the Official Selling Price (OSP) of Durban crude oil lifted during the previous month. This becomes the Free On board (FOB) loading port price applicable to the tenders

I

called in Kenya. The balance of 10% of crude imports is Arab Medium crude from Saudi Arabia. Tenderers quote a fixed Freight and Premium figure to bring the crude from the loading port to Mombasa. Crude oil is imported in large ships (80,000 Metric tons) and therefore freight on crude is not a major component of local prices.

The components in the landed cost of crude delivered to the refinery include; Free On Board (FOB) cost, Freight and Premium, 0.105% for both marine and war insurances, 2.75% Import Declaration Form (IDF) fee, 0.85% Letter of credit charges, 0.5% Ocean Loss allowance (for loss not covered by insurance), US$ 3.82/MT Port Handling charges, 0.5 C1F importer administration fees, Kshs.1.50 /MT +VAT Discharge Inspection fee, potential demurrage and cargo clearing charges.

Crude oil prices and petroleum pump prices have been on an upward trend in the recent past. The high oil prices are mainly attributable to unprecedented high demand for petroleum fuels in the global economy particularly China and India which registered high economic growth rates. Secondly supply constraints are being caused by reduced production from mature fields, low levels of new discoveries and tight enforcement of production quotas by Oil Producing and Exporting Countries (OPEC). Due to this unprecedented increase in international and local pump prices there have been calls from several quarters for the government to introduce price controls. In addition, there has been increased

speculation in the commodity market inspired by depreciation of the US dollar against major currencies.

1.7 Problem Statement

It has been argued variously that the retail petroleum prices in Kenya do not closely reflect the true costs of product supply. In particular, petroleum prices do not seem to change in tandem with shocks in the international crude oil prices. Proponents of this argument such as the Ministry of Energy, Energy Regulatory Commission and the public indicate that firms in the petroleum industry arc quick to increase retail prices immediately upon a spike in international crude oil price but are reluctant to lower the same and pass the benefits to oil consumers when the reverse happens.

Oil companies especially the Multinational Corporations on the other hand argue that petroleum prices just reflect crude oil prices; supply adjustment costs and the normal interaction of supply and demand. Many consumers and politicians have interpreted these petroleum price movements as an attempt by the oil companies to exploit their market power for financial gain.

Consequently, organized stakeholders in Kenya like Parliament, Central Organization of Trade Unions (COTU), Kenya Association of Manufacturers (KAM) and the general public have strongly agitated

for re-introduction of price controls ostensibly to tame a seemingly predatory petroleum industry. In view of this conflict, policy decisions are bound to appear biased in favour of or against each of the antagonists, unless such decisions are informed by macro economic realities, of the market. An important aspect of such market realities is the confirmation of the effect of crude oil prices on the petroleum pump prices in Kenya. The study therefore seeks to fill this gap.

1.7 Objectives of the Study

This study seeks to determine the nature of the relationship between international crude oil prices and pump prices. The primary objective of this study therefore, is to analyze the response of the Nairobi market retail petroleum pump priccs to crude oil price shocks.

The specific objectives of the study arc;

i. To determine the impact of crude price on petroleum pump prices in Nairobi
ii. Test whether crude priccs and pump prices follow long-term trends
iii. To use (i) and (ii) above to generate policy prescriptions.

1.8 Justification of the Study

Energy plays an important role in the process of economic development of any economy. Kenya relics wholly on imported crude oil as the major source of energy. The rise or fluctuations of international crude oil costs therefore lead to unpredictable petroleum prices whieh act to deny petroleum consumers and the economy the inherent gains of predicting subsequent pump prices for purposes of planning appropriately.

The information to be generated from this study is vital as it can be used by policy makers to assess the effect on the economy of changes in the price of crude oil. In addition, price dynamics may be used by petroleum traders and other industry participants to forecast subsequent downstream prices for various regions if the crude oil prices are consistent and predictable.

CHAPTER TWO

2.0 LITERATURE REVIEW

This chapter examines literature on petroleum price movements and the subsequent impact on pump prices in Africa in general and Kenyan scenario in particular.

2.1 Theoretical Literature

The link between crude prices and pump prices is best described by the concept of pass through. In economic literature, pass-through is defined as the total effect a nominal exchange-rate change has on the import price. The estimate thus includes the direct effect on import prices as well as the effect working through home market prices. Pass-through can also be defined as the effect that a change in price at any intermediate point of sale is expected to have on prices at each successive sale.

According to Borenstein et al, (1997), high pump prices have welfare cost implications to petroleum consumers since it generates higher consumer costs when crude oil prices increase by more than the costs would decrease when crude oil prices decrease. The authors argue that the difference in the magnitude of adjustment to positive and negative cost shocks over the same lag length can be

integrated over the entire adjustment period to get the total adjustment cost to consumers of a given shock. This implies that volatility in input costs, even if there is no systematic increase or decrease in price, is costly to consumers.

Ye et al, (2005) document 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 hence the process of pass-through.

Borenstcin ct al, (1097), state that eventually there is a complete transmission of crude oil price shocks to wholesale prices, but the process takes several weeks. The authors however argue that since wholesale prices are formed in competitive and well-organized markets, the lags in the adjustment process are peculiar. A change in crude oil price changes the opportunity cost of the primary input, and under most standard models of firm behavior, 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 (MOP), the marginal cost is now greater than price (MOP) 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 petroleum will therefore adjust immediately to reflect the changes in crude oil prices.

Several arguments have however been advanced to explain why the adjustment process is usually lagged. Borenstcin and Shepard (2000) posit 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 petroleum. 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

behaviour such as menu costs that make changing transaction prices costly, information imperfections and demand inelasticity.

Consumer search models can also be used to explain such costs in the petroleum markets. They take the form of information asymmetry and thin intra-station retail margins. While information asymmetry weakens the consumers' ability to make informed comparative shopping for better prices due to the scattered nature of petroleum sellers (retail stations) and similarity of prices within certain market clusters, thin retail margins on their part do not generate adequate incentives for price searching. In addition, consumers' search behaviour and their decision whether to buy petroleum in a given place or search further is dependent on historical information of previous prices. Similarly, during periods of price volatility, consumers associate the frequent price changes with the entire industry and not the particular firm behaviour, and this further discourages searching for lower prices. These factors, including market power therefore sustain lags in price adjustment process.

The multiplicity and prcdictive limitations of oligopoly pricing theories arc well documented and appreciated. Grant (1982) argues that competition between two sellers will result in aa 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 behaviour 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 behaviour, 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 must 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-pricc 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. Moreover, Grant (1982) argues that successful pricc 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, this 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.

In general therefore, due to the desire by colluding firms to adjust prices to reflect different circumstanccs 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 rebates (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 presence or otherwise of price asymmetry is an emotive petroleum policy issue in any country. Ye et al, (2005) argue that the subject of petroleum price pass-through arouses curiosity to many interest groups; the general public, petroleum industry, policy makers and regulators. The most visible energy statistics to most consumers is the retail price of petroleum products. When substantial price changes occur therefore, especially upwards, there are often allegations of impropriety on the part of the petroleum marketers.

2.2 Empirical Literature Review

Ye et al, (2005) investigated the spot to retail price adjustment behaviour of the US petroleum market at the national and regional level using weekly wholesale and retail motor petroleum priccs from 2000 to 2005. They encountered pattern asymmetric across all

regions with faster pass-through when prices arc rising relative to when they are falling. However, the pass-through process, in terms of time and speed of completion varied from one region to another.

Based on the well-known existence of co integration between spot and retail prices, both spot and retail prices were modeled in first difference with an error correction term added to rcflect the long-term relationship. The study found that the speed of adjustment for spot price increase as measured by the coefficient of the first lag of the spot price ranged from 16% to 74%, while the speed of price declinc was much lower at between 11% and 46%. The results showed evidence of pattern asymmetry as the pass through speed was significantly greater when spot prices increase than when they dccrcasc in all regions.

Asplund et al, (2000) on their part analyzed the pass-through of costs to retail petroleum prices in the Swedish petroleum market. The study used daily data to examine price responses in the Swedish petroleum market to changes in the Rotterdam Spot price, exchange rate and taxes. The study tested various symmetries such as downward and upward flexibility of prices, symmetry in response to exchange rates, spot market prices and taxes. The results showed that the relationship between prices and costs in the Swedish petroleum 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 Energy Information Administration (ElA) of the US, (1999), undertook a study to ascertain whether retail prices in Midwest were downward sticky. The study compared the spot prices of West Texas intermediate (WTI) crude oil with average petroleum pump price, including taxes in Midwest. The study tested pattern and amount asymmetry using weekly price data from October 1992 to June 1998 between Midwest downstream (e.g. wholesale and retail petroleum prices) resulting from an upstream (e.g. crude and spot) prices changes. The study results found that about 60% of upstream price changes in Midwest were transmitted to the retail level within two (2) weeks, about 75% of the changes were passed through within four (4) weeks and the price pass-through process in Midwest was usually complete in eight (8) to nine (9) weeks.

Borenstein and Shepard (2000) undertook a study to test an explanation for lagged adjustments of wholesale petroleum prices to changes in crude oil prices. The study examined the response of petroleum prices to cost shocks and how that response is influenced by market power. The study regressed estimated adjustment rates on indicators of market power (i.e. price-cost margin) and found evidence of faster adjustment in markets that were considered more competitive, hence giving credibility to the claim by politicians that market power actually induces price stickiness. In addition, the study tested and confirmed that supply adjustment costs caused price stickiness.

Bacon (1991), in reference to petroleum price movements in Britain from 1965 to 1990, undertook a test of price asymmetry statistically, using biweekly data from June 1982 to January 1990. He used an adjustment model which 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 study concluded that all petroleum price changes are eventually fully passed on to the consumer (amount symmetry), but noted a high prevalence of pattern asymmetry in petroleum prices in Britain since retail prices rise faster than they fall in response to crude oil cost changes.

Karrenbrock (1991), used a partitioning model on monthly data for the US for Januaiy 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 wholesale level within two months after the shock.

The study found that if wholesale petroleum prices rose by 10 cents per gallon in one month, retail petroleum prices rose by 6.8 cents in the same month and 3.5 cents in the following month. Conversely, if wholesale petroleum prices fell by 10 cents per gallon in one month, retail prices fell by only 3 cents in the same month but fell

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, and complete price pass-through was achieved in both cases, so the ultimate effect of asymmetry on the retail consumer is small.

Balke et al, (1998), used a modified version of Borenstcin et al (1997) error correction model. The study used weekly data for the US from January 1987 through August 1996, and searched for price asymmetry by considering two forms of models, one with price levels and the other with price changes. The latter they called 'an error corrcction' model. Their two model types produced opposite results. The levels model showed very little evidence of price asymmetry, while the error correction model showed asymmetry was pervasive.

Kevin and Dcno, (1996), analyzed the relationship between weekly wholesale and retail prices in the Salt Lake City area from 1989 to 1993. His price series included the market shocks from both the Exxon Valdez oil spill in 1989 and the Persian Gulf War in 1990 and 1991. The study concluded that petroleum price asymmctiy was absent at the retail level during market shocks. When there was a market shock, complete pass through for both rising and falling prices occurred with 3 weeks. However, there was retail price asymmetry during normal times. According to his analysis, the

complete effect of a price rise took longer than the complete effect of a price drop. On average, 10 cents per gallon rise in the wholesale price of petroleum would take 4 weeks to be reflected as a maximum of 8 cents per gallon retail price rise. On the other hand, 10 cents per gallon drop in the wholesale price of petroleum would only take 2 weeks to be reflected as a maximum of 4.6 cents per gallon fall in the retail price.

2.3 Summary of Literature Review

Overall, therefore it has been established that energy is a critical primary input in the production process and the latent efficiency and welfare costs associated with price asymmetry in the sector is likely to have cascading effects on all productive sectors of any economy.

The negative welfare implications of pattern asymmetry as documented by Borenstein et al, (1997) and the already appreciated asymmetrical pricing and market failure nexus makes the subject of petroleum price asymmetry an attractive policy issue for Governments and regulators. The reported presence of pattern asymmetry in the petroleum market in Kenya and its close correlation with market power implies that the post deregulation level of competition in the petroleum market is inadequate to induce optimality in supply, pricing and resource allocation in the sector.

Most studies reviewed have concentrated on demand for energy at the aggregate level, but a few have tried to access the scope and magnitude of demand for each product. It is notable however, that little has been done to obtain the direct effect of crude oil price on petroleum pump in the developing countries, hence the justification for the present study.

CHAPTER THREE

3.0 METHODOLOGY

Understanding retail petroleum price movements require a thorough grasp of its cost structure. The retail petroleum priccs can be decomposed into several components, namely crude oil pricc, refining costs, transportation costs, marketing costs, profits, and taxes. Of these components, crude oil prices arc the most volatile, and thus hold the key to any short term frequency analytical work on petroleum price responses to upstream cost shocks.

Taxes ccrtainly changc, but usually in discrete jumps that are far apart compared to the monthly price data that will be analyzed in this study. Similarly, refining and industry managed costs change but relatively slowly. Crude oil prices, on the other hand, can be extremely volatile, even on a daily basis. Thus for the purpose of analyzing short-term retail petroleum price movements, it is imperative to track crude oil pricc and petroleum prices as they move through the market chain.

In the present study, we proceed at two levels. First we estimate a log linear model of pump priccs on crude oil prices and several other covariates including lagged pump priccs, Gross Domestic Product and exchange rates. Second, wc estimate an Error

Correction Model with a view to determining the existence or otherwise of long term relationship between crude oil prices and pump prices.

3.1 The Model

Let the pump price for super petrol at the current time be a function of the price of crude oil at the current quarter (t), price of crude oil at previous quarter, the exchange rate and the gross domestic product, then;

$$P_P = / (P_c , AT , Pc - \ >Y) \quad (1)$$

Where;

P_f Is pump price of super petrol

P_t Is price of crude oil per barrel

X is the exchange rate (US dollars against Kshs)

$P_{r\,l}$ Is the price of crude oil at previous quarter per barrel

Y: is Gross Domestic Product.

Available theory and literature does not provide any guidance on the nature and form of the functional relationship between these variables. A multiplicative form of equation (1) can therefore be expressed as;

$$P_P = P_c^{bi} P_c\backslash^2, X^{h J} Y^{b 4} \quad \textbf{(2)}$$

When transformed into a log linear specification, equation (2) would provide very distinct advantages sincc it would give direct estimates of elasticities. In addition, a log-linearised form would be simple to use besides satisfying homosccdasticity assumptions underlying the use of least squares estimates.

The log linear form of equation (2) which is our deterministic equation can then be expressed as;

$$\ln P_p = 61 \ln P_c + b2 \ln P_{rm\%} + />3 \ln X + M \ln Y + e \quad (3)$$

3.1.1 Error Correction Model

It would be of immense interest to policy makers and other stakeholders to know whether Pump prices have any long run tendency to grow relative to crude oil prices. Therefore, if the pump prices (P_c) and Gross Domestic Product (Y) are considered as stochastic trends and if they follow a common long run equilibrium relationship, then these variables should be co-integrated. If P_p and Pc are co-integrated then an ECM representation could be of the following form;

$$A / \wedge + a1, e,, \quad -LYsPc. \quad \textbf{(4)}$$

»-1 **(5)**

Where L and A arc the lag and difference operators respectively, €$_r$, and F,_, arc error correction terms which correspond to lagged values of the residuals from the OLS regression of p on $P_c$and P_c on P_r respectively.

Granger (1969, 1988) further indicates that in a co-integration system of two series expressed by ECM representation, causality must run in at least one way. Within the ECM formulation such as equations (4) and (5) therefore P_p docs Granger causc P_p if all uj, -0 and ui=0 and P_p does Granger cause P_p if all /J* =0 and fii^{m}0

To ascertain the effect of crude oil priccs on petroleum pump prices we take into account the time-series characteristics of the data. This allows us to distinguish between short and long-run responses. In addition, the speed of adjustment towards long run values can then be directly estimated.

The estimation of petroleum demand using ECM has been conducted at three different stages. At the first stage, we examine the time scries under consideration in order to determine whether the time series has a unit root. That is whether it is of first-difference, second-difference or n-difference stationarity series. A time scries process is said to be stationary if the mean and variance

are constant over time and if the autocorrelation between the values of the process at two points, are dependent only on the distance between the time points and not the time period itself.

In the second stage we assess from the first stage results if the variables in question arc co- integrated, that is if the variables have a long-run relationship, confirmation of which enables us to estimate the long-run elasticities from the co -integrated regression. In the third stage, we rely on the first and second stages to determine whether or not to proceed to the estimation of the short-run elasticities and the speed of adjustment of the ECM.

3.2 Area of study

Nairobi was chosen as the preferred area of study for two reasons. First, Nairobi and its environs constitute about 60% of the petroleum market in Kenya. It is therefore plausible to generalize findings on the behavior of the petroleum market in Nairobi to the rest of the country. Second, it is important to establish the long term trend between pump prices and crude oil prices bccause national data usually smooth out important regional differences in the petroleum market. For instance there is a much better match between wholesale and retail prices at the local level than at the national level. As the largest petroleum market in the country, Nairobi offers an attractive opportunity to study this phenomenon.

3.3 Data Sources and Variable Definition

The study makes use of time series data on monthly crude oil prices and average Nairobi retail petroleum prices respectively. This data has been sourced from the Kenya National Bureau of Statistics (KNBS) as published in the Leading Economic Indicators, a monthly statistical bulletin, for the period January 2000 to April 2009 analyzed on quarterly basis. The reference crude oil was Murban which accounted for over 80% of total crude oil deliveries in Kenya during the year 2008 and the reference price was the Abu dhabi National Oil Corporation (ADNOC) quarterly average price. The reference downstream petroleum product was unleaded premium motor petroleum (PMS or Super) and its reference price was the average pump price for a given quarter. The exchange rate component is based on the quarterly average. The GDP is composed of sum of the following sectors agriculture and forestry, mining and quarrying, manufacturing, electricity and water, construction, wholesale and retail trade, hotels and restaurants, transport and communication and finally financial intermediation. This GDP is also computed to generate the quarterly average.

CHAPTER FOUR

4.0 EMPIRICAL ESTIMATION RESULTS

In this chapter, we present results of the empirical estimation and the interpretation of the same. First, we present the descriptive statistics of the variables contained in the OLS regression, followed by the regression output for the same.

Table 5: Descriptive Statistics

Variable	Mean	Std. Deviation	No. of obs.
PUMP PRICE	4.3825	0.1084	38
PRICE OF CRUDE OIL PER BARREL	3.7311	0.5347	38
EXCHANGE RATE	4.3051	0.0952	38
PRICE OF CRUDE IN PREVIOUS QUARTER	3.6988	0.5330	38
QUARTERLY GDP	12.1517	0.1335	38

Table 5 shows that all the data points for all the variables listed deviated quite closely to the mean. Table 6 reports the OLS regression output.

Table 6: OLS Regression Results (Pump Price of Crude Oil is Dependent Variable)

Variables	**Coefficient**	**t-statistics**
Price of Crude Oil	0.4460	1.8670
Exchange Rate	0.1300	1.5750
Price of Oil in Previous Quarter	-0.2000	-0.4040
Gross Domestic Product	0.4050	1.2280
Adjusted R Square	0.8950	

Table 6 shows that exccpt for the price of crude oil in the previous quarter, the other three variables are fairly statistically significant determinants of oil pump prices in Nairobi. Price of Crude Oil, exchange rates and Gross Domestic product are directly related to the pump priccs while price of oil in the previous quarter arc inversely related to pump priccs. Jointly, the four variables explain 89.5% of changes in the price of pump prices in Nairobi.

Secondly, we determine any long-term relationship between pump priccs of various petroleum products; Automotive oil, Kerosene, Premium and Regular petrol on one hand and the international crude oil prices per liter (Intern. Price/Liter) on the other. Table 7

reports the descriptive and summary statistics of the relevant variables.

Table 7: Descriptive and Summary Statistics

Statistics	Automotive	Kerosene	Intern. Price/Liter	Premium	Regular
Mean	4.07	3.83	3.04	4.24	4.23
Median	4.10	3.84	3.07	4.28	4.26
Maximum	4.64	4.48	4.06	4.68	4.64
Minimum	3.69	3.36	2.24	3.90	3.87
Std. Dev.	0.25	0.30	0.47	0.20	0.20
Skewness	0.21	0.18	0.11	0.09	0.03
Kurtosis	1.93	1.83	1.81	1.94	1.89
Jarque-Bera	6.89	7.68	7.60	5.98	6.39
Probability	0.032	0.02	0.022	0.050	0.041

Analysis of Table 7 reveals that all the variables in the model are non-normal as indicated by skewness, kurtosis and Jarque-Bera statistics. Additionally, the null hypothesis of normality cannot be accepted at the 5 per cent level of significance for all the variables as indicated by the probability value.

4.1 Graphical Data Analysis

in order to determine the trends in the prices of various petroleum ucts over time, we carry out a trend analysis. Such an analysis js important because it provides information about the movement of prices of the various products over the period under analysis. In addition, such trends provide information for the model of the unit root tests. Figures 1, 2, 3, 4 and 5 report the trends for Automotive Oil, Kerosene, International Crude Oil per Liter, Premium and Regular Petrol respectively.

Figure 2: Trends in Automotive Oil Prices (2000- 2010)

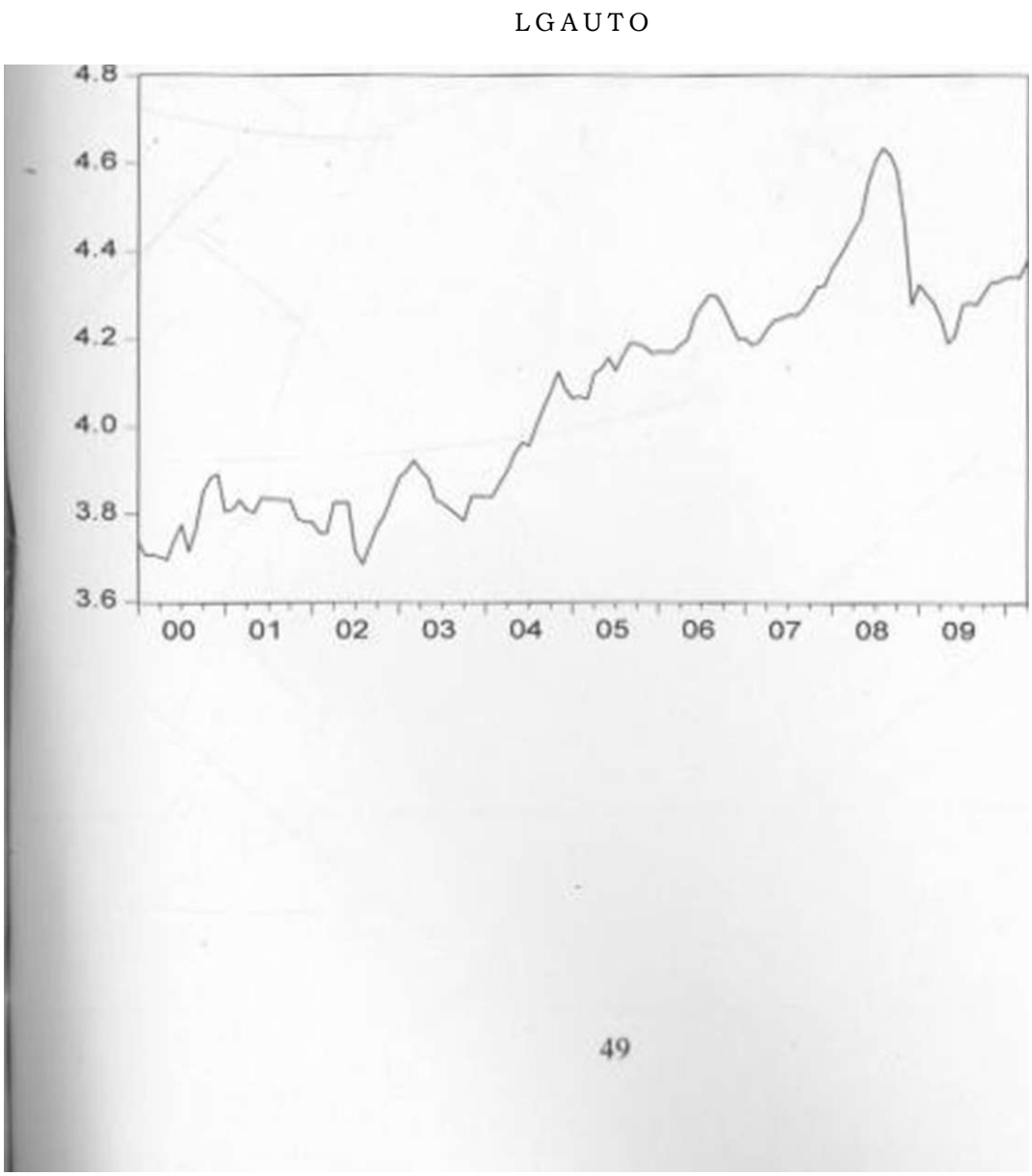


figure 3: Trends in Kerosene Prices (2000-2010)

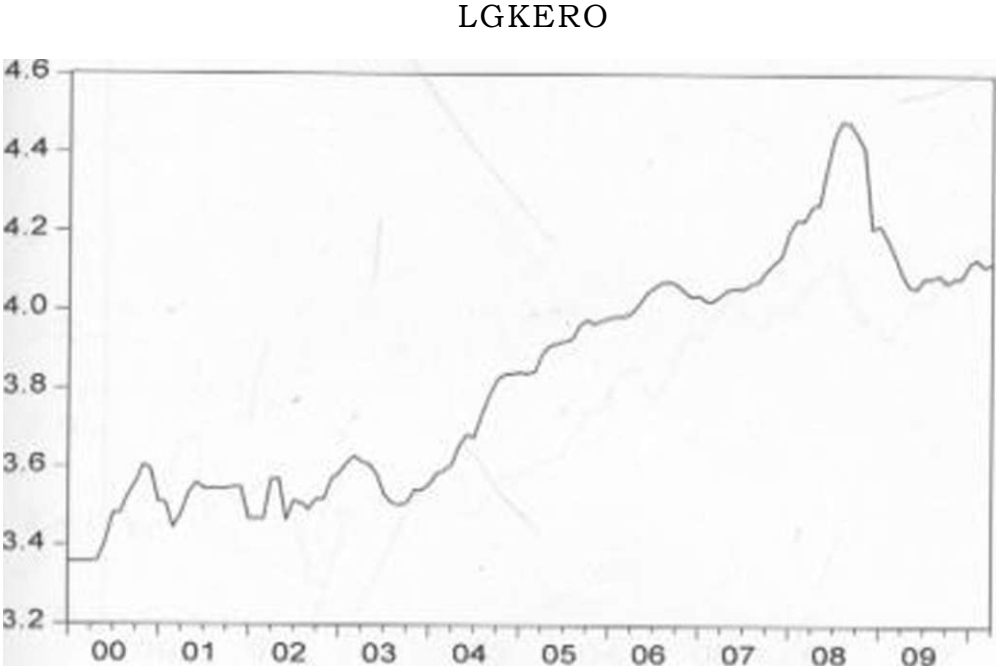


figure 4: Trends in International Crude Oil Prices (2000-2010)

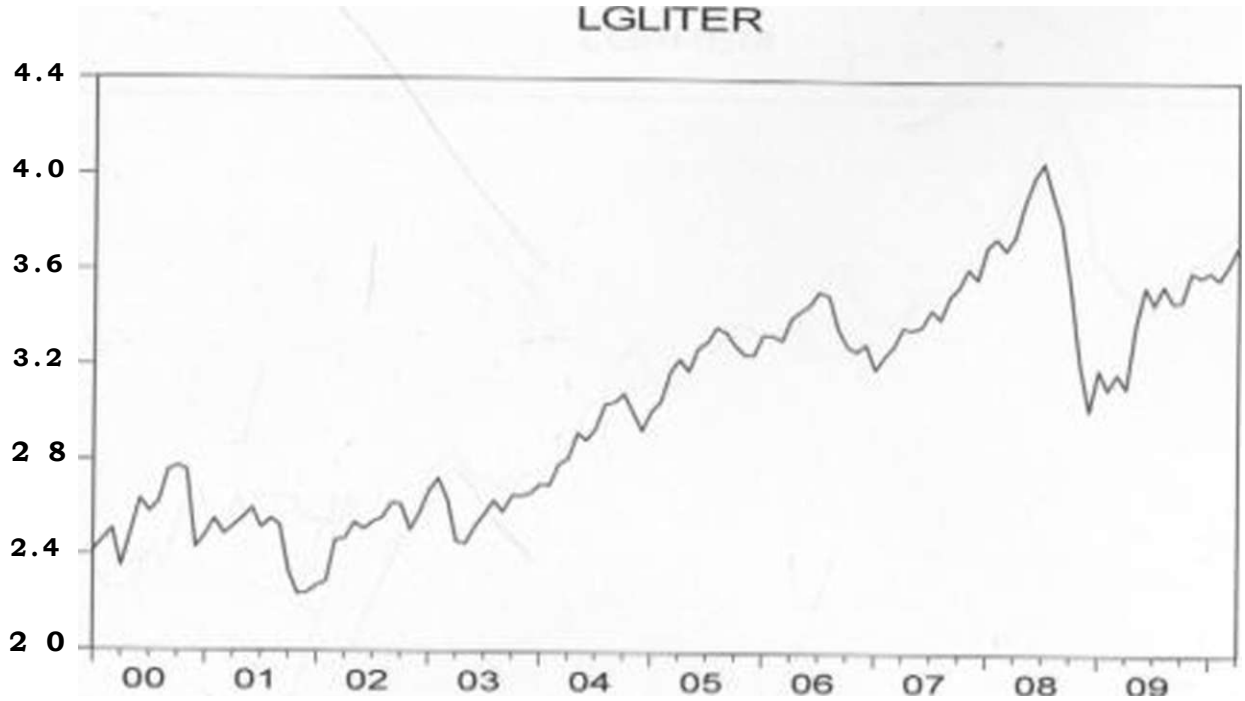
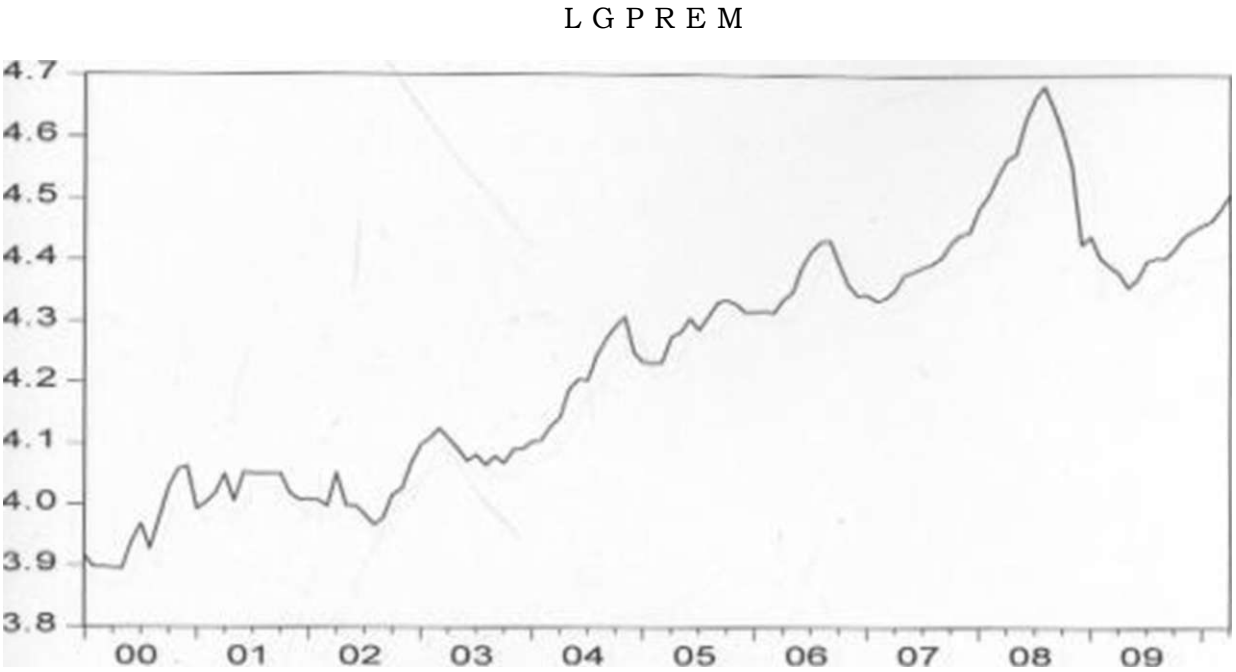
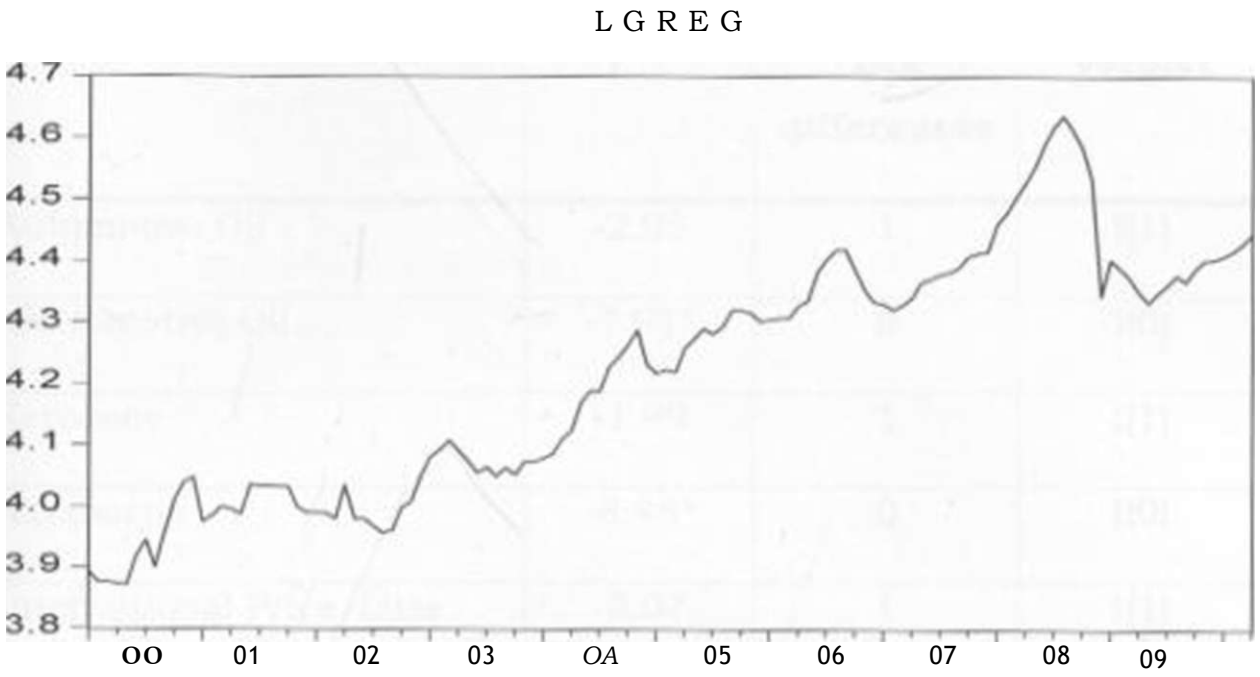


figure 3: Trends in Kerosene Prices (2000-2010)



For all the variables under analysis, the trends show a fairly consistent rise in prices that reach a crescendo in 2008, before dipping sharply in 2009 and starting to pick up again immediately thereafter.

figure 3: Trends in Kerosene Prices (2000-2010)



4.2 Unit Root Test Results

The ADF unit root test is based oil the null hypothesis of unit root against the alternative hypothesis of no unit root. Results of unit root test are reported in Table 8. Analysis of the ADF unit root test results in Table 8 shows that all of the variables are non-stationary at log levels but stationary at log first differences.

Table 8: ADF Unit Root Test Results

Variable	ADF Unit Root Test		
	T^{ADr}	Lag differences	Verdict
Automotive Oil	-2.95	1	Id)
^Automotive Oil	-7.91*	0	1(0)
Kerosene	-1.99	1	Id)
AKcroscne	-8.48*	0	1(0)
International Price/Liter	-3.07	1	1(1)
Alnternational Pricc/Liter	-9.11*	0	1(0)
Premium	-3.35	2	1(1)
APremium	-18.72	0	1(0)
Regular	-2.06	2	1(1)
ARegular	-9.88*	0	1(0)

ADF critical values for a constant and a linear trend model: 1 percent is -4.03: 5 per cent is -3.44: 10 per cent is -3.15. * and ** means significant at 1 and 5 percent respectively.

4.3 Model Estimation Results

Given the results obtained from Table 8, we proceed to use the Englc-Granger procedure to error correction modeling since our variables arc all integrated of the same order. We therefore estimate the long run model with non-stationary variables and test the residuals. The results are reported in Table 9.

Table 9: Estimated Coefficients of the Long- run Model

Variables	Coefficient	Std. Errort-Statistic		Probability
(PREMIUM	-0.48	1.25	-0.39	0.7004
AUTOMOTIVE OIL	1.50	0.54	2.76	0.0067
KEROSENE	-0.61	0.33	-1.88	0.0623
REGULAR	1.76	1.16	1.52	0.1319
CONSTANT	-6.12	0.68	-8.96	0.0000

Table 9 therefore reports results from our estimated model. Since our model was formulated in a log-linear form, our estimated coefficients are interpreted as partial price elasticities. The elasticity of international Crude Oil Price per liter with respect to premium is inelastic meaning, a 1 per cent change in international crudc oil prices will cause a 0.48 per cent decline in the price of premium petrol but this coefficient is statistically insignificant at all conventional levels of significance.

The elasticity of international crude oil prices per liter with respect to automotive oil is elastic meaning, a 1 per ccnt change in the

former will cause a 1.5 per cent increase in the latter and the coefficient is statistically significant at 1 per cent. The elasticity of international crude oil price per liter with respect to kerosene is inelastic meaning a 1 per cent change in the former will cause a 0.61 per cent decline in the latter. The coefficient is statistically significant at 10 per cent level of significance.

The elasticity of international crude oil per liter with respect to regular is elastic meaning a 1 per cent change in the former will cause a 1.76 per cent increase in the latter. This coefficient is statistically insignificant at all conventional levels of significance. A log-linear specification pre-supposes that the constant coefficient has no economic interpretation.

Table 10: Additional Long-run Regression Output

Statistics	Value	Statistics	Value
R-squared	0.9090	Mean Dependent Variable	3.0358
Adjusted R-squarcd	0.9059	S.D. Dependent Variable	0.4674
S.E. of Regression	0.1433	Akaike info Criterion	-1.0080
Sum Squared Residual	2.4442	Schwarz Criterion	-0.8943
Log Likelihood	67.4975	Hannan-Quinn Criterion	-0.9618
F-statistic	297.3626	Durbin-Watson Statistics	0.5021
Prob(F-statistic)	0.0000		

Analysis of Table 10 reveals that about 91 per cent of the variations in the pump prices of Automotive Oil, Premium petrol, Regular petrol and Kerosene are explained by changes in the international

price of crude oil. The F-Statistics, the test ofjoint parameter significance reveals that the parameters are jointly statistically significant at 1 per cent.

The Durbin-Watson statistics shows signs of positive autocorrelation. Conventionally, the remaining statistics in Table 10 should not have been reported but we decidcd to report them in order to aid us in model selection. As a rule of thumb, the model with the smallest of these statistics will be the preferred model.

A point of caution is that these variables arc non-stationary and as such these results could as well be spurious. To confirm or dispel this, we conduct the Englc-Granger two-stage procedure- the cointcgration test.

4.4 Cointegration Test Results

Cointegration test entails estimating the long-run model with non-stationary variables, generating the residuals and subjecting them to the ADF unit root test. The test model omits a constant and a linear trend. If the residuals are stationary, we can then proceed to estimate an Error Correction Model. Table 11 reports the cointegration test results.

Table 11: Cointegration Test of the Long-run Residuals

Augmented Dickey-Fuller Test Statistic		-4.1430	0.0001
Test for Critical Values:	1% level	-2.5839	

	5% level	-1.9434	
	10% level	-1.6150	

Tabic 11 shows that residuals from the long-run are stationary at the 1 per cent level of significance; hcnce wc proceed to run our Error Correction Model.

4.5 Error Correction Model

Table 12 reports results from our estimated Error Correction Model. Since our model was formulated in a log-linear form, our estimated coefficients arc interpreted as partial pricc elasticities. The elasticity of international crude oil price with respect to Premium, Kerosene and Automotive Oil are individually inclastic with their coefficients being individually statistically insignificant at all conventional levels of significance.

The elasticity of international crude oil price with respect to Regular is elastic meaning a 1 per cent changc in the former will causc a 1.13 per cent increase in the latter. The coefficient is however, statistically insignificant at all conventional levels of significance. The cocfficicnt of the ECM term shows that about 9 per cent of the errors are correct each month but this coefficient is statistically insignificant at all conventional levels of significance.

Table 12: Error Correction Model Coefficients

Variables	Coefficient	Std. Error	t-Statistic	Probability
D1KEROSENE	0.06	0.32	0.20	0.8425
D1 AUTOMOTIVE OIL	0.04	0.48	0.08	0.9330
D1 PREMIUM	0.21	0.92	0.23	0.8189
D1REGULAR	1.13	0.87	1.40	0.1966
ECM	-0.09	0.08	-1.18	0.2388
CONSTANT	0.00	0.00	0.46	0.6442

Table 13 reports the additional Error Correction Model regression output. Analysis of the table reveals that about 14 per cent of the variations in the prices of Automotive Oil, Premium, Regular petrol and Kerosene are explained by changes in the price of international crude oil.

The F-Statistics, the test ofjoint parameter significance reveals that the parameters arc jointly statistically significant at 1 per cent. The Durbin-Watson statistics shows no signs of autocorrelation. Conventionally, the remaining statistics in Table 13 should not have been reported. We however report them in order to aid us in model selection. As a rule of thumb, the model with the smallest of these statistics will be the preferred model.

Table 13: Additional ECM Regression Output

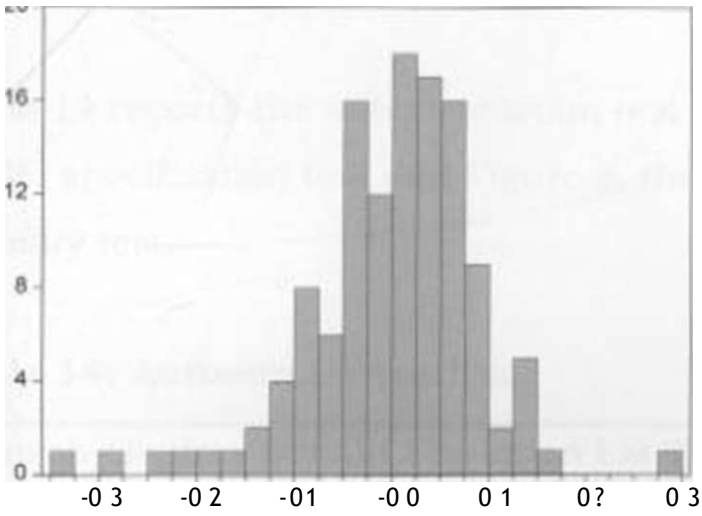
R-squared	0.1415	Mean Dependent Variable	0.0105
Adjusted R-squared	0.1049	S.D. Dependent Variable	0.0932

S.E. of Regression	0.0882	Akaike info Criterion	-1.9696
Sum Squared Resid	0.9112	Schwarz Criterion	-1.8324
Log Likelihood	127.1341	Hannan-Quinn Criterion	-1.9139
'-statistic	3.8599	Durbin-Watson Statistics	1.8585
prob(F-statistic)	0.0028		

4.6 Diagnostic Test Results

To test the adequacy and appropriateness of the estimated ECM, wc conduct some diagnostic tests. Figure 6 reports the statistical properties of the residuals and Figure 7 the residuals plot.

Figure 7: Statistical Properties of the Residuals



Senes Residu
Sample 2000V102 2010M04
Observations 1123

Mean	5 08e-18
Med«an	0 010871
Maximum	0 275903
Mtumum	-0 330673
Std Dev	0 086426
Skewness	-0 750504
Kurtosis	5.343714
Jarque-Bera	39 69835
Probabrfrty	0000000

Analysis of Figure 6 reveals that the residuals are non-normal.

Figure 8: Residuals Plot

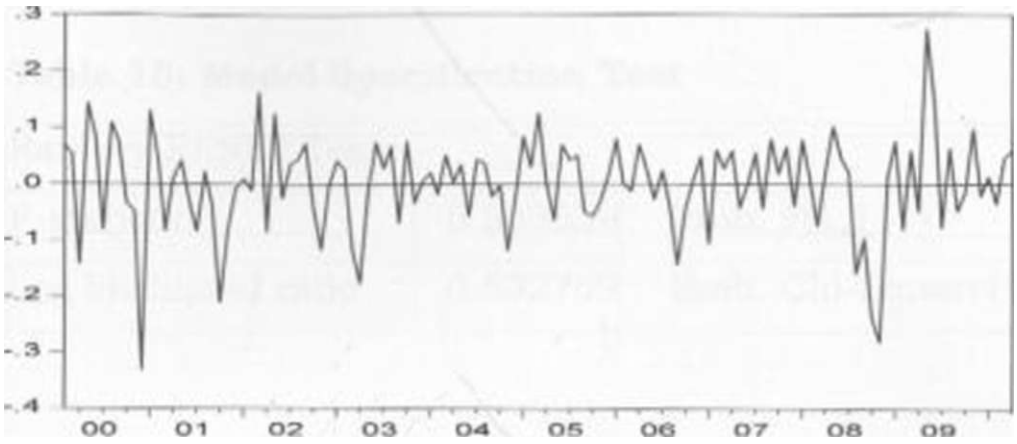


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Figure 7 shows evidence of outliers in the model as the residuals oscillate outside the plus and minus 0.1 band widths. This is indicative of the fact that the residuals arc not white noise.

Table 14 reports the autocorrelation test results, Table 15 the model specification test and Figure 8, the recursive coefficients stability test.

Table 14: Autocorrelation Test

Brcusch-Godfrcy Serial Correlation LM Test:

F-statistic	0.49801	Prob. F(12,106)	0.609
Obs*R-squared	1.056161	Prob. Chi-Square(12)	0.5897

I

Analysis of Table 14 confirms the conclusion drawn from the Durbin-Watson statistics that there is no autocorrelation in the model.

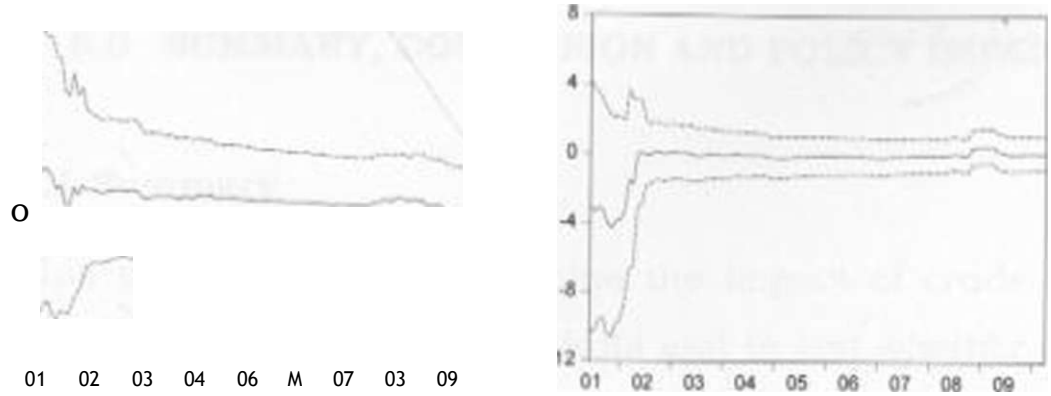
Table 15: Model Specification Test

Ramsey RESET Test:		
F-statistic	0.503539 Prob. F(l,117)	0.4794
Log likelihood ratio	0.532769 Prob. Chi-Square(1)	0.4654

Analysis of Table 15 shows that there is no specification error in the formulation of the model.

Figure 8, which contains results from the recursive estimates, shows that all of the estimated parameters arc relatively and individually stable as they oscillate between plus and minus 2 standard deviations.

Figure 9: Recursive Coefficients Stability Test



Ra>cuimr«iC|1)Fitmrtat
• 2 S F

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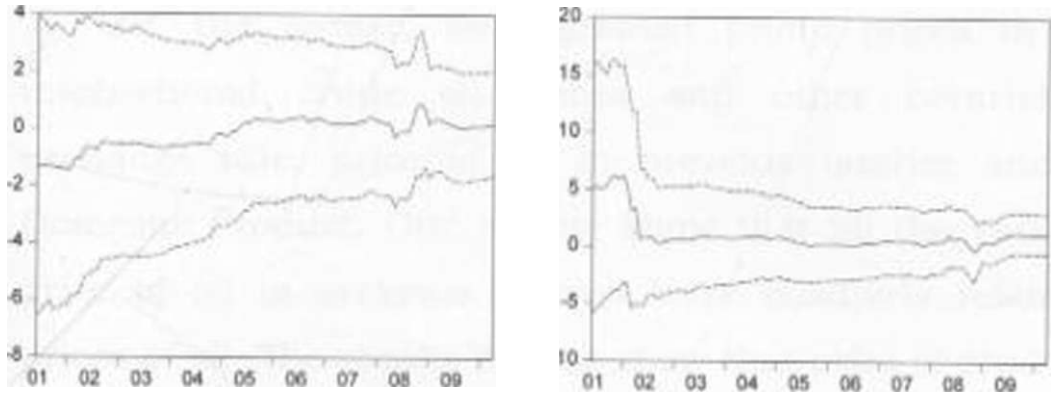
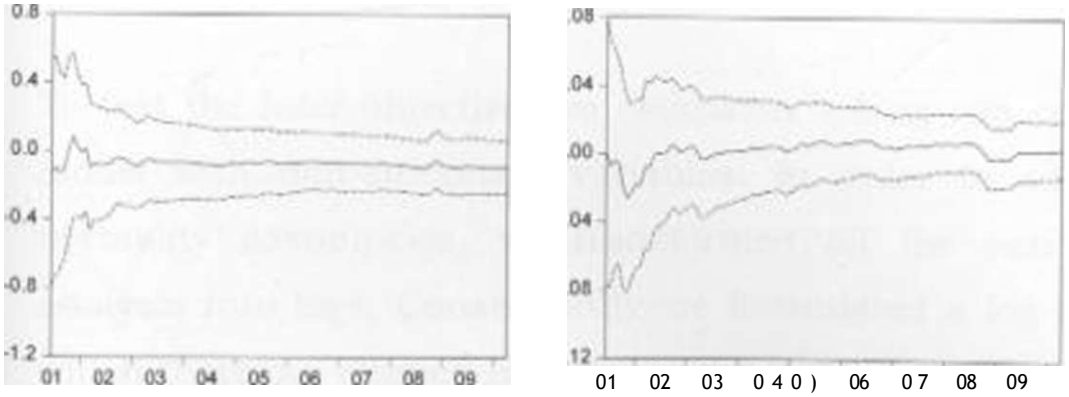
3



RecummsCCMEMmaAw
» 2 8 E

Recursive C«)E*BmaBs
» 2 S E



R«curtn«C(8)
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CHAPTER FIVE

5.0 SUMMARY, CONCLUSION AND POLICY IMPLICATIONS

5.1 Summary

This study sought to determine the impact of crude oil price on petroleum pump prices in Nairobi and to test whether crude prices and pump prices follow long-term trends.

To test the former, we regressed pump prices in Nairobi on international crude oil prices and other covariates namely; exchange rate, price of oil in previous quarter and the Gross Domestic Product. Our results show that all the variables except price of oil in previous quarter were positively related to pump prices of oil. The results further show that price of crude oil was the most statistically significant determinant of pump priccs and price of oil in previous year the least significant.

To test the later objective, we estimated a long run co-integration model with non-stationary variables. In order to adhere to the normality assumption, we transformed all the variables under analysis into logs. Consequently we formulated a log-linear model which therefore allowed us to interpret the estimated coefficients as partial price elasticities.

Results showed that price of international crude oil with respect to Premium and Kerosene were inelastic. With respect to Automotive Oil and Regular petrol however, it was found to be clastic. The results further showed that about 91 per cent of the variations in the pump prices of Automotive Oil, Premium petrol. Regular petrol and Kerosene were explained by changes in the international price of crude oil.

To test the adequacy and appropriateness of the estimated ECM, we conducted some diagnostic tests. Results showed that the model was stable and that the residuals were non-normal. Evidence of outliers in the model however, seemed to suggest that the residuals arc not white noise. The diagnostic tests further showed that there was neither autocorrelation nor specification error in the formulation of the model.

5.2 Conclusion

The findings of this study confirm the view that prices of international crude oil have a critical bearing on the domestic pump prices. They also confirm the commonly held belief that they follow long term trends. More importantly, this suggests the prcscncc of some loose form of pattern asymmetry in the pump price for petrol and other oil products in Kenya. Contrary to popular expectations, these findings suggest that the price of oil in the previous quarter has no significant bearing on the domestic pump priccs.

5.3 Policy Implications

The possibility of the presence of pattern asymmetry implies that the post deregulation level of competition in the petroleum market in Kenya is inadequate to induce optimality in supply, pricing and resource allocation in the sector. This problem is compounded by the fact that the market efficiency watchdog, the Monopolies and Pricc Control Commission, is, in the current frame, incapable of properly enforcing a competitive culture in the petroleum industry.

Many reasons explain this state of affairs. Critically however is that the structural set-up of the commission and the attendant legal framework were designed for a pricc control regime, and are therefore ill equipped to envisage and resolve the challenges associated with liberalized markets such as asymmetrical pricing. In particular, the definition of offences, the envisaged litigation process and the applicable fines and penalties make it virtually impossible either to detect these offences or discourage them from recurring when found.

While these concerns may not warrant reintroduction of price controls as being advocated by a section of stakeholders, certain policy actions are indeed necessary. At the national level, the country urgently requires a comprehensive modern-day competition law that addresses problems inherent in liberalized markets and which adequately provides for their resolution. This may necessitate, among other things, a repeal of the moribund

Restrictive Trade Practiccs, Monopolies and Prices Control Act Cap 504 to re-engineer the Monopolies and Price Control Commission into a relevant competition policy infrastructure with a mandate that addresses market efficicncy concerns for deregulated markets in Kenya such as sticky pricing, vertical integration and mergers and acquisitions.

At the sectoral level, there is need for a deliberate policy to reduce recognized entry barriers to petroleum oil trading in Kenya with a view to reducing market concentration by ensuring that independent firms collectivcly capture at least 30% that will giof the market with a view to giving them some significant clout on gasoline pricing decisions.

In addition, there is need to design and implement an appropriate regulatory structure whose mandate should include regular monitoring of petroleum market efficiency and product standards in addition to advising the Government accordingly.

The liberalization process for the petroleum industry in 1994 was not accompanied by institutional capacity building and there is therefore a need to establish an effective legal and regulatory framework for the sector. It is noted that an umbrella law for the entire energy sector is being developed that provides for broadening of the regulatory mandate of the existing power industry regulator to include the petroleum industry. This process should include the

establishment of a reliable oil data collection mechanism through which price statistics at the retail, wholesale and crude level can be collcctcd on weekly or even daily basis. This would permit carrying out of robust short frequency dynamic studies on the sector that would generate accurate information upon which future regulatory policies for the industry can be based.

The individual petroleum markets in net oil importing countries in Africa are very small yet crude oil import bills constitute a major expenditure items for most of these economies. Wc submit that substantial economies of scale could be realized through synchronized procurement, refining and supply of petroleum products for the entire region. Kenya could therefore commcnce a regional initiative with like-minded countries in the great lakes region with view to establishing formal legal and administrative structures for joint procurement of petroleum products.

Since Uganda, Northern Tanzania, Rwanda and Burundi import the bulk of their fuel supplies through Kenya, these countries could establish a special purpose Petroleum Import Company domiciled in an agreed country and co-owned by these Governments and the private sector. This company could then be mandated to coordinate and organize for joint supply of petroleum products for the region.

Such measures could help reduce concentration and increase competition in the industry. This would reduce pattern asymmetry

and ensure market responses that efficiently mimic upstream changes in both directions.

5.4 Areas for Further Research

In order to develop bigger and more accurate picture on the nature and pattern of relationship between international priccs of crude oil and the domestic pump prices, it may be necessary to consider use of aggregate data. Further studies could therefore explore pattern asymmetry from the country level perspective.

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APPENDIX

Appendix 1: Data Uted

	QUARTER	Nairobi Pump	QUARTERLY ADNOC	AVERAGE		QUARTERLY
YEAR	NO	prlcas	PRICK	EXCHANGE RATE	PCT1	OOP
2000	1	67.27	23 00	77 08	22.85	159919 00
	2	70 16	27.09	77.35	23.00	148199.00
	3	72.55	22.3b	76 98	27.09	160316.00
	4	Viss	1791	78.04	22.35	171706.00
2001	5	74.95	25.00	78.20	1701	165737.00
	6	7307	2628	7822	25.00	150585 00
	7	75.29	25 38	78 06	26.28	175449.00
	8	76 52	19.55	78.87	25 38	180273.00
2002		73.46	21 28	78 32	19.55	170297 00
	10	76 82	24.90	78.42	21 28	159809.00
	11	79.92	26.48	7873	24 00	170926 00
	12	8301	26 30	79.47	26 48	181449 00
200.1	13	75 46	30.13	77 05	2630	170995 00
	14	77.82	25 88	74 66	30 13	150104 00
	15	79.02	27 85	76 18	25 88	181121 00
	16	84.01	20 58	76 83	27.85	187967 00
2004	17	88.90	31.70	76.65	29 S8	182550 00
	18	01 76	35 60	7881	31 70	165521.00
	10	100. SO	39 58	80 51	35 60	185752 00
	-20	86 01	10 32	HO 73	39 58	1976/6 OO
2005	21	68.17	45.68	76 56	40 32	174866 00
	22	71 16	52 60	76 41	4568	179412.00
	23	73.55	59.70	75.38	52 60	203067 00
	24	73.55	56 62	73 85	59 70	211777.OO
21XX.	25	73 85	61.32	72.10	5662	196365 00
	2b	77 0-1	68 28	72 16	6132	192955.00
	27	83 og	69.63	72.97	fiM JH	221481 OO
	28	77 32	60 37	70 45	69.65	22202 l.OO
3007	29	75.46	58.57	69.82	60.37	211753.00
	30	78 82	68 57	67 IS	58.57	210045 OO
	31	80 02	74.67	67.01	h8 57	237035.00
	32	85 01	88 05	6521	74.67	234470 00
2008	33	00.')0	96.52	67.83	88 05	205929.00
	34	97.76	123.03	62 95	96.52	212830 00
	35	103 60	118 74	6976	123 03	237959 00
	36	89.01	54.25	78 62	118.74	235824.00
2000	37	89 97	»8 22	7981	54 25	214141.00
	38	90.02	77 86	48 22	48 22	224049 00

Appendix 2: Natural Logs of Data Used

QUARTER	LHPP	LH PC	LNIF.XCHAKOR RATRI	LN PC 1	t.N OOP
1	4 20871437$	3 135494	4 344017896	3128951	11 982fi1
2	t 250778348	3299128	4.348275934	3 135494	II 90631
3	4 284275979	3 106603	4 343543648	3299128	11.9049
4	4.27039ft 506	2.885136	4.357157444	3 I06G03	12.05354
5	4 316821225	3 2188/6	4 359305453	2.885136	1201816
(i	4.291417886	3 268935	4 359522812	3.218876	11.98033
7	4,32134732-1	3 234093	4 368934218	3 268935	12.0751
n	4.337552145	2.972975	4 367810648	3 234093	12.10223
9	4.19674104	3 057924	4.360806829	2.972975	12.0453
IU	4.341465023	3 214868	4 362043291	3 057924	11 98173
11	4.381026134	3.276516	4 365973046	3.214H68	1Z04899
12	« 4189010HJ	3 269569	4 375435796	3.276516	12.10873
13	4.323602715	3.40M)32	4 .144416058	3.269569	12 04939
14	I 364398468	3 253599	4 312971708	3 405632	11 97788
15	4.369700986	3.326833	4 333137028	3.253599	12.10692
1b	1 430935839	3 387211	4 341586078	3 326833	12 14402
17	4.487512143	3.456317	4 339232645	3.387211	12.11483
IB	4.551347379	3.572346	4 367040738	3456317	1201685
19	4.610157727	3678408	1 38840914	3.572346	12.13217
20	4.454463569	3696765	4 391070614	3 678408	12 194|3
21	4 222004585	3.821734	4 138034691	3 696765	120/178
22	4 264930863	3 962716	4 336086094	3 821734	12.09744
23	4.297965447	4.069332	4322566309	3 962716	12 22571
24	•1297965447	4.036309	4 302048647	4089332	12 26329
25	4.302036009	4 116052	4.27805127	4 036303	12 18773
26	4.344334767	4.223666	4 278850768	4 116052	12 17021
27	4.419924358	4 243483	4 290094078	4.323666	12 30811
28	4 347952654	4 100437	4 254971843	4 243483	12.31053
29	4.323602715	4 07016(>	4 245851274	4.100437	1226318
30	4 367166772	4 227807	4,211352977	4 070166	12.25508
31	4 382776603	4 313034	4 204882651	4 227807	12 37596
32	4 442768897	1477905	4 17764H101	4 313034	12 36508
33	4 509760001	4.56V7I6	4 217062561	4 477905	12 23529
34	1 582515495	4 812455	4 142335995	4 569716	12 26829
35	4.64053733	4.776925	4.24 SO12996	4.812455	13.37985
36	4 488748723	.1 993603	4 364681236	4 776926	12 37084
37	1 499476281	3.875705	4.379607043	3.993603	12.27439
38	4 VK10318<>H	4 354848	3875704743	3 875705	12 31962