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Determinants of pass-through of international oil prices to domestic consumer fuel prices: evidence from Uganda

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ABSTRACT

Uganda, a land locked and net oil importing country, upward shift in the international oil price are normally matched with increase in the local consumer fuel prices. However, when there is a downward adjustment in the international oil price, local fuel prices tend to be sustained at the new revised high levels. This study sets out to examine key determinants of local consumer fuel prices influencing the oil price pass-through. We begin the market analysis by examining the level of market competition (degree of concentration), followed by a vector autoregressive and error correction model (ECM) model estimation techniques. Results indicate that there has been high concentration and market dominance by a few oil companies over the years. Findings also indicate that exchange rate, oil price and government duty are key in explaining oil price pass-through. The study recommends a legal framework to encourage new firms to come on board and existing small firms to increase their market share, reduce government duty and control exchange rate fluctuations.

IMPACT STATEMENT

The paper investigates the determinants oil price pass through for a developing country like Uganda. The points out the high concentration and dominance of few firms, exchange rate volatility, and government duty a key factors influencing the pass through.

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1. Introduction

Oil is the most widely traded oil worldwide. The most visible statistic for the oil industry is oil price. The nature and level of international oil and local fuel prices affect the overall performance of the economy. Changes in international oil prices are expected to have an impact on domestic fuel prices. This is because changes in international oil prices are directly transmitted to local consumer fuel prices, although the rate and magnitude of the changes vary depending on the rate of passing through. If changes in international oil prices result in high local fuel prices, they can affect a country's economic growth, as they affect almost all economic activities of a country. This is especially important for oil-importing countries, such as Uganda. Petroleum products consumed in Uganda are sourced from the international oil market, mainly from the Arab Gulf.

According to Farrell et al. (2001), the fundamental determinant of oil prices is the balance between demand and supply in the international market, and each side of the market is in turn influenced by several factors. In addition to these fundamentals, expectations and speculation about future demand and supply conditions, which in turn are stimulated by economic and political conditions, play a large part in the determination of crude oil prices in the futures and spot markets, particularly when inventories are low (Farrell et al., 2001, p. 82). A major factor in oil supply is the Organization of Petroleum Exporting Countries (OPEC), which can sometimes exert a significant influence on oil prices by setting an upper production limit on its members. The OPEC member countries produce approximately 40% of

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the world's crude oil. OPEC's oil exports represent approximately 60% of the total petroleum traded internationally and possess almost three-fourths of the world's estimated proven crude oil reserves.

It is evident that the international oil price has exhibited high volatility and has been so since the early years of oil production 1861–1879. Relative stability was experienced in the period 1880–1970 with oil trading at an average of \$18.48/barrel and most of the time below \$20/barrel. The oil crisis in the 1970s caused prices to rise, reaching a high of \$100.54/barrel in 1980 before falling to \$28.38/barrel in 1988. With the increase in volatility of the oil price, the passing through of the oil price has become more important, especially for oil-importing countries. Data from British Petroleum Statistical Review of World Energy (2014) shows that oil prices rose dramatically in the early years, mainly because of strong global demand, limited oil production capacity and continuing political instability in certain oil-producing regions. Using values indexed to 2010, published by the BP Statistical Review of World Energy (2014), crude oil prices¹ were US \$11.84/b in 1861 rose to a high of US \$111.92/b in 1864, before falling to US \$20/b in 1879 remaining in that range before rising to US \$51.23/b in 1974. It peaked at US \$94.94/b in 1979 before falling to US \$17.01/b in 1998. However, from 1999, oil prices increased significantly, reaching an all-time high of US \$101.61/barrel (in real terms) in 2008, falling to US \$62.7/b in 2009 and rising again to over US \$80/b in 2010. In the recent past, the world has seen a sharp fall in global oil prices.

However, in Uganda, consumer fuel prices have remained very high over the years. From 2010 to mid-2014, world oil prices were firmly stable, trading at approximately \$110 a barrel. From June 2014, world oil prices dropped sharply to sometimes below \$50 per barrel to \$49 per barrel in February 2015. While the international oil price almost halved, in Uganda, the local fuel price of gasoline decreased from Ushs 3,705 per litre to Ushs 3,542 per litre, a drop of only 4.3%. The kerosene price dropped from Ushs 2,852 per litre to Ushs 2,770 per litre, dropping by only 2.8%, while the diesel price had the highest drop, reducing from Ushs 3,232 per litre to Ushs 2,882 per litre, an average of 10.8%. The domestic fuel prices observed between 2006 and 2022 show a stable 'sticky' prices overtime as shown in Figure 1

The average price of kerosene was maintained at shs 2,100 per litre from September 2010 to December 2010. The average price for diesel increased from Ushs 2,718 in January 2011 to Ushs 3,356 per litre on April 2011, and this price remained the same for one month and was adjusted to Ushs 3,300 per litre of diesel in May 2011, and this new price remained the same until July 2011. In October 2012, prices were adjusted from shs 3600, shs 2,750 and 3,300 per litre to shs 3,660, shs 2,790 and shs 3,380 per litre for premium kerosene and diesel, respectively. These prices remained almost stable for 11 months until September 2013, when they were reduced by approximately 2%. The established equilibrium produces a sticky price, similar to that determined by Noel (2007).² Thus, prices tend to be nearly identical across retail outlets. This price uniformity is not only limited to Kampala City, but is spread throughout the country.

When substantial local fuel price changes occur, especially upward adjustments, there are often allegations of impropriety, or even cartels, on the part of oil-marketing companies. Therefore, changes in local fuel prices observed in the market could also be due to internal factors. This is further augmented

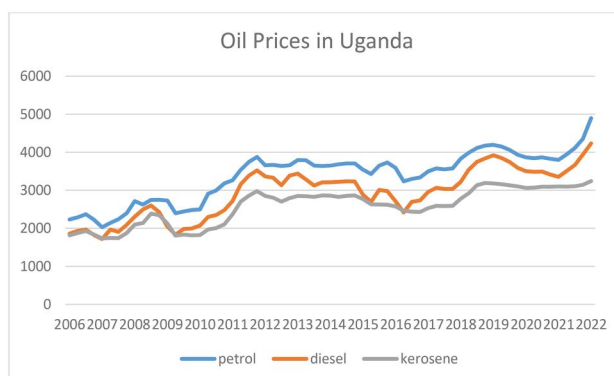


Figure 1. Domestic fuel prices (first quarter 2006–first quarter 2022). Source: Uganda Bureau of Statistics (UBOS).

by decimal local fuel price adjustments despite the sharp fall in international oil prices, as witnessed in the recent past. Ugandan industry players such as oil marketing companies have often tended to use an increase in international oil prices to justify the upward adjustment of fuel prices, arguing that changes in domestic fuel prices reflect the pass-through effect of oil prices.

According to Tyakagire (2012), little success been overshadowed by failure to realise a competitive market that would have resulted into low domestic oil product prices. That the high local prices are due to collusive pricing market structure and due to lack of an effective and appropriate legal and institutional regulatory framework.

The Government has often tended to justify high fuel prices based on high international oil prices. The challenge, however, is that, whereas we find that domestic consumer prices adjust upward following an upward adjustment in the international oil price, this is not observed in the case of a downward adjustment. The observed consumer fuel prices when they are adjusted upwards tend to be sustained at new revised high levels. Downward fuel price adjustments were rarely observed.

Borenstein et al. (1997) argue that an oil price increase would trigger an immediate fuel price adjustment; otherwise, the retail margins may become negative. There is no such restraint when crude oil prices decline. In this case, retailers would decrease their prices slowly over time in an equilibrium response to the threat of price cutting by competitors. Thus, fuel prices adjust faster to oil price increases than to decreases. However, this theory does not explain how retailers coordinate a particular price. Firms cannot sell below the competitive price, as they would incur losses.

While the average consumer probably believes that fuel prices are related to those of crude oil in the international market, there is little understanding as to why local fuel prices remain high when international oil prices fall. Some analysts have suggested that oil companies do not want to lose their profits. They argue that dealers are greedy and thus keep raising prices to make large profits. Local fuel dealers normally ignore world tendencies, especially when the price decreases, but respond quickly when the global oil price increases. This is critical because the price of fuel at retail service stations is the most visible oil statistic in the country. Understanding the relationship between oil prices and local fuel prices can help to validate the results of local fuel prices and by industry and government analysts wishing to forecast the movement of fuel prices over the near term.

Consumers in Uganda have observed that fuel prices continue to rise and fluctuate over time. The decline in international oil prices is not clearly reflected in the decline in local consumer fuel prices. This raises the question of why the price of fuel in Uganda is still high despite the record-low prices in the international market. In other words, why is it that fuel prices at retail stations are adjusted immediately in response to a slight increase in crude oil prices and never go down when crude oil prices stabilise? What are the other factors that influence local fuel prices? This calls for an examination of the determinants of local fuel prices. The non-commensurate changes in fuel prices to changes in international oil prices have raised questions about what actually determines fuel prices in Uganda. This study provides and understanding of the factors contributing to the downward rigidity of oil prices in Uganda.

2. Background of the oil industry in Uganda

2.1. An overview of the local oil industry

Uganda does not produce any petroleum at the moment, and therefore, all its petroleum product requirements are imported from abroad. Uganda imports refined products, mainly from the Arab Gulf region. Uganda is a landlocked country, which implies that oil products must transit through countries before reaching their final destination. Oil product imports from the source (Arab Gulf or Singapore) are landed at the Indian coast ports of Mombasa in Kenya and Dar Es Salaam in Tanzania, from where they are transported to Uganda. Thus, there are two principal supply routes: through Kenya (commonly referred to as the northern corridor) and Tanzania (commonly referred to as the southern route). At Mombasa, storage facilities are owned by private oil marketing companies and some by government state corporations, while in Tanzania, storage facilities are wholly owned by private companies.

For the Northern route, in Kenya, the industry operates an open tender system (OTS) on a monthly basis. With the OTS, the industry amalgamates its requirements, which are centrally tendered. The

winner of the tender supplies the entire industry in that month. Given that Ugandan products are sourced through Kenya, OTS volumes contain Uganda's requirements. In Kenya, products are transported by a combination of pipelines, railways, pipelines and road tankers. The pipeline runs from Mombasa on the eastern coast through Nairobi and terminates in Eldoret/Kisumu in Western Kenya at a total distance of 896 km and approximately 60 km from the Ugandan border. The Mombasa-Nairobi pipeline was commissioned in 1978 and the Nairobi-Kisumu/Eldoret extension in 1994. The pipeline is owned and operated by Kenya Pipeline Company (KPC), a state corporation (Kenya Pipeline Company, 2012). From Kisumu/Eldoret, the products are transported by road tankers to Kampala and beyond. Some volumes are also moved by rail from Mombasa to Kampala, but this constitutes approximately 10% of the volume along this route. Sometimes, especially in situations of scarcity or occasional pipeline breakdowns, the products are also moved by road from Mombasa to Kampala, although this mode is highly discouraged by the respective governments.

On the southern route, through Tanzania, products are transported exclusively by rail from Dar Es Salaam to Mwanza on the shores of Lake Victoria. The Wagons were then loaded onto Lake Ferries at Mwanza and shipped across Lake Victoria to Port Bell about 10 km from Kampala city or to Jinja about 60 km east of Kampala. Through the Southern route, petroleum products are moved by a total distance of approximately 1,500 km to reach the Ugandan market. The movement of products from the source to this point (inland depots in Uganda) is referred to as primary transportation.

Once in the country, the product is stored in independent oil storage facilities, which are mainly located in Kampala city (approximately 60% of storage capacity) and others in the upcountry towns of Jinja, Mbale and Kasese, which are located approximately 60 km, 200 km and 400 km, respectively, from Kampala city. Most oil storage facilities are owned by major oil marketing companies that were developed several years before the liberalisation process.

Uganda Liberalised the downstream petroleum sector in 1994, and that it was believed that by opening up the sector and letting the industry manage and sustain itself, this would translate into low prices (Tyakagire, 2012). In 2000, in a bid to attract new companies into the sector, the government decided to allow oil companies to use their strategic storage facilities for the storage of petroleum products under a hospitality arrangement.³ However, this arrangement ended in 2008, when the strategic storage facility was closed for repair and later leased to a private company for management.

From the depots, the product is transported by truck to various retail outlets throughout the country. This is referred to as secondary transportation. In 2004, the government introduced a tax payment system at the border point of entry. This system removes the requirements for warehouse petroleum products before distribution. With this system, oil companies settle their tax obligations on imported petroleum products at the border point and may thereafter transport the products either to storage facilities or directly supply retail outlets.

Oil companies have developed retail distribution networks across the country. Companies make individual and separate supply arrangements mainly through their overseas principals and/or affiliate companies. This is mainly for vertically integrated majors. Most companies, especially new ones, source their products from intermediaries in Kenya, where there are large and bulk importers for the wholesale and export markets.

2.2. Petroleum sector reforms undertaken in Uganda

Along with the growth in the demand for petroleum products, there have been numerous changes in legal regimes. For instance, in the late 1980s, the country undertook various reforms on factors identified as the causes of internal and external disequilibria. Structural adjustment programs were designed to eliminate distortions in the macroeconomic framework and promote efficient allocation of resources. The stabilisation policies aimed to control excess demand, promote market efficiency and promote private sector-led growth. The key elements emphasised included fiscal and monetary arrangements and the liberalisation of domestic markets.

In 1987, the government introduced transportation funds. Under this fund, oil companies distribute their products throughout the country. Transportation tenders were to be awarded to transportation companies, and the government determined the cost of transportation (rate per kilometre). Companies

were not allowed to award at a rate higher than the government-determined rate. The cost of transportation can be recovered from the pump price. The government provides subsidies for the transportation mechanism. The difference between the transport cost recovered by the company and the actual cost paid was settled by the transport fund, which was controlled and managed by the government. Oil companies, therefore, made no loss or gain in the transportation of petroleum products.

Before deregulation, the government controlled the petroleum prices. The government established the consumer retail price for petroleum based on the product cost variables, which included the landed cost, distribution cost, dealer or company margin and taxes. These variables form the principal cost structure, above which the government establishes the pump price. The difference between the price computed by the government and the actual retail price is transferred to an account called the *libet fund*. A deficit by oil companies is compensated for by this fund. In the 1970s, the government undertook nationalisation and owned 50% of the oil companies. As already shown, these shares were divested in the 1990s with the liberalisation of the sector. The Government divested its shareholding by selling it to the holding companies, which were the majors, thereby making the majors wholly independent. By 1994, there were only 5 (five) operating companies: Shell (a subsidiary of Shell International), Caltex (a subsidiary of ChevronTexaco), Agip, Total and Esso. After liberalisation, new companies did not immediately enter the market until 1999, when two new companies were licenced. During this period of government-controlled pricing, consumer fuel prices exhibited relative stability.

After independence in 1962, most of the economic systems that were in place prior to independence remained and were transferred to the new independent government. In the early 1970s, the government proposed a nationalisation process. The government proposed to take 50% of shares in companies that were delivering services and considered priority to the government. Oil companies were some of the enterprises in which the government gained interest. The oil companies operating then were Shell, Agip, Total, Esso and Uganda Petroleum (UPET). The Government maintained this shareholding until the early 1990s, when the government opted for a private sector-led growth strategy. The Government then started the liberalisation process, which included the divestiture of government shareholding interests in oil companies. The divestiture of government shares included the reconciliation of *libet* and transport funds with the respective oil companies. Most shares were sold to their respective shareholding partner companies.

The entire petroleum sector was liberalised on 31 December 1993. At the time of liberalisation, only five international oil marketing companies were operating in Uganda. The underlying theory was that opening up the sector would have more players entering the industry, leading to a competitive market that would result in fair local consumer fuel prices. Although the underlying theory was that opening up the sector would lead to a competitive market that would result in fair fuel prices, fuel prices have continuously fluctuated and increased significantly.

2.3. The domestic oil market

The Ugandan oil industry has evolved significantly. This is not only on the energy balance and the trend of demand and supply, but also on the seller concentration, level of industry competition and infrastructural capacity of the sector. These aspects have a significant influence on price movements and may account for some of the movements and volatility in consumer fuel prices observed in the Ugandan oil market. Oil is also one of the major imports to Uganda. Over time, oil import bills have steadily increased. According to Budget 2014/2015, the oil import bill has been increasing by an average of 42% per annum. The oil import bill increased from Uganda shillings (UGX) 468 billion in 2005 to UGX 5011 billion in 2014. The highest growth was registered in the period 2009/2010, when the oil import bill increased from UGX746 billion in 2009 to UGX 2516 billion, an increase of more than 200% increase (Ministry of Energy and Mineral Development [MEMD], 2014).

According to the World Bank (2015), oil accounts for approximately 20% of Uganda's total imports. Therefore, an increase in the oil import bill implies a significant increase in total national import bills. The significant growth of this oil import bill reflects Uganda's over-dependence on oil imports.

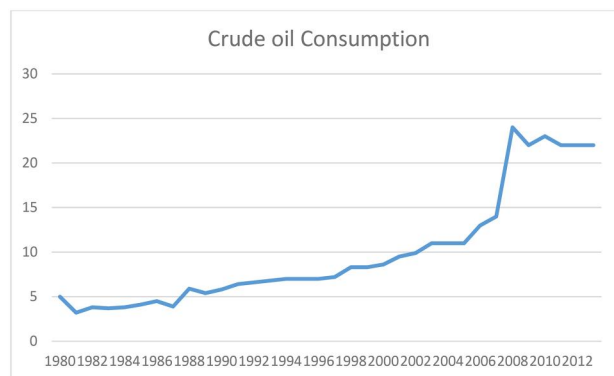


Figure 2. Consumption of crude oil in Uganda. *Source:* United States Energy Information Administration.

2.4. The local fuel prices

Before liberalisation of the petroleum sector in 1994, the Ugandan government was responsible for determining the price of petroleum products under its price control regime. The government adjusted the prices by changing the cost parameters. With liberalisation, oil companies in Uganda obtained the freedom to set their own prices.

Sharp changes began in 1994 with liberalisation but were, however, not very significant until 2000. Domestic fuel nominal prices have continued to rise, increasing from an average of \$0.6/litre in 2001 to \$1.65, \$1.5 and \$1.3 per litre for premium, gas oil and kerosene, respectively, by 2011 and did not revert to previous levels, remaining in the range even as of December 2014 when products sold at \$1.37, \$1.05 and \$1.27 per litre for premium, kerosene and gas oil respectively. In this period there was an increase in volatility with a sharp rise in fuel prices in 2008, when petrol traded for about \$4 per litre for a few days. This was when the supply was cut off after the Kenyan political crisis, and the country ran out of petroleum products completely. Although supply was restored after the crisis, prices remained volatile and ever-increasing, and the upward trend continued unabated. According to Tyakagire (2012), price determination is far from being determined by market forces, but Uganda has the opportunity to realise the full benefits of deregulation if the necessary infrastructure can be established.

What can be concluded from the trend of local fuel prices is that fuel prices in Uganda were relatively stable before the liberalisation of the petroleum sector, and the volatility and frequency of changes increased after liberalisation. The sources of these increases and volatility continue to be debated. Oil companies have attributed changes in domestic fuel prices to changes in international oil prices. However, not all these changes can be attributed to the international market. For instance, an upward shift in international oil prices is normally matched by an increase in local consumer fuel prices. However, when there is a downward adjustment in international oil prices, it is rarely proportional and sometimes not seen at all.

2.5. Demand for petroleum products

As indicated, Uganda does not produce oil, and all its current requirements are imported. After independence, Uganda was progressing economically, and equally, there was growth in the consumption of petroleum products. In the 1970s, Uganda experienced an economic crisis that affected many sectors, including oil. Therefore, the oil consumption in the 1970s was low.

Figure 2 shows the trend in the consumption of oil products over time. This figure shows a growing trend from 1965 to 1970. The national consumption of petroleum products has increased from 251,882 m³ in 1965 to 522,487 m³ in 1970, with an average annual growth of 15.8%. The economic crisis of the 1970s reversed this trend, when annual consumption fell to 479,346 m³ in 1971 and continued to decline at an annual average rate of 7.64% (MEMD, 2014).

By 1979, the consumption of petroleum products was reduced to 247,746 m³. After the economic crisis of the 1970s, the petroleum sector rebounded and consumption rose and continued on an upward

Table 1. Oil industry storage capacity (m³).

Company	Product					Total	Industry proportion
	Petrol	Diesel	Kerosene	Jet ^a	Fuel oil		
Total	2,250	1,350	430	2,500	352	6,882	27%
Petro (U)	531	530	531	–	–	1,592	6%
Shell	2,557	3,626	632	–	–	6,815	26%
Caltex ^b	2,751	781	212	–	–	3,744	15%
Gapco	1,969	498	2,690	–	522	5,679	22%
Kobil	160	210	80	–	–	450	2%
Jovenna	80	80	80	–	–	240	1%
Hared	116	116	116	–	–	348	1%
TOTAL	10,414	7,191	4,771	2,500	874	25,750	46.1%
Government	10,000	10,000	10,000	–	–	30,000	53.8%
National total	20,414	17,191	14,771	2,500	874	55,750	
Proportion private	0.51	0.42	0.32	1.00	1.00	0.461	

Source: Ministry of Energy and Mineral Development (MEMD, 2013) database.

^aRefers to joint ownership and operation of the jet fuel storage facility.

^bCaltex was in 2008 acquired by Total and thus the storage facilities are now owned by Total.

trend. Oil consumption increased from 186,693 m³ in 1981, to 296,191 m³ in 1990, to 513,252 m³ in 2000 and to 1,400,629 m³ in 2014.

2.6. Storage facilities

Table 1 shows the storage facilities in the country. The table shows that the government has the largest single-owned storage capacity for the three fast-moving products. The other storage is owned by the majors who have 90% of the private storage capacity in the market, which gives them an edge over the new market entrant. The few small companies with storage facilities have a capacity that is too small to have a significant impact on the market.

Most small companies have no storage facilities on their own, implying that they have to use third-party facilities. The charged tariffs put them in a disadvantaged position as they cannot effectively compete with their hosts because of their relatively increased costs.

The present storage capacity can only cover the country for a period of 10 days as compared to the IEA recommended 90 days of operation (for more on strategic oil reserves see Bhattacharyya, 2011, p. 478).⁴ In November 2023, Uganda disclosed that effective 1 January 2024, Uganda National Oil Company (UNOC) was to become the sole refined petroleum products importer in Uganda. UNOC would then distribute to oil marketing companies (OMCs) in the country. The plan was to build storage terminal in Kampala with capacity of 320,000,000 litres (MEMD).

Availability of sufficient storage facilities/reserves has an impact on the pricing of products in the market, as they can pacify the market and dampen price rises (Bhattacharyya, 2011).⁵ Since the entry of new players, only a few new companies have established their own storage facilities, confirming the relatively high costs of developing storage facilities.⁶

The petroleum industry in Uganda has an oligopoly like market structure. The industry is dominated by a few giant firms, such as Shell, Total and Caltex (which later sold to Total), and few regional companies, such as Kobil, Petrocity and Hass. However, there are many small firms that exist in the market and small independent fuel stations that sell in sometimes just one town or just a limited region. The market

Table 2. Oil company retail stations as at December 2013.

Company	Industry share of retail stations	Company classification
Caltex ^a	21%	Major
Gapco	11%	Major
Petro Uganda	11%	Regional
Total	12%	Major
Shell	29%	Major
Others	16%	Local

Source: Ministry of Energy and Mineral Development (MEMD, 2013) database.

^aTotal acquired the Caltex Holdings in Uganda and Kenya in November 2008 with the deal concluded in first quarter 2009. The acquisition included the storage facilities, operating terminals and retail outlets, URN (3 November 2008). The retail stations of Caltex therefore in effect were transferred to Total giving it a control of about 35% of the Ugandan oil assets.

is oligopolistic in nature, given that the number of real operators with influence in the market is small. This results in a high concentration in the industry, with a few firms having the largest market share (Lieberman and Hall, 2008). The scarcity of firms in a market results in mutual interdependence. Since liberalisation, the country's retail network has greatly expanded. For instance, in 1999, there were about 343 retail stations in the country and by December 2003, this number had grown to 643 (six hundred and forty-three) and has continued to grow and by 2014 it was estimated to be over 700 retail stations MEMD (2014). Table 2 shows the percentage of ownership of retail stations in 2013.

Table 3. Variables in the model.

Variable	Symbol	Definition	Units of measurement	Source of data	Expected sign
Fuel price	FP	Uganda shs converted to US dollars	US\$	MEMD	Dependent
Oil price	OP		US\$	By the Platts in DataStream	+
Exchange rate	ER	The price of US currency in terms of Uganda Shs	The average rate of Uganda shilling against the U.S \$	UBOS	+
Taxes/ government duty. Amount of tax charged per litre of fuel	T	Uganda shs converted to US dollars	US\$	UBOS	+
Quantity of fuel demanded	Q		Metric cubes (m ³)	MEMD	-

Table 3 shows the variables used in the estimation of the model, sources of data for the respective variables, and the expected relationship with the dependent variable. These variables are selected to analyse the phenomena of fuel prices in Uganda.

Table 4. Market shares (%) of oil companies in Uganda.

Company	1999	2000	2001	2002	2003	2007	2009	2010	2011	2012	2013	2014
Agip	7.73	9.26	2.70									
Caltex	23.39	23.50	20.70	17.40	16.80	16.60	17.60	17.60				
Delta				1.77	2.50			2.70			2.16	1.96
Gapco	11.11	12.16	9.20	10.56	11.98	5.20	6.20	5.60	8.00	7.00	4.84	3.97
Jovenna	1.33	1.76	2.90	2.05	2.02							
Kobil			5.10	7.20	10.13	8.80	8.80	8.92		3.00	2.63	2.14
Petrol-Uganda				9.01	9.94	10.00	11.00	9.50	3.00	6.00	3.19	2.93
Shell	34.92	32.59	31.60	31.95	29.96	25.20	27.20	27.50	31.00	27.00	15.38	18.61
Total	19.76	16.83	16.00	15.52	15.76	17.00	19.00	18.60	24.00	25.00	16.57	16.33
MGS						2.10	3.10	2.90	2.00			
Engen						1.70	2.70	2.90				
Others	0.64	2.21	8.8	4.54	3.04	13.3	12.00	3.78	13.00	11.00	12.19	10.57
Hass									8.00		3.96	3.64
Petrocity									6.00	8.00	6.14	5.05
Nile									5.00	10.00	7.06	6.45
Hared										3.00	1.75	
Stabex											5.22	5.84
Synergy											3.57	
Mogas											3.01	2.98
Shire											2.42	2.42
City oil											2.34	2.26
Olympic											1.80	2.07
Hashi											1.80	
Tosha											1.50	1.92
Don											1.38	2.12
Mobil											1.09	2.28
Ainusha												3.64

Source: Ministry of Energy and Mineral Development (MEMD, 2013) database.^a

^aWith availability of data we have been able to compute the markets shares for the latter years. However, although there were more mergers and acquisitions in the industry for example Total's acquisition of Caltex (a subsidiary of Chevron) in 2008, which increased the concentration in the 2008/9 period, this has been reversed with entry of more new oil companies.

Table 5. Oil industry market concentration index.

Year	1999	2000	2001	2002	2003	2007	2009	2010	2011	2012	2013	2014
HHI	2,343	2,142	1,912	1,837	1,792	1,588	1,823	1,652	1,908	1,742	883.4	815.4

Source: Author's computation.

Table 4 shows the market share of oil companies in Uganda between 1999 and 2014. The table shows that over the years, new oil firms have entered the market, reducing the market share of the dominant firms. The table shows that major oil companies control more than 70% of the retail network. There has been overinvestment in gasoline stations with majors at the forefront. Although the country has national standards for retail stations, the majority of multinational oil companies have their own standards, which in some cases may be higher than national standards. Thus, the quality of retail stations for major oil companies tends to be higher than that of local firms, which may have no company standards of their own or are of low quality. However, there has been a tendency to overinvest in retail stations over time. Regional comparisons suggest the possibility of excessive investments in gasoline stations in Uganda. Thus, there has been a tendency to over-invest because an increase in the number of gasoline stations has not been accompanied by a reduction in prices.⁷ Whereas investment in oil facilities and installations is good for the country, if this investment is driven by rent-seeking, it can bring undesirable outcomes.⁸ Many stations have developed new services beyond the traditional fuel-dispensing services.⁹ The overinvestment in stations is double-edged; on the one hand, it enables major companies to out-compete small companies as very attractive stations attract customers and increase the output, a positive outcome for the firm. On the other hand, increased investment in distribution facilities reduces consumer welfare (see Nagaoka & Kimura, 1999).¹⁰

The evolution of the market has been such that it has tended to create large firms with large market shares that inhibit competition in the industry. As indicated, during the divestiture process, the government sold its shares to holding companies that were the majors. This has created a large few (five) multinationals in the country.¹¹ For instance, in the late 1990s, the government allowed the acquisition of UPET by Shell, and in 2000, Shell acquired the Agip. This increased Shell's market shares from 26% to over 32%. It must be noted that these levels of market share create dominant firms in the industry and can stifle competition. Thus, they are prohibited in most of the well-regulated markets.¹² In 2008, the government allowed the acquisition of Caltex (a subsidiary of Chevron), making it the second largest company with a market share of over 30%.¹³ These mergers and acquisitions have created large companies that reduce the possibility of competitive behaviour in the market. However, the rate of market entry by new players remains low, and the market remains concentrated. Several factors, such as high capital costs and the lack of a clear legal framework, account for this delayed entry. With the new government guidelines for licencing new companies, some companies entered the market in early 2000, and by 2003, the number of operating oil companies reached over 20. The number continued to grow, and by 2014, the number of operating companies was over 50. Most new companies are indigenous or regional. Although the number of oil companies operating in the country has grown, new companies have taken on a decimal market share, with some small companies having one or two retail stations; thus, the industry has largely remained concentrated.

Overall, major oil companies have influenced the entire supply system. They sourced the products from their refineries in the Arabian Gulf, controlled the available tanker vessels for moving products across oceans, had the distribution infrastructure in the local market countries in the form of oil terminals and have branded petrol stations run by their appointed dealers selling to consumers on prices 'set' by the parent majors.

2.7. Cooperation among oil dealers

The main oil marketing companies operating in Uganda had a long history of cooperation, even before deregulation. Before liberalisation, the price was determined by the state that would reimburse individual companies' related product expenses. There were no losses on the part of companies, as their profits were negotiated with the government. This arrangement would be done as a group, a factor that increases close cooperation. Therefore, there is no incentive for oil companies to engage in aggressive competition, a relationship that has been sustained over time. Inertia to free competition implies that companies tend to agree to maintain stable prices and thus affect fuel pricing and the oil price pass through.

2.8. Literature review on oil prices and inflation

Crude oil price is one of the key drivers of inflation worldwide, where high oil prices can pass through into inflation in different countries (Nasir et al., 2020). The crude oil price has risen above \$120/barrel due to the conflict between Russia and Ukraine in early 2022. This high price caused massive concerns about high inflation in the U.S., and the corresponding wage and price-setting process act as echoes of those concerns (Kilian & Zhou, 2022).

Oil price volatility activates the exchange rate movement of oil exporting and importing countries, as their economies are dependent on crude oil trading (Dąbrowski et al., 2022). In fact, oil-importing countries usually undertake risk management strategies to hedge against highly volatile oil price by devaluing the real currency exchange rate and thus obtaining oil resources at a relatively low price (Zhou, 1995). Lizardo and Mollick (2010) prove that oil prices can significantly explain the changes in the value of the US dollar against major currencies. Likewise, Reboredo (2012) reveals a positive correlation between the US dollar exchange rate and oil prices.

More recently, scholars have also accommodated that the exchange rate activates the connection between oil prices and stock returns in both oil-importing and oil-exporting countries (Philips et al., 2022).

Other than developed economies, recent studies have also focused on the impact of oil prices on emerging economies through exchange rates. Ogundipe et al. (2014) verifies the correlation between oil prices and currency exchange in Nigeria by adopting the GARCH family models. Jain and Biswal (2016) support that a positive correlation exists between crude oil prices and exchange rate fluctuations in India by employing the DCC-GARCH model. Nusair and Olson (2019) reveal a mixed relation with both positive and negative impacts of oil prices on exchange rate returns from developing currency markets in Asia. Salisu et al. (2021) collected monthly exchange rates of BRICS (Brazil, Russia, India, China and South Africa) countries and global oil prices from January 1973 to April 2020. They build a bivariate predictive model for the oil-exchange rate nexus and conclude that the oil price can well predict the change of exchange rate whether in net oil exporters or net oil-importers. Similarly, X. Zhang and Baek (2022) uncover the asymmetrical relation between oil prices and exchange rates in 11 Asian countries. Sun et al. (2022) revealed the close relation between the USD/CNY exchange rate and crude oil price by using the Shanghai International Energy Exchange (INE) oil futures data.

In fact, both exchange rates and oil prices have valuable implications for inflation and other macro-economic conditions (Ding et al., 2020). For instance, the exchange rate plays an important role in inflation stabilisation. Uribe (1997) constructs a dynamic general equilibrium model of small open economies to illustrate the interactions between inflation and exchange rates.

Furthermore, the oil price also serves as the crucial constituent influencing inflation worldwide, and oil price volatility is a key element for economic development (Ding et al., 2022). Darby (1982) applies an extended Barro-Lucas real income equation to demonstrate the direct real-oil-price effects on inflation in eight countries.

Raheem et al. (2020) recently used a multiple threshold nonlinear Autoregressive Distributed Lag (ARDL) model to uncover the asymmetric relationship between oil prices and inflation. Similarly, Philips et al. (2022) reveal the cyclical relationship between the inflation rate, oil price and stock return by employing the ADRL model. W. Zhang (2022) reveals that the oil price acts as a vital channel that transmits the international spillover effect of Chinese government expenditure on global inflation dynamics. As a result, it could be arguable that both exchange rates and oil prices have considerable impacts on inflation, and thus, the connection between them would exhibit stronger effects on inflation. As both exchange rates and oil prices are traded in the market daily, the measure of connection between exchange rates and oil prices is mainly on a daily basis. Since inflation is usually measured by the Consumer Price Index (CPI), which is low-frequency data, the MIDAS (mixed data sampling) model has been widely applied in analysing and forecasting inflation when high-frequency explanatory variables are involved.

According to Barriga et al. (2020), market concentration is one of the main impediments to productivity growth globally. Local industry concentration also has heterogeneous effects on productivity across industries, while its impact on productivity varies by level of exposure to international markets. The

effect of greater exposure to trade offsets and, in most cases, reverses the negative effects of local concentration on productivity.

Nasir et al. (2020) provide evidence for heterogeneity across countries regarding the effects oil prices on domestic inflation. Their results show that although the oil price has a significant influence on the domestic price inflation in the short-run and in the long-run for most of the oil-importers and oil-exporters, it is not the main factor affecting CPI and PPI inflation.

Asgharian et al. (2013) use the GARCH-MIDAS model to explore the impact of the information contained in macroeconomic variables on short-term and long-term forecasts. Their empirical analysis results show that the mixed use of low-frequency macroeconomic information with high-frequency stochastic volatility in the GARCH-MIDAS model can improve model predictability.

Use of microdata studies on effects of market concentration have concentrated on developed economies (De Loecker, 2011; Nickell, 1996, Schmitz, 2005). Lack of adequate data has led to this research question to be understudied in developing countries. To fill this gap in the literature, we explore the links between local market concentration and product prices for the oil sector in Uganda. This paper contributes to the literature on developing countries, specifically on the dynamics between market concentration and price pass-through.

3. Methods and materials

We begin the market analysis by examining the level of market competition (degree of concentration) of the oil industry in Uganda, followed by an analysis of other determinants of international oil price pass-through to domestic consumer fuel prices.

3.1. Methodology for analysis of the level of market competition

Using companies' market shares, we develop the Herfindahl Hirschman Index (HHI) to assess the level of competition in the oil industry. The HHI squared market share value for each company is given as

Herfindahl–Hirshhman index:

$$HHI = \sum_{i=1}^n S_i^2 \quad (1)$$

where S_i is firm i 's market share for firm i .

The determination criterion for the HHI is such that if the HHI is less than 100, the market is highly competitive. A market with an HHI between 100 and 1,000 is competitive. With an HHI between 1,000 and 1,800, the market is moderately concentrated, and above 1,800, the market is highly concentrated.

3.2. Methodology for analysis of the determinants of local consumer fuel prices

In the examination of the factors that determine local fuel prices, we begin with a description of the variables and further undertake econometric analysis to determine the effect of each variable on local consumer fuel prices.

3.2.1. Nature and source of data

The study used monthly data on the variables for the period (1996–2014). Five series are used in the study: fuel price (gasoline price, diesel price and kerosene price), exchange rate, international oil price, quantity demanded and government duty.

Fuel price. This is the price at which petroleum products are sold to the consumers. The fuel price is displayed at retail fuel service stations and reflects the price at which consumers purchase petroleum products. For this purpose, we use the prices of three fast-moving petroleum products: gasoline (petrol), automotive gas oil (diesel) and illuminating kerosene (paraffin). We use the average retail petrol prices for Kampala obtained from the MEMD (2013) database. *Local consumer fuel prices* are quoted in local Uganda shillings, which are converted to US dollars at the ruling exchange rate. *Exchange rate,* we use the average rate of Uganda shilling against the U.S. dollar. *International Oil Price,* this is the price at

which the oil products are sourced from the international market. It is the price quoted for the trade of refined oil products in the market as a source of oil products for Uganda. This market is mainly the Arab Gulf or Mediterranean, Italy, or Singapore. Data on oil prices were reported by the Platts in DataStream.

Quantity demanded. This represents the amount of fuel consumed by Uganda. For this analysis, we used the total monthly petroleum sales of petroleum products. The volumes were reported in metric cubes (m^3), and these data were obtained from the MEMD (2013) database.

Government Duty is the amount of tax charged per litre of fuel. Uganda charges an ad valorem tax, which is a fixed amount per litre. For this analysis, the data were obtained from the MEMD (2013) database.

3.2.2. Testing and estimation procedures

A unit root test is carried out to check the level of integration of the variables, which leads to the estimation technique. This methodology is based on the model adopted by Calvo (1998).

3.2.2.1. Econometric model and estimation. The local fuel price is assumed to be a function of oil price, exchange rate, government duty and fuel demand. That is;

$$\text{Fuel price (FP)} = f(\text{Oil Price (OP)}, \text{Exchange Rates (ER)}, \text{Taxes}, \text{Quantity of fuel demanded (Q}_d)) \quad (3.1)$$

Therefore, the model for estimation is:

$$FP = \beta_0 + \beta_1 OP_t + \beta_2 ER_t + \beta_3 T_t + \beta_4 Q_t + \beta_5 D_{year} + \varepsilon_t \quad (2)$$

Where ε_t is identically and independently distributed with zero (0) mean and constant variance (σ^2) and is serially uncorrelated.

Given that we have three products (Petrol, Kerosene and Diesel), we estimate the following three models, respectively.

$$FP_{Pt} = \beta_0 + \beta_1 OP_t + \beta_2 ER_t + \beta_3 T_{Pt} + \beta_4 Q_{Pt} + \beta_5 D_{Pt} + \varepsilon_t \quad (2a)$$

$$FP_{Dt} = \beta_0 + \beta_1 OP_t + \beta_2 ER_t + \beta_3 T_{Dt} + \beta_4 Q_{Dt} + \beta_5 D_{Dt} + \varepsilon_t \quad (2b)$$

$$FP_{Kt} = \beta_0 + \beta_1 OP_t + \beta_2 ER_t + \beta_3 T_{Kt} + \beta_4 Q_{Kt} + \beta_5 D_{Kt} + \varepsilon_t \quad (2c)$$

4. Results

Below are the results of the level of competition in the oil industry using the Herfindahl–Hirschman Index (HHI).

4.1. Level of market competition

In Uganda, major oil companies have traditionally dominated the market since the precolonial period. Although the two new companies joined the industry in 1999, the majority still controlled 96.9% of the market, with Shell alone having 35% of this market. The buyout of Agip by Shell in 2000 reduced the number of major companies to four and cemented the dominant position of Shell in the market. For instance, in 2000 and 2001, Shell had market shares of 32.59% and 31.6%, respectively. Shell further acquired Agip with market shares of 9.26% and 5.7% in 2000 and 2001, respectively. This gave the new company a market share of 41.8% and 37.3% in 2000 and 2001, respectively. The entry of new companies does not significantly affect market share levels. For instance, even in 2001, when new companies joined the market, the majority still controlled 70% of the market, which increased to 74.4% in 2003, with the market leader having about 30% of the market share. It is important to note that such market share is not acceptable in fairly regulated markets.

In 2011, the leading two companies were Shell and Total, with a combined market share of 55%, and the two new companies Petro (U) and MGS had a market share of 3% and 2%, respectively. From 2012 through 2013 to 2014, Shell and Total still dominated the market, although their market share was

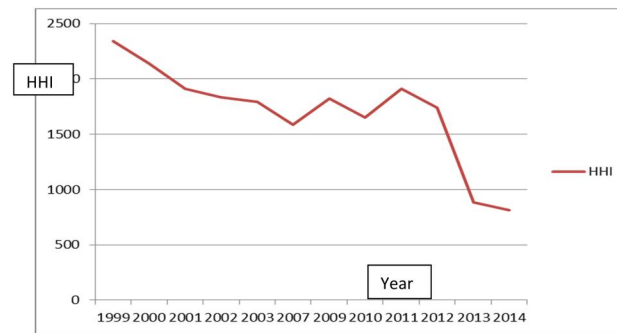


Figure 3. A graph of Herfindahl Hirschman Index (1998–2014). *Source:* Author based on data from Table 5.

significantly reduced. In 2012, Shell had a market share of 27%, which reduced significantly to 15.38% in 2013 but had a small increment to 18.61% in 2014. On the other hand, the total market share reduced from 25% in 2012 to 16.33% in 2014, a decline of 35%. Notable in the latter years is the significant gain in market share by the new entrants. Small companies increased their combined market share from under 30% of the market share in 2011 to over 68% of the market share in 2014. The recent mergers in the industry have, however, reversed this progress, with the major companies regaining a large proportion of the market share.

From the Table 5, we note that the HHI has been over 1800, which shows that the Ugandan petroleum market has been highly concentrated. The market was highly concentrated in the early years of liberalisation. There was a sharp decline in the level of concentration up to 2007, with the HHI declining from 2,343 in 1999 to 1588, a decline of 32.2%. This can be attributed to the entry of new companies, which were mainly regional companies that had the ability to influence the market by taking off some market share from the major oil companies, thus introducing limited competition.

As seen from the graph in Figure 3, the period 2008–2012 was relatively stable, with no significant variation in market concentration. However, the years–2013–2014 witnessed a dramatic fall in the level of concentration with HHI reaching 815.4 in 2014, indicating that the market is no longer concentrated, although it still has some dominant players giving market leadership. This influences the level of competition in that although it is not concentrated, the dominant companies are able to provide price leadership, especially in situations of information asymmetry where the small companies will just follow the price levels posted by the dominant companies with small price differentials.

The high concentration and market dominance of a few oil companies over the years have been sustained by a number of factors. The capital-intensive nature characterises the oil industry. The oil industry is capital-intensive, and this has been a challenge for local indigenous firms to enter the market and later expand. High cost of developing storage facilities. Storage facilities are critical in the oil industry, especially downstream petroleum operations. Companies need storage facilities to store their products for subsequent distribution to retail and consumer locations. Companies that do not have their own storage facilities must seek the use of third-party facilities very often from competitors, and the storage tariffs charged there can be prohibitive. This situation was further exacerbated by the country's lack of sufficient storage facilities.

4.2. Determinants of the local consumer fuel prices

4.2.1. Graphical analysis

Before econometric analysis, we conduct a graphical analysis to provide a visual impression of the behaviour of the series over time. Five series are shown: domestic fuel price (fuel price for petrol-FPP), exchange rate (ER), international oil price (OP), quantity demanded for petrol (QP) and government duty or tax on petrol (TP). Figure 4 shows graphs for the series.

As shown in Figure 3, the series appears to move together with the consumer fuel prices following the oil price with a lag. Oil price, exchange rate and quantity demand all appear to have high fluctuations. However, government duties appear to have long periods of constant values. Government duties have a higher degree of relative stability. This is due to the fact that government tax on petroleum

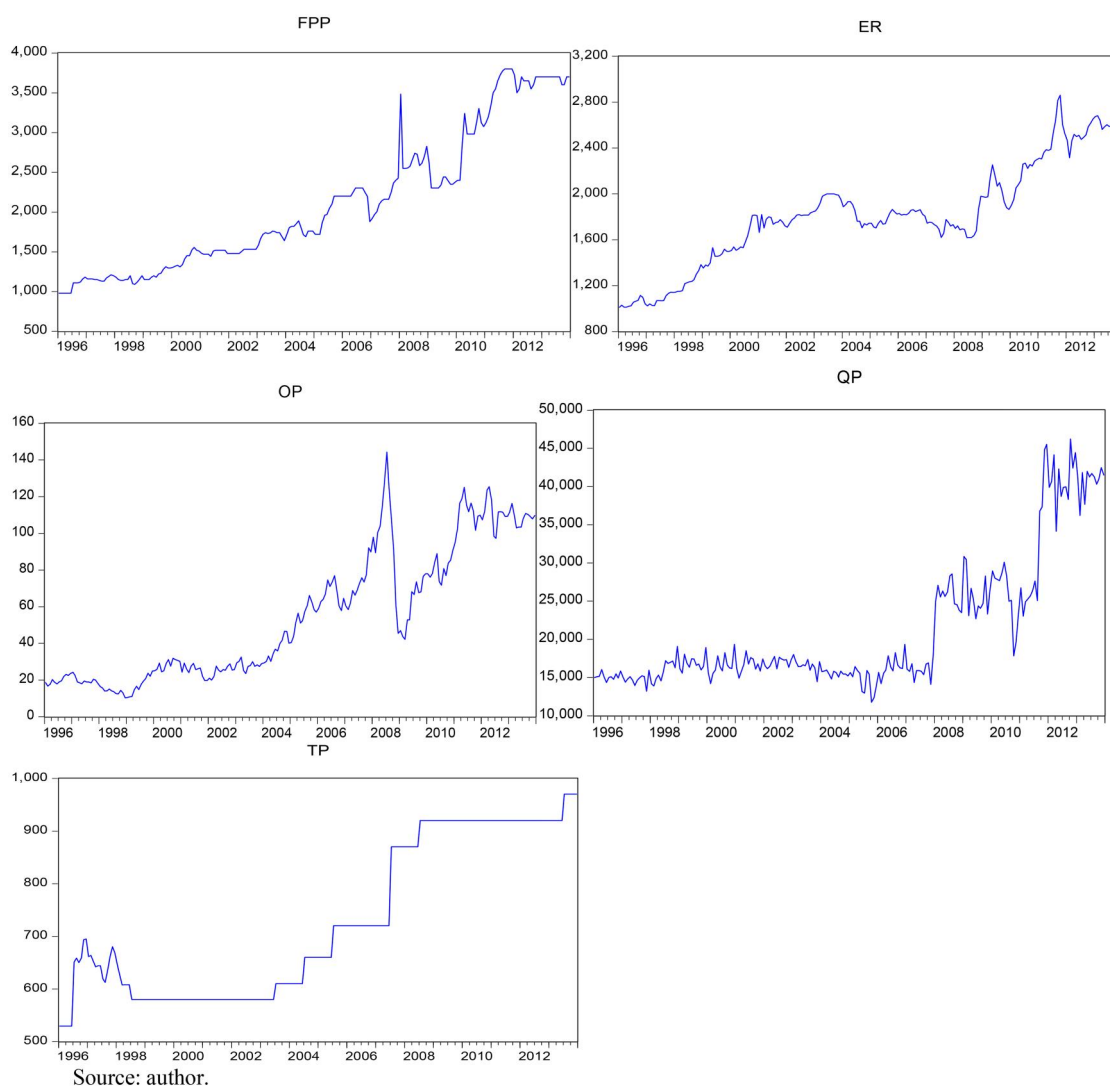


Figure 4. Graphical representation of series. *Source:* author.

Table 6. Correlation coefficients for premium motor spirit (petrol).

	Petrol price	Exchange rate	Oil price	Quantity demanded	Government duty
Petrol price	1				
Exchange rate	0.906911	1			
Oil price	0.925507	0.755044	1		
Quantity demanded	-0.850966	0.765868	0.77468	1	
Government duty	0.856217	0.695621	0.896059	0.775726	1

Source: author's calculations.

Table 7. Correlation coefficients for illuminating kerosene (paraffin).

	Kerosene price	Exchange rate	Oil price	Quantity demanded	Government duty
Kerosene price	1				
Exchange rate	0.887554	1			
Oil price	0.952901	0.775312	1		
Quantity demanded	-0.255937	0.279331	0.182790	1	
Government duty	0.631639	-0.712057	-0.577591	-0.105302	1

Source: author's calculations.

products are announced once and set during the Government budget for a specific financial year. The set tax per product did not change throughout the year. In subsequent financial years, some taxes may change and others may not. This implies that the government tax on petroleum products can be constant for several years.

Table 8. Correlation coefficients for automotive gas oil (diesel).

	Diesel price	Exchange rate	Oil price	Quantity demanded	Government duty
Diesel price	1				
Exchange rate	0.876189	1			
Oil price	0.957698	0.775312	1		
Quantity demanded	-0.872615	0.774006	0.885902	1	
Government duty	0.754480	0.505620	0.758966	0.644553	1

Source: author's calculations.

4.3. Correlation

We provide a correlation between the variables to enable us obtain a better understanding of the overall relationship between the variables (consumer fuel prices, oil price, exchange rate, demand and government duty). The correlation analysis results are shown in Tables 6, 7 and 8. From Table 6, we find that there is a strong positive correlation between petrol price and oil price at 0.926. This was followed by an exchange rate of 0.91. Government duty has a strong positive relationship, while quantity demand has a strong negative relationship with fuel prices of 0.856 and -0.851 respectively. From Table 7, we note that there is a strong positive correlation between oil price and price for kerosene at 0.95, followed by the exchange rate at 0.88, but a weak negative correlation with the quantity demanded at 0.25. The weak negative correlation implies that the quantity of kerosene demanded is not sensitive to price changes, suggesting inelastic demand. Table 8 shows that, as in the other products, the diesel price has a strong positive correlation with the oil price, exchange rate and government duty, at 0.96, 0.87 and 0.75, respectively. However, the strong negative correlation with the quantity demanded was 0.87.

From the descriptive statistics, we can conclude that the series indicates a strong effect of the oil price, exchange rate, quantity demanded and government duty on the local fuel prices of petroleum products. Econometric analysis provides robust quantitative results on the extent to which these factors affect local consumer fuel prices.

4.4. Unit roots test

We begin the econometric analysis by analysing the stationarity of the series using an ADF test. From the graphical presentations, the series appears nonstationary. The first step of the analysis involved testing each variable to determine its order of integration. The Augmented Dickey Fuller (ADF) unit root testing procedure (Dickey & Fuller, 1979) is used to test the stationarity of the series. This tested the size of the coefficients in Equation (3).

$$\Delta y_t = \beta_0 + \lambda t + \psi y_{t-1} + \beta_i \sum_{i=1}^{\ell} \Delta y_{t-i} + \varepsilon_t \quad (3)$$

where t denotes time trend.

Acceptance of the null hypothesis (ie $|\psi|=0$) confirms the presence of a nonstationary process. If the results indicate that at least one series is integrated in the same order as the dependent variable, this is followed by the formulation and estimation of the theoretical long-run equilibrium relationship. If there is a long-run relationship between two or more nonstationary variables, this implies that deviations from long-run relationships are stationary. To test for cointegration among the series, the multivariate cointegration technique developed by Johansen (1988) and applied by Johansen and Juselius (1990) was used.

Details of the augmented Dickey–Fuller (ADF) results are summarised in Table 9. Next, we determine the order of integration. Given that the variables are non-stationary, we determine the order of integration. In addition, we use an error correction model, which enables us to estimate the speed at which the dependent variable returns to equilibrium after a change in the independent variables.

The results in Table 9 show that the variables are non-stationary in levels but stationary in their first differences. Hence, they are all integrated in order I(1).

Table 9. Order of integration.

Variable	ADF levels		ADF first differences	
	ADF	Order integration	ADF	Order integration
Exchange rate	-1.208281	I(1)	-12.33632**	I(0)
Petrol fuel price	-0.901038	I(1)	-16.81242**	I(0)
Oil price	-1.307629	I(1)	-13.26270**	I(0)
Quantity demanded petrol	-0.429145	I(1)	-14.93399**	I(0)
Tax for petrol	-0.822111	I(1)	-13.86422**	I(0)
Diesel fuel price	-0.747823	I(1)	-11.76202**	I(0)
Quantity demanded diesel	-1.695058	I(1)	-15.10122**	I(0)
Government duty-diesel	-0.559019	I(1)	-13.31121**	I(0)
Kerosene fuel price	-0.699018	I(1)	-12.67816**	I(0)
Quantity demanded kerosene	-0.812342	I(1)	-14.86738**	I(0)
Tax kerosene	-1.460820	I(1)	-12.70854**	I(0)

Source: Author's analysis.

** significant at 5% level.

Table 10. Lag length for petrol price.

Endogenous variables: LNFP LER LOP LQP LTP

Exogenous variables: C

Included observations: 208

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-1,107.602	NA	0.030462	10.69810	10.77833	10.73054
1	183.9331	2508.559	1.57e - 07 ^a	-1.480126 ^a	-0.998750 ^a	-1.285482 ^a
2	205.7474	41.32140	1.62e - 07	-1.449495	-0.566972	-1.092648
3	222.8329	31.54244	1.75e - 07	-1.373394	-0.089725	-0.854344
4	238.3490	27.89915	1.92e - 07	-1.282202	0.402613	-0.600950
5	248.9138	18.48832	2.21e - 07	-1.143402	0.942560	-0.299946
6	261.8841	22.07448	2.49e - 07	-1.027732	1.459376	-0.022073
7	296.3282	56.96518 ^a	2.29e - 07	-1.118540	1.769714	0.049322
8	312.4774	25.93188	2.51e - 07	-1.033436	2.255964	0.296629

Note: LR: sequential modified LR test statistic (at 5% level); FPE: final prediction error; AIC: Akaike information criterion; SC: Schwarz information criterion; HQ: Hannan-Quinn information criterion.

^aIndicates lag order selected by the criterion.

Table 11. Results of cointegration for petrol price.

Unrestricted cointegration rank test (trace)

Hypothesised	Trace		0.05	
No. of CE(s)	Eigenvalue	Statistic	Critical value	Prob.
None *	0.240643	102.2242	69.81889	0.0000
At most 1	0.112803	43.03830	47.85613	0.1316
At most 2	0.057451	17.30525	29.79707	0.6175
At most 3	0.018917	4.584314	15.49471	0.8513
At most 4	0.002221	0.478149	3.841466	0.4893

Unrestricted cointegration rank test (maximum eigenvalue)

Hypothesised	Max-eigen		0.05	
No. of CE(s)	Eigenvalue	Statistic	Critical value	Prob.
None *	0.240643	59.18594	33.87687	0.0000
At most 1	0.112803	25.73305	27.58434	0.0846
At most 2	0.057451	12.72094	21.13162	0.4783
At most 3	0.018917	4.106165	14.26460	0.8480
At most 4	0.002221	0.478149	3.841466	0.4893

Source: author's analysis.

* significant at 1% level.

4.5. Determination of the lag length

Next, we determine the lag length. We use vector autoregressive (VAR) lag order selection criteria. We also convert the series into logs. Table 10 shows the results with respect to petrol price.

Table 12. Long run estimation results for petrol price.

Dependent variable: petrol price				
Independent variable	Coefficient	Std. error	t-statistic	Prob.
Exchange rate	1.084332	0.040619	26.69528	0.0000
Oil price	0.361551	0.021938	16.48072	0.0000
Quantity demanded	-0.049767	0.031248	1.59265	0.1127
Government duty	0.194885	0.076906	2.534053	0.0120
Constant	-4.15823	0.457663	-9.08579	0.0000

Source: Author's analysis.

Table 13. Long run estimation results for diesel price.

Dependent variable: diesel price				
Independent variable	Coefficient	Std. error	t-statistic	Prob.
Constant	3.733675	0.269624	13.84771	0.0000
Exchange rate	0.000355	1.96E-05	18.14178	0.0000
Oil price	0.353699	0.019654	17.99638	0.0000
Quantity demanded	-0.013323	0.019159	-0.695363	0.4876
Government duty	0.300674	0.041739	7.203597	0.0000

Source: author's analysis.

Table 14. Long run estimation results for kerosene price.

Dependent variable: kerosene price				
Independent variable	Coefficient	Std. error	t-statistic	Prob.
Constant	4.308731	0.301983	14.26811	0.0000
Exchange rate	0.000378	2.43E-05	15.52805	0.0000
Oil price	0.412051	0.016759	2.222783	0.0273
Quantity demanded	-0.037252	0.012623	32.64192	0.0000
Government duty	0.077761	0.048807	1.593254	0.1126

Source: author's analysis.

With a sample of 208 observations, the Akaike information criterion (AIC) provided the minimum number, and we found that the appropriate lag length for the variables was one. This implies that the variables in the subsequent analysis lagged by one.

4.5.1. Test for cointegration

Having confirmed that the variables are all integrated of order one, we now determine whether the variables are cointegrated. The results with respect to petrol prices are shown in Table 11.

The results indicated the presence of one cointegrating equation at a significance level of 0.05. This suggests that consumer fuel prices are cointegrated with oil prices, exchange rates, quantity demanded and government duties.

4.5.2. Long run relationship

Having determined that the variables are cointegrated, we can now establish a long-run relationship. This indicates how different markets interact in a longrun. Given that the different products may have different reactions, we analysed the product by product. Using petrol prices, the long-run relationship results are shown in Table 12.

We find that, although the quantity demanded coefficient has the expected sign, it is not significant, even at 10%. Only two factors, oil price and exchange rate, are significant at the 1% level, and government duty is significant at the 5% level. The results show that a unit change in the exchange rate changes the petrol price by 108%. Similarly, a unit change in the international oil price will cause the petrol price to change by 36%, while a unit change in government duty will lead to a change in the petrol price by about 20%. These results show that the exchange rate, international oil price and government duty are the main factors that explain the changes in local fuel petrol prices.

4.6. Model results for diesel price

In Table 13, we provide the model results for the local diesel fuel price.

Table 15. Error correction model results.

Dependent variable	Petrol price	Kerosene price	Diesel price
ECM adj (α_{ij})	-0.258593	-0.155000	-0.193284
Probability	0.000812	0.000277	0.000990
t-statistics	-4.192927	-5.089734	-4.076790
Adjusted R^2	0.193970	0.193626	0.192792
No. of observation	214	214	214

Source: Author's analysis.

As in the case of petrol price, we find that although the quantity demanded coefficient has a negative sign, it is not significant at the 10% level. All other variables, namely, international oil price, exchange rate and government duty, are significant at the 1% level. The results indicate that a unit change in international oil price will cause the diesel price to change by 35%, while a unit change in government duty will lead to a change in diesel price by about 30%. Although the exchange rate is significant, its impact on diesel price changes is very small. A unit change in the exchange rate leads to a change in the diesel price by 0.036%. Thus, international oil prices and government duties play a key role in the case of diesel prices.

From the results in Table 14, we find that the exchange rate, quantity demanded and oil price are significant at 5% level, while government duty, although it has the right sign, is not significant at 10% level. Thus, the most significant factor in explaining the changes in kerosene fuel price is international oil price, where a unit change in international oil price will cause the kerosene fuel price to change by 41%, exchange rate (0.038%) and quantity demanded (3.7%). Government duties have little impact on the changes observed in the price of kerosene. All of these factors explain 96% of the changes observed in kerosene fuel prices. The low impact of factors other than the international oil price explains the rigidity observed with respect to the kerosene fuel price in the market.

4.7. Equilibrium error correction model

The error correction model shows how prices adjust after departures from their long-run equilibrium. Given that the series are cointegrated, although they are integrated with order one $I(1)$, the residuals are integrated with order $I(0)$. This enabled us to undertake an error correction model. The results are shown in Table 14.

From the results in Table 15, we note that the coefficients on the cointegrating residuals have the correct sign, implying that the model corrects the disequilibrium; that is, consumer fuel prices respond to departures from the equilibrium. As indicated, the coefficient of the cointegrating residual also indicates the speed of adjustment. From the table, the adjustment of consumer fuel prices ranges between 0.155 and 0.258, with petrol price registering the highest adjustment rate of 0.258 and kerosene price the least adjustment rate of 0.155. All the results are significant at the conventional significance level. The model results show a number of key aspects with regard to fuel price changes. First, there are strong price rigidities, in that once prices are set, they tend to remain stable for a long period. Second, there is a slow process of adjustment back to the equilibrium, with the petrol price registering the highest adjustment rate at 0.258 and kerosene with the least adjustment rate of 0.155. This could be due to the quantity demanded for each of the products.

5. Conclusions and policy recommendations

The results show that the oil price and exchange rate are key to explaining the observed changes in local fuel prices. Changes in international oil prices and exchange rates are directly passed through to the fuel price. Government duty is highly significant for petrol and diesel prices, but not for kerosene, while the quantity demanded is highly significant for kerosene.

Seller concentration at existing levels may explain the sticky consumer fuel prices observed in the market. This has an implication on fuel pricing and, most importantly, on the oil price pass-through. Because of the desire to maintain high profit margins, when the international oil price increases, oil companies also increase the consumer fuel price, providing an opportunity to make higher returns. In addition, when oil prices decrease, oil companies are less incentivised to reduce the local consumer fuel

price, as this would imply a reduction in their profit margins. Thus, the resultant effect is the inability of an efficient oil price to pass. If the market predicts a future product shortage, it will be an incentive for the industry to charge high prices.

As indicated earlier, one of the key rationales for liberalisation was that an open and free market would lead to efficient market allocation. However, evidence here suggests that this is not forthcoming. Given that Uganda has recently discovered commercial oil reserves in the country, with production and the consequent refining of crude oil into finished white products for the domestic market initially planned to start in 2018 (MEMD, 2014) and now pushed to July 2026, refining crude oil into final petroleum products is not only guarantee of energy security of the country, but also has the potential to achieve low fuel prices in the domestic market. If the cost of transportation, supply chain management and industry losses experienced in the movement of petroleum products from the current sources in the Arab Gulf to Uganda are eliminated, the resultant fuel price for the locally produced oil products should be significantly lower than what is prevailing in the market today. A depreciated local currency increases the price of fuel due to the increase in cost of petroleum product acquisition in the international oil market. This increased cost could be transferred directly to the final fuel consumer.

Therefore, efforts could be aimed at promoting market efficiency and a free pricing environment supported by free and fair competition by removing incentives for companies to engage in monopolistic and oligopolistic tendencies. Exclusive supply agreements with brand-bearing companies may remove the incentives for retailers to set their own prices, thus curtailing competition in the retail fuel market. A broad framework should ensure increased and sustainable supply of petroleum products. Reducing the over-reliance on one supply route (northern route) by promoting alternative transportation routes. This is more pertinent given that Uganda is a land-locked country and thus needs efficient alternative and competing supply routes. Increased product security through the development of sufficient national strategic fuel reserves: Erratic fuel supplies and forecasts of possible future product shortages can stimulate upward price movements. Uganda, as a landlocked country, can hedge against such possible effects by having sufficient emergency stocks inland.

There is also a need for a strong and effective legal and institutional framework to regulate and manage this sector. A strong and effective regulator is a prerequisite if incentives for companies to engage in oligopolistic behaviour are removed. The restrictions may include fixing the retail consumer price for the dealer, establishing long-term dealership contracts and restricting retailers from sourcing alternative supplies. For example, if retailers were allowed to source cheap products, they could obtain the least cost supplies, which would provide an incentive to adjust prices and possibly contribute to making the demand price elastic. Managing the fuel price will require the management of the movement of the local currency against the US dollar. The appreciation of the local currency will help ameliorate fuel price increases.

Promoting other sources of energy, such as solar energy, electricity, or biogas, can reduce the pressure on liquid fuels and help stabilise prices. The promotion of alternative energy sources to expand the country's energy mix ensures the supply of energy from many sources, which can help reduce the over-reliance on oil products. In the long run, it helps reduce the pressure on demand for petroleum products, leading to reduced incentives for agents in the oil industry to increase fuel prices.

All in all, there is need to get data that is more current to the assess the situation, which was not possible for this study.

Notes

1. Crude oil price measures the spot price of various barrels of oil.
2. Noel (2007) analyses the Canadian retail gasoline market and using a Markov-switching regression, he finds that the cycles are more prevalent where there are more small firms and are accelerated with many small firms.
3. Under the hospitality arrangement companies would be allowed to store their products at the government national strategic storage depot in Jinja. The storage would be on short term and companies would pay a storage fee which was at shs 8 per litre.
4. Bhattacharyya (2011) shows that as a response to the 1970s oil price shocks, the developed countries developed the concept of strategic petroleum reserves. The initiative engineered by IEA, sees the member countries hold 90 days of net imports. This stock can then be released during periods of emergency.

5. Bhattacharyya (2011) further shows that strategic reserves have several advantages including (1) stocks when released pacify the market and dampen price rises (2) allow time for economies to adjust to the changes, (3) consumers benefit due to market reaction, and (4) can allow for countries to cooperate on development and management of strategic reserves.
6. The storage costs are estimated at \$5m to put up a fairly sized storage facility. This cost is high for most indigenous companies and thus two companies MOGAS and Petrocity have since developed their storage capacity, which matches their throughput which is still small relative to the majors.
7. Increase in petrol stations should effectively lower the price of gasoline.
8. Rent seeking means investment geared towards making supernormal profits at the expense of the consumers and country.
9. A 2003 retail survey in the district of Kampala, the capital city which accounts for over 70% of the national petroleum demand found that most stations had developed many non-traditional services.
10. Nagaoka and Kimura (1999) show how over investment in retail distribution facilities reduce the welfare of consumers.
11. The large five were the oil companies in operation at liberalisation. They were Shell, Caltex, Total, Agip and Esso.
12. A merger that results into a market share of more than 30% would be sufficient to raise potential concerns.
13. Total's acquisition of Chevron in Uganda and Kenya at a cost estimated at \$200m. This led to expansion of its market share in Uganda to over 35% (see URN 3 November 2008, The Monitor 5 November 2008)

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The data that support the findings of this study are available from the author upon reasonable request.

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