

## CASE STUDY

# Empirical analysis of transportation demand for oil products in Nigeria: Using error correction approach



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## ABSTRACT

This paper analyses the demand for petroleum products (gasoline and diesel) in Nigeria using time series data (1980–2013). The analyses of the trend in the consumption of products has shown that the consumption initially maintained and increasing trends, latter declined considerable with the increase in domestic prices. This underscored the important of market base pricing which will encourage efficiency, save foreign exchange, reduce fiscal burden and attract investment in the sector. Further the paper uses the Unrestricted Error Correction Models (UECM) developed by Pesaran and Shin (1999) to estimate the demand functions for oil products. The price and income elasticities for the demand function for gasoline, diesel and aggregate – are estimated in the analysis. The estimated elasticities are compared with those of similar studies in developing countries. The outcome shows that there is no significant difference between the findings of this study and previous studies in similar contexts. The results suggest that consumption of individual products is more elastic to changes in income than real prices. The income elasticities of demand are 0.6513 for the aggregate, 0.5886 for gasoline and 1.3456 for diesel. However, the price elasticities are  $-0.1763$  for the aggregate,  $0.0973$  for gasoline and  $-0.3199$  for diesel.

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## 1. Introduction and background

The consumption of oil products in Nigeria has since the early 1970s maintained an upward trend, outpacing domestic production. This has created disequilibrium between demand and supply in the domestic market and this can partly be attributed to limitations in the domestic refining capacity. To address this imbalance, government has had to resort to importing such products. According to the Major Oil Marketers Association of Nigeria (2012), about 90% of petroleum products consumed in Nigeria are imported due to the inadequate and limited local production. The

rise in the consumption of oil products in Nigeria is partly due to the sudden rise in individuals' per capita income as a result of the two OPEC-induced oil price shocks. Furthermore, low price of products helped to promote smuggling and inefficient consumption. Moreover, rapid population growth in the country has led to rural–urban migration as well as oil-income-driven urbanisation, with a concomitant expansion in motorization that has helped to compound the problem. Consequently, the consumption of oil products has grown faster than the average annual growths in real incomes and population.

Over 80% of gasoline and diesel demand in Nigeria is from the transportation sector. Therefore, accurate information on income and price elasticities of transport sector demand for oil products is important for

projecting future aggregate energy demand and in planning the required capacity to meet future domestic consumption and exports. Such information will also guide policy makers on the extent to which prices need to be adjusted so as to control internal consumption and the potential for the market to realise the energy-efficiency objectives of government. Thus, the current study seeks to help guide policy makers and investors in making wise investment decisions in the energy and transport sector. Furthermore, this work is among the few attempts to apply econometric tools to an empirical study on the demand for petroleum products in the Nigerian transportation sector. To the best of our knowledge, apart from the study by Iwayemi et al. [22], Nigeria has not been the focus of any previous work. Also, this study is

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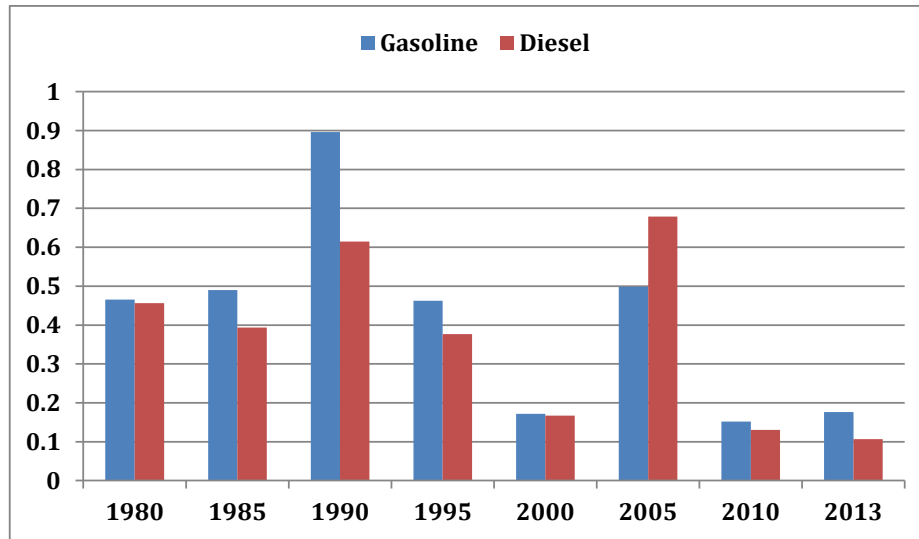


Fig. 1. Comparisons in the trends of per capita consumption of gasoline and diesel in thousands barrels (1980–2013).

likely to be an improvement on the existing research in Nigeria, based the methodology used.

In this paper, the Unrestricted Error Correction Model developed by Pesaran and Shin [30], often referred to as the ARDL bound testing approach to cointegration, is used to estimate demand functions for two oil products (gasoline and diesel) alongside aggregate consumption for Nigeria's transportation sector using time series data from 1980 to 2013. The organization of the paper is as follows: Section 2 provides descriptive statistics on oil-product consumption in Nigeria, while Section 3 presents the methodology and the description of data. Then, Section 4 presents the results of the analysis and Section 5 provides conclusions and policy implications.

## 2. Evolution of oil-product demand in Nigeria

Previous studies of energy demand in developing countries including Iwayemi et al. [22] on Nigeria strongly suggest that petroleum products particularly gasoline and diesel dominates the commercial energy mix during the last four decades. This underscored the importance of transportation sector in Nigeria's commercial energy consumption. The consumption of natural gas has also increased tremendously, suggesting that the fuel has started penetrating gradually, given the desirability of natural gas as an efficient and clean source of energy. Liquefy Petroleum Gas still remains very insignificant despite the fact that Nigeria has four refineries and most of the associated gas is flared during refining process. This means the need for utilizing flared gas is crucial for not only for mitigating the health and

environmental hazards associated this anomaly; but to minimise wastage and ensure smooth transition to cleaner energy for economy and the transport sector in particular.

Fig. 1 presents the comparisons of the relative share of gasoline and diesel in 1980–2013 in Nigeria. As can be seen, generally the consumption skewed in favour of gasoline in greater part of the period under consideration. The consumption of gasoline has been increasing over the years. In 1980, the comparison of the consumption of gasoline and diesel suggest that the difference between the consumption of the two products was insignificant. However, from 1985 to 2013, except in 2000, there was a noticeable significant differences in the consumption of the two products; implying that gasoline played a major role in the consumption of petroleum products in Nigeria during those decades. Two factors are likely to account for the dominance of gasoline in the petroleum products mix; one most important factor is subsidization of gasoline which encourages smuggling and inefficiency, secondly, as can be seen from Fig. 2, the transportation sector is dominated by small vehicles that use gasoline.

Although the price of diesel was partially deregulated in 2009, a huge deficit supply of diesel for domestic consumption persists. While the deregulation of diesel prices reduced the rate of its smuggling, it encourages adulteration of other substitutes. Of the total consumption, almost 90% is by the transportation sector whereas the industrial and household sectors account for about 10%. It has been argued that if electricity is provided the way it should be in Nigeria, there will be less pressure on the use of diesel to power generators and this will reduce the cost of the product. The figure shows that

the diesel consumption maintained a declining trend. Nevertheless, as the case of gasoline, there has always been a narrow gap between domestic production and consumption recorded. Hence, government still has to import the product to meet domestic demand. Two factors might account for the decline in diesel consumption; first, partial deregulation of diesel prices might have reduced the rate of smuggling; and second is the kerosene subsidies that may result in inter-fuel substitution.

Arguably, the major factor influencing the demand for transportation services and demand for energy and the type of fuel used in this sector is income. The two positive global oil shocks have led to an increase in household incomes, particularly in urban areas. As a result, the middle class has expanded and individuals' lifestyles have been transformed, resulting in an increase in the desire for personal mobility and ownership of motor vehicles. Interestingly, once people have personal vehicles, they use them even if alternative transportation modes are available. Further, people consider owning a vehicle is considered as a symbol of status in Nigeria. Similarly, oil-induced changes in individual incomes also led to an increase in the demand for public transportation by low-income families and haulage of goods by companies and primary goods producers in rural areas. Therefore, the stock of both private and commercial vehicles increased substantially, leading to the marked increase in energy consumption in that sector. The study by the Pew Centre on Global Climate Change (2002) underscores the aforementioned assertion that the principal determinant of vehicle ownership in both developed and developing countries are income levels. As economies grow and incomes rise, more people purchase vehicles (See Fig. 3 for a

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