



OIL RESOURCE MANAGEMENT AND INDUSTRIAL DEVELOPMENT IN NIGERIA: EMPIRICAL EVIDENCE FROM NBS PETROL PRICE WATCH

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Abstract

Industrializing Nigeria requires steady and affordable energy supply and distribution. Hence, this paper examined Nigeria's petrol market for evidence of consumers paying above the government approved prices and for evidence of asymmetric response of retail petrol prices to changes in oil price. National Bureau of Statistics' (NBS) Petrol Price Watch data was used together with descriptive analysis and an ARDL-ECM model. Overall, we find that even when the product is subsidized, consumers in most states pay above the government approved prices. In addition, we find that both in the short-run and long-run, retail

petrol prices in Nigeria respond asymmetrically to changes in oil price. These findings are contrary to Nigeria's status as an oil-rich

KEYWORDS:

*Natural resource;
Petrol pricing;
Industrialization;
Nigeria;
Competitiveness;
Consumers;
Energy supply and
Distribution.*

country, thereby capturing the stark reality of poor utilization of the country's oil resources to improve its industrial competitiveness.

INTRODUCTION

Attainment of sustainable industrial and technological advancement in Nigeria, underpinned by rapid and continuous job creation in the real sectors of the economy, has been identified as a major means of achieving and sustaining the country's goal of inclusive growth and development (Audi & Mohammed, 2014; Mba, 2015). However, this dream of industrializing Nigeria cannot be realized without steady and affordable energy supply and distribution, which is the life blood of modern industrialization and civilization (Borenstein, Cameron and Gilbert, 1997; Greenwood-Nimmo and Shin, 2013). Stern and Kander (2012) show that the expansion of energy services is a major factor in explaining economic growth, but when energy services are scarce they strongly constrain output growth.

Similarly, United Nations Industrial Development Organization, UNIDO (2015) explained that industrial energy use is a key lever for sustainable industrial development since the availability and cost of energy supplies have major influence on industrial development. UNIDO (2015) further emphasized that the size and structure of the industrial sector determines the amount and type of energy needed. This means that the relationship between the energy sector and the industrial sector is bidirectional so that developments in the energy sector affect industry while industry is a major market for energy. In other words, the interdependence between the energy sector and the industrial sector should be of major concern to the Nigerian government in formulating both energy and industrial policies.

Furthermore, Sendich (2014) identified the industrial sector, which mainly consists of manufacturing, construction, agriculture, and mining industries, as one of the largest consumers of energy. Indeed, the importance of energy in every sphere of our lives cannot be over stressed.

Typically, Nigerians and many other developing countries use energy in different spheres of human activity such as in industries, for mining, milling, smelting, forging of primary metals, electricity generation, raw material transformation (into plastic, fertilizers, solvents, lubricants, and other chemicals for commercial uses), manufacture (of cement, glass, tiles, paper,

bricks), processing of food etc; in agriculture for powering of machines and equipment as well as for storage; in construction, for powering of machines and equipment; in residential and commercial buildings, for heating, air conditioning, lighting, powering of electronic equipment (such as computers, copy machines, television, radios, etc), refrigerating, etc; in transportation of humans, goods and services; in schools, for powering of electronic boards and conducting of research; and in hospitals, for powering of electrical and electronic equipment used for medical examination (Mbalisi and Offor, 2015)

The foregoing paragraphs indicate that the role of energy in Nigeria's journey to industrialization is quite critical. However, the important question that motivated this study is how can energy play a major role in Nigeria's industrial revolution yet occupy a small share of the costs of production? This question became absolutely necessary following the realization that even though Nigeria is an oil-rich country, it has nonetheless witnessed persistent energy shortage over the years, especially in the retail petrol market where consumers appear to have been paying more than the official price per litre of product consumed (Onifade & Ojukwu, 2010; Akpan & Nnamseh, 2014). Indeed, there cannot be any question that such persistent energy shortage imposes hardship on businesses and households, and renders the overall Nigerian business and industrial environment relatively uncompetitive to both foreign and local investors (Ocheni, 2015; Akpan & Nnamseh, 2014). Quite recently, Sadik (2015), Olaoye (2016) and Ogunlowo, Bristowe and Sohail (2017) highlighted the sad reality that despite its large oil and natural reserves, Nigeria's electrification rate is less than 50% of the population, showing that Nigeria suffers from extreme energy shortage. They also stated that Nigeria is endowed with oil and natural resources but the country cannot be said to have ever had adequate supply of electricity in the history of its electricity generation. All in all, it can be seen that industrial and economic development in Nigeria will be crawling perpetually without affordable and reliable energy.

A major consequence of the energy supply challenges in Nigeria has been aptly identified by Iwayemi (2008), who stated that the Nigerian energy industry is probably one of the most inefficient in meeting the needs of its customers globally. Iwayemi (2008) pointed out that the inefficiency of Nigeria's energy sector is most evident in the persistent disequilibrium in the markets for petroleum products and electricity, especially petrol, kerosene and diesel markets. The study further observed that the dismal energy service provision in Nigeria has adversely affected living standards of the population and exacerbated income and energy poverty in an economy where the majority of the people live on less than \$2 a day. Yet, energy and income poor Nigeria is energy resource rich and the sixth largest exporter of crude oil in the world. Nigeria's persistent energy crisis has weakened the industrialization process, and significantly undermined the effort to achieve sustained economic growth, employment generation and increased industrial competitiveness (Iwayemi, 2008).

The Nigerian experience as detailed above is indicative of poor natural resource utilization, which is such that even when the price of petrol is subsidized by the government, the product hardly gets to the consumers at the government control prices due to irregular behaviors by retailers that are detrimental to the overall social welfare (Akov, 2015; Majekodunmi, 2013; Ezeh, 2012). This suggests that: (i) consumers may be paying above the government approved prices in most states of the federation; and (ii) retail petrol prices in Nigeria may be responding asymmetrically (inversely) to crude oil price changes. Obviously, these are challenges that should be addressed through evidence-based policies so that Nigeria's journey to industrialization can proceed seamlessly. Against this background, this paper uses the Petrol Price Watch data published monthly by the National Bureau of Statistics (NBS) to investigate Nigeria's petrol market for evidence of consumers paying above the regulated prices and for asymmetric price adjustment following oil price changes. In addition, the paper makes recommendations on how any undesirable pattern of asymmetry observed in the market can be avoided. Overall, the motivation behind this paper is that a key bottleneck in Nigeria's journey to

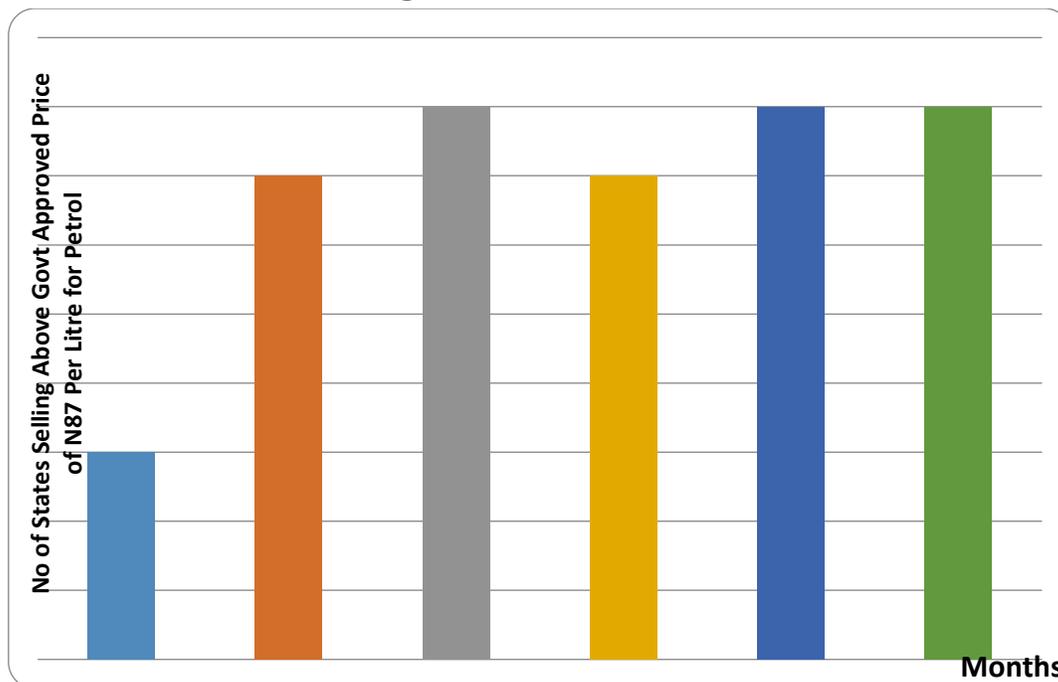
industrialization can be dismantled by ensuring affordable and steady supply of petrol to both businesses and households.

Some descriptive evidence from NBS petrol price watch:

Notwithstanding that Nigeria is the largest producer of crude oil in Africa, the Nigerian retail petrol market has been witnessing prolonged periods of product scarcity, uncompetitive pricing, product hoarding and other practices that are detrimental to consumers’ welfare (Akov, 2015). Indeed, these unwholesome practices have not only driven many Nigerians into poverty but have also led to the death of many small scale enterprises, thereby worsening the nation’s unemployment status, income generation ability, and overall business environment. In what follows, some stylized facts about the retail petrol market in Nigeria are presented based on data from the National Bureau of Statistics (NBS), Abuja. This is with a view to establishing whether consumers have been paying above the regulated prices or otherwise.

Figure 1: No of States Selling Petrol Above the Govt Approved Price

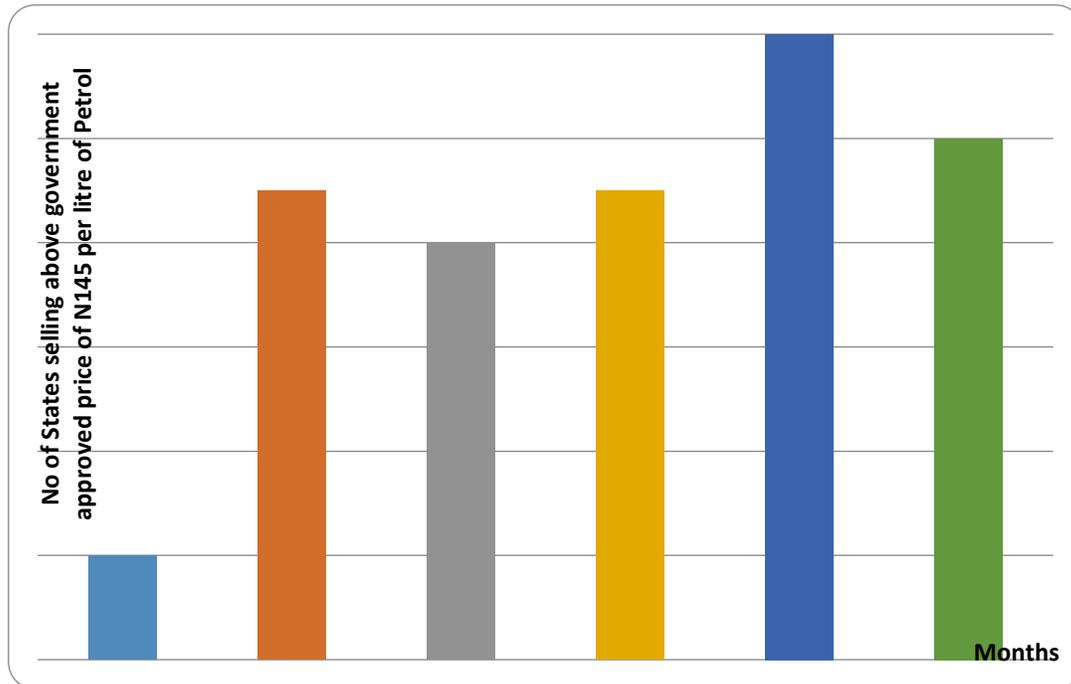
Panel A: No of States Selling Above N87 Per Litre



Note: Retail petrol price in Nigeria was reduced from N97 to N87 effective midnight of January 18, 2015.

Source: National Bureau of Statistics (NBS) Publication, 2015.

Panel B: No of States Selling Above N145 Per Litre



Note: Retail petrol price in Nigeria was increased from N86.5 to N145 effective May 12, 2016.

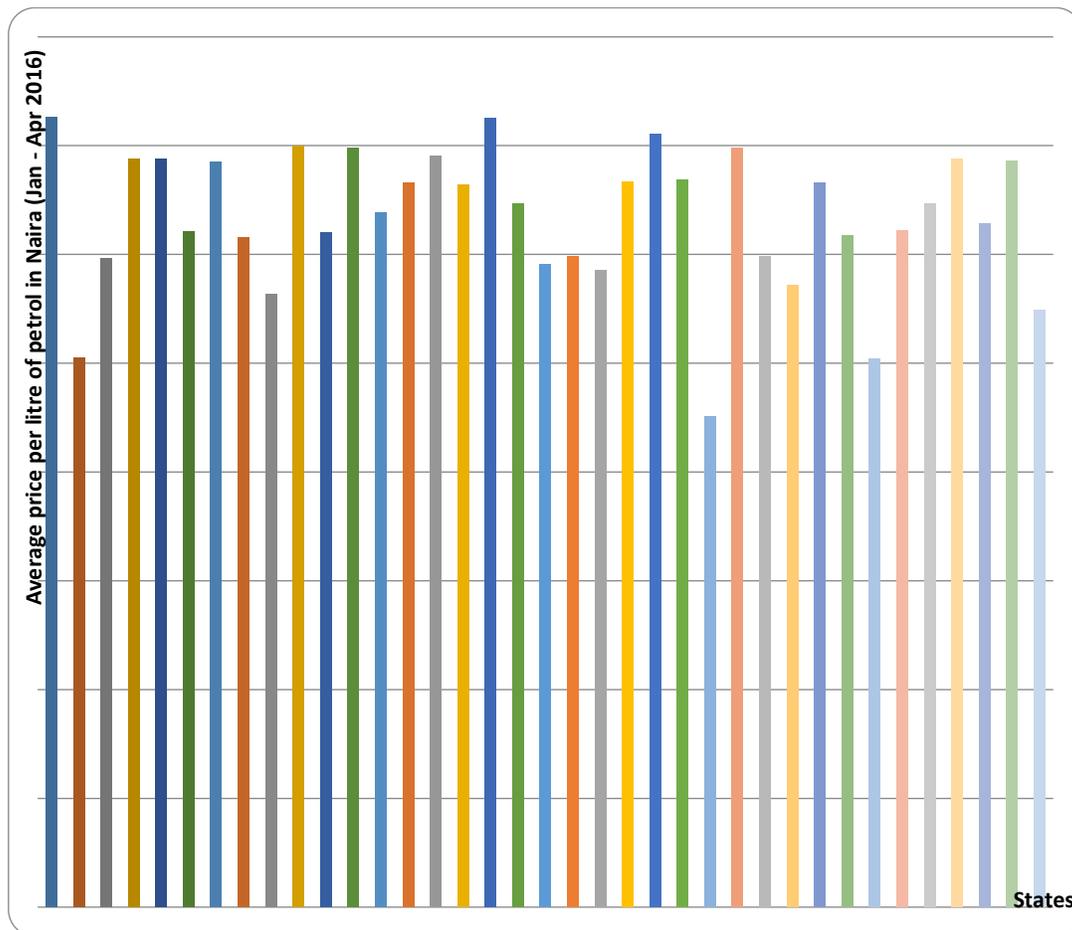
Source: National Bureau of Statistics (NBS) Publication, 2015.

Figure 1 above shows the number of States in Nigeria (including the Federal Capital Territory, Abuja), where petrol sold for prices above the government approved retail prices. Panel A reports for states that sold above N87 per litre while Panel B reports for states that sold above N145 per litre. Let us focus on Panel A. we find that a number of stylized facts are discernible from this figure, and these facts can be summarized as follows. One, from February to July 2015, most States in Nigeria persistently sold petrol above the government approved pump price. Two, in the months of April, June and July 2015; all the States and Abuja sold petrol above the official price. Three, only one state (i.e. Adamawa State) sold petrol at pump at the

government approved price of N87 per litre in March 2015. These facts indeed buttress the widely held concerns that the Nigerian retail petrol market may have been witnessing prolonged periods of uncompetitive pricing and other irregular behaviors that are detrimental to the nation’s journey to industrialization and the survival of the overall economy. These facts identified for Panel A are qualitatively similar to the patterns in Panel B. The graph in Panel B specifically shows that between January 2015 – May 2015, at least 28 states sold petrol above the regulated price every month.

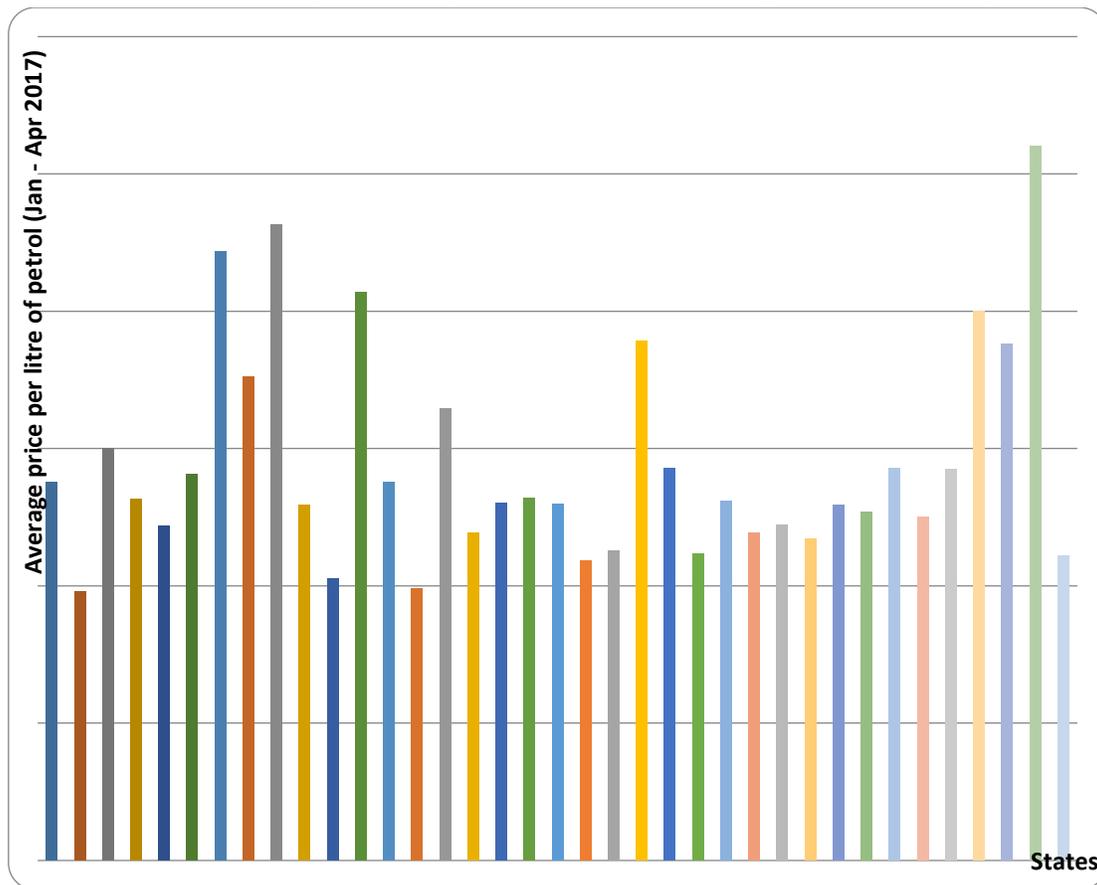
Figure 2: Average Price Per Litre of Petrol

Panel A: From January 2016 – April 2016 when official price was **N86.50** per litre



Note: From January 1, 2016 to May 12, 2016, official price per liter was N86.50
Source: National Bureau of Statistics (NBS) Publication, 2015.

Panel B: From January 2017 – April 2017 when official price was **N145** per litre



Note: From May 12, 2016 to April 30, 2017, official price per liter was N145
Source: National Bureau of Statistics (NBS) Publication, 2015.

Figure 2 above shows the average price per litre of petrol paid by consumers across the 36 States in Nigeria and Abuja. Panel A reports for the period January 2016 – April 2016, when the official price was N86.50 per litre; while Panel B reports for the period January 2017 – April 2017, when the official price was N145 per litre. To begin, let us consider Panel A. The main facts are summarized as follows. One, on the average, consumers in Abia, Imo and Kogi States paid over N140 per litre of petrol even though the official price was N86.50 per litre. Two, on the average, consumers in 26 States paid over N120 per litre of petrol, which is still quite higher than the regulated price of N86.5 per litre based on the then prevailing subsidy regime. Three, on the average, the least price of N95 per litre of petrol was paid by consumers in

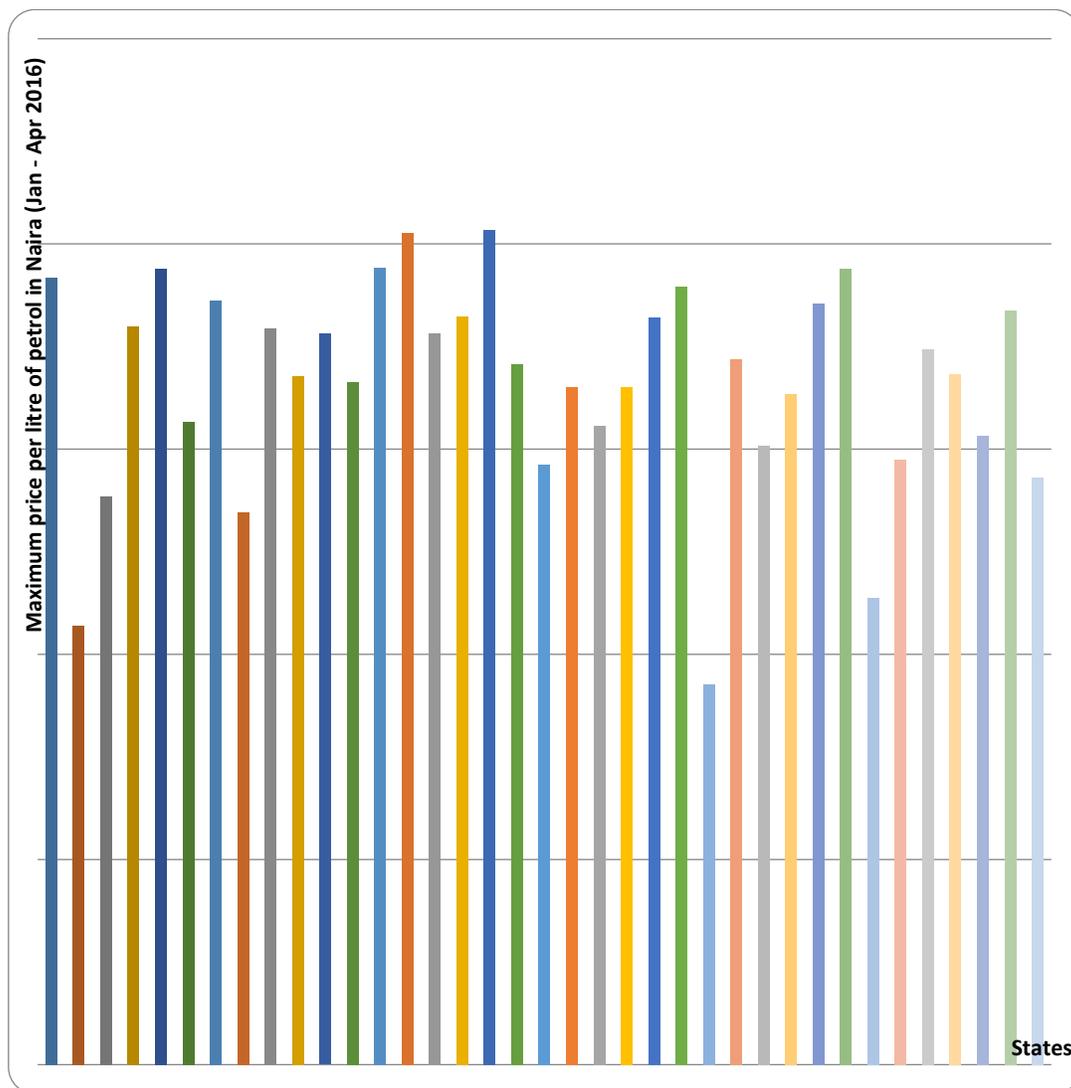
Lagos State, followed by Abuja and Oyo State where consumers paid averagely N100 per litre. Overall, on the average, consumers across the entire 36 States and Abuja paid prices that are above the government approved price of N86.50 per litre of petrol over the period January 2016 – April 2016. This is a clear evidence of market failure that has implications not only for the country's drive for industrialization but also for antitrust and consumer welfare policies. The patterns in Panel B are qualitatively similar to those in Panel A. The major differences include: (i) consumers in Abuja, Delta and Ekiti States averagely paid the government approved price of N145 per litre of petrol; (ii) consumers in 34 states averagely paid above the regulated price of N145 per litre; and (iii) quite remarkably, consumers in Yobe State paid above N160 per litre, which is far in excess of the regulated price.

The above facts become more interesting when the maximum price paid by consumers across the states is considered. Figure 3 shows the maximum price per litre of petrol consumed across Nigeria. Panel A reports for the period January 2016 – April 2016, when the official price of subsidized petrol in Nigeria was N86.50 per litre; while Panel B reports for the period January 2017 – April 2017 when the official price was N145 per litre. Focusing on Panel A, we find that the following points are in order. One, consumers in Ekiti and Imo States paid the overall highest price per litre of petrol, which is above N200 per litre. Two, consumers in 28 States paid above N150 per litre of petrol. Three, only consumers in Lagos State paid below N100 per litre of the product. The patterns in Panel B are quite similar to those in Panel A. However, the following facts are worth noting in Panel B: (i) consumers in Yobe State paid the highest price of almost N180 per litre of petrol; (ii) consumers in Bayelsa, Borno, Kebbi, Oyo, Sokoto and Taraba paid about N160 per litre, which is still higher than the official price of N145; and (iii) consumers in 28 states paid above the official price of N145 per litre. Overall, these stylized facts point in the direction of an obvious situation of market failure that deserves attention and study. Therefore, to achieve evidence-based energy policies that will ensure affordable and stable product availability, shield the people from the ups and downs of the global oil

market, create jobs for teeming unemployed youths and jump-start Nigeria’s journey to industrialization, there is an urgent need to scientifically investigate the Nigerian retail petrol market for asymmetric price adjustment following oil price changes. This is the direction to which we now turn.

Figure 3: Maximum Price Per Litre of Petrol:

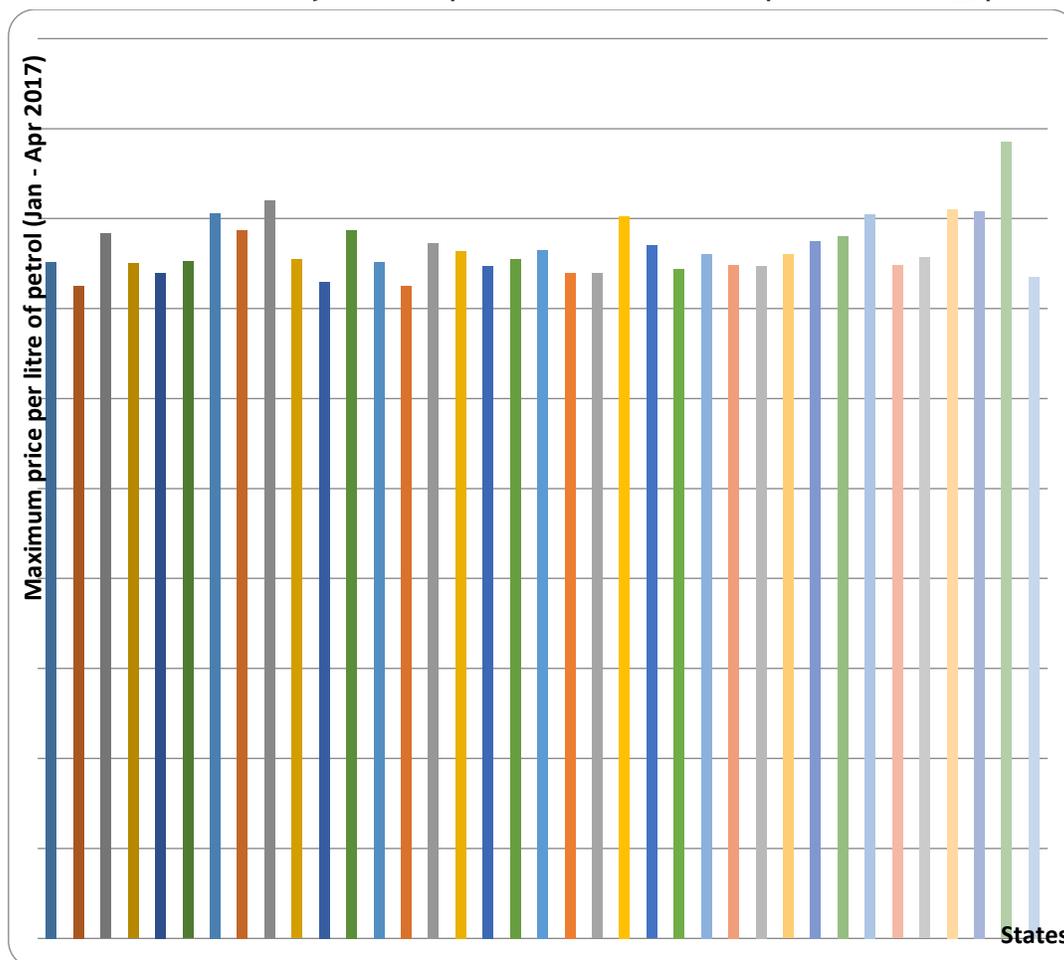
Panel A: From January 2016 – April 2016 when official price was **N86.50** per litre



Note: From January 1, 2016 to May 12, 2016, official price per liter was N86.50

Source: National Bureau of Statistics (NBS) Publication, 2015.

Panel B: From January 2017 – April 2017 when official price was N145 per litre



Note: From May 12, 2016 to April 30, 2017, official price per liter was N145
Source: National Bureau of Statistics (NBS) Publication, 2015.

Model specification: Estimating the response of petrol prices to oil price changes

To investigate Nigeria’s petrol market for evidence of asymmetric price adjustment following oil price changes, we follow Borenstein, Cameron and Gilbert (1997) in assuming a simple linear long-run relationship between retail petrol price (r_t) and crude oil price (c_t) of the form:

$$r_t = \alpha + \beta c_t + \varepsilon_t \quad (1)$$

where: r_t is the retail petrol price per litre, c_t is the price of crude oil per barrel, and ε_t is a normal and i.i.d. error term. The retail prices are taken from

NBS Petrol Price Watch while the oil prices are taken from Energy and Information Administration (EIA). First, the retail prices are converted from Nigerian naira to U.S. dollars since the crude oil prices are measured in dollars per barrel. Second, to achieve uniform scaling and following Greenwood-Nimmo and Shin (2013), all the prices are indexed to year 2015 (i.e. 2015Y = 100), and then logged prior to estimation. The static cointegrating model in (1) is generally associated with two main challenges, namely: the residual usually show significant serial correlation and c_t is not usually exogenous with respect to ε_t . The last point is particularly important since Nigeria has significant domestic oil production activities. In this case, the OLS estimator of the cointegrating parameter is poorly determined in finite samples, suggesting that the problems of serial correlation and endogeneity of the regressor must be addressed. To address these twin problems, we adopt the approach of augmenting an ARDL specification with adequate number of lagged changes in the dependent and the independent variables by specifying the following ARDL(p,q) model in its error correction form (ECM)¹:

$$\Delta r_t = \alpha_0 + \alpha r_{t-1} + \theta c_{t-1} + \sum_{j=1}^p \lambda_j \Delta r_{t-j} + \sum_{j=0}^q \gamma_j \Delta c_{t-j} + \mu_t \quad (2)$$

where: the orders of the ARDL model, p and q , are selected using Akaike Information Criteria (AIC); λ and γ embed the short-run dynamics; α and θ embed the long-run relationship; α_0 is the constant; μ_t is i.i.d. error term; and Δ is the first difference operator. Equation (2) recognizes that the adjustment of retail prices to changes in oil prices is not instantaneous but dynamic. According to Pesaran, Shin and Smith (2001) and Pesaran and Shin (1999), the finite sample performance of (2) is much superior to that of the

¹ The nonlinear ARDL model of Greenwood-Nimmo and Shin (2013) that decomposes the regressors into positive and negative partial sum processes is not used in this study because our sample is relatively small. Our data consists of 36 monthly observations for the period June 2014 to May 2017. However, the ARDL approach used here is super-consistent in finite samples and generally performs better than the static model in equation (1). The parameters of our model have obvious economic interpretation since the variables are logged prior to estimation. If the estimated coefficient of oil price is positively signed, it means that there is symmetry in the oil-petrol price relationship; but if it is negatively signed, then an inverse or asymmetric relationship is established.

static cointegrating regression in (1). Estimation of (2) proceeds in three steps. First, we use the bounds testing procedure of Pesaran, Shin and Smith (2001) to check if the variables are cointegrated. If cointegration is established, then the second step involves the estimation of the long-run relationship, which is given by:

$$r_t = \alpha_0 + \sum_{j=1}^p \lambda_j r_{t-j} + \sum_{j=0}^q \gamma_j c_{t-j} + \mu_t \quad (3)$$

The last step involves the estimation of the short-run dynamics, which is given by:

$$\Delta r_t = \alpha_0 + \rho ECM_{t-1} + \sum_{j=1}^p \lambda_j \Delta r_{t-j} + \sum_{j=0}^q \gamma_j \Delta c_{t-j} + \mu_t \quad (4)$$

where: *ECM* is the error correction term embedding the long-run relationship; ρ is the speed of adjustment; λ and γ are the short-run parameters; while μ_t is well behaved.

Empirical results and discussion:

Using the Phillips-Perron unit root test, we find that the two variables in this study (i.e. r_t and c_t) are $I(1)$, which is consistent with the underlying assumptions of the ARDL model in (2). To conserve space, we do not present the unit root results explicitly, but they are available on demand. Following the bounds testing approach of Pesaran, Shin and Smith (2001), we conducted cointegration test on the variables. The results, which are presented in Table 1, indicate that the null hypothesis of no cointegration is clearly rejected.

Table 1: Bounds test result

Test statistic	Value	K	Level of significance	of Critical value bounds	$I(0)$	$I(1)$
F-statistic	10.02509	1	10%		4.04	4.78
	10.02509	1	5%		4.94	5.73
	10.02509	1	1%		6.84	7.84

Pesaran, Shin and Smith (2001), Following the establishment of equilibrium relationship between the variables, we estimated the long-run relationship and the results are shown in Table 2 while the accompanying stability test results are shown in Figure 4. The results indicate that in the long-run, oil prices do not significantly impact on retail petrol prices in Nigeria; rather, it is the previous retail prices that significantly influence the current prices at the 5% level. This is consistent with the dynamics of the retail petrol market in Nigeria, where consumers easily engage in panic buying of the product at the slightest ‘rumour’ of an impending shortage in supply. Besides, it is common practice for consumers to store the product since they are not sure of getting it at a stable price in the future. Apart from lags 1 and 4, the oil prices exhibited an inverse long-run relationship with retail petrol prices, thereby capturing long-run asymmetric adjustment which is however not significant. This asymmetry provides evidence that Nigeria has not managed its crude oil resources to achieve all round long-run symmetry in the response of retail petrol prices to oil price changes. In other words, we have established evidence of poor resource utilization in Nigeria’s oil industry, at least in the long-run. It remains to be seen whether the short-run dynamics is robust to this finding. Meanwhile, the diagnostic checks on our results indicate that the model is not only dynamically stable but also free from the problems of serial correlation and heteroskedasticity.

Table 2: Long-run model selected by AIC [ARDL(2,4)]

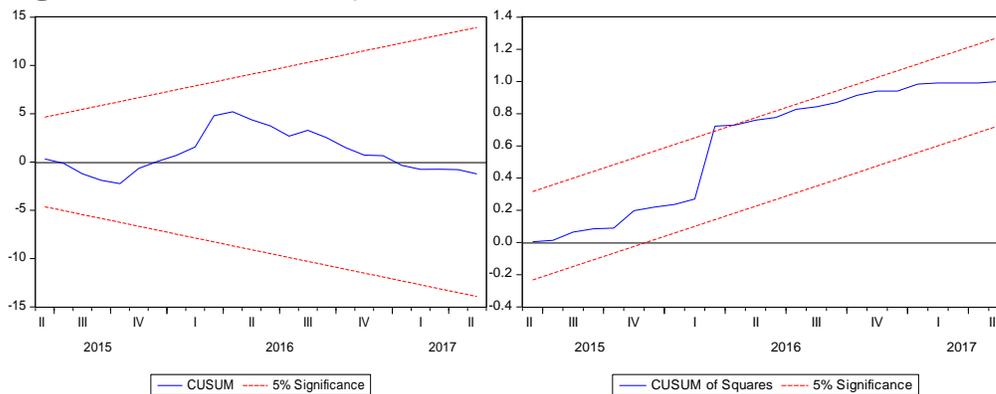
Dependent variable = r_t

Variables	Coefficient	Std Error	t-statistics	P-values
Constant	1.385470	0.589471	2.350364	0.0273
r_{t-1}	1.082861	0.171065	6.330129	0.0000
r_{t-2}	-0.387082	0.171936	-2.251309	0.0338
c_t	-0.011973	0.159969	-0.074847	0.9410
c_{t-1}	0.287611	0.221387	1.299130	0.2062
c_{t-2}	-0.442746	0.227873	-1.942950	0.0638
c_{t-3}	-0.067597	0.237849	-0.284201	0.7787

c_{t-4}	0.237096	0.144648	1.639118	0.1142
$R^2 = 0.734827$	$Adj. R^2 = 0.657485$		$DW-statistics = 2.156023$	
$F-stat = 9.501011$	$Prob(F-stat) = 0.000013$			
$P-value\ of\ Breusch-Godfrey\ Serial\ Correlation\ LM\ Test = 0.5012$				
$P-value\ of\ Breusch-Pagan-Godfrey\ Heteroskedasticity\ Test = 0.1747$				

Source: Long-run model selected by AIC [ARDL(2,4)]

Figure 4: Model Stability test results



Source: Model Stability test results

The ECM results in Table 3 capture the short-run dynamics, while the model stability test results are shown in Figure 5. Again, we find that at 5% level, the additive short-run impact of previous retail petrol prices on the current petrol price is positive and significant. This shows some level of symmetry. However, the overall additive impact of oil price changes on petrol price changes in the short-run is negative, though not statistically significant at the 5% level. This overall negative impact somewhat reflects the inverse or asymmetric adjustment of retail prices to oil price changes. Like before, this is contrary to Nigeria’s status as an oil-rich country, showing that the country has not properly managed its crude oil resources. The ECM term is negatively signed as expected and has a coefficient of -1.07 that is statistically significant at the 1% level, showing that perfect adjustment or error correction is made every period. Like before, the diagnostic checks on the results indicate that the model is not only dynamically stable but also free from the problems of serial correlation and heteroskedasticity.

Table 3: ARDL-ECM results selected by AIC [ARDL(2,2)]

Dependent variable = Δr_t

Variables	Coefficient	Std Error	t-statistics	P-values
Constant	-0.007757	0.014764	-0.525417	0.6041
Δr_{t-1}	1.057912	0.242327	4.365636	0.0002
Δr_{t-2}	-0.515838	0.146605	-3.518549	0.0018
Δc_t	-0.041025	0.129131	-0.317699	0.7535
Δc_{t-1}	0.275839	0.129232	2.134451	0.0432
Δc_{t-2}	-0.419851	0.140906	-2.979661	0.0065
ECM_{t-1}	-1.067177	0.306885	-3.477450	0.0019

$R^2 = 0.573340$

$Adj. R^2 = 0.466675$

$DW-statistics = 2.068717$

$F-stat = 5.375154$

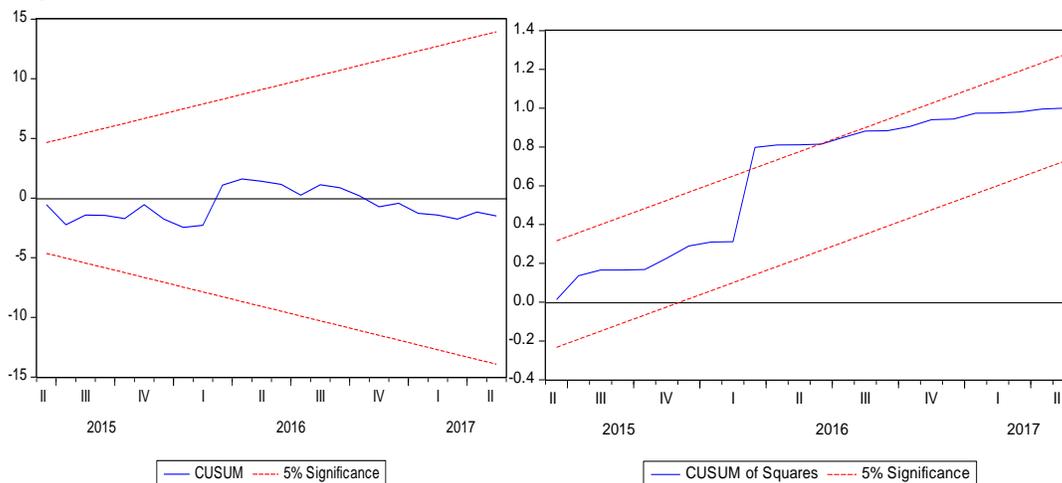
$Prob(F-stat) = 0.001220$

P-value of Breusch-Godfrey Serial Correlation LM Test = 0.5433

P-value of Breusch-Pagan-Godfrey Heteroskedasticity Test = 0.1055

Source: ARDL-ECM results selected by AIC [ARDL(2,2)]

Figure 5: Model Stability test results



Source: Model Stability test results

Conclusion and recommendations:

This paper examined Nigeria’s petrol market for evidence of consumers paying above the government approved prices and for evidence of inverse or asymmetric response of retail petrol prices to changes in oil price. Data

from the Petrol Price Watch published monthly by the National Bureau of Statistics (NBS) were used together with descriptive analysis and an ARDL-ECM model. In sum, the findings are in two parts. First, we find that even when the product is subsidized, consumers in most states pay above the government approved prices. Second, we find that both in the short-run and long-run, retail petrol prices in Nigeria respond inversely/asymmetrically to changes in oil price. These findings are contrary to Nigeria's status as an oil-rich country, thereby capturing the stark reality of poor natural resource utilization, which in turn constrains the country's industrial competitiveness.

To ensure that the retail petrol market in Nigeria plays its expected role in Nigeria's journey to industrialization and at the same time account for a small share of the costs of production, this paper makes the following recommendations. One, government should, as a matter of policy, strengthen the regulatory agencies like the Department of Petroleum Resources to ensure that the retail energy sector is continuously and adequately monitored to preserve the overall social welfare. Two, government should, as a matter of policy, encourage investments in both upstream and downstream facilities such as refineries and pipelines. For instance, this can be achieved by using government policies to encourage oil multinationals like Shell, Mobil, Agip/Eni, and so on to build refineries and pipelines in Nigeria. Doing this will not only diversify the country's oil industry but also ensure that domestic demands for petroleum products are satisfied from domestic refining capacity. Three, government should also fully deregulate the downstream oil industry in order to make it more competitive while the government intervenes whenever the market fails, for example, due to abuse of dominant positions or oligopolistic collusive behavior. Four, state and local governments should be more involved in managing the oil industry in order to give them greater sense of belonging and ownership. Doing this will ensure that every tier of government is actively involved in the protection of oil facilities in their domain like pipelines that are used in the distribution of refined products.

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