Petroleum Products pricing and Price stability in Nigeria: An ARDL investigation.

Abstract

This study employed the Autoregressive Distributed lag (ARDL) technique to investigate the effect of petroleum products pricing on price level in Nigeria over the period 1990 – 2022. In order to achieve the purpose of the study, data on inflation rate, price of premium motor spirit, price of automotive gas oil, price of household kerosene, price of compressed natural gas and price of crude oil were sourced from secondary source. The results of our analysis revealed that: in the long run, prices of Premium motor spirit and compressed natural gas retarded inflation level marginally while prices of automotive gas oil, dual purpose kerosene and crude oil spurred general price level marginally. Prices of premium motor spirit and compressed natural gas fueled inflation in the short run significantly while prices of automotive gas oil and crude retarded general price level. Price of dual-purpose kerosene had mixed but significant effect on price level. The study also found that a long run nexus existed between petroleum product prices and price level in Nigeria. Petroleum product prices had serious implications on the Nigeria's economy in the short run than long run. Based on this conclusion, the study recommended Increase investment in the downstream petroleum sector and strengthening existing policies in the oil and gas sector as possible measures towards stabilizing price level in Nigeria.

Key words: Price stability, premium motor spirit price, automotive gas oil price, Household kerosene price, compressed natural gas price and crude oil price

i. Introduction

The price of petroleum products in Nigeria has raised considerable concern owing to its substantial influence on the country's macroeconomic performance. Nigeria's economy relies substantially on the oil and gas industry, with petroleum products playing a crucial role in stimulating economic development, generating government income, and earning foreign currency. Nevertheless, the price of petroleum products in Nigeria encounters a multitude of obstacles and issues, which have substantial consequences for overall economic stability, financial viability, and societal well-being.

An important obstacle in the price of petroleum products in Nigeria is the presence of fuel subsidies, namely on Premium Motor Spirit (PMS) and Household Kerosene. Historically, the government provided financial support to reduce the prices of these items in order to mitigate the effects of expensive gasoline on consumers. Nevertheless, fuel subsidies place a substantial economic strain on the government's budget, resulting in fiscal difficulties, budget shortfalls, and diminished fiscal capacity for essential expenditures in infrastructure, education, healthcare, and social services. The presence of government interventions, fuel subsidies, price restrictions, and regulatory limits in Nigeria's petroleum products market leads to price distortions. These distortions result in market

inefficiencies, rent-seeking behaviour, and misallocation of resources. Price limitations often lead to fabricated scarcities, illicit trade, stockpiling, and illicit market operations, which undermine market rivalry, investment motivation, and economic effectiveness. Market inefficiencies impede the growth of a dynamic downstream petroleum industry and discourage private sector involvement and investment in refining capacity and infrastructure. The macroeconomic performance of Nigeria has been adversely impacted, leading to a high inflation rate, unemployment, and poverty.

One of the major obstacles confronting the Nigerian economy is the rising price level, leading to augmented living costs and persistent poverty. Nigeria has had substantial volatility in the pricing of petroleum, gas, and energy sectors owing to the deterioration of its refineries. This has led to the need for importing petroleum products, despite the country's abundant crude oil resources. The use of subsidy regimes to regulate the pricing of petroleum products has proven ineffective in stabilising prices. This is because the government is unable to maintain the regulated prices, since it negatively impacts government income and deprives important sectors of development money.

The government implemented the Petroleum Industry Act (PIB) in order to promote investment in the oil/gas and energy sectors. As part of this act, the government fully deregulated the petroleum downstream industry in 2023. These advancements have also elevated the costs of petroleum items, which serve as the primary supplies of energy in the nation. This research aims to analyse the impact of petroleum products pricing on the price level in Nigeria, considering the current situation. To further our inquiry, we will review existing literature on the stimuli of energy and petroleum product pricing on the economy, particularly in relation to price levels.

ii. Literature Review

The theoretical plank of this study is the Asymmetric Price Transmission (APT) theory. Exploring the pass-through process, the theory zeroes down on the Rocket and Feather Effect (RFE) to determine how changes in the costs of energy sources, such crude oil, impact the price of petrol. Changes in the pricing of other inputs are often linked to this process, as Bacon (1991) explains. In addition, in congruent withOjeyinka and Olayungbo (2021), what is known as the Rocket and Feather Effect (RFE) shows that as input costs go up, prices climb quickly like rockets, and when they go down, they fall slowly like feathers. We have a two-variable model in equation 2.1 where y varies directly with q and k is the constant, mathematically speaking.

$$y = k\,q \# 1 \quad (1)$$

In a three-variable model, where y changes directly with q and z but k remains constant, we obtain the following nexus:

$$y = kqz \# 2 \quad (2)$$

In a perfect market system, the Asymmetric Price Transmission (APT) happens when there exists a change in the price of a homogeneous, cross-elastic, substitutable good. As an example, electricity tariffs and crude oil and natural gas prices are not directly proportional to one another. This nexus follows the rocket and feather theory, as described by Asikhia and Orugboh (2011), assuming that all other parameters stay same. In addition, Asane-Otoo and Schneider (2015) have contended that the Asymmetric Price Transmission (APT) effect impacts the inequality in consumers' welfare owing to the rate at which prices adapt as input costs rise or fall. They have observed that some market players are placed at a disadvantage during price fluctuations.

The theory of Asymmetric Price Transmission (APT) focuses on the changes in prices in a perfectly structured market, whereas market structure refers to the structural features (These include producers and customers) of an industry in any economy (Jhingan, 2011). Makwe, Akinwale, and Atoyebi (2012) further asserted that pricing and price equilibrium are mostly determined by the theories of demand and supply.

$Qd = Qs = (P_t)$ # 3 (3)

The distinguishing characteristic of a competitive market is in the fluctuating nature of pricing (P), which is influenced by factors that determine producer profit and consumer utility (PS), ultimately resulting in the social welfare (SW) function defined as follows:

P = CS (pt) + PS (pt) = SW # 4 (4)

Consequently, the energy market economy determines the volatility of energy prices, which include the pricing of crude oil, natural gas, and electricity tariffs. Many factors, both internal and external to the market, impact these swings, which in turn have both immediate and long-term effects (Zhang, 2015). Just as it does for many other countries with a net energy import and export, the price of crude oil and natural gas has a significant upshot on Nigeria's economic performance. Because of these prices, the government is unable to meet its economic responsibilities, which in turn drives up the cost of goods and services for everyone (Iwayemi&Fowowe, 2010). But, critics of the rocket and feather hypothesis (RFH) and assumptions about the Nigerian economy's market structure, such as Aregbeyeni and Kolawole (2015) and Nkang (2018), have argued that factors like factor pricing, product heterogeneity, price fluctuations, and government policies—which in turn affect social capital investment—may undermine the law of equilibrium price.

A study conducted by Adebisi, Alenoghena, and Charles (2023) examined the effect of petroleum product prices on the production of Nigeria's manufacturing sector from 1981 to 2019. The studyutilised yearly time series data and applied the ARDL Model for estimate. The upshots indicate that the costs of Petrol and Diesel have a considerable and negative upshot on the industrial production in Nigeria. Nevertheless, there was a direct correlation between petrol price and output.

Hence, the research suggests that the dormant refineries should be revitalized in order to substantially decrease the extent of petroleum product imports in Nigeria. Similarly, it is essential to enhance the power sector in order to provide the necessary energy to these enterprises, therefore reducing their production costs and enhancing their productivity.

Meyer (2018), observed the effects of fluctuations in gasoline costs on both inflation and economic development in South Africa. This analysis wasutilised as a representation for other developing nations that rely on fuel imports. This studyutilised a quantitative research methodology, applying time series data spanning from 2001 to 2018. Analysedapplying the Johansen cointegration and Granger causality econometric models, we examined the effects of gasoline price upsurges on inflation and economic growth. The upshots demonstrated the presence of both enduring and temporary connections among the variables. The Granger causality tests revealed that changes in gasoline costs had a causal effect on economic production and inflation. The study's upshots have potential applications in monetary and fiscal policy. However, there is little influence over gasoline price fluctuations, save for the option of reducing taxes as a direct form of taxation.

With inflation costs as their primary stimulus, Lingyun, Zhihua, Fang, and Meng (2016) studied China's energy consumption in response to relative energy prices. The research covered the years 1988–2012. Ridge regression and the state-space model are some of the methodsutilised to represent the direct, regulatory, and time-varying influences. Total energy consumption is 0.337 times more sensitive to changes in relative energy costs, whereas intensity is 0.250 times more sensitive. The energy structure and the economic structure are both negatively impacted by comprehensive restrictions on energy usage, with -0.144 and -0.148 values, respectively. There exists a positive relationship between energy use and either raising or lowering energy costs (r=0.3520, r=0.3564, respectively). Inflation persisted even though the economy was expanding and energy prices were rising. Thus, the economy and the environment were both benefited by the spike in energy costs. In order for policymakers to create effective energy-pricing plans that ensure both energy savings and price system stability, the research study is vital.

In his 2013 research, Kojima examined the price of petroleum products and the accompanying regulations, drawing upon the experiences of 65 cases. Underdeveloped nations have seen a trend of policy reversals by governments since 2009, as a response to the rising global oil prices. The economic challenges have been exacerbated by the increasing costs of food. From January 2004 to January 2013, there was a strong positive nexus between the upsurge and decrease in world oil prices and energy and food costs on the global market, as shown by a correlation value of 0.89. In nations with extensive exposure to petroleum price escalation, public demonstrations often targeted

elevated fuel and food costs. Certain regimes, such as Egypt and the Islamic Republic of Iran, implemented an upsurge in fuel subsidies and food subsidies.

Uchechi, Iheukwumere, and Ogbonna (2022) conducted a study to examine the influence of petroleum product prices on the Nigerian economy from 1986 to 2015. The econometric techniques of Co-integration and Error Correction Mechanism (ECM) wereutilised to determine the degree of correlation between the dependent and independent variables. The upshots indicate a substantial correlation between RGDP and the prices of Dual-Purpose Kerosene (DPK) and Premium Motor Spirit (PMS). Inflation, on the other hand, has an insubstantial correlation with the price of DPK and PMS. However, unemployment shows a substantial correlation with the price of Automotive petrol oil (AGO), likewise the prices of PMS and DPK. The research concluded that in order to maintain a stable petroleum product market in Nigeria, it is crucial to closely monitor the oil prices of DPK, AGO, and PMS, which are essential economic factors.

In order to determine the exact relationship between domestic petrol prices and other macroeconomic variables in Nigeria between 1986 and 2011, Nwosa (2012) performed an empirical study. To conduct appropriate analysis, the studyutilised two models: a vector auto-regressive (VAR) and a vector error correction (VEC). There exists a one-way causality from domestic gasoline price to short-term interest rate, in congruent with the VAR model, when two variables are integrated of the same order but not co-integrated. However, the VEC model indicated a long- and short-run causal relationship between the local fuel price and the inflation rate when the two variables are co-integrated and of the same order.

The report advised the government to exercise great care when considering a rise in domestic gasoline prices, particularly while attempting to eliminate fuel subsidies and deregulate the downstream sector of the oil industry.

Ukangwa et al (2022) examined the influence of Nigerian petroleum product prices on the Nigerian economy by analysing data from 1986 to 2015. The authorsutilised co-integration, error correction mechanism, and unit root test to ascertain the correlation between the variables. The study revealed a substantial correlation between the Real Gross Domestic Product and the prices of premium motor spirit and dual-purpose kerosene. However, there was no substantial association identified between the prices of premium motor spirit and dual-purpose kerosene and inflation. There exists a strong correlation between the cost of automotive petrol oil, premium motor spirit, dual-purpose petrol and unemployment.

Clement (2022) conducted a study to analyse the correlation and influence of petroleum product prices on inflation, with data spanning from 1981 to 2020. The following statistical tests were

employed: unit root test, error correction mechanism, cointegration test, and Granger causality test. The author discovered that the prices of domestic kerosene and premium motor spirit contributed to inflationary pressure, but the outcome of diesel price on inflation was minimal and favourable. There exists a reciprocal cause-and-effect link between premium motor spirit and inflation. Diesel has a unidirectional causal link with inflation.

Kabiru and Rabiu (2021) examined the causal correlation between the prices of Nigerian petroleum products, currency rates, and inflation from 1985 to 2019. The Johansen co-integration test, Vector Error Correction, and Granger Causality test wereutilised. The research discovered a substantial co-integration between the prices of petroleum goods in Nigeria and the macroeconomic variables of exchange rate and inflation rate. A unidirectional causal nexus was discovered between the exchange rate, inflation rate, and the cost of petroleum items. There was no long-term connection seen between the inflation rate and the cost of petroleum products in Nigeria.

Applying data collected from April 1991 through April 2021, Meleni (2021) analysed the effects of oil price variations on inflation trends in Nigeria. To find out how changes in oil prices affect inflation, the researchers employed unit root tests and ARDL analysis. Inflation and exchange rates benefit from oil price variations over the long run, in congruent with research.

Ologbenla (2021) investigated the factors influencing energy costs in Nigeria by analysing data from 1980 to 2020. The ARDL model wasutilised. A substantial correlation was discovered between the price of petroleum products and the inflation rate. Energy prices are influenced by factors such as oil prices, input costs, and production levels.

Otoakia (2020) examined the reaction of the consumer price index to the price shock that occurred during the worldwide financial crisis of 2008. This research includes the period before and after the financial crisis. The datasetutilised spans from January 2000 (2000M01) until December 2019 (2019M12). The data was analysedapplying a structural vector autoregressive model. Prior to the financial crisis, studies showed that the spike in crude oil prices boosted the CPI. But after the crisis, the impact was constant and lasted for a long time. However, there had little effect on price stability in the long run.

In his study, Raymond (2020) investigated the stimuli of fluctuations in oil prices on the overall economic performance of Nigeria. The analysis included the time frame spanning from 1980 to 2018. This study examines the stimuli of changes in oil prices on key macroeconomic indicators such as economic growth, inflation, interest rates, currency rates, and industrial production index. The analysis is conducted applying the structural vector autoregression (SVAR) method. The inquiry upshots indicate that oil price shocks have had a substantial and adverse upshot on both economic

growth and industrial production. Moreover, the upshots indicate that oil price shocks have a noteworthy impact on inflation, likewise a favourable impact on interest rates and exchange rates. However, the upshoton interest rates and exchange rates is not statistically substantial. The impulse response function reveals a detrimental upshot on output growth, a favourable effect on inflation, and a moderate and uncertain influence on industrial production, interest rate, and exchange rate. The study's conclusions suggest that the government should separate its real sector from the unpredictable fluctuations in oil prices. Additionally, it is advised that the country adopts a strategy of economic diversification to decrease its reliance on oil.

In their study, Manasseh (2018) examined the influence of oil prices and oil income on the well-being of Nigerians. They analysed data from the years 1981 to 2014. The data was analysedapplying multi-variable regression, descriptive statistics, and co-integration. The research concluded that oil price variations did not have a substantial effect on the wellbeing of Nigerians. However, it found that money from oil had a large and beneficial influence on the welfare of Nigerians.

Ergin and Abdullahi (2018) conducted a study to analyse the stimuli of oil price volatility on economic development over the period from 1981 to 2015. The Vector Error Correction model indicates a positive correlation between oil price and real effective exchange rate with economic growth, whereas government spending and inflation exhibit a negative correlation. The Granger causality analysis revealed that changes in oil prices had a substantialupshot on economic growth and the exchange rate. Conversely, fluctuations in the exchange rate were shown to have a causal nexus with inflation. Oil price volatility is the main factor that causes changes in economic growth and exchange rates, in congruent with the variance decomposition research. The currency rate, on the other hand, is the single most important variable affecting inflation rate fluctuations, followed by the price of oil.

Okwanya and Pristine (2015) examined the stimuli of the Nigerian fuel subsidy policy change reform on the Nigerian consumer price index. Theyutilised Cointegration and error correction model for their analysis. The datautilised spanned the years 1980 to 2014. The analysis revealed that fluctuations in petroleum prices had a substantial influence on both the consumer price index and the Nigerian economy.

Oriakhi and Osaze (2013)utilised the VAR methodology to examine the consequences of fluctuations in oil prices on the economic development of Nigeria from 1970 to 2010. The investigation revealed that fluctuations in oil prices had an impact on the real exchange rate, real imports, real government spending, and real exchange rate. However, oil price volatility indirectly impacts the real money supply, inflation, and real GDP via changes in real government spending. In congruent with the

argument, changes in the price of oil impact government expenditure and therefore influence economic development.

Bobai (2015) conducted a study to know if any relationship exists between petroleum products prices and inflation in Nigeria over the period 1990 – 2012 using quarterly time series data. In order to achieve the purpose of the study, the VAR model (Vector Autoregression Model), granger causality test, impulse response function and variance decomposition were used to analysed the data. The VAR result indicates an increase in petroleum product prices leads to a simultaneous rise in the level of inflation. The granger causality test revealed that bi-directional causality existed between petroleum product prices and price level, while the accumulated impulse response function and the variance decomposition also indicated a positive relationship existed between price level and petroleum product prices in Nigeria. Based on this result, the study concluded that increase in the prices of petroleum products (PMS, AGO, and DPK) has a positive impact on the general price level of goods and services in the Nigeria economy. The study therefore recommended that the CBN and policy makers in Nigeria should also pay special attention to the supply management of petroleum products in the country.

Arinze (2011) investigated the influence of oil prices on the Nigerian economy, specifically analysing the economic consequences of price volatility and identifying the factors contributing to the rise in oil product prices. The researchutilised basic regression analysis to demonstrate a positive correlation between petroleum price fluctuations and inflation rate rises. The reason for the aforementioned outcome is that there exists a considerable correlation between the inflation rate and the price of gas. The research suggested that more resources should beutilised in order to broaden the economic base.

The literature analysis reveals that much research has been conducted on the subject of petroleum product price, energy pricing, and their impact on economic performance. However, none of the previous studies comprehensively examined all the elements of the essential petroleum product prices that are accessible and utilised in Nigeria, including premium motor spirit price, household kerosene price, compressed natural gas price, automotive gas oil price, likewise other related product prices such as crude oil price and natural gas price. This research was conducted in Nigeria to address the gap in knowledge. It empirically examined the stimuli of petroleum product pricing on price stability in Nigeria.

iii. Methodology

The theoretical foundation of this research is the Asymmetric Price Transmission (APT) hypothesis proposed by Bacon in 1991. The theory focuses on the Rocket and Feather Effect (RFE) and examines how changes in the price of energy resources, such as crude oil, affect the price of petrol due to changes in other input costs. The analytical framework of this study is owing to the work of Kabiru and Rabiu (2021), with slight modifications to include all the variables relevant to this study's purpose. Therefore, the revised model is expressed as follows:

IFR = f (α_0PMS $^{\alpha1}$, $HHK^{\alpha2}$, $CNG^{\alpha3}$, $AGO^{\alpha4}$, $COP^{\alpha5}$) 1

To enhance estimation of equation 1, it istransformed into linear form thus:

$\ln IFR_t = \alpha_0 + \alpha_1 \ln PMS_t + \alpha_2 \ln HHK_t + \alpha_3 \ln CNG_t + \alpha_4 \ln AGO_t + \delta_5 \ln COP_t + U_t 2$

Where: *Ln*=Natural logarithms;IFR_t= Inflation rate; α_0 = intercept; PMS_t= Premium motor spirit price, HHK_t= Household kerosene price, CNG_t= Compressed natural gas price, AGO_t = Automotive gas oil price, COP_t = Price of crude oil, $\alpha_1 - \alpha_5$ = Coefficients of independent variables in inflation rate model, U_i= error term. The time series data on the mentioned variables were acquired from various sources including the Central Bank of Nigeria (CBN) Statistical Bulletin, the National Bureau of Statistics (NBS), the Petroleum Products Pricing Regulatory Agency (PPPRA), the Nigerian National Petroleum Company Ltd (NNPCl), and the World Development Indicators (WDI) of the World Bank. The dataset spanned from 1990 to 2022, including a total of 33 years of observations.

The ARDL model wasutilised to estimate the link between petroleum products pricing and price level (inflation rate) in Nigeria, taking into account the mixed order of integration of the variables. Equation 3 represents the ARDL modelutilised to analyse the pricing of petroleum products and their stability in Nigeria.$\Delta(\ln IFR_t) = \alpha_0 + \sum_{t=1}^{p} \alpha_{1i} \Delta(lnIFR_{t-1}) + \sum_{t=1}^{q} \alpha_{2i} \Delta(lnPMS_{t-1}) + \sum_{t=1}^{q} \alpha_{3i} \Delta(lnHHK_{t-1}) + \sum_{t=1}^{P} \alpha_{4i} \Delta(lnCNG_{t-1}) + \sum_{t=1}^{P} \alpha_{5i} \Delta(lnAGO_{t-1}) + \sum_{t=1}^{P} \alpha_{6i} \Delta(lnCOP_{t-1}) + \eta_{1i} \Delta(lnIFR_{t-1}) + \eta_{2i} \Delta(\ln PMS_{t-1}) + \eta_{3i} \Delta(lnHHK_{t-1}) + \eta_{4i} \Delta(\ln CNG_{t-1}) + \eta_{5i} \Delta(\ln AGO_{t-1}) + \eta_{6i} \Delta(\ln COP_{t-1}) + \varepsilon_{1i} (3)$

Where: Δ = the difference operator and indicates the optimum lag;t = time lag; α_0 = constant variable; $\alpha_1 - \alpha_6$= long-run dynamic coefficients of the model;$\eta_1 - \eta_6$ = short-run dynamic coefficients of the model; ε_{1i} = serially uncorrelated stochastic term with zero mean and constant variance. Next, we estimated the long-run equations for price stability once we established the long-run nexus among the variables. The procedure was as follows:

$\ln IFR_t = \alpha_0 + \alpha_1 InPMS_{t-1} + \alpha_2 InAGO_{t-1} + \alpha_3 InHHK_{t-1} + \alpha_4 InCNG_{t-1} + \alpha_5 InCOP_{t-1} + \mu_t$ -

4

By applying a lag length of three (3) for both the regressors and regressan, the Akaike Information Criterion (AIC) wasutilised to determine the ARDL model's lag duration. In order to ascertain the dynamics in the near term, the ARDL error correction model was developed in the following way:

$$\Delta\ln(IFR_t) = \sum_{i=1}^{n} \alpha_0 \Delta 1n(IFR_{t-1}) + \sum_{i=1}^{n} \alpha_1 \Delta 1n(PMS_{t-1}) + \sum_{i=1}^{n} \alpha_2 \Delta 1n(AGO_{t-1}) + \sum_{t=1}^{n} \alpha_3 \Delta 1n(HHK_{t-1}) + \sum_{t=1}^{n} \alpha_4 \Delta 1n(CNG_{t-1}) + \sum_{t=1}^{n} \alpha_5 \Delta 1n(COP_{t-1}) + \sum_{t=1}^{n} ECM_{t-1} + U_t \quad 5$$

iv. Results

The descriptive statistics in Table 1 reveal that the inflation rate (IFR) and price of PMS have very little change during the provided time, owing to their mean, lowest and maximum values, likewise their standard deviation values. Nevertheless, there is substantial variation in the prices of crude oil (COP), automated gas oil (AGO), kerosene (HHK), and compressed natural gas (CNG) when considering the mean, lowest, and maximum values, likewise the standard deviation values. Owing to the probability values, it can be deduced that the crude oil price and the price of Premium Motor Spirit exhibit a normal distribution around their mean values. However, the inflation rate, price of automated gas oil, price of kerosene, and price of compressed natural gas do not exhibit a normal distribution around their mean values. In summary, it can be concluded that the prices of petroleum products in Nigeria had substantial volatility over the time of analysis.

Table 1. Descriptive Statistics Result

Statistic	IFR(%)	COP($/barrel	PMS(N/litre)	AGO(N/litre	HHK(N/litre	CNG(N/kg)
Mean	18.25	49.65	70.81	170.33	109.69	137.56
Median	12.00	41.47	65.00	60.00	50.00	75.00
Maximum	76.80	109.45	195.00	2140.00	809.00	816.00
Minimum	0.200	12.28	0.60	0.50	0.40	0.50
Std. Dev.	16.80	31.74	60.02	385.32	176.52	202.77
Skewness	2.20	0.57	0.50	4.36	2.45	2.20
Kurtosis	7.09	1.99	1.86	22.28	9.04	7.23
Jarque-Bera	49.50	3.14	3.18	615.24	83.21	51.19
Probability	0.00	0.21	0.20	0.00	0.00	0.00
Sum	602.35	1638.29	2336.55	5620.96	3619.90	4539.50
Sum Sq. Dev.	9032.94	32243.90	115283.1	4751192.	997075.1	1315646.
Observations	33	33	33	33	33	33

Source: author's Computation

The test upshots shown in Tables 2 suggest that the inflation rate (IFR) and the price of PMS are stationary at level i(0), meaning they do not exhibit unit roots. This suggests that these variables were in a stable state at order zero or without undergoing any differencing. Therefore, we reject the null hypothesis that there are unit roots present in the real upsurge of GDP and premium motor spirit. Nevertheless, the prices of automated gas oil (AGO), compressed natural gas (CNG), crude oil (COP), and kerosene remained constant when considering the initial difference i(1). After applying first differencing to the variables, the null hypotheses about the existence of unit roots were rejected. To summarise, the unit roots test conducted applying the Philip-Perron method indicated that the variables exhibit varying levels of stationarity. The use of the ARDL approach was influenced by this advancement, as it was employed to analyse the stimuli of petroleum product prices on economic growth in Nigeria.

Table 2: Unit Roots Test Result applying Philip-Perron Procedure

Variable	Philip-Perron Statistic	1% critical level	5% critical level	Probability	Inference
Log(IFR)	-4.45	-3.65	-2.96	0.00	Stationary@ I(0)
Log(PMS)	-4.40	-3.65	-2.96	0.00	Stationary@ I(0)
Log(AGO)	-8.43	-3.66	-2.96	0.00	Stationary@ i(1)
Log(HHK)	-6.07	-3.66	-2.96	0.00	Stationary@ i(1)
Log(CNG)	-6.56	-3.66	-2.96	0.00	Stationary@ i(1)
Log(COP)	-4.98	-3.66	-2.96	0.00	Stationary@ i(1)

Source:Author'sComputation

Table 3 confirms the existence of a long-term link among the variables in the price level model (IFR). With an F- statistic of 3.868107 which is greater than the lower and upper bound critical level at 5 percent, we confirmed that the variables in the inflation model converge in the long run. Estimating the long-term and short-term/error correction impacts of petroleum product prices on important macroeconomic performance in Nigeria is necessary to establish the existence of a long-term link.

Table 3: ARDL Bound Test Result for Inflation rate (IFR) Model

F-Bounds Test		Null Hypothesis: No levels nexus		
Test Statistic	Value	Signif.	I(0)	I(1)
			Asymptotic: n=1000	
F-statistic	3.868107	10%	2.08	3
K	5	5%	2.39	3.38
		2.5%	2.7	3.73
		1%	3.06	4.15
Actual Sample Size	30		Finite Sample:	

			n=30	
		10%	2.407	3.517
		5%	2.91	4.193
		1%	4.134	5.761

Source: Author's Computation

Estimation of the Inflation rate Model

The ARDL upshot in Table 4 shows that the price of PMS and the price of compressed natural gas have a negative nexus with the price level. The analysis also indicates that there exists nosubstantialnexus between the price of PMS and the price of compressed natural gas (CNG) at a 5 percent level of significance. From what we can see, the little increase in the price of gasoline and compressed natural gas had a completely insignificant effect on Nigeria's general price level over the course of the study. Results also show that crude oil, fuel for automobiles (AGO), and dual-purpose kerosene (HHK) all have a positive association with inflation, albeit it is not statistically significant. That these variables, even with their relatively small price increases, contributed to the general increase in Nigerian prices throughout the study period is supported by the data.

Table 4: ARDL Long run Result for Inflation rate (IFR) Model - ARDL (2, 3, 3, 2, 1, 1)

Variable	Coefficient	t-Statistic	Prob.
LOG(PMS)	-10.05969	-0.930599	0.3704
LOG(AGO)	4.758805	0.833114	0.4211
LOG(HHK)	3.223066	0.861117	0.4061
LOG(CNG)	-0.942505	-0.372575	0.7160
LOG(COP)	1.574449	0.661961	0.5205
C	7.726797	0.992903	0.3404

Source: Author's Computation

The short run error correction ARDL result reported in Table 5 indicates that price of premium motor spirit (PMS) bears a negative relationship with price level at level but has positive relationship with price level at lags 1 and 2. The result also indicates that price of premium motor spirit is significant at 5% level. This implies that increase in the price of PMS has serious and direct implication on price level in Nigeria over the period of the study.

The result further shows that price of automotive gas oil (AGO) bears a negative nexus with price level at level, lags 1 and 2. From the result price of automotive gas oil is not significant at level but significant at lags 1 & 2. This implies that price of AGO has serious negative implication on price level. That is as price of AGO rises, general price level falls and vice versa.

The price of household kerosene (HHK) is positively and insignificantly related to general price level at level but negative and significantly related to general price level at lag 1. This implies that price of kerosene has mix implications on inflation rate in Nigeria over the period of this study.

Price of compressed natural gas stimulated inflation significantly from the result reported. This implies that rise in the price of compressed natural gas fueled general price level in Nigeria during the period of this study. Price of crude has a negative and insignificantly nexus with general price level. This implies that increase in the price of crude oil retarded general price level in Nigeria over the period of the study.

The speed of adjustment of the error correction term reveals that petroleum products prices in Nigeria adjust slowly to long run changes in general price level in Nigeria over the period of this study. Also, the goodness of fit of 0.84 indicates that about 84% of the total change in general price level is influenced by changes in petroleum products prices in Nigeria over the period of the study.

Table 5: Short run/ECM Result for Inflation rate (IFR) Model - ARDL(2, 3, 3, 2, 1, 1)

Variable	Coefficient	t-statistic	Probability
DLOG(IFR(-1))	-0.307493	-2.091771	0.0584
DLOG(PMS)	-2.535231	-3.896510	0.0021
DLOG(PMS(-1))	2.778180	4.090343	0.0015
DLOG(PMS(-2))	4.067869	4.688089	0.0005
DLOG(AGO)	-0.308695	-1.278965	0.2251
DLOG(AGO(-1))	-1.781702	-5.669821	0.0001
DLOG(AGO(-2))	-0.818831	-3.937091	0.0020
DLOG(HHK)	0.242574	0.760552	0.4616
DLOG(HHK(-1))	-1.086278	-2.578256	0.0242
DLOG(CNG)	1.972962	3.625112	0.0035
DLOG(COP)	-0.831781	-1.743566	0.1068
CointEq(-1)*	-0.450670	-6.373000	0.0000
R^2 = 0.84; R^2-adjusted = 0.85; Durbin Watson Statistic = 2.30			

Source: Author's Computation

Post Estimation Test Result of the Inflation rate model

The diagnostic tests upshots presented in Table 6 indicate that the Jarque-Bera statistic is 6.64, with a probability value of 0.06. This value exceeds the expected level of significance at the 5 percent level, suggesting that the error terms are normally distributed. Therefore, we accept the null hypothesis of normal distribution. The Breusch-Godfrey test, also known as the Lagrange Multiplier (LM) F-statistic of 1.13, indicated that there was no serial correlation in the residuals. This was confirmed by the null hypothesis of no serial correlation, since the probability value was 0.30. The Bresch-Pagan-Godfrey Heteroskedasticity test indicated that there was no presence of heteroscedasticity in our model, as

shown by the F-statistic of 0.50. We maintained the null hypothesis of homoscedasticity owing to a probability value of 0.91. The null hypothesis, which holds that the model was adequately stated, was rejected in congruent with the results of the Ramsey Regression Equation Specification Error Test (RESET), which had an F-statistic of 9.1 and a probability value of 0.01.

Hence, there exist a potential for the model to be inaccurately stated, leading to the exclusion of key variables. Furthermore, it is possible that the model has an incorrect functional form. The model is adequate for analysis, and predictions derived from it are trustworthy, even if we found a specification error.

Table 6: Model Diagnostic Test Result for Inflation rate (IFR) Model

Diagnostic Test	F-ratio	Probability	Inference
Normality	6.64	0.06	Accept H_0
Serial Correlation	1.13	0.36	Accept H_0
Heteroskedasticity	0.50	0.91	Accept H_0
Ramsey RESET	9.1	0.01	Reject H_0

Source: Author's Computation

The Recursive Residual, Cumulative Sum (CUSUM), and CUSUM of Squares graphs wereutilised to assess the stability of the residual for the long-run coefficients in the inflation rate model, while also considering the short-run dynamics. Figures 2(a), 2(b), and 2(c) show the Recursive Residual, CUSUM, and CUSUM of Squares lines, respectively, consistently staying below the crucial threshold of 5 percent. The stability of the long-run coefficients of petroleum products prices impacting inflation rate in Nigeria is shown by the fact that neither the Recursive Residual nor the CUSUM or CUSUM of Squares plots go over the 5 percent crucial lines. The validation of parameter stability demonstrates the model's prediction of how changes in petroleum product prices influenced the inflation rate in Nigeria.

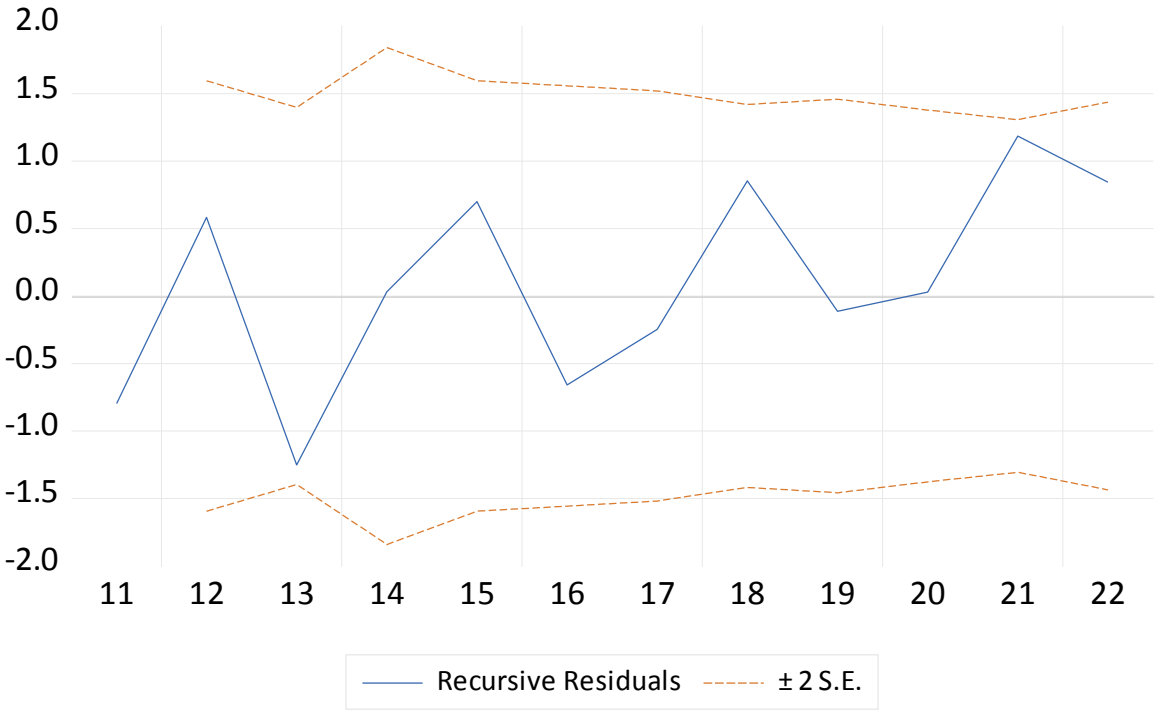

Figure 2(a): Recursive Residuals test Result for Inflation rate model

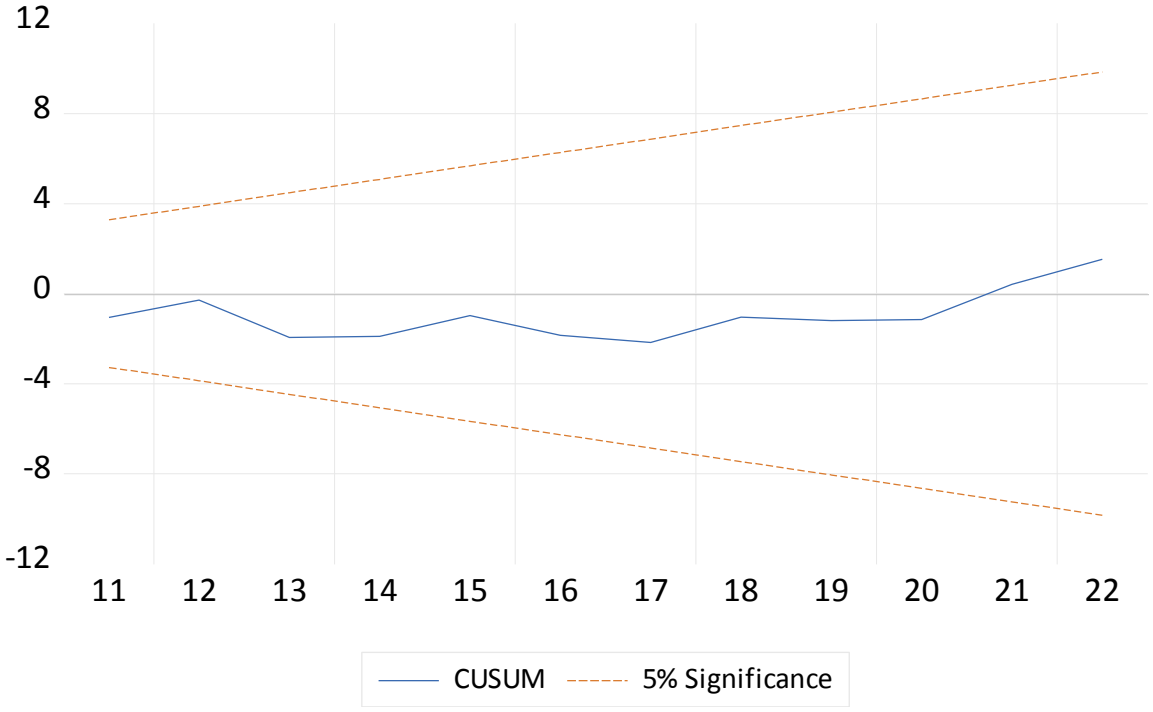

Figure 2(b): CUSUM Graph for Inflation rate model

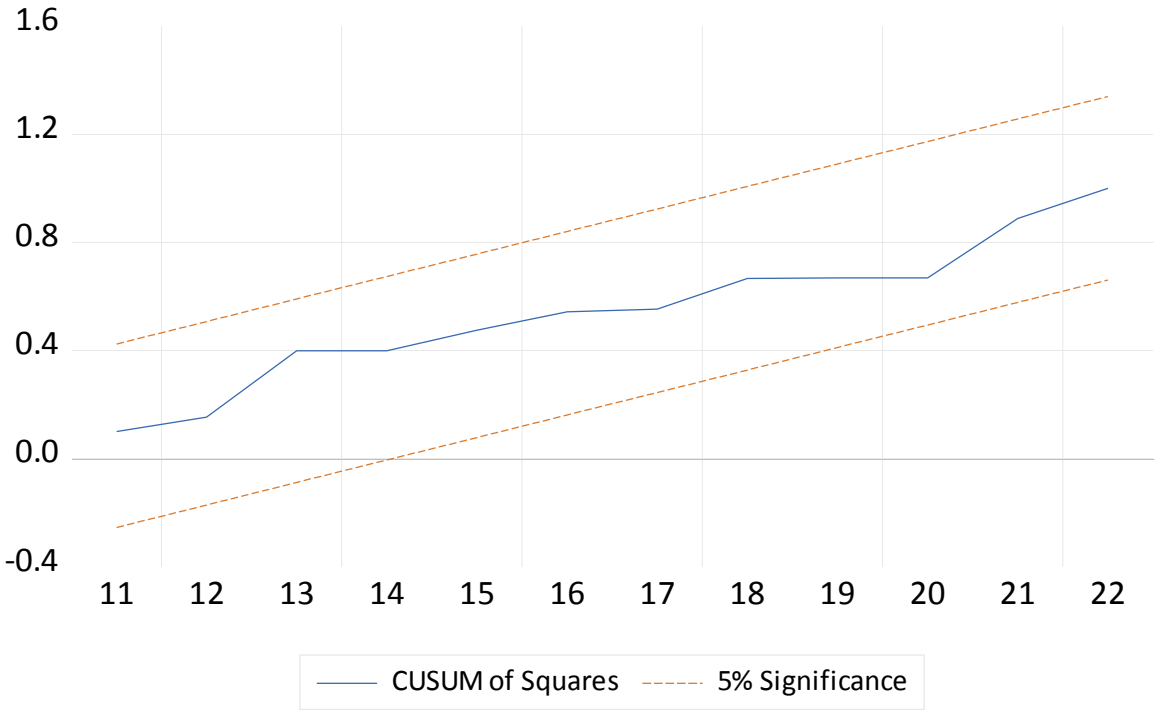

Figure 2(c): CUSUM of Square graph for Inflation rate model

Source: Author's Computation

v. Discussion of Results

The result indicated that price of premium motor spirit (PMS) and compressed natural gas (CNG) had negative and insignificant effect on general price level in the long run but positive and significant impact on general price level in the short run. The positive nexus between price of PMS and inflation is in consonance with the studies by Nwosa (2012), Francis (2012), Clement (2022) and Arinze (2011). Increase in the price of petrol (PMS) usually increase cost of transportation and raise prices of commodities in Nigeria. This is because premium motor spirit is one of the major sources of energy for domestic transport and small business operators in Nigeria. It should be noted that the current increase in general price level in Nigeria is partly attributed to the hike in the price of PMS due to the complete deregulation of the downstream sector of the petroleum industry.

Prices of automotive gas oil (AGO), dual purpose kerosene (HHK) and crude oil price were all positively and significantly related to price level in the long run. However, price of automotive gas oil had negative and significant effect on price level in the short run while crude oil price had negative and insignificant effect on price level in the short run. Price of Dual-purpose kerosene was found to have mixed and significant effect on price level in the short run. The positive effect of AGO on inflation rate as found in this study is in consonance with the works of Francis (2012) and Clement (2022) which found positive nexus between price of automotive gas oil and inflation rate in Nigeria.

Increase in the price of diesel (AGO) usually increase cost of production, transportation and raise prices of commodities in Nigeria. This is because diesel is one of the major sources of energy for industrial production and large business operators in Nigeria.

Price of compressed natural was negative and marginally related to price level in the long run but had positive and significant nexus with price level in the short run. Compressed natural gas (CNG) is a major source of energy for household use and its price and consumption has serious implications on cost of living and environmental sustainability. Cost of living in Nigeria is currently very high due to increase in the price of energy (especially, PMS and CNG). This increase in price of energy has further worsened environment sustainability as the level of deforestation has increased in the country.

The result revealed a positive and insignificant nexus between crude oil price and inflation in the long run but a negative and marginal relationship between crude oil price level in the short run. The long run result is in consonance with earlier study by Arinze (2011) who found a direct relationship between crude oil price and inflation rate in Nigeria. Though Nigeria is one of the major producers of crude oil in the world but her inability to refine crude had led to the direct effect of changes in crude oil price on general price level in the country. Nigeria is a net importer of petroleum products hence any rise in price of crude oil in the international market trigger domestic price level.

i. Concluding Remarks

This study employed the Autoregressive Distributed lag (ARDL) technique to investigate the effect of petroleum products pricing on price level in Nigeria over the period 1990 – 2022. The results of our analysis revealed that: in the long run, prices of Premium motor spirit and compressed natural gas retarded inflation level marginally while prices of automotive gas oil, dual purpose kerosene and crude oil spurred general price level marginally. Prices of premium motor spirit and compressed natural gas fueled inflation in the short run significantly while prices of automotive gas oil and crude retarded general price level. Price of dual-purpose kerosene had mixed but significant effect on price level. The study also found that a long run nexus existed between petroleum product prices and price level in Nigeria. Petroleum product prices had serious implications on the Nigeria's economy in the short run than long run. Based on this conclusion, the study recommended Increase investment in the downstream petroleum sector and strengthening existing policies in the oil and gas sector as possible measures towards stabilizing price level in Nigeria.

References

Adebisi, S. D., Alenoghena, R. O., & Charles, (2023). The impact of petroleum product prices on the Nigerian economy. *International Journal of Humanities Social Science and Management (IJHSSM) 3*(2), 12-20.

Aregbeyeni, O., & Kolawole, B. O. (2015). Oil revenue, public spending and economic growth relationships in Nigeria. *Journal of Sustainable Development*, 8(3), 114–123.

Arinze, P. E. (2011). The impact of oil price on the Nigerian economy, *Journal of Research in National Development (JORIND),9*(1), 211-215

Asane-Otoo, E., & Schneider, J. (2015). Retail fuel price adjustment in Germany: A threshold cointegration approach. *Energy Polic y, 78*:1–10.

Asikhia, O. &Orugboh D. (2011). Marketing cost efficiency of natural gas in Nigeria. *Petroleum Gas University of Ploiesti, Bulletin, Economic Sciences Series*, *53*(3), 1-13.

Bacon R.W. (1991), Rockets and feathers: the asymmetric speed of adjustment of UK retail gasoline prices to cost changes. *Energy Economics 13, 211 -218*

Bobai, F. D. (2015). Petroleum product prices and inflation in Nigeria 1990 – 2012. *Journal of Economics and Social Research* 6(1) 1 - 24

Clement, K. (2022). Petroleum products prices and inflation using data from 1981 to 2020. *Journal of International Economics, 94*(2), pp. 239–247.

Ergin, A., & Abdullahi, B. N. (2018). The impact of oil price instability on economic growth: evidence from Nigeria. *Business, Economics and Management Research Journal - BEMAREJ, 1*(1), 39-53.

Iwayemi, A., &Fowowe, B. (2010). Impact of oil price shocks on selected macroeconomic variables in Nigeria. *Energy Policy, 39*(3) 603-612.

Jhingan, M. L. (2011). *The economics of development and planning*. (39th ed.). Delhi:Vrinda Publications (P) Ltd.Pp.1-457.

Kabiru, L. G., & Rabiu, M. (2021) Nigerian petroleum products prices, exchange rate and inflation during the year 1985 to 2019. *Energy Policy, 39*(2011), 8062- 8069.

Kojima, K. (2013). *Petroleum product pricing and complementary policies: Experience of 65 Developing Countries since 2009.* Policy Research Working Paper 6396, World Bank.

Lingyun, H., Zhihua, D., Fang, Y., & Meng W. (2016). The impact of relative energy prices on industrial energy consumption in China: A consideration of inflation costs. *Sprigerplus*, *5*: 1-21.

Makwe, J.N., Akinwale, Y.O & Atoyebi, M.K. (2012). An Economic Assessment of the Reform of Nigerian Electricity Market. *Journal of Energy and Power 2(3):24-32.*

Bacon RW (1991) Rockets and feathers: the asymmetric speed of adjustment of UK retail gasoline pricesto cost changes. *Energy Economics Journal 13:211–218.*

Manasseh, O.C, Ogbuabor, J.E, Orji, A & Aneke, G.C. (2018) Did the global financial crisis alter the oil-gasoline price relationship? Springer

Meleni, M. (2021). The effect of oil price changes on the inflationary dynamics in Nigeria. *Journal of Economics and Finance, 50*(1), 1-19.

Meyer, D. F. (2018). The impact of changes in fuel prices on inflation and economic growth in South Africa. *RAIS Conference Proceedings,19*(20), 65-73.

Nkang, M. N. (2018). Oil price shocks, agriculture and household welfare in Nigeria: Results from an Economy-Wide Model. *European Scientic Journal,* 14(31), 158 -177.

Nwosa, P. I. (2012). Domestic fuel price and the Nigerian macroeconomy. *African Journal Economic and Sustainable Development*, 4(3), 89-101.

Okwanya, I., & Abah, P. O. (2018). Impact of energy consumption on poverty reduction in Africa. *CBN Journal of Applied Statistics,* 9(1), 105-139.

Ologbenla, L. (2021). The determinants of Nigerian energy prices using data of 1980 - 2020. *Asian Economic and Financial Review, 3*(2), 178-185.

Olayungbo, D.O. &Oyeyinka, T. (2021). Crude oil prices pass-through to retail petroleum product prices in Nigeria: evidence from hidden cointegration approach. *Economic Change and Restructuring 55(3) 951–972*

Oriakhi, D. E., & Osaze, I. D. (2013). Oil price volatility and its consequences on the growth of the Nigerian economy: An examination (1970-2010). *Asian Economic and Financial Review, 3*(5), 683-702.

Otoakia, O. (2020). *Consumer price index response due to the price shock during international financial crisis 2008*. MPRA Paper No. 62797.

Raymond, A. (2020). Oil price shocks and macroeconomic performance of the Nigerian economy: a structural VAR approach.*Economics and Organization, 17*(4), 299 – 316.

Uchechi, U. J., Iheukwumere, I. V., & Ogbonna, B. M. (2022). Impact of petroleum product pricing on Nigerian economy. *Journal of Research in Humanities and Social Science, 10*(7), 19-30.

Ukangwa, J., U., & Chin, L. (2022). Nigerian petroleum products prices impact on the Nigerian economy using data of 1986 to 2015. *International Journal of Humanities and Social Science Invention, 6*(9), 9-14.

Zhang, F. (2015). Energy price reform and household welfare: The case of Turkey. *The Energy Journal,* 36(2), 75-95.