STICKY PRICES AND MARKET POWER IN GASOLINE MARKET IN NAIROBI

By

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SUBMITTED TO THE SCHOOL OF ECONOMICS IN PARTIAL FULFILLMENT FOR THE REQUIREMENTS OF THE AWARD OF A MASTER OF ARTS (M.A) DEGREE IN ECONOMICS.

DECLARATION

This is my original work and has never bee prosented for any degree award in any other university

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APPROVAL

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A C K N O W L E D G E M E N T

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DEDICATION

To my wifo Glory Kagwiria,

Son Ryan ***Munene.*** *and*

Daughter Gma Kendi

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Abstract
Are Nairobi gasoline retail prices downward sticky? Do gasoline prices in Nairobi rise faster than they fall in response to upstream cost shocks? These are important research questions this study seeks to answer The study is motivated mainly by the unrelenting agitation for reintroduction of pnce controls in the petroleum market in Kenya premised on the view that gasoline retail pnces do not respond to the market fundamentals The study undertakes a pnce passthrough analysis to ascertain presence of Amount Asymmetry (whether upstream cost changes are NOT fully transmitted to the retail level) and Pattern Asymmetry (whether crude oil price increases are transmitted faster and more efficiently than crude oil price decreases) The study finds no evidence of amount asymmetry but pattern asymmetry was found to be prevalent This implies that indeed retail gasoline prices in Nairobi rise faster than they fall The policy import of this finding is that presence of pattern asymmetry imputes an asymmetry cost to consumers in periods of pnce volatility (Borenstem et al, 1997)

In addition the paper probes whether gasoline pricing in Kenya is influenced by a cartel-like behaviour in the industry by introducing a market concentration parameter, the Herfindahl-Hirshman index (HHI) into the passthrough model HHI for the industry is found to be in the range associated with either oligopoly or monopolistic competition. In addition, econometric results show that the index has a significant negative influence on gasoline price adjustments, implying that presence of pattern asymmetry in Nairobi retail prices can be ascribed to market power

Chapter 1

1.0 Introduction

The Kenyan economy has been undergoing reforms since the early 1990s with a view to Improving the overall macro-economic performance, increase incomes, create employment opportunities, reduce the incidence of poverty and enhance the performance and productivity of public investments These reforms have included abolition of commodity price controls and allowing the market forces of demand and supply to determine prices and allocation of resources in the economy Other reforms have included liberalization of foreign exchange and Interest rate regimes, privatisation of the government stake in non-strategic public institutions and scaling down government participation in activities of a commercial nature In addition, rationalization of government revenue and expenditure has been pursued through budgetary reforms, civil service reforms, restructuring of the tax system and debt management programmes

In tandem with these economic reforms in other productive sectors of the economy, the Government Kenya has. over the same penod 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 The reforms included liberalization of distnbution and pricing of petroleum products In the country and partial liberalization of petroleum supply The 'White Oil Rule" that required oil marketing firms in the country to, as closely as possible, sen/ice their domestic product supply obligations by processing crude oil at the refinery in Mombasa was also abolished together with the National Oil Corporation of Kenya's (NOCK S) 30% crude oil supply quota Other reforms included liberalization of the oil transportation modes and the attendant transportation tariffs and legalization of minimum operation stocks for motor gasoline and liquefied petroleum gas (LPG) In addition, a suspended duty at Ksh 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 dunng the transition period

In seeming to build a case for petroleum sector deregulation in Kenya. Little (1993), posits that 'the petroleum end-use prices in Kenya would go down in a competitive market environment free of exogenous factors as long as the country was not going through an inflationary period" Since liberalization, the oil industry has attracted a substantial number of independent petroleum traders engaged in importation, exportation, distnbution and wholesaling of petroleum products in the country

1.2 Problem Statement

It has been argued variously that post deregulation retail petroleum prices in Kenya do not closely reflect the true costs of product supply, In particular, petroleum prices do not change in tandem with shocks in the international crude oil prices. Proponents of this argument indicate that while firms in the petroleum industry are quick to increase retail prices immediately upon a spike in international crude oil price they are reluctant to lower the prices and pass the benefits to oil consumers when the reverse happens, hence alluding to the likely presence of pnce asymmetry Oil companies aver that gasoline prices Just reflect crude oil prices, supply adjustment costs and the normal interaction of supply and demand. Many consumers and politicians have interpreted these gasoline price movements as an attempt by the oil companies to exploit their market power for financial gain

There is strong suspicion that the perceived rigidity in gasoline pricing in Kenya is due to lack of competition in the industry This could be due to high start-up costs coupled with a relatively high cost of capital, absence or insufficient petroleum supply and distribution infrastructure, base load processing where all firms are required to process a minimum crude oil threshold volume even when supply economics dictate that direct importation of refined products would be more cost effective, and line fill requirement where all firms using the pipeline are required to maintain a dead stock of about 2 4 Million litres within the pipeline system

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-mtroduction of price controls ostensibly to tame a seemingly predatory petroleum industry Although the lobbying for price controls is popular from the consumers' viewpoint, it evokes none trivial market efficiency considerations. While the Government has given clear and firm signals that pnce controls is not the right way to go due to efficiency considerations, a regulatory framework for the petroleum industry is already being developed by way of reviewing the existing electnc power act in order to convert the Electricity Regulatory Board (ERB) into an Energy Regulatory Board and thereby expand its regulatory mandate to include the petroleum industry as well

Price asymmetry can be defined as the pass-through process in which prices move differently depending on the direction of change in the independent variable(s) In the context of Kenya's petroleum industry, this principally implies that retail prices rise faster than they fall when observed over some penod In economics literature this is referred to as 'downward sticky' prices Blinder (1982) defines the phenomenon of 'sticky prices" as the apparent insensitivity of prices to the fluctuations in demand

In the absence of any analytical work on the petroleum pnce passthrough in Kenya this researcher is aware of, this study seeks to evaluate the dynamism and optimality of the pnce making mechanism for petroleum products The increased agitation for overt regulation or reintroduction of price controls by organized stakeholders in the industry is premised on the perceived prevalence of pattern asymmetry. This study will be able to answer this question and therefore provide a firmer basis for arguments for or against this position.

1.3 Study Objectives

This study is motivated by the unusual pattern in the gasoline price movements: wholesale and retail gasoline prices in Kenya do not respond fully and immediately to changes in the price of crude oil. In addition, retail petroleum prices seem to rise faster than they fall in response to crude oil price increases and decreases respectively

The overall objective of the study is therefore to undertake a passthrough analysis for the petroleum market in Nairobi The specific objectives of this study are to ascertain whether upstream cost shocks are eventually transmitted to Nairobi retail prices, upstream cost increases are transmitted more efficiently than cost decreases and market structure has an influence on the adjustment rate of retail pnces to crude oil cost shocks

Nairobi market was chosen for this study mainly for two reasons First Nairobi and its environs constitute about 60% of the gasoline market in Kenya, while Coastal and Western Kenya regions account for the remainder 40% of the market share. It is therefore plausible to generalize the findings on the behaviour of the gasoline market in Nairobi for the whole country In addition it is necessary to examine price asymmetry in individual markets because national data usually smooth out important regional differences in the gasoline 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 gasoline market in the country Nairobi offers an attractive opportunity to study this phenomenon

The study seeks to find out the nature of the passthrough process to the Nairobi retail prices after a shock in the crude oil pnce In particular, the paper will probe whether Nairobi retail prices nse faster than they fall in response to increases and decreases m crude oil pnces respectively. In the absence of pattern asymmetry, one would expect the speed and magnitude of the eventual change of retail prices in response to upstream costs changes to be similar for an upstream cost increase or decrease

In addition, the study will test whether the lagged response of retail gasoline prices in Kenya is a result of market power This will be done by Introducing a market concentration parameter into the analysis and estimating its influence on the speed of adjustment of retail prices to crude oil cost shocks However due to absence of consistent petroleum sales data for the entire period under review, It was only possible estimate the market concentration parameter for the period 2003-2005.

1.4 Significance of tho Study

The presence or otherwise of price asymmetry is an emotive petroleum policy issue in any country Ye et al (2005) observed that the subject of petroleum pnce passthrough arouses cunosity 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 pnce changes therefore occur, especially upwards, there are often allegations of Impropriety on the part of the petroleum marketers For forward planning purposes, petroleum traders and other industry participants are interested in the price dynamics since upstream prices may be used to forecast subsequent downstream prices for vanous regions if the relationship between spot and retail pnces is consistent and predictable

In addition, Issues relating to price pass-through are of interest to policy makers, regulators and administrators in evaluating the market performance of a certain industry. There is great interest in passthrough analysis on many subjects in economic literature {Michael Ye, 2005) These Include international trade for passthrough of exchange rates or tariffs to the export and import pnces (Parsely 2001), the pass-through of money supply to price inflation (Smets and Wonter. 2002). passthrough of tax to Government revenue, passthrough of wages to output pnces (Peltzman, 2000) and product price passthrough of agricultural commodities. Gasoline price passthrough analysis draws particular attention in both empirical and theoretical literature (Ouffy-Deno. 1996 Borenstein et al.. 1997; Dale et al., 1996; Lewis 2003, and Zyren and Shore, 2003)

The concern for economists is whether pnce passthrough is symmetric or not According to Borenstein et al. (1997), price asymmetry has welfare cost implications to gasoline consumers since it generates higher consumer costs when crude oil prices increase 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 corresponding lag lengths can be Integrated over the entire adjustment period to generate the total asymmetry cost to consumers of a given shock Price asymmetry therefore implies that volatility in input costs, even if there is no systematic increase or decrease in price, is costly to consumers

1.5 Conceptual Framework (Structuro, conduct and porformanco analysis)

The multiplicity and predictive limitations of oligopoly pricing theories are well documented and appreciated Grant (1982) argues that competition between two sellers will result in "a monopoly price, a competitive pnce. 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 pncing 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 pncmg behaviour in a number of mdustnes. This approach is analytically informal in that it does not seek to develop an empincal model of oligopoly pricing such as the Coumot 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-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 argues that successful pricing synchronization in an industry is pnmarily 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 barners Prices in collusive oligopoly cannot exceed the long-run perfectly competitive price by more than the enormity of entry barners 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 pnce 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

In general therefore due to the desire by colluding firms to adjust pnces 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 equilibnum 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

Based on the above broad hypothesis, we can examine the structural character of the downstream gasoline market in Kenya and make inferences on its ability to encourage oligopolistic pricing Because 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 barner 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 penpheral 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 maiors restncts 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 firms, which is often denied or granted at premiums that dimmish any possibility of price undercutting at the retail level

Other entry barriers in Kenya's gasoline market include base load processing requirement at KPRL where some of the major firms are co-owners with the Government, dead stock requirement at the Kenya pipeline system and high start-up capital requirement coupled with a relatively high cost of borrowing These entry barriers have literally made the senous petroleum business in Kenya an unassailable "members club for the big boys.*

The domestic petroleum industry is dominated by international firms that have a history of close commercial partnership in other markets through joint exploration and exploitation of crude oil activities, joint ownership of refinenes such as KPRL, product exchanges to minimize the costs of distribution and information sharing This history of mutual cooperation is likely to dissuade aggressive competitive initiatives in any market due to the latent threat of revenge in other markets

These factors have cumulatively led to Herfindhal-Hirshman Indices (see appendix I for computation) for the gasoline market in Kenya ranging from about 1200 to 1600 for the penod 2003-2005 as shown in table I below Economic literature associates HHI ranging from 800 to 1800 with oligopoly or monopolistic competition markets libit 1: H«rtin<Uhl HIf»lvn*n lixtox (HHI) and Coivcenlralton Ratios |CR4)

y^UVYMf	HHI	CR4	MonthfYear	HHI	CR4	Month/Year	HHI	CR4
JM^QM	14891'j	70 20	Jan-04	1389 4a!	~ 8 7 91	Jan-05	1529.45	74.25
Feb-03	1399 70	M 73	Feb 04(	1440 4oi	70 39	Feb-05	1454.54	71.55
~MirQ3	**1389 33j**	**87 >9**	Mar-04	**1382 ssj**	**80 M**	Mar-05	1526.33	74.07
AyOT	~1450881	70 60	Apr-04	12172ol	82 48	Apr-05	1550.06	72.92
~MtiV):	14815?.;	89 5'	Moy-04	1282 44	88 30	May-05	1552.18	74.92
Jun-03	**14t7.4fll**	**W 7 t**	**Juft-04**	**1362 421**	**87 61**	Jun-05	1521.05	75.04
Jul-03	1340.76	67.62	Jw* 04	1358.97	67.62	Jul-05	1385.16	70.32
Aug-03	1286.25	65.74	Aug-04	1411.82	68.67	Aug-05	1519.09	74.78
Sep-03	1527.50	64.76	Sep-04	1394.22	67.73	Sep-05	1530.91	77.00
Oct-03	1241.63	63.25	Oct-04	1451.04	70 86	Oct-05	1554.77	75.50
Nov-03	1174.63	60.00	Nov-04	1566.95	74.54	Nov-05	1488.94	73.50
Dec-03	1341.33	67.21	Dec-04	1421.45	70.09	Dec-05	1441.33	73.12

Source: Own Computation

From the above analysis, certain deductions can be drawn with regard to the expectation of pncmg behaviour for petroleum products in Kenya Firstly, the combination of low price elasticity of demand, high degree of brand substitutabihty, similarity of costs and technology and a background of past and present cooperation in the Kenyan and other gasoline markets by the major firms are likely to encourage collusive pricing behaviour in the petroleum industry

In addition, the most potent sources of effective competition in Kenya's gasoline market since liberalization in 1994 has been the entry of new players Their ability to undercut the scheduled prices of the major firms and the inducement to the individual major firms to undercut the coordinated price for individual gam in market share (sales) and profits has however low. This Is because heavy entry barriers and a strong history of cooperation among the major firms have frustrated this potential

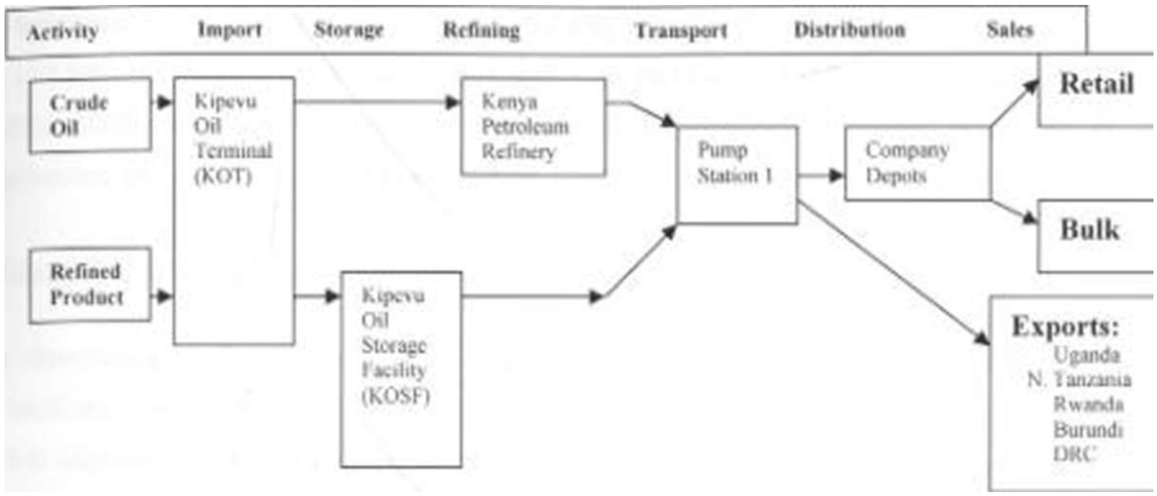
Moreover in close parallelism with other oligopolistic structures, competition in Kenya s petroleum industry is in the form of discounts, allowances and credit lines to buyers and not in vanations in scheduled prices Branded retail stations of the major firms located In market clusters where competition is intense due to the prevalence of independent dealers are usually offered attractive discounts in order to remain in the market, and these costs are recovered in markets that are less competitive through higher prices. This tends to partly explain why branded retail stations belonging to the same supply chain would have lower prices for a product (say diesel) in Western Kenya and Nairobi's Eastlands where independent stations are widespread (and hence more competitive prices), and higher prices for the same product in seemingly captive market clusters such as Nairobi's up market areas and the Central Business District (CBD) where independent station are either non-existent or few In addition. Kenya s gasoline industry **is** known to offer attractive discounts and credit lines in order to win lucrative supply tenders from large consumers such as power generators and other Industrial consumers Discounts and other benefits are preferred because of their flexibility to suit market circumstances on a localized basis and the lower risk of retaliatory across-the-board price cuts that would result from more overt cuts in scheduled prices

These broad statements about the structural character of the petroleum industry in Kenya, and the relatively high market concentration as illustrated by the Herfindahl-H.rshman Index and concentration ratios, lead to the conclusion that the petroleum market in Kenya is oligopolistic in nature and the pnce determination process for petroleum products is significantly influenced by this market structure.

I.5.1 Gasolino Supply Structure 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 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

Figure I. Petroleum Supply Structure in Kenya



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 distnbution, 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 The pipeline tariffs for all products except jet fuel in Nairobi and Mombasa international airports are Ksh 1 53/M? to Nairobi, 2 105/M* to Nakuru, 2.706/M' to Eldoret and 2 703/M5 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

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 the prevailing international crude oil price of about US$ 70 per barrel would require about US$48 3

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%) were won by Kobtl, 6 (18 8%) by Shell. 4 (12.5%) by Total. 2 (6.3%) by Caltex and 1 (3 1%) by Tnton Similarly, over the period 2002-2005 large oil companies accounted for about 82% of total refined products cargo deliveries while the combined independent operators account for only about 18%.

1.5.2 Gasoline Storage and Distribution Infrastructure

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 2 and 3 below

Tabic 2 Qv»nor»Mp of storage depot* and loading facilities

Location	Category	Name	Ownership
Momba»a	Depot	M c n t t U	Kenya Pipeline Company
Na<ob<	Depot	N»«ot» Jotfit Depot	Kenol Kobii Total & Caltex
		Natfotx Joint Depot	Kenya Ppelino Company
	Loading Facilities	Nairobi Joint Depot	Kenoi KoM. Total & CaCex
		Natonal Oil Corporation	National Oil Corporation
Sagana	Depot	Sagana Depot	Kenol Kotwl
Nakuru	Depot	Ntfumi	Kenya Pipeline Company
		Nakuoj	Kenol Kobii
1	Loading Fac*t>at	Nahuru Loading Fecilty	Kenya Pipeline Company
kid (vol	Depot	E Hotel	Kenya P*mlmo Company
		Kitumu	Kenot Kotel
	Loading TacilKwt	EkJoret Loading Fac.Ky	Kenya Pipe-.no Company
Kitumu	Decot	Kitumu	Kenya Pipeline Company
		Kitirrnj	Kenol Kobtl
	Loading racAtot	K»urrw Loading feciKy	Kenya Pipeline Company

Source MOE

It is apparent from the table 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 respectively comprise about 60% and 20% 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

Tablo): Ownership and Distribution of Retail Outlets (2005)

Region	New Entrants		Maioo		I Total
	No	%	No	%	No
Central	59	41 5	63	58 5	142
Nairobi	123	39 9	165	601	308
Coast	63	49 9	65	508	128
Rift Valley	170	569	129	43 1	2W
EastemN Eastern	53	43 4	69	566	122
Western	30	57 7	22	42 3	62
Nyanza	62	60 6	40	39 2	109
Total	560	48 6	593	514	1 153

Table 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 low 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 majors is substantially high as demonstrated by table 4 below

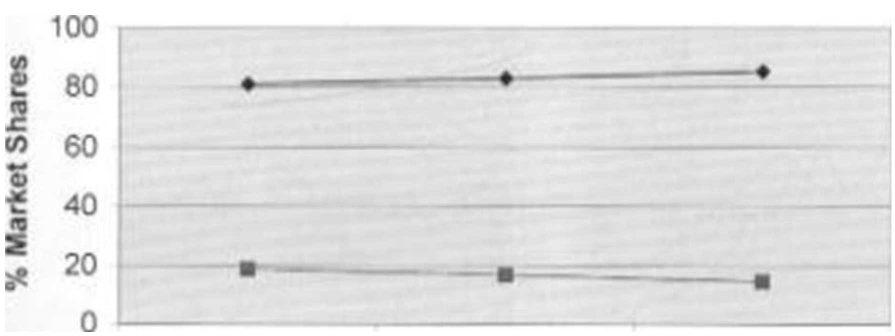
4 petroleum Market Share Profile (2003-2006)

Compel-	YMf 2003 S Jlo»	MM Shete (%)	Year 2004 Company	Sain	MKl Share (*]	Year 2005 Company	Sale*	Mkt snare (H
	565020	21 41	Sbefc-BP	956740 3	18 42	'Sheitt)l>	572305 7	174
_	423403	18 05	CiMi	417490 6	13 76	Calle«	527713.	160
Tnltl	443149 2	16	Total	616462 6	20 3B	Total	712236 6,	21 7
lAoC.l	332589	126	Uobii	3J2166 3	12 27	Mob<l	263415 5	86
K0t)'l	782846 3	10 72	KoW	418861 3	16 13	Kobil	604169 6	184
<*noi	89800 1	34	Kenol	__?M10C	3 07	Keno4	101906 6	31
Sub-total	2136898	W>rr	Sub-total	KIJ7M	«J.04	Sub-total	2MP4?	**.»
		I'»0I	n do pendent Dealer*	514721.5	|6.9«	Independent Dealers	I7"6*t.4<)	14.5
Orw>d Total	2838736	100	Grand Total	3033473	*m*	Grand ToUI	3279446	10

Table 4 shows that despite entry of new players in the petroleum market since liberalization (19 in 2004 and 15 in 2005) and the seeming equal distribution of retail dispensing sites between the established firms and the new players, the total market **share** controlled by independent dealers has been low and declining from 19% in 2003, 17% in 2004 and 15% in 2005 relative to 81%. 83% and 85% market share controlled by **the** large firms over the same period as graphically demonstrated below

Major Firms

Independent Dealers



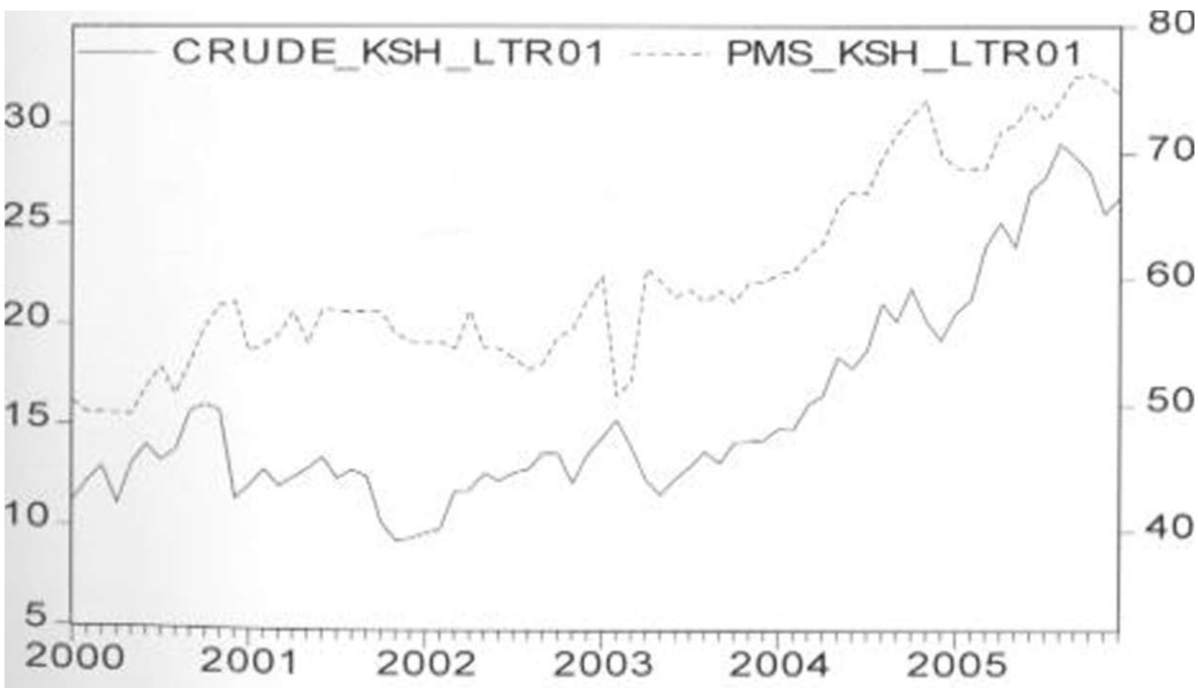
2003 2004 2005

Years

r*®u"2 Market Share Profile *tor* the gasoline M«rket In Kenya (2003-2005)

1.5.3 Pricing of Potroloum Products

Prior to deregulation, 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 amve at the wholesale price in Mombasa Inclusion of pipeline and rail transport tariff from Mombasa generates landed costs In other towns (Nairobi, Nakuru. EkJoret 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 while figure III below shows the time series between Murban crude oil pnces and Nairobi retail prices for the period January 2000 to December 2005



F»flur« 3: Tim. Son** b«tw*»n Murban Crutfa Oil Prleaa and Nairobi Retail Prico»

From the above figure, it is apparent that retail gasoline prices and crude oil pnces trend v0ry closely implying that crude oil price is an important variable in explaining short frequency dynamic changes in gasoline retail pnces in Kenya The data reveals that from around Apnl 2002 to August 2002, there was a consistent decline in domestic retail pnces in Nairobi This penod coincides with the commencement of operations of the National Oil Corporation s track loading facility in Nairobi that was meant to provide new entrants with easy access to their products at a standard fee and therefore open up the Nairobi market to more competition This facility therefore posed a competition threat to established depots and the decrease in prices can be attributed to attractive product supply terms offered as the market adjusted in anticipation of the intended official commissioning of the facility later that year

Chapter 2

2.0 Literature Review

Available literature on gasoline price movements in Africa in general, and Kenya in particular are in the form of consultancy reports and policy documents prepared for Governments by consultancy firms However, substantial scholarly work on the field has been undertaken in Europe. North America and Asia

2.1 Theoretical Literature Review

The theoretical underpinning of this study is that downstream pnces in the gasoline market adjust with a lag in response to input cost shocks Although the subject of price asymmetry has generated interest by many researchers in various fields, most of the studies have been empirical in nature and have ignored the causal factors for this pricing behaviour

An analysis of price asymmetry necessitates a consideration of the speed and degree to wnich price shocks at one level are transmitted downstream. Karrenbrock (1991) defines two types of price asymmetry: amount asymmetry, in which eventually the upstream cost snock is never completely transmitted downstream, and pattern asymmetry, in which the passthrough rate of upstream cost shocks occur at different speeds between market levels depending on the whether the shock is positive (Increasing) or negative (Decreasing) In seeming to give credence to the prevalence of asymmetrical prices in petroleum markets. Bacon (1991), in reference to the gasoline market in Britain likens gasoline pnce rises to rockets and price drops to feathers.

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 palicipating 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**

Borenstein et al. (1997). 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 pnces 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 pnmary 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 (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

Several arguments have however been advanced to explain why the adjustment process is usually lagged Borenstein 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 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 industnal organizations and microeconomics and focuses on the difference between market clearing prices and spot transaction prices The concern in these models is why changes m spot transaction prices do not strictly correlate with changes in market clearing prices, and vanous reasons have been given to explain this behaviour such as menu costs that make changing transaction pnces costly, Information imperfections and demand inelasticity.

Other models have explained price asymmetry in terms of consumer search model (Lewi® M., 2003), price volatility (Radchenko. 2004) and market power (Borenstein and Shepard 2000) Search costs in the gasoline markets 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 gasoline 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 deosion whether to buy gasoline in a given place or search further is dependent on histoncal 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

2.2 Empirical Literature Review

Ye et al, (2005) investigated the spot to retail pnce adjustment behaviour of the US gasoline market at the national and regional level using weekly wholesale and retail motor gasoline pnces from 2000 to 2005 They encountered pattern asymmetric across all regions with faster passthrough when prices are rising relative to when they are falling. However, the pass-through process, in terms of time and speed of completion va-ied from one region to another

The study used gasoline spot prices and weekly prices collected from January 2000 to December 2003. Spot gasoline price were obtained from Reuters and PLATTS while retail gasoline pnces were collected from 'Motor Gasoline Survey", a publication of the Energy Information Administration (EIA). Based on the well-known existence of cointegration between spot and retail prices, both spot and retail prices were modeled in first difference with an error correction term added to reflect the long-term relationship Additionally to incorporate potential asymmetric responses of retail prices to changes in spot prices, both short-run and long run relationships were broken into separate terms of positive and negative movements of spot prices The passthrough model estimated was

Arotail, - p; A'SPOTm • p, A'SPOT$_H$«V*EC,.,** Y EC$_M$>T,

»-i i-I

Where

A is the first order backward difference operator;

A' refers to the case where spot prices are rising;

A refers to the case where spot prices are falling.

Retail, is the Monday morning retail price in week t;

SPOT, is the average gasoline spot price in week t;

EC* is the error correction term when retail pnce is above its long-term level.

EC' is the error correction term when retail price is below its long-term level.

K' is the number of lags for spot price increase,

K is the number of lags for spot price decrease; and.

£, is the error term at time t.

The lag length was chosen to minimize the Alkaike Information Criterion (AIC) The coefficients (3 and y m the equation were estimated using Ordinary Least Squares (OLS) for the period under review. Pattern asymmetry responses are reflected in the P and y set of parameters In the absence of pattern asymmetry in the pass-through of spot pnces to retail prices, then

(T=0 for I=j. v*=y, and K*=K

If |3'>p for all I=j. especially in the early lagged periods, then there is pattern asymmetry as the pnce pass-through is faster when pnces are rising than when they are falling The speed of pass-tnrough is given by B,, which is the coefficient for the first lagged period The coefficients on the error correction term also provide an alternative and independent criterion for detecting pattern asymmetry The coefficients y" and y. which are both expected to be negative, capture the speed of adjustment towards the long-run equilibrium wnen retail prices are above and below the long-run equilibrium level respectively Hence | y'| <| y'| depicts a slower immediate downward adjustment towards the long-run equilibnum when retail pnces are above the equilibrium level and faster immediate upward adjustment towards the long-run equilibrium when retail prices are below equilibrium

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 **pnce** decline was much lower at between 11% and 46% The results showed evidence of pattern asymmetry as the passthrough speed was significantly greater when spot prices increase than when they decrease in all regions To test for pattern asymmetry. Wald test was performed to ascertain whether p'* p in the same week The null hypothesis for pattern asymmetry is

P '= P for any i

Asplund et al, (2000) on their part analyzed the passthrough of costs to retail petroleum prices m 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 argue 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 cosl The study emphasized that for a fuller understanding of pnce 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, 8pot market prices and taxes

The study uses data on retail prices of leaded premium gasoline in Sweden for the period January 1980 to December 1996 The authors argue that the gasoline market in Sweden is vertically Integrated where gasoline is sold almost exclusively through branded stations, and therefore retail prices are determined by the list pnces 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% and 21% 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

ARP = /(ASP. AE. AMC. WAGE. TAX)

Where

•RP is the retail list pnce 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/USS),

-MC is the marginal cost of gasoline which is also denoted SP*E. and.

-AWAGE is an index of nominal wage rate

.

Using monthly data, the study estimated the long-run relationship between retail prices and costs, i e RP and explanatory vanables MC. Tax and WAGE and produced the following results

$$RP = 22.9 \cdot 0.902'MC \cdot 0.658'TAX + 2.01'WAGE + 14$$
$$(6\ 29) \quad (0\ 03) \qquad (0\ 03) \qquad (0\ 12)$$

$$DW=0\ 63 \qquad\qquad Adj\ \ R^* = 0.988$$

A non-negative relationship between recent cost changes and pnce adjustment is expected However, sometimes the pnce moves In one direction when the MC moves in another (unexpected sign) due to omitted variables or hedging opportunities and inventory situation The study argues that the explanation for the large number of wrong signs was a gradual adjustment pattern If the firm for some reason wishes 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 vanables were included in the subsequent econometric analysis and estimated the relationship between all the price adjustments and the preceding changes In MC and taxes The coefficient for AMC was found to be greater (0.28) for price rises than for price cuts (0.19), indicating presence of pattern asymmetry in price adjustment

Examination of asymmetric gasoline price movements requires a careful analysis at many possible markets Borenstem et al, (1997) first 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 the end of 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 model an empirical test for the common belief that retail gasoline prices adjust 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 assumes a simple linear long-run relationship between retail gasoline pnce and crude oil prices such that

$$R = a + a_,C + t$$

Where:

R is the retail gasoline pnce

C is the crude oil pnce

£ is the error term

The study recognizes that retail pnce adjustments to crude oil price shocks are not instantaneous but assumes that the adjustment function is time-invariant during the sample period and is independent of the absolute magnitude of the crude oil pnce change

Defining **AC, = C, - CM**. and

AR, = R, - R,.,

The adjustment can be modeled as

(1) $AR\ t^{1\ B}\quad AC,$

$AR\ |,|^{1} = PiAC,$

$AR\ ,._{n}' = p_{n}\ AC,$

Where the subscript on AR indicates that it Is solely the change resulting from period t change in crude oil price, and n is the number of periods it takes for retail pnces to completely adjust to the period t change in crude oil prices Under these assumptions, ,he total change in retail gasoline price in any penod t will depend on the crude oil price changes in the previous n periods

(2) $AR, = AR,' + AR,^{M} + AR, *$

AR, = IP, AC,

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

(3a) **AR/ = (3$_0$*ACII**

AR,./ = p/ACu

AR$_{t.B}$' = Pn'ACn

If AC, > 0. and

(3b) AR/ => p$_0$ AC,.,

ARI/^PIAC,.

AR,.n' = 3nAC,.,

If AC, so

(4) Defining AC," = Max{ AC,, 0} and AC, = Min(AC,, 0}. the simple empirical model for adjustment of retail gasoline prices to crude oil changes allowing for the possibility of asymmetric adjustments becomes:

(5) AR, = £w>^{n}(B,*AC,.»* + B, AC,.,) + c,

Where £, is assumed to be normally distnbuted

However, a number of issues need to be resolved before estimating equation (5) above These issues arise in the estimation of all downstream price transmissions and result in a model specification more general than (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 = a$_a$ + a,C + c,. then we can estimated a partial adjustment model (PAM) such that

(6) $R_{,} - R_{M} = q(a_{0} * A_{1} C_{T.,} - R«_{,}) + £.$

Bacon (1991) tests (or asymmetry in adjustment rate by introducing a quadratic term in the adjustment process

(7) $R,-R|.i \bullet q, (do \bullet a,C, ,-R,,) + q^* (a_{0} + a,C, ,-R, ,)^{7} + e,$

so that the test for q^ = 0 is the test for whether adjustments to increases and decreases in crude oil pnces 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 mam advantage of the PAM over the lag adjustment model in (5) 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 (5) is estimated with an error correction term, which is a one period lagged residual from the relationship R, « Oo + a.C, The model then becomes

(8) R,-R,, = J>o"(ft*ACvi'+ft AC,,) • q,(R,ao - a.C.) + e,

A concern for the above model is the possibility of endogeneity of upstream prices Crude oil pnces could be correlated with the error term in equation (8) if unobserved determinants of the retail price were also correlated with crude oil price

The Energy Information Administration (EIA) 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 gasoline pump price, including taxes in Midwest WTI was used because it is widely used, is important crude to the refineries in the region and is also used to index the price of many other crude streams 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 gasoline pnces) resulting from an upstream (e g crude and spot) prices changes

The study used a modified version of Balke. Brown and Yucel model where the lag length was eliminated The estimated model was:

ADOWNi» C+IaAUP,.,*Zp$_i$ASSVM:i*e,

Where

ASSYM, is equal to (U, *AUP.)

A is the week-to-week change

DOWN, is the downstream price at time t

UP, is the upstream price at time t

U. is 1.0 If UPi> P,.|. and 0 0 otherwise

The test for pattern asymmetry consisted of a joint F-test of parameter coefficients on the ASSYM terms

H_0. all of the 3 are jointly equal to zero

$\mathbf{H}_a$: not all the p, are equal to zero

The estimation method was Ordinary Least Squares (OLS) The lag length (and AR. MA terms) was chosen to minimize the Akaike Information Critenon (AIC). The study results found evidence of pervasive pattern asymmetry at the retail level

In addition, the study also tested for amount asymmetry using a passthrough model developed by Zyren

ADOWN, = I . , " 0AUP,, + D04CT93 + AR. MA TERMS + e,

Where;

A is the week-to-week change

DOWN, is the downstream gasoline pnce for week t

UP, is the upstream price for week t

e, is the random error term at time t

AR MA are autoregressive and moving average terms

Amount asymmetry was tested by determining whether the sum of current and lagged upstream variables sum to one. The statistical test for amount asymmetry was to test the hypothesis z , V p , = 1 o

The study results found that about 60% of upstream pnce 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 pnce passthrough 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 gasoline prices to changes in crude oil pnces The study examined the response of gasoline 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 R W (1991), In reference to gasoline price movements in Britain from 1965 to 1990 likens gasoline price rises to rockets and pnce 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 cham 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 pnces 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, JD (1991), distinguishes 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, taster than a decrease in price is oassed 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, he 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 passthrough was about the same (2 months) whether wholesale prices were nsing or falling

In March 1993. in response to numerous petitions by the Congress, the US General Accounting Office (hereafter GAO) issued a report on gasoline pricing The GAO was especially interested in gasoline price adjustments during a period of shocks, since the interest of Congress was the effects of the Iraq-Kuwait war of 1990 and 1991 They noted that the existence of viable futures markets in crude oil and gasoline on the New York Mercantile exchange made it possible for rapid price changes in crude oil prices to be reflected very quickly in spot gasoline prices The immediacy of futures price changes gave sophisticated buyers adequate information that could be used when buying and selling gasoline

The GAO built a partitioning model explicitly to analyze periods of market shocks Unlike prior studies they also constructed their model to incorporate crude oil shocks, gasoline stocks and refinery utilization rates, all of which could be especially important in a period following a market shock Theoretically. Including all these additional important vanables in their model should make their asymmetry estimates more credible.

The GAO model found price asymmetry during market shocks, but only in the price of wholesale gasoline in response to a change in crude oil price. They concluded that crude oil pnce increases would be reflected in wholesale prices within one week and found no asymmetry at the level from wholesale to retail prices In particular, the study found that for every 10 cents per gallon rise in the price of crude oil during a shock, wholesale prices would rise by 10 2 cents within the same week while a crude oil pnce reduction by a similar magnitude would generate only 8 cents per gallon reduction in wholesale prices within the same week.

Balke et al. (1998), have also revisited the gasoline price asymmetry question They used a modified version of Borenstem et al (1997) error correction model To search for asymmetry they could also have used Bacon's adjustment model. But that kind of model contains an implicit behavioral assumption, that retail gasoline prices adjust partially in each time period towards a target price. That assumption is not critical to use such models to try to detect price asymmetry Partitioning models, on the other hand, are primarily statistical models that attempt to estimate the effect on retail prices of current and lagged wholesale or crude oil prices, without assuming any theory Since they were not interested in explaining asymmetry, but just determining whether or not it existed, they used the partitioning model

The study used weekly data from January 1987 through August 1996 and searched for price asymmetry considering two forms of models, one with price levels and the other with price changes, the latter they called 'an error correction' model In the absence of asymmetry, the two types of models are identical. They could not distinguish between the levels model and the changes model on any theoretical basis

Unfortunately, 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 They could not explain these anomalous results, other than to note that asymmetry tests can be very model dependent

Duffy-Deno. (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 gasoline price asymmetry was absent at the retail level during market shocks. When there was a market shock, complete pass through for both nsirvg and falling pnces occurred with 3 weeks However, there was retail pnce asymmetry during normal times According to his analysis, the complete effect of a price nse took longer than the complete effect of a price drop On average, a 10 cents per gallon rise in the wholesale price of gasoline would take 4 weeks to be reflected as a maximum of 8 cents per gallon retail price rise On the other hand, a 10 cents per gallon drop in the wholesale price of gasoline would only take 2 weeks to be reflected as a maximum of 4 6 cents per gallon fall in the retail price

In conclusion one can see that since Bacon did his pioneering quantitative work on gasoline pnce asymmetry in the United Kingdom, economists have refined and expanded price asymmetry research They have advanced from Bacon's rather weak results to more consensual conclusions that the degree and prevalence of price asymmetry varies from market to market and its detection is overly sensitive to model specification and the data set employed

This study will adopt the approach used by the US Energy Information Administration in testing for amount and pattern asymmetries in Kenya's gasoline market mainly for two reasons First, the EIA study focuses on a single gasoline market in the US, Midwest, similar to what is intended in this study for the Nairobi market Secondly the EIA study undertakes an analysis of pnce passthrough at various levels in the supply chain, namely crude oil price to wholesale price, crude oil price to retail price and wholesale price to retail price Just like the EIA study, this study intends to analyze the price passthrough between crude oil pnces and retail prices in the Nairobi gasoline market

Chapter 3

3.0 METHODOLOGY

Understanding retail gasoline pnce movements require a thorough grasp of its cost structure The retail gasoline pnces can be decomposed into several components, namely crude oil pnce. refining, marketing and profits, and taxes Of these components, crude oil prices are the most volatile, and thus hold the key to any short frequency analytical work on gasoline pnce responses to upstream cost shocks Taxes certainly change, but usually in discrete jumps that are far apart compared to the monthly price data that will be analyzed m this study. Similarly, refining and industry managed costs change relatively slowly Crude oil pnces. on the other hand, can be extremely volatile, even on a daily basis Thus for the purpose of analyzing short-term retail gasoline price movements, it is imperative to track crude oil and gasoline prices as they move through the market chain Grant (1982) argues that most studies of administered pncing identify changes in variable costs as the chief cause of price changes In the supply of petroleum products, the pnncipal cost item is crude oil.

3.1 Data Description

The study will utilize time series data on monthly crude oil prices and average Nairobi retail prices respectively This data was sourced from the Central Bureau of Statistics (CBS) as published in their Leading Economic Indicators, a monthly statistical bulletin, for the period January 2000 to December 2005 The reference crude oil was Murban Crude oil which accounted for over 80% of total crude oil deliveries in Kenya during year 2004/2005 and the reference price was the Abdubi National Oil Corporation (ADNOC) monthly price. The reference downstream petroleum product was unleaded premium motor gasoline (PMS or Super) and its reference price was the average pump price for a given month

3.2 Econometric Model

Let downstream motor gasoline price changes at the retail level during periods of nsmg crude oil prices be given by

Ay,: • C + p, A X_M • p_2AX,$_2$ + pjAX,$_3$ •. . . . . + p.AX,, + e, ...(i)

Where Ay, is the change in retail gasoline price at time t. and

A X,. is the change in crude oil price at time penod t-i

During periods of stable and falling crude oil prices, the model too becomes

Ay_t: • C • a,A X_M • $a_2AX,_2$ • $a_3AX,.j$ •. . . . . • $a_tAX,_t$ • E, ...(ii)

Where Ay. and A X., are similarly defined for periods of stable and falling crude oil prices

If p, = a, for all i, then there is pattern symmetry and the speed of adjustment of retail prices in response to upstream cost shocks is the same for an increase or decrease Hence equations (i) and (ii) can be combined into a composite passthrough model

Ay_t: = C • **p,A** X,., • **$p_2AX,_2$** + PJAX,$_{.3}$ + P**<AX,$_{.f}$ + E, ...(iii).**

In addition, if p, * o, for some i, it implies that pattern asymmetry is present and retail prices adjust differently to increases and decreases of crude oil price shocks Consequently, equations (i) and (ii) can then be combined to become:

Ay_t. =C • P,A X,, • P..AX,, + pjAX,$_3$ •. . . . . + (5,AX_W + 6,D_MAX,.. • 6,D,$_2$AX,; + 6_3D, jAX,.5 +. . . . . + 6.-0u-AXu- + e, ...(iv)

Where for all i • 1. , D,., = 1 if crude oil prices are rising and D_t. • 0 otherwise A statistical test for pattern asymmetry is to test the Joint hypothesis 6, = 0 for i = 1, {

Equation (iv) has the same form with

ART,= C+ZaACT,.$_1$+ZP,ASSV/Vl_t.i+e, (V)

Where:

A: is the month-to-month change

ART,: is the retail gasoline pnce in Kenya Shillings per litre for month t

CT,	**is** the crude oil price in Kenya Shillings per litre for month t
ASSYM.:	is the pnce asymmetry test term equal to (U, * A CT,)
U,	is 1 0 if CT, > CT,., and 0 0 otherwise

Equation (V) is the estimable equation for the study, which is a passthrough model with an asymmetry test term and will be used to test for pattern asymmetry is shown in 3.3.2 below

3.3 Hypothesis Testing

3.3.1 Amount Asymmetry

Presence of amount asymmetry will be ascertained by testing the following hypothesis from the passthrough model represented by equation (ni) above

H_0: sum of all p, is oqual to unity

H_A: sum of all P, is NOT equal to unity

3.3.2 Pattern Asymmetry

The test for pattern asymmetry will consists of a Wald test of parameter coefficients on the ASSYM, term for the following hypothesis:

H_0: all p, are jointly oqual to zero

H_A: not all p, are oqual to zero

3.3.3 Causality

In addition a causality test will be undertaken between retail prices and crude oil prices to ascertain the presence and direction of causality between the two variables. From theory, it is expected that crude oil prices cause downstream retail pnces The direction of causality will be established by testing the following hypothesis:

$H_„$: **Crude oil prices do not grangor cause retail prices**

H_a: **Retail prices do not granger cause crude oil prices**

3.3.4 Correlation Coefficients

A correlation matnx will also be generated for all the variables in order to ascertain the presence and magnitude of correlation coefficients Usually, correlation coefficients close to 1 can cause multicollmeanty, which would violate the standard assumption of independence in econometric modeling and therefore reduce the accuracy and reliability of the estimation results.

3.3.5 Role of Market Powor

The study will test the role of market power in the retail gasoline price adjustment by introducing the Herfmdahl-Hirshman Index (HHI) as a proxy for market concentration. A priori, economic theory predicts an inverse relationship between HHI and amount and pattern asymmetry

3.4 Generation of Variables

3.4.1 Changes in Retail Price (ART) and Crude Oil Price (ACT)

Changes in retail pnces (ART) will be generated by differencing the retail price at the previous period ($RT_{,-t}$) from the retail price in the current period ($RT_,$). Changes in crude oil price (ACT) will be similarly generated

3.4.2 Asymmetry Test Term (Assym,)

The Asymmetry Test Term (Assym,) that is used to test for pattern asymmetry will be generated from a product of a dummy **(D,)** that assumes a value of unity (1) if ACT>1 and 0 otherwise and changes in crude oil price (ACT) i e Assym,= D;ACT

3.5 Determination of lag length

Economic theory provides no rule of the thumb on the determination of the lag length in econometnc modeling However, empirical literature provides that the lag length that minimizes the Akaike Information Criteria (AIC) **is** the optimal lag length for econometnc analysis. This study will adopt this approach and use the lag length at which the AIC is lowest

Chapter 4

4.0 Econometric Results

Investigation of the time series properties of the pnce data set was conducted in order to assist in the model specification

4.1 Doscriptive Statistics

Table S: Preliminary Statistic*

Cross Tabulation

		ORT				
		1-10, -5)	15. 0)	[0, 5)	|5,10)	Total
	[-6. -4)	0	0	1	0	1
	1-4. -2)	0	1	1	0	2
DCT	(-2.0)	0	6	15	1	22
	(0.2)	1	19	23	0	43
	(2.4)	0	0	3	0	3
	Total	1	20	43	1	71

Table 5 above shows that dunng the period under review, there were a total of 71 changes in retail prices in Nairobi, 46 (65%) of which were increases and 25 (35%) were decreases. There were 7 (9 9%) cases when decreases in crude oil prices were followed by decreases in retail prices, and 20 (28 2%) cases when crude oil price increases were followed by retail price decreases. In addition, there were 18 (25 4%) cases when crude oil prices decreased but retail prices in Nairobi increased, and 26 (36 6%) when crude oil price increases generated a similar response in Nairobi retail prices

In addition, other descriptive statistics for the data confirmed that the data set was normally distributed as shown in table 5 below

TaWo 6: Other Descriptive Statistics

	CT'	RT'	HHI*
SW D«jv	5178612	7 905206	100 9476
Sfcewnesa	1.162510	0 068240	0 634629
Kuitosis	3 209161	2 231990	2 755153
Jarque Bera	16 07069	6 968681	7 506668
Probability	0 000324	0.030671	0 285691
Ocssrvaiions	72	72	36

' *Crude OH Pnc«a*
[1] *R#t>iil Prices*
' *hteifinilttal-Htrshman Index*

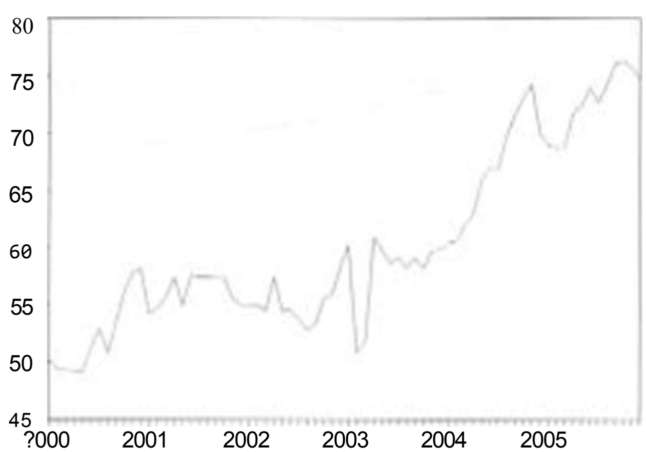
Skewness measures deviations from symmetry and ranges from +2 to -2 for normally distributed data and it is apparent that the dataset is normally distributed In addition, the jarque-bera chi-square Is greater than the probability in all cases again reinforcing the normality of the dataset under consideration

Observations for HHI are 36 because it is only for three years, namely 2003. 2004 and 2005 that sales figures were consistently and regularty available for computation of the index.

4.2 Stationarity Tests

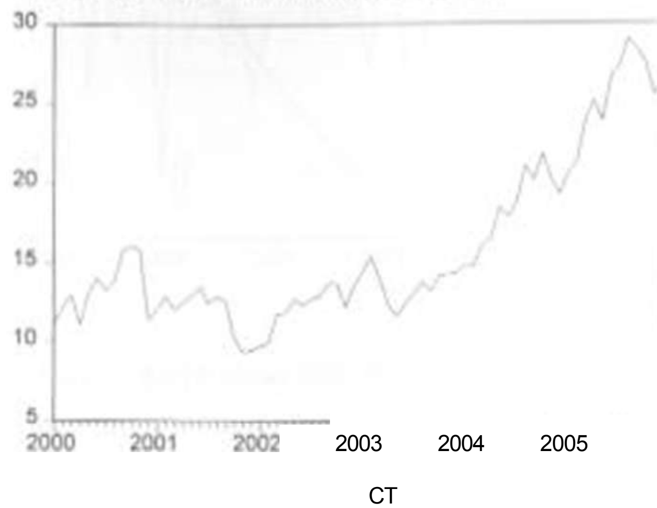
In addition stationanty tests were performed in order to determine whether the estimation could be undertaken at levels or at difference Data series that are stationary can be estimated at levels while data sets with unit root properties yield better results when analyzed at difference Preliminary time series properties showed that both retail prices and crude oil prices had an upward trending over time confirming that the two variables were non-stationary at levels but turned stationary on first difference as reported below

figure 3: Time Series of Retail Price* *at* Levels



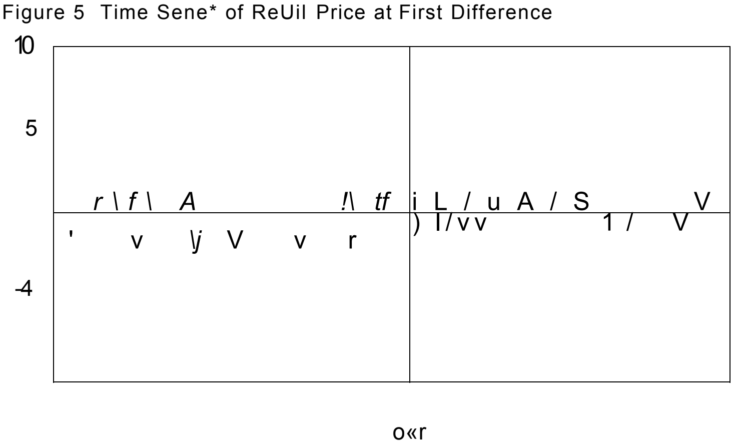
The graph shows that except for the mid to later part of year 2002 when retail pnces sharply reduced, retail gasoline pnces in Kenya have on average assumed an upward trending over time since the year 2000 As explained in section 1 5 3. this exception could be attributed to commencement of operations of NOCK s common-user loading facility in Nairobi

Figure 4: Time series ol Crude Oil Price* «1 Level*

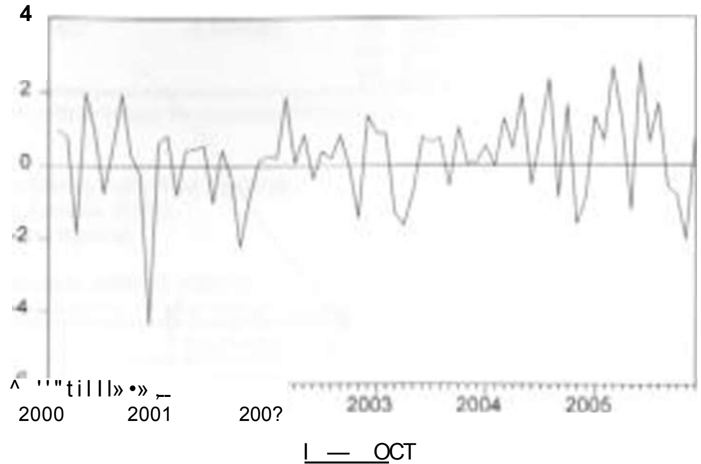


Similarly, due to geopolitical issues such as the war in Iraq, disruption of crude oil supplies from Nigeria due to instability in the Niger delta, interruption of production and refining capacity in the aftermath of hurricane Katrma and increased global demand on account of high economic growth especially in China and America, crude oil prices have shown a pronounced steady nse since 2003 It is however apparent from the two graphs above that retail prices in Kenya display more volatility relative to crude oil prices

Figure 5 Time Sene* of ReUil Price at First Difference



Flour* •: Tim. Seno* of Crud* OH Prlc« at Fir»» Dlrt«r*nc«



Figures 4 2 3 and 4 2.4 above show that on differencing, retail prices and crude oil price now assume a stationary trend over the penod under review

However, a more rigorous stationarity test analysis was undertaken using Dickey Fuller and Augment Dickey Fuller tests as reported here below

Table 7: ADF Summary Statistics

ADF	RT	ΔRT	CT	ΔCT
Lags	0	0	0	0
ADF Test Statistic	-2.4383	-8.7600	-1.5069	-8.3920
1% Critical Value	-4.0928	-2.5958	-4.0909	-2.5958
5% Critical Value	-3.4739	-1.9450	-3.4730	-1.9450
10% Critical Value	-3.1640	-1.6182	-3.1635	-1.6182
p-value	0.0230	0.000	0.0756	0.000
Observations	70	70	71	70
Null Hypothesis	Not Rejected	Rejected	Not Rejected	Rejected

Not rejected means that the null hypothesis that the variable has a unit root cannot be rejected (unit root is present) while rejected means the null hypothesis that the variable has a unit root is rejected (Stationary) It is therefore apparent from table 4 2 5 above that the variables under consideration exhibit unit root properties at levels and stationary characteristics on first difference If the absolute value of ADF statistic is less than the critical value at 1% or 5% or 10%. then the vanable is considered to have a unit root at that respective level In this case. RT has a unit root at all levels (1%. 5% and 10%). Conversely, ARt and ACT are stationary at all significance levels since the absolute values of ADF statistics are greater than the critical values at 1%. 5% and 10% Stationarity tests undertaken for specific variables are shown below

Tabled ADF of RETAIL PRICES AT LEVELS Non-atatlonary

ADf Tosi Statisuc	-2 59404/	1% Critical Value'	-4 0909
		S% Critical Value	-3 4730
		10% Critical Value	-3 1635

'MacKinnon critical values !w rejection of hypothesis *of* a unit root

Augmented Oickey-Futer Test Equation
Dependent Vanaelo 0<RT)
Method Least Squares

SampiB(adiutUd) 2000 02 2006:12
Ir-ciodes coservatisns 71 alter aa.ustng eodpoir:s

Variable	Coefficient	Std Error	t-Statistc	Prob
RT(-l)	-0 182093	0.070197	-2 594047	u o-16
C	6 906334	3.412310	2 610053	00111
	0 065981	0 026414	2 497924	0 0149

R squared	0 092350	Mean dependent var	0 347163
Ad|u«ed R-squaied	0 065655	SO dependent var	2 200048
S E o* regression	2 126600	Akafco info cnterion	4 386261
Sum squa;eo revd	307 5252	Sctvwarz crxenon	4.46386/
lug IlKetfiood	•132 7633	1 statistic	3 459362
Durbin-Welson itat	1 979075	Prob<F-statistic)	0 037087

Therefore the null hypothesis that retail price (RT) has a unit root cannot be rejected (p-value=0.0149)

Table 9: AOF of RETAIL PRICE AT FIRST DIFFERENCE: Stationary.

ADF Toel Stalin*	-6 759976	1% Critical Value'	-2 5958
		5% Critical Value	-19450
		10% Critical Value	-16162

'MacKinnon critical values for (ejection of hypothesis of a unit root

Augrranted Dicfcey-F uiler Test Equation
Dependent Variable 0(RT,2)
Method Least Squares

Sa-npe'.adiusteai 200003 200612
included cbservatons /0 anei aaiusi.ng encooma

Vanabie	Coetfioent	Std Error	t-Statistic	Prob.
tXRTMM	•1 053356	0 120246	-6 /599/6	ooooo

R-squaied	0 526545	Mean dependent var	•0 001429
AdjusSed R-squared	0 526545	S D dependent var	3 252682
S E ct regression	2 238106	Akafce info criterion	4 463321
Sum squared res-d	345 6298	Schwa rz cnterion	4 495443
log Ikefhood	•155 2162	Durtun-Watson stat	2 028617

Therefore, the null hypothesis that changes in retail price (ART) has a unit root is rejected at 1%. 5% and 10% significance levels (p-value=0.00)

Tab* 10 ADF of CRUDE OIL PRICE AT LEVELS: Non*tatlonary

ADF Test Statist*	.1 506949	1% Critical Value"	-4 0909
		5H Critical Value	-3 4730
		10* C n W Value	-3 1635

•MacKinnon critic®! values for rejection *of* hypotnos* of a un4 root

Augmented OckeyFuter To»! Equation
Dependent Varats* 0(CT)
Method Least Squares

Sample<ed)usted) 2000 02 2005 12
Included observations 71 after arfristig endpoims

Variable	Coefficient	Std Error	I Stalistc	Prob
CT(-I)	-0 069935	0 0464C8	•1 506949	0 1365
c	0 571475	0.603254	1 135562	0.2601
fITRENOi 2000 01)	0 020526	0 011374	1 804645	0 0756
R-squared	0 046035	Mean dependent war		0 213737
Aisled R-Squared	0017977	SD depended var		1 238741
SC of regression	1 227556	AKaAe >nfo criterion		3 289262
Sum squared resid	102 46M	Schwarz criterion		3 384869
Log iketihood	-113 7688	F-statistc		1 640708
Durbin Watson stat	2 017620	ProbiF-statistO		0 201423

The null hypothesis that crude oil price (CT) has a unit root can therefore not be rejected (p-value = 0 0756)

Table 11 AOF of CRUOE OIL PRICES AT FIRST DIFFERENCE Stationary, insignificant coefficient and tnmd

ADF Test Statist c	-4 391955	IS Critical Value"	-2 5958
		5* Critical Value	.1 0450
		10% Critical Value	-16182

'MacKinnon critical vofcjet for rei«ct<on of hypomests of a una root

Augmented Dickey-Fuimr Test Equation
Depended Vanatfe D(CT.2)
Method least Squares

Samp*(ad|ustod) 2000 03 2005 12
includod observations 70 alter adiusling endpoints

Variable	Coeffoent	Std Frror	t-Statittic	P'ob
wen. in	-1 008749	0 120204	J) 391955	00000
R squared	0 505109	Mean dopendent var		•0 002681
Aa.'jited K-squared	0 505109	S D. dependent var		1 792651
SE of regression	1 281103	A* aike info criterion		3 316033
Sum squared tew)	109 7363	Schwar* cntonon		3 348155
log likelihood	-115 0612	Durbm-Watson stat		2 003218

The null hypothesis that changes in crude oil price (ACT) has a unit root is rejected at 1%. 5% and 10% (p-value=000)

4.3 Correlation Matrix

Table 11 below shows that both retail pnces and crude oil prices are highly correlated as the correlation coefficient between both senes equal 0.890. High close correlation between variables signals presence of multicollmearity and econometric analysis using such vanables would generate imprecise results. At first difference however, the vanaWes displayed no correlation The econometnc analysis will hence be undertaken at difference since this reduces the likely presence of multicollmeanty in the data set

Table 12: Correlation Matrices for RT and CT

At Levels

	RT	CT
RT	1 000000	0 890105
CT	0 890105	1 000000

On First Difference

	\RT	ACT
ART	1 000000	-0 020007
ACT	-0 020007	1 000000

4.4 Grangor Causality

Granger causality test was also conducted to determine the direction of causality between crude oil pnces and retail prices The results rejected the null hypothesis that crude oil prices do not granger cause retail prices indicating presence of a unidirectional causality from crude to retail prices as shown below

Table 13: Granger Causality Test

Sample: 2000.01 2005:12
Lags 7

Null Hypothesis	Obs	F-Statistic	Probability
CT does not Granger Cause RT	70	7 21408	0.00148
RT does not Granger Cause CT		2 06365	0 13523

Since both series portray a strong autoregressive component, first differences were used in the econometric analysis Retail prices and crude oil pnces were defined to correspond to the same month, so that retail prices were estimated as a function of lagged crude oil prices

4.5 Estimation Results

4.5.1 Amount Asymmotry

The test for amount asymmetry comprises a test of whether the sum of the coefficients for the lagged independent variables in the passthrough model is jointly equal to one A prion, one would expect a one-to-one transmission of crude oil price changes to the retail level in a perfectly competitive market Test results reported in appendix III show no evidence of amount asymmetry (F-statistic=0 021747 and p-value=0 883392) implying that the null hypothesis that the sum of all the coefficients of the independent variable in the pass through model is equal to one cannot be rejected The sum of the parameter estimates for the lagged explanatory variable for all the lags is not significantly different from one (0 94445) implying that approximately 95% of crude oil pnce changes are ultimately passed on to the retail level, and this seems to explain the apparent absence of amount asymmetry between crude oil pnces and retail gasoline prices. The lag length and ARMA terms were chosen to minimize the Akaike Information Criteria (AIC)

Similar results have been reported by Bacon R W (1991) in UK and Energy Information Administration (EIA) study (1999) in USA where the passthrough process was found to be complete in 8 to 9 weeks after the cost shock

4.5.2 Pattern Asymmetry

While amount asymmetry estimates the magnitude by which the dependent variable (Retail Price) adjusts in response to changes in the independent variable (Crude Oil Price), pattern asymmetry tests the speed of retail price adjustment to increases and decreases in crude oil prices respectively Test results reported in appendix IV reject the null hypothesis that all the coefficients for the pattern asymmetry test term (Assym,.,) are equal to zero (F-statistic=6 238833 and p-value=0.000117), indicating presence of pattern asymmetry in the gasoline market in Nairobi This confirms the perception by fuel consumers, labour organizations and legislators that indeed gasoline prices rise faster than they fall in response to crude oil price shocks The lag length and autoregressive Moving Average (ARMA) terms were chosen to minimize the Akaiko Information Criteria (AIC)

Other studies where prevalence of pattern asymmetry in the gasoline market has been reported include Ye et al (2005) in USA. Asplund et al (2000) in Sweden. Bettendorf et al (2003) in Netherlands, Bettendorf et al (2005) in Netherlands. Borenstein et al (1997) in USA. Energy Information Administration (1999) In USA. Bacon R W (1991) in UK and Duffy-Deno (1996) in USA Similar results have also been reported by Salas (2002) in Philippines. Bhaskara and Gyaneshwar (2005) in Fiji and ZhukJyz (2005) in Russia

Presence of pattern asymmetry implies that crude oil pnce volatility induces adverse welfare cost implications to gasoline consumers in Nairobi As noted by Borenstein et al (2000), pattern asymmetry implies that the losses borne by gasoline consumers from a given increase in crude oil price outstrips the gains accruing to them from crude oil pnce decreases

4.5.3 Role of Market Powor in Gasoline Price Adjustments

Economic literature documents that one of the causes of price asymmetry is market structure Prices are expected to adjust faster and more efficiently in perfectly competitive markets and more sluggishly and less efficiently in markets that are close to monopoly In order to discern the role of market structure in the gasoline price adjustments in Kenya, the study introduced the Herfmdhal-Hirshman Index (HHI) into the passthrough model for the period 2003-2005 as reported in appendix V As anticipated, the parameter estimate for the index is negative and significant, implying that indeed market power inversely affects retail gasoline price adjustments These results are analogous to those found by Borenstein and Shepard (2000) on the role of market power in explaining lagged gasoline prices in the US The study found out that the price adjustment rates for unbranded gasoline stations to crude oil costs was faster relative to branded stations and that markets with higher price-cost margins (usually concentrated markets) display a slower adjustment rate to cost increases These findings validate the market power hypothesis that indeed market concentration reduces the speed of retail gasoline price adjustments to upstream cost shocks It is therefore plausible to associate the presence of pattern asymmetry in the petroleum market in Nairobi to the fact that five major firms control the oil market It is also reasonable to conclude that more competition would reduce this problem of price asymmetry.

Chapter 5

5.1 Policy Implications

The negative welfare implications of pattern asymmetry as documented by Borenstein et al, (1997) and the already appreciated asymmetrical pncing and market failure nexus makes the subject of gasoline price asymmetry an attractive policy issue for Governments and regulators This is because energy is a critical primary input in the production process and the latent efficiency and welfare costs associated with price asymmetry in the sector are likely to generate undesirable cascading effects on all productive sectors of any economy

The results of this study lead to the following policy recommendations:

The reported presence of pattern asymmetry in the gasoline market in Kenya and its close correlation with market power as explained by the Herfindahl-Hirshman Index (HHI) implies that the post deregulation level of competition in the petroleum market is inadequate to induce optimally in supply, pricing and resource allocation in the sector This problem is compounded by the fact that the market efficiency watchdog, the Monopolies and Price Control Commission, is, in the current frame, incapable of properly enforcing a competitive culture in the petroleum industry First, the structural set-up of the commission and the legal framework were designed for a price 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 recurnng 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 adequately provides for their resolution This may necessitate among other things, a repeal of the monbund Restrictive Trade Practices, 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 efficiency concerns for deregulated markets in Kenya such sticky pricing, vertical integration and mergers and acquisitions;

At the sectoral level there is need for a deliberate policy to reduce recognized entry and operational barriers to petroleum trading in Kenya It is anticipated that this would reduce market concentration by enabling independent firms to attain a market presence that gives them significant clout on gasoline pricing decisions;

In addition there is need to design and implement an appropriate regulatory institution whose mandate should be regular monitoring of petroleum market efficiency and product standards and advise 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 so that price statistics at the retail, wholesale and crude level can be collected 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;

Moreover, individual petroleum markets in net oil importing countries in Africa are very small Yet crude oil import bills constitute a major expenditure items for these economies with adverse effects on the balance of payments and gasoline pump prices At the current international crude oil price, crude purchase costs constitute about 40% of the gasoline retail pnces In Kenya, while the 2006 Economic Survey reports that the total import bill for petroleum products rose by about 8% from Ksh 88 8 billion in 2004 to Ksh 95 7 billion in 2005 Similar circumstances obtain in neighboring countnes and substantial economies of scale could therefore be realized through synchronized procurement, refining and supply of petroleum products for the region Kenya should therefore commence a regional initiative with like-minded countries in the great lakes region aimed at 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 co-owned by these Governments and the private sector to coordinate and organize for joint supply of petroleum products for the region This process would however require harmonization of products standards and refining, storage and distribution infrastructure in the region in order to succeed

These measures would reduce concentration and increase competition in the industry This would reduce pattern asymmetry and ensure market responses that efficiently mimic upstream cost changes in both directions

Herfindahl-Hirshman Index (HHI)

Herfmdahl-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 The formulae for computing HHI can be expressed as

HHt»2a*,

Where

HHI	•	Herfindahl-Hirshman Index
I	-	Summation Sign
a	•	Market share of the i* firm
i	•	Number of firms m the industry

HHI ranges from 0 for perfectly competitive industries where individual firms have zero or near zero market shares, to 10,000 for monopolistic industries where a single firm has 100% market share. Economic literature indicates that HHI below 800 occur in competitive markets while that ranging from 800 to 1800 occurs in oligopoly or monopolistic competition markets

Oemo of Pnce Build up tor Selected Petroleum Products'

I'MS	TI'SVMT	j~AGO	I SVMT	DPK	US$/MT
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fmfht& PraiMum		Fre^hi* Premium	2035"	rrciylilA Premium	30.00
|a r SluTnh.ua		CII M.wnhatT	IMTT	OF M>«nNiia	237.00
pnvurance	0)7	InsuiMKc	0 28	Iniuiarxc	0.30
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II IWJ*<.AI 1) 0125%)		(I OOJTAFM 0125%)		(IOO)*C*r*OOI25SI	
CII[1] Mombau		CIF Mombasa	18* M>	IMF Monihaw	237.39
cilk Icc <2 I		tbKfee (2 75%C7F>	TiT	CHK Fee |2 7<*X7f)	6.52
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UUnitLX. 11 i V c Z b		Bant IX (I 2%'CAF)	! 26	NJNI I.V(I ?S*C*H	2.84
furl W		CIFLW	rnW	CIFLW	249.25
U M		Ocean 1r*»	I)W	Ocean Im«	1.25
p ? (0 >%'<IFI W»		<0 5V.TIFLW)		<0 5%TIFI.W)	
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IAvhuuK Rue iK\h pci 1 UNS)		txclumitr Kak-tKth pa I	7100	Exchange RIIK iKihpci I IIS$)	7100
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Adam lot t» 5%UM~ Kth'MS	48.62	Aiiwi Fee (0 5%CIK). Kth,' NU	4.rgi	Adun FCC (0S%C1F>. K«h/SU	M I T
Mi.S Ini^cum Thetgex K*hMJ	6 JO	MiS In>pcvUi<n Charge* Kih/MJ	8 20	S<!S Ifwpcilmo ("hmt\> KO/KO	I. •
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ponded IHK\. Kvd'Mr		SirtpcwJcJ I)UI>. ksh<\0		Suw«kk\J Dui>. kih'TVO	
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				'Rv'fjnff	I.7S9J0
				Nauohi landed Con (kthWj)	12.657 59
				Nairuhi Landed (.Oil 41. SVOaJ»	0 87

!

Source MOE

' All the variables used in price build-up change oser time and the applicable rates arc applied tor a panicial.it crude oil cargo; e.g. exchange rate changes daily

OLS Test Equation for Amount Asymmetry from Crude Oil Price to Rotail Prico

Indepenaent Variable	Coefficient	Sid Error	t-Statistic	Prob
C	0.168646	0114847	1 468441	0 1486
DCT(-I)	0 415560	0 246415	1.686426	0.0983
DCT(-2)	•0 044410	0 268893	-0.165160	08695
DCT(-3)	0 414883	0 216362	1 917543	0 0613
DCT(-4)	-0130185	0 253948	-0 512644	06106
DCT(-5)	-0 051074	0 251995	-0 202679	0 8403
DCT(-6)	-0 092985	0 252932	-0 367629	07148
DCT(-7)	0 260390	0 265017	0 982538	03309
DCT(-8)	-0 013608	0 213999	-0 063591	09496
DCT(-9)	0 045571	0 256227	0177856	0 8596
DCT(-10)	0140313	0263654	0532185	0.5971
AR(1)	0602331	0123588	4 873707	0 0000
MA(1)	-1 135350	0 097084	-11 69449	0 0000

Amount Asymmetry F-Statistic	0 021747
PValue	0 883392
Sum of Crude Pnce lags	0 94445
Akaike Info Criteria	4 371530
Adjusted R-squared	0 277042
F-Statistic	2 884099
Proe(F-statistic)	0 004664
Durbin-Watson stat	1 929172

Estimation Equation

DRT = C(1) • C(2)'DCT(-1) • C(3)'DCT<-2) • C(4)'DCT(-3) • C(5)'DCT(-4) + C(6>'DCT{.5) * C(7)'DCT(-6) • C(8)'DCT(-7) • C(9)'DCT<-8) • C(10)'DCT(-9) • C(11)'DCT(-10) • (AR(1)=C(12) MA(1)«C(13),INITMA=2001 01)

OLS Test Equation for Pattern Asymmetry from Crudo Oil Price to Retail Price

Ir*j«pend«<it Variable	Coefficient	Sid Error	t Statistc	Prob
C	2 336771	0 420410	5 556314	00000
DCT(-I)	•1 086201	0 845570	-1 284686	0.2161
DCn-2)	0511594	0 969948	0 527445	0 6047
DCT<-3)	4 067362	1 048344	3 877596	00012
DCT(-4)	-0130614	0971655	•0 143687	0 8874
DCT(-5)	-1 697364	0 992274	•1 609801	0 1259
0CT(-6)	0 892971	0 860510	1 014152	0 3247
DCT<-7)	-0 473363	0 782961	•0 604!««	05535
DCT(-6)	0901181	0 658028	1 369518	0 1887
DCT(-9>	1 174677	0 533206	2 203045	0 0417
DCT(-IO)	0897166	0 527007	1 702381	0 1069
OCT(-II)	0 866244	0.510478	1 696927	01079
OCTM2I	0078797	0 506659	0155524	0 6782
DCT<-13)	-1 678356	0 543268	3 089374	0 0067
DCT(-U)	0 441372	0.548763	0 804302	0 4323
OCTI-15)	1 519843	0 546527	2 780910	0 0128
0CT<-16)	-0 029383	0 494488	0 059420	0 9633
DCT(.|7)	0 462363	0292989	1.578155	0.1330
ASSYM(-I)	2 809738	1.337474	2100779	0 0509
ASSYM;-2>	-1 962629	1 47*641	•1 330018	02011
ASSYM(-3|	•6 025343	1 599705	•3 766535	0 00t5
ASSYMi-4)	0 428012	1 452688	0 294635	07718
ASSYMi-6)	2354520	1 482541	1 568166	01307
ASSYMi-6)	•0 931020	1 307843	0 711875	0 4662
ASSYM.-7)	1 209654	1 256700	0 962564	0 3493
ASSYMi 8)	-3 112913	1 163350	-2675816	0 0160
ASSY**;-®)	•7 076879	1 035191	•2 006275	0 0610
ASSYM(-IO)	0165368	1 010645	0162660	0 6727
ASSYMi 11)	-2 160963	1 044782	•2 068339	0 0547
ASSYM 12)	1 080551	1 132411	0 954204	0 3534
ASSYM(-I3)	5 433076	1 257519	4 320471	0 0005
ASSYMi* 14)	1 082509	1 364407	•1 233143	0 2343
ASSYMi-15)	•2 243162	1 338565	1 675796	0 1121
ASSYM<-I«)	0 937748	1 081280	0 867257	0 3979
AR<1>	0 211470	0 236505	0 894146	0 3837
MA,1)	0 999948	0 000849	•1165 917	ooooo
Pattern Ajymmeiry SUt*tIC	F-6 236833			
P value	0 000117			
R-souare<j	0 873473			
Akaiko Info Criteria	3 788700			
SE of 'eg'cwon	1 440090			
Dwbw-Watson slat	1 869092			

Estimation Equation

DRT » C(1) • C(2)*DCT(-1) • C(3)'DCT(-2) + C(4)'DCT(-3) + C(5)'DCT<-4) + C(6)'DCT(-5) • C(7)'DCT(-6) * C(8)*DCT(-7) • C(9)'DCT(-8) • C(10)'DCT<-9) • C(11)'DCT(-10) • C(12)'0CT(-11> • C(13)'DCT(-12) + C(14)*DCT(-13) • C(15)'DCT(-14) • C(16)'DCT(-15) • C(17)'DCT(-16) • C(18)*DCT(-17) + C(19)'ASSYM<-1) • C(20)'ASSYM(-2) C(21)*ASSYM(-3) C(22)*ASSYM(-4) • C{23)*ASSYM(-5) + C(24)'ASSYM(-6) - C(25)*ASSYM(-7) C(26)"ASSYM(-8) • C(27)'ASSYM(-9) + C(28)'ASSYM(-10) + C(29)'ASSYM(-11) C(30)*ASSYM(-12) • C(31)*ASSYM(-13) • C<32)'ASSYM<-14) - C(33)*ASSYM(-15) C(34>*ASSYM{-16) * |AR(1)=C(35),MA(1>*C(36>,BACKCAST»2001 08]

Regression Results with Herfindhal-Hirshman Index as a Proxy for Market Power

Variable	Coefficient	Std Error	t-Statistic	Prob
C	8 728739	4 147020	2104822	0 0526
DCT(-I)	0437272	0 231562	1 888355	0 0785
DCT(-2)	0.322122	0 250848	1 284134	02186
DCT(-3)	0 448737	0240818	1.863390	0 0821
DCT(-4)	-0 558407	0 241913	-2.308295	0 0356
DCT(-5)	0 014735	0 275888	0 053411	09581
DCT(-6)	0 516728	0 273397	1 890029	0 0782
DCT(-7)	0.354817	0 356009	0996651	0 3347
DCT(-8)	0.190786	0 294397	0 648057	0 5267
0CT(-9)	-0 026832	0 240187	-0111715	09125
DCT(-IO)	0 610689	0 279618	2 184008	0 0453
HHI	-0 006394	0 003123	-2 047411	0 0586
AR(7)	-0 246503	0073047	-3 374603	0 0042
MA(S>	-0 950716	0.000316	•3006 149	0 0000

R-squared	0.766670	Mean dependent var	0 538621
Adjusted R-squared	0 564450	SO dependent var	1.521521
SE of regression	1 004147	Akaike info cnterion	3 152425
Sum squared resid	15 12465	Schwarz cntenon	3 812498
Log likelihood	-31 71016	F-statistic	3 791270
Durbin-Watson stat	1 874814	ProtXF-statistic)	0 007986

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