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Economic effects of fuel subsidy in oil producing countries
the case of Nigeria

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ECONOMIC EFFECTS OF FUEL SUBSIDY IN OIL PRODUCING COUNTRIES: THE CASE OF NIGERIA

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Centre for Energy, Petroleum, Mineral Law and Policy (CEPMLP)
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DECLARATION AND CERTIFICATION

I hereby declare that I am the author of this thesis and that I have consulted all references cited. All the work, of which this thesis is a record, has been done by the author and has not been previously used for a higher degree.

Signed…………………………
Ismail Oladimeji Soile, PhD.

Date 15/10/2015

CERTIFICATION

This is to certify that Mr. Ismail Oladimeji Soile conducted his research under my supervision in the Centre for Energy Petroleum and Mineral Law and Policy (CEPMLP), Graduate School of Natural Resources Law, Policy and Management, University of Dundee. Mr. Soile has fulfilled all the conditions of the relevant Ordinances and Regulations of the University of Dundee for obtaining the Degree of Doctor of Philosophy.

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DEDICATION

This work is dedicated to my late mother who was there for me at the beginning, during but not at the end.

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ABSTRACT

The thesis conducts a specific to general investigation on petroleum product subsidies in oil exporting countries. Starting with a specific focus on Nigeria, I examine the benefit incidence and the economic effects of fuel subsidies using the 2009/10 Harmonized Nigeria Living Standard Survey and the 2011 input-output table respectively. I then proceed to conduct a general analysis by empirically estimating the effects of subsidies on fuel consumption, CO_2 *emission and social welfare for OPEC and member countries.*

Results from the Benefit Incidence Analysis (BIA) show that the richest household quintile enjoys twice as much the benefit of fuel subsidies as the poorest household quintile on the aggregate. Both the gasoline and kerosene subsidies are found to be more regressive than the per capita expenditure suggesting the inefficiency of fuel subsidy as a mechanism for income redistribution. Using the Input-Output and SAM multiplier approach, I study the effect of reducing gasoline subsidy as implemented in January 2012 on sectoral outputs, household expenditure and government spending under two scenarios. When there is no reinjection from the reduced subsidy spending, the results show that the 49% increase in gasoline price would lead to a 0.01% and 0.18% reduction in GDP and government spending respectively. There is also a fall in labour and capital income by 0.29% and 0.34% respectively while household expenditure increased by 0.33%. When the savings from subsidy reduction is reinjected to the economy, the results show that labour and capital income increased by 0.24% and 0.17% respectively while both GDP and government expenditure increased by 1% and 0.12% respectively

In the general analysis, I apply the Pesaran, (2007) cross-sectionally augmented Im, Pesaran, and Shin Panel unit root test to check for cross sectional dependence, the four panel cointegration tests developed by Westerlund, (2007) to inspect long-run relationship and the Common Correlated Effects (CCE) Mean Group estimation to obtain consumption elasticities for OPEC and member countries. The results confirm that subsidies on fuel prices in these countries are quite large while products are highly price inelastic suggesting that price reforms and fuel taxes can help improve revenue, reduce wasteful consumption and CO_2 *emission.*

1 CHAPTER ONE: INTRODUCTION

1.1 Statement of Problem

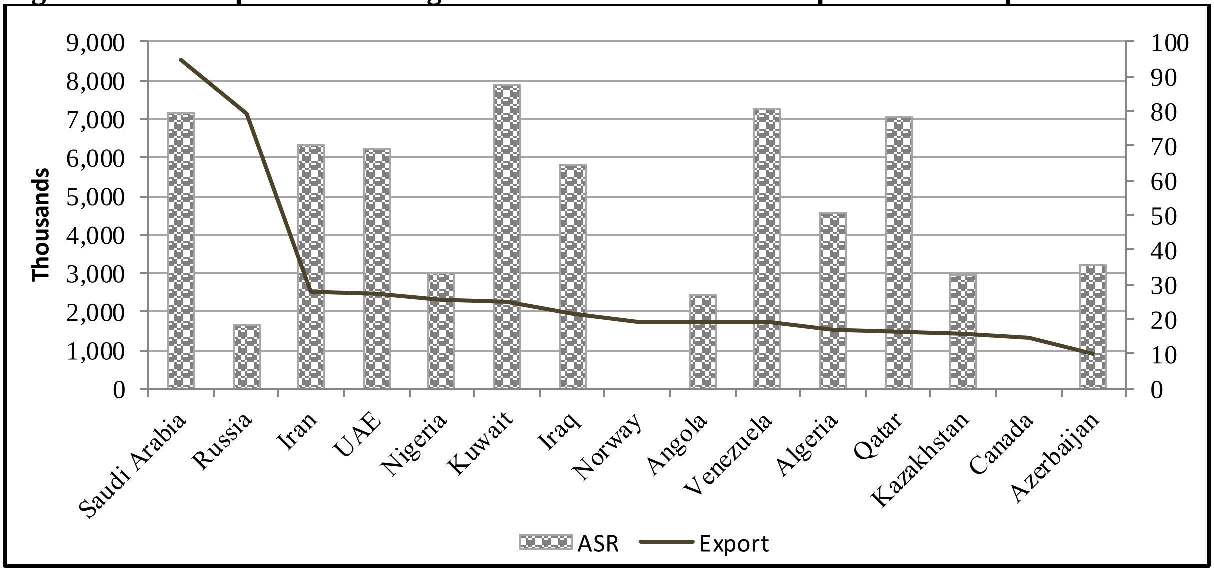
The amount of money governments all over the world spend on subsidizing energy particularly fossil fuels is astounding. This, in addition to the increasingly more subsidy made accessible to other alternative and renewable types of energy in the wake of global and national economic recession definitely call for concern. The IEA's World Energy Outlook (2014) asserts that 40 countries subsidise fossil fuel consumption globally with subsidies accounting for an average of 5% of aggregate GDP[1]. Globally, fossil fuel consumption subsidies grew from $412 billion in 2010 to $548 billion in 2013 with petroleum products subsidies accounting for more than 50%. Less than 10% of the total fossil fuel subsidies value reach the poorest 20% of the income group in these countries (WEO, 2014).

Subsidies exist globally in a number of economic sectors, including agriculture, fisheries and energy because they are one of many policy instruments used by governments to accomplish economic, social and environmental objectives. In fact, energy subsidies are specifically used in developing countries to ease energy poverty and promote economic development by facilitating access to affordable modern energy services. It is therefore conventional to find governments providing support for the production or consumption of energy in different ways either by maintaining lower prices with subsidies in the case of consumption or giving grants or concessionary loans, providing tax exemptions/holidays and lending supports for energy related research and development in the case of production. In most oil producing non-OECD countries, governments engaged in state financing of energy and in most cases subsidize energy products. This is a phenomenon prevalent in all OPEC[2] member

[1] These 40 countries account for over 50% of global energy consumption in 2013.
[2] Organisation of Petroleum Exporting Countries founded in September 1960 presently with twelve members

countries including Nigeria (see figure 1 below which shows the export and the average subsidisation rate (ASR) for the top 15 net oil exporting countries as at 2011)[3]. One of the arguments in the literature is that adequate provision of energy promotes economic growth and increase energy access. At the micro level, it increases the standard of living of individual in the long run. However, for many decades, and especially since the 1980s, there has been an increasing call on the governments by many international agencies like the World Bank, IMF and UNEP to eliminate fuel subsidies in order to remove economic distortions, improve countries' fiscal health and or reduce air pollution. This is because fuel subsidy usually conflict with overall energy policy in many ways.

Figure 1.1: Oil Export and Average Subsidisation Rate of the Top 15 net Oil Exporter



Source: Author with data sourced from IEA, 2012 subsidy online database

First, apart from diverting much needed public and private finances from other priority sectors, they are quite expensive and usually have serious fiscal implications[4]. Without doubt, in majority of the poorest countries of Africa and Asia, the government expend several folds

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[3] In the figure, the Average Subsidisation Rate is defined as the share of fossil fuel subsidy to supply cost of fuel in percentages.

[4] For instance, subsidy payments by government to national oil company and other marketers of petroleum products in Nigeria between year 2006 and 2008 was about US$9.7 billion compared to the total capital allocation to priority sector such as security, the Niger Delta, critical infrastructure, Human capital development and Land reform & food security in the 2009 annual budget which was US$6.57 billion. Annually, this translates into about 1.5% and 2% of the GDP

extra on fuel subsidies than on health, education and other key public welfare disbursement (World Bank, 2009). Second, there is also an indirect harm that subsidy does to the environment. This is particularly so when the subsidies lead to disproportionate consumption of energy services, which proliferates the harmful effects of pollution and highlight the inherent energy insecurity in most energy systems (see Bacon and Kojima, 2006; World Bank, 2009; Guiyang, 2007; and IEA, 2008). Third and consequent on the belief that subsidies offer much superior advantage to those segments of the populations that can afford and already possess large quantities of high-energy intensive goods and services, there is an obvious challenge on the reason often cited as an incentive for subsidizing energy. Contrary to improving the quality of life for the poor masses, there is a widespread opinion that the vast majority of this populace naturally receive extremely little benefit.

In addition, fuel subsidy can also encourage fuel smuggling particularly when the domestic prices are cheaper than that of other neighbouring countries. The issue of trans-border leakages of petroleum products due to wide price differentials arising from subsidy is a common phenomenon in Malaysia in South East Asia and Nigeria within the West African sub region[5]. There is also available evidence that energy subsidy caused stealing and excessively luxurious life style[6]. All these suggest that fuel subsidies evidently do not support the efficiency in energy use which is perhaps an important issue in the world today. However, government policies on fuel pricing usually attract a great opposition from many interest groups in the society who are of the opinion that reduction/removal of subsidies would have bad implication

[5] Diversions of government subsidized petroleum products from Nigeria to neighbouring Togo and Benin republic appear to be an unending crisis despite serious sanctions and border tightening.
[6] In Nigerian for instance, each medium and high income households has on the average three (3) and six (6) cars respectively while the poor majorities rely on public transport systems. See Akpoghomeh and Badejo (2006)

on the poor and reduce economic growth[7]. A large number of agitations in this regard have resulted in worse socio economic condition.

Despite considerable subsidy reform efforts made by countries, fossil-fuel subsidies being notoriously complex to remove remain widespread. The growing resistance to fuel subsidy reforms in many countries has lend credence to the political arguments that subsidies are invasive not much for the reason that the demand for subsidy is so enormous but because the subsidy supplies systems is in place and it is politically knotty for several regimes to defy using them. For most governments, there is no other willingly available apparatus for gratifying important interest groups. While most economic analysts detest subsidies on the ground that it can be a predominantly harmful form of public policy, customarily, subsidies exist because they are embedded in a political logic that is a lot complex to adjust (see Victor, 2009; Anderson, 1995; and Andresen, 2008).

The mixed empirical outcome of studies investigating the effect of fuel subsidy is another critical factor. While some studies confirm that fuel price subsidies cause inefficient resource allocation and sometimes unreasonably benefits people beyond the targeted poor (IEA, 2011; World Bank, 2010; Coady et al, 2006; Baig et al, 2007; and Saboohi, 2001), others found reduction or removal of fuel subsidy to exert unintended consequences on the poor population (Koplow, 2009; World Bank 2010) and on the development of other sectors of the economy particularly in developing world. For instance, Bazilian and Onyeji (2012) observe that removal of subsidy in Nigeria and other similar economies put further pressure on the existing high cost of power supply thereby raising cost of doing business in general and slowing down industrial development while Fattouh and El-Katiri (2012) find that despite the associated

[7] Though, the distinction may not be firm, interest group in this case differ from advocacy and pressure groups normally set up for specific political aim. We refer to voluntary associations and the general public that seeks to publicly protests and challenge some unfavourable and ill-conceived government's political and economic programmes or policies. The latter are often in the mid and high income group of the society and can lobby governments.

negative impacts, energy subsidies represent a significant safety net for the poor populace in several Arab countries, such that reducing and or eliminating these subsidies without compensatory social programmes would further reduce households' welfare and grind down the competitiveness of some sectors.

From this backdrop and given seemingly lack of general consensus from available empirical evidence, it is obvious that there is a gap between the dictates of economic theories and the practical issues surrounding energy pricing on the one hand and the understanding of how different countries actually operates in the context of subsidy reform policies on the other. Accordingly, the major problem informing this study is an attempt to fill this gap. Understanding the link between the prescriptions of economic theory and the practical issues pertaining to energy pricing in any economy depends on a detailed and robust empirical analysis of the pattern of domestic demand. In typical oil exporting countries like OPEC where petroleum products' prices are subsidised either for political, social and economic reasons, analysing domestic demand can provide clearer intuition to contentious issues about subsidies.

1.2 Research Questions

This research is therefore aimed at addressing the following three research questions.

i. Who benefits from fuel subsidies in Nigeria and how well-targeted is each fuel's subsidies to the intended poor groups in Nigeria?
ii. What are the economic effects of fuel subsidy removal in Nigeria?
iii. How large are the fuel subsidies and what are the associated effects on fuel consumption, carbon emission and social welfare in OPEC countries?

Given that government spending on subsidy should in general promotes efficiency and equity (Cuenca, 2008; Rosario, 2007; and Akosile, 2012), the extents to which governments spending on fuel subsidies benefits the poor remains germane in subsidy debate. The first question addresses this by examining whether expenditures on petroleum product subsidies had redistributive impact in Nigeria. This and the second question are of particular relevance because their resolution can assists immensely in guiding future subsidy (and other policy) reforms and also in identifying the segment of population or economic sectors that require assistance and those that can better shoulder higher fuel prices so that the unfavourable side effects and destructive opposition to subsidy removal can be avoided. The third question provides information about the extent of welfare and economic losses embedded in the existing fuel pricing structure which is of important policy interest to OPEC member countries who desire to reform their petroleum products' pricing system in order to minimise distortion and welfare losses in the economy.

1.3 Objectives

The broad objective of the research is to analyse the socio-economic effects of petroleum products' subsidies in OPEC member countries with specific in-depth analysis on Nigeria. Specifically, this research will

i. Assess the incidence of petroleum product subsidies by different population income/expenditure groups to determine the extents to which government spending on fuel subsidies benefits the poor in Nigeria

ii. Evaluate the economic effects of removing fuel subsidies and reinjecting the saving on the various sectors and agents of the economy in Nigeria.

iii. Empirically analyse the domestic demand for petroleum products in OPEC member countries, estimates the size of fuel subsidies in OPEC countries and assess the effects on carbon emission and social welfare.

1.4 Justification of the Study

A research of the type being proposed here is unique in several ways.

First, available evidence from the literature review indicates that no study has used recent data to analyse multi fuels petroleum product subsidies for OPEC. Whereas, OPEC members account for 10 of the 15 top oil exporting countries in the world with an average subsidisation rate of 64%. In fact, IMF (2008) fiscal affairs department study confirms that 19 of the 25 countries that subsidized aggregate consumption of gasoline and diesel are net oil exporters. Given the prevailing difference in the socio economic condition of countries, multi fuels studies can offer great insight into the specifics of inefficient subsidy by fuel type. More so, as rich as the literature is on OPEC's behavioural response to international oil market dynamics, less effort has been given to the analysis of petroleum products pricing within the OPEC members' domestic markets. This is a major gap in the literature that I am motivated to fill.[8]

Secondly, the measurement of subsidy and certain implicit approximations particularly on the use of one end-user prices of petroleum products as proxies for opportunity cost at end-user level in virtually all regional and cross country studies can grossly affects the results and conclusions since the price paid by a country depends on the differences in purchasing arrangement, and the considerably variations in the handling and local transportation costs across countries[9]. Not only can the adoption of a single end-use level price across countries erroneously ignored countries' differences, it may also renders the inferences based on these results inaccurate. Therefore, I am motivated to conduct country specific study for OPEC membership with the hope of estimating the actual price differentials and hence subsidies.

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[8] Doug Koplow (2009), while highlighting the many inconsistencies in periodic subsidy estimates across different countries by different studies particularly by IEA and the World Bank concluded that studies on subsidies should be conducted at least once every five years for the top ten global fossil fuel producing and consuming nations and more importantly, increased attention should be accorded countries deriving a significant share of their national output from these industries.

[9] The much-cited paper by Larsen and Shah (1992) uses United States pre-tax end-user prices of petroleum products as proxies for opportunity cost at end-user level for all other countries.

Third, there is no doubt that considerable attempt have been made to examine the distribution of fuel subsidy benefits in several countries, none has applied the Benefit Incidence Analysis (BIA) approach. While the Benefit Incidence Analysis (BIA) approach has been used to examine the distribution, incidence and targeting of government subsidies on education, health, water and sanitation and even electricity subsidies[10], this is the first attempt to apply the method to fuel subsidies in general and Nigerian in particular.

Lastly, quite a number of highly subsidising countries have initiated fuel subsidy reforms in the last couple of years and the trend appear continuous[11]. However, studies have not kept pace with empirical assessment of the socio-economic impacts of these reforms. For instance, with particular reference to Nigeria where fuel subsidies has been adjusted 20 times between 1978 and 2012[12]. It is important to know that no study has researched into the effect of any of these reforms on the people, industries and the economy. Yet all the reforms have been met with protests and civil unrest with attendant loss of lives. This is the first attempt in this regard. Hence I apply the I-O and SAM multiplier – a typical static General Equilibrium Model approach to analyse both the effects of removing fuel subsidies and reinjecting the saving in Nigeria.

1.5 Data Source and Methodology

First, the distributional impacts of petroleum products subsidies is analysed using the benefit incidence (BIA) approach. A benefit incidence measure follows a three-stage process. The first process is to obtain estimates of the unit subsidy of providing a particular product. This is usually based on officially reported public spending on subsidising the product in

[10] The World Bank poverty assessment report (1994) also applied the method to analyse the benefit incidence of subsidies on electricity and other sources of power in Colombia
[11] IEA's World Energy Outlook provides a list of countries alongside recent developments in terms of fossil fuel subsidy reforms. See table 9.1, pages 330-331.
[12] Despite the promise by successive governments to reinvest the subsidy saving back into the economy, only in 2012 has the government kept his words on reinjecting the saving back into the economy

question rather than budget allocations. The second stage is to identify the various households or individuals who are the users or consumers of the product. Individuals who consume a subsidized public product in effect gain an in-kind transfer. It is the distribution of this transfer across the population that benefit incidence analysis seek to measure. The last stage entails aggregating the households (or individuals) into sub-groups of the population so as to evaluate how the subsidy is distributed across different groups. The most widespread grouping is by income, or a similar measure of the welfare of the individual e.g. expenditure. The input-output and SAM multiplier general equilibrium methods is used to evaluate the impacts of subsidy removal on other sectors and agents in the economy. The input-output analysis is a highly flexible Leontief technique that analyses the inter-industry or inter-sectoral relationship in order to understand the interdependencies and complexities of the economy. It is essentially invaluable in measuring both the direct and indirect outcomes of planned changes in the demand for the product of one sector on output and employment of other sectors and other key macroeconomic variables. Afterwards, the SAM multiplier models are estimated to reveal the extent of inter-sectorial linkages and the impact of subsidy on an economic agent (say household) or any other sector (say manufacturing) in the economy. Analysing the consumption of petroleum products involve an econometric analysis. This study applied common correlated mean group panel data estimation techniques alongside stationarity and cointegration tests. Unlike direct financial transfers, evaluating the level of fossil fuel subsidies is a task challenged by poor quality, limited and in some cases complete lack of data. To this end, the price-gap method is used to quantify product subsidies for all the countries considered in this study. Despite its limitations, the price gap approach remains essentially useful in many regards[13]. By providing information on subsidies that alter end-user prices, price-gap method

[13] Though, the price-gap method is limited in its inability to account for subsidies which do not affect prices but impact on the structure of supply in the economy and the estimates are usually very sensitive to the assumptions made with regards to the reference price, the prime value of the price-gap method lies in its comparative ease compared with other subsidy evaluation methods. At least, by focussing on market clearing prices with few

produce intuitive data on essential factors that will almost certainly affect short-term energy demand and supply decisions in a format that can be quite easily fed into global macroeconomic models which permits more extensive testing of how subsidy reforms might affect consumer welfare and energy markets. We complete the analysis by applying partial equilibrium analysis (PEM) to estimate the effects of subsidy on consumption, emission and social welfare.

All secondary data for all the OPEC member countries were sourced primarily from 2014 issue of the OPEC Annual Statistical Bulletin and the World Bank Development Indicators These data are complemented by Nigerian input-output data obtained from the Nigeria Institute of Socio Economic Research (NISER) Ibadan, Nigeria and the Harmonised Nigerian Living Standard Survey (NLSS, 2009/10) from the Nigeria Bureau of Statistics (NBS)

1.6 Scope of the Study

While the general focus of this study is on OPEC member countries, Nigeria has been selected for a specific in-depth analysis due partly to the huge input-output, SAM and other survey data required and partly because of the recent crisis in the country following gasoline subsidy reduction.

The choice of OPEC for the general investigation is informed by several factors. Aside the fact that member countries are leading fossil fuel producing countries whose significant share of national earnings comes from oil, the strategic influence of OPEC on the international price of oil is striking. The level of economic development and major economic indices suggest that pro–poor distribution process deserves adequate recognition in major macroeconomic policies which entrenched subsidies in the political equation of member countries. Yet, inaction in reforming the fuel subsidies can be highly risky and costly.

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adjustments to enhance the comparability of the pricing data, researchers can avoid considering ample individual energy related policies in specific countries. More so, the ability to examine subsidies to some extent independent of government cooperation can be better appreciated in non OECD countries that cannot provide correct information on government's energy-related activities (see Koplow, 2009)

In terms of product coverage, the study pays attention to four petroleum products namely Motor gasoline, Household kerosene, Diesel, and Fuel oil.

1.7 Outline of the Study

The thesis has been organised into six chapters. Chapter two covers the conceptual, theoretical and methodological review while chapter three investigate the benefit incidence of fuel subsidy in Nigeria. The economic effects of subsidy removal in Nigeria is addressed in chapter four while the estimation of fuel subsidy and the effects on consumption, CO_2 and social welfare in OPEC occupied the fifth chapter. The study is concluded in chapter six.

2 CHAPTER TWO: LITERATURE REVIEW

2.1 Conceptual Issues

2.1.1 Defining Subsidies

There is a considerable harmony that in theory, subsidies indicate a transfer of economic resources to the agents in the market which in turn affects either the price or the cost of producing particular commodities. This definition of subsidy is limited to in kind transfers targeted to the energy sector directly via organization costs or through tax relief. In practice however, the concept of subsidy is much broader. For instance, most policies that shift private financial and/or market risks onto the general public, the tax payers or even the government such as subsidies on lending and guarantees on loans are all considered as subsidies despite the lack of direct monetary transfers. Some other programs which are not directly targeted but are of substantial benefit to the energy sector are also included in subsidy. Some category of energy related studies has widened the definition of subsidies further to include externalities. These include certain benefits or costs shifted onto third parties without compensation (externalities) and complementary goods or services that encourage the increased use of fossil fuels, such as general transportation infrastructure. In order to accurately assess the impact of subsidy on the environment and economy, this class of subsidy requires appropriate offsets (deducting all forms of interventions which act as taxes on particular fuels) to arrive at a net subsidy value.

Subsidy is sometimes defined to encompass all energy policy interventions. For instance, Greenpeace idea that subsidies represent government policies that benefit particular sectors of the economy[14] could be used to describe any government intervention in energy markets. According to the Energy Information Administration (2000), subsidies are any government actions which had as their purpose alteration of energy markets by benefiting some group of

[14] See Koplow and Dernbach (2001)

consumers or producers. Specifically, the IEA (1999) defines energy subsidy as any form of government action mainly in the energy sector which pull down the cost of production, increases the price received by producers or reduces the price paid by consumers of energy[15].

The International Monetary Fund (2008) define subsidy as any form of government interference that brings about a deviation of the actual price facing consumers and producers from a specified reference price and affects consumption and production patterns along with the distribution of resources with significant consequences for the budget, expenditure structure, and growth in the long run. In general, a price subsidy ultimately reduces (increases) the consumer (producer) price of a good or service below (above) what it would be in the absence of the subsidy depending on whether it is a consumer or producer subsidy respectively. While the latter often come in form of producer support, the former are usually administered through price legislation and both will in practice result in shortages or excess supply of the commodity.

In several third world countries, government and policy makers can control the price of petroleum product directly where there is monopoly in the production and distribution of petroleum products and indirectly with the use of pricing regulations, taxes and or subsidies (Hossain, 2003). Where this is the case, subsidy will comprise of both the implicit and the explicit components[16]. Implicit subsidies may not be an instantaneous transfer from the government to the producers and are therefore off budget. According to Saavalainen and Berge (2006), such off budget subsidies may translate into a quasi-fiscal activity and results in a quasi-fiscal deficit as the subsidies are finance from the budget in the long-run.

[15] See World Energy Outlook (1999): 'Looking at Energy Subsidies: Getting the Prices Right'

[16] Though, implicit price subsidies cannot be easily pinpoint in a government budget, they often manifest in the form of losses by government owned enterprises resulting from prices being set below cost recovery levels; diverse rates for various consumers or regulations that alter market prices or restrict market entry. In like manner, explicit subsidies may not always appear with the caption "subsidies" but they are usually provided for in the government budget as expenditures either by government directly or on its behalf by designated public agencies

The size of implicit subsidies is often not well known because they are much harder to measure and as large as it could be, they are often not reported. However, they include off budget costs borne by public agent such as national oil producing companies; tax expenditures in the form of tax exemptions for petroleum products; and the difference between import parity prices and applicable retail prices. Explicit subsidies on the other hand essentially reflect compensation to the national oil company for the difference between the international price of fuels and the wholesale domestic price.

2.1.2 Measuring Subsidies

Defining subsidies poses less conceptual difficulties than its measurement[17]. First, there is a Program Specific method which measure the value transferred from a particular program to all market partakers. This is a common approach employed by public sector analysts. The method tries to quantify the value of specific government programmes to a given industry. The major strength of this method is its ability to capture transfers whether or not they affect end user prices. The Program Specific method captures the value of government programs that benefits a particular sector, whether these benefits end up with consumers via reduction in prices, producers via higher revenues or resource owners via higher rents). Unless this information is integrated into a macroeconomic model, they do not tell us much about the issue of ultimate incidence of the subsidy or the distortions they have on product pricing.

Second is the Producer/Consumer Subsidy Equivalent method which attempt to consolidate both the net market and net budgetary transfer into a single measure. This approach captures both the pricing distortion and transfers that do not affect end market prices and it can also separate the effects on producer and consumer markets. Though it has been employed to assess Producer Subsidy Equivalent for coal in a handful of countries, the method is widely use

[17] For an overview of subsidy measurement approaches as well as the relative strengths and weaknesses of each method, see Koplow and Dernbach (2001)

in the agricultural sector. The major limitation of the approach is that it is data intensive. In addition, there exist little empirical producer/consumer subsidy equivalent data for fossil fuel markets.

Third and final is the Price Gap method which measures the variance between the observed and the "free-market" price for an energy commodity. By definition, the price gap method draw attention to observed price distortions but leaves out the considerable fiscal supports that may not affect consumer energy prices but do have significant influence on the structure of supply. The method is of great value in that it can be estimated with relatively little data and can be very useful in the area of cross country studies. In addition, the approach provides estimates which can serve as good indicators of pricing and trade distortions. Assuming the international market is devoid of any form of trading constraints, the efficient price in the case of a fully traded commodity such as petroleum products will be the international or import price duly adjusted for quality differentials, plus domestic transportation costs as well as the distribution margins. However, there is usually a difference between the price of a good with government intervention and the price of such good in the absence of such intervention. This is what Gupta et al, (2002) classified as implicit price subsidy i.e. the difference between the subsidised retail price and the free market price for petroleum products [18]

2.1.3 Effects of Subsidies

In order to understand the effect of subsidies, it is imperative to know why they are provided in the first instance. As discussed in the statement of the research problems in section one, notable among the reasons for subsidizing petroleum products is to make such products reasonably priced for the poor and the low income rural populace. By correcting underlying market failures, subsidies are also considered the most optimal means of promoting access to

[18] The free market price is the price that will ordinarily prevail in the absence of government intervention in the market and should naturally b set equal to the cost of importing extra unit of the product in any net oil importing nation. Detailed explanations on the definition are provided in chapter 3 and 5 of the thesis.

commercial energies for the poor. In addition, subsidy scheme are administered to promote a more equitable distribution of income among the various income group of the population.

Hence, subsidies are not problems in themselves but in trying to deliver them, their effects go beyond the main targets thereby affecting economic agents and sectors other than those intended. In this process, they generate either equity effects (by affecting the distribution of income and wealth within the society) or efficiency effects (by distorting the efficiency of primary economic activities) and sometimes both. The effects may be beneficial or harmful, slight or key, direct or indirect, anticipated or unintended. Whatever the case, both the equity and the efficiency effect are worth and should be considered autonomously.

2.1.3.1 *Efficiency Effects:*

This is one major and perhaps the most prevalent issue in the energy subsidy debate. The majority of condemnations of subsidy received today imply that public policy generate an inefficient energy use both in the aggregate level and the various composition. In a perfectly competitive environment, economic theory consents to the fact that allocation of goods and services based purely on the invisible hand of free private markets tend to provide far less or far more than the optimal quantities of some goods. If the free market forces undervalue an economic activity, then government subsidies may possibly enhance economic efficiency. Similarly, if the same markets overvalue an economic activity, then taxes possibly will enhance economic efficiency. On the other hand, if the free market forces perfectly allocate or value an economic activity, then government intervention (via subsidies or taxes) distorts resource use and generates inefficiency. This form of inefficiencies is what is referred to in the economic literature as non-market failures or more ingenuously, as government failures (see Wolf, 1991). The basic thrust of the above economic theory is that subsidies can be either market distorting (in which case, they cause a government failure) or market augmenting (where they reduce a market failure). Dealing with the subject requires multifaceted policy analyses without which it will be practically impossible to determine the actual efficiency effects of subsidy.

One principal argument often adduced for the inefficiency of petroleum subsidies is that they are poorly or ill targeted. Available evidence points in the direction that the higher the household income, the higher the accruable benefit from a given subsidy. This is because high income households consume more quantities of petroleum products and accordingly benefit comparatively more from subsidized prices. A World Bank (2006) study found that in the early 1990s, the poorest third of the population received six times less than the richest 20% of the populace in fuel subsidy per person in Venezuela. In another perspective, since subsidies alter free market price signals, they end up distorting the efficient allocation of resources and may bring about wasteful consumption and investment preferences that hardly reflect relative scarcities

2.1.3.2 Social and Equity Effects:

Equity in this context refers to the ways and manner in which socio economic benefits and costs are distributed among economic agents or the population in a given society. Practically all government actions generate socio-equity effects because there are both the beneficiaries and losers from most government actions, programs and policies. When government policy (such as fuel price subsidies) benefits certain people or agents in the economy, there are several other categories of people who do not benefit or better put, who bears the burden (by paying the associated taxes or other regulatory costs) to shelter these benefits for the beneficiaries. UNDP (2006) observed that while the economies of many developing countries have been growing steadily, income inequalities continued to widen. As crucial as economic growth is among the important driver of economic development, higher growth rates, budget surpluses and accumulated foreign reserves can only be meaningful when they are accompanied by a more socially equitable distribution of resources, improved access to socio economic goods and services among others.

As far as subsidy issues are concerned, economists are concerned chiefly with the economic efficiency of any government intervention while politicians and policy makers are more apprehensive of the equity effects of governmental interventions in the economy. Besides, the general public appears to be more concerned about the *fairness* of government policies (i.e. the equity effect) than about its efficiency effects. A socially equitable distribution involves the systematic allocation of resources to ensure redistribution of income, goods and services from the well off in the society to the poor and the less privileged thereby reducing the income gap and promoting welfare and 'social good' in the economy. While those who generally do not oppose welfare in principle believe in subsidies on the ground that a society's moral classification depends on how the less privileged are treated, they do, however, oppose subsidy where it increases the welfare for the already better off in the society.

2.1.3.3 *Initial and Ultimate Effects:*

While government may propose subsidies to achieve a set of effects on production and consumption, market agents often adjust to the prevalence of subsidies so as to alter the ultimate cost or benefit of the subsidy from the intended to unintended economic agents. In actual fact, subsidies on the whole have such complex effects on the economy that mere examination of outlays will only offer patchy and incomplete information. Therefore, the distinction that is often made between the incidence and the ultimate burden of a tax is particularly important when measuring energy subsidies. The difference between the initial incidence and the ultimate burden of a subsidy is particularly applicable to tax allowances for energy. Tax allowances (tax expenditures in economics) results in a reduced tax rate for certain goods and services relative to that paid by consumers of competing goods and services. Moreover, the benefits of subsidies are diminished by competition and captured partly by other consumers. If the initial subsidy lowers costs to the producer, those lower costs may translate into reduced market prices that benefit consumers. Regrettably, most subsidy studies ignore the details of this allocation of subsidies between consumers and producers purely because accounting data can hardly make such distinction.

2.1.3.4 Direct and Indirect Effects:

When the domestic prices for petroleum products are reduced as a result of subsidy, the subsidy package will affect the real income of households through two channels. The first effect will be the resultant reduction in the prices paid by households for consumption of petroleum products such as kerosene for cooking and lighting or gasoline for private transport. This is referred to as the direct effect of subsidy. Since these fuels also serve as inputs in the production process, the indirect effect arises as producers pass on the lower costs of fuel input through reductions in prices of other goods and services (in the form of lower prices for food, electricity and transportation) consumed by households. According to Coady et al (2006) in a study for the IMF's Poverty and Social Impact Analysis (PSIA) unit submitted that the indirect effect of subsidies is typically larger than the direct given that a substantial share of most fuel oils (e.g. diesel, gasoline etc) are used in the production and distribution of goods and services. This implied that most of the indirect effect arises from the pass through of lower fuel prices to food and transportation costs for households.

2.2 Energy Subsidies: The Good, the Bad and the Ugly

The case for government subsidies is well established in the theory of public expenditure. Governments spending in any economy are generally justified based on efficiency and equity considerations. According to Rosario, et al (2007), such spending will promote efficiency when it corrects market failures and/or generate positive externalities and uphold equity by improving the access of the poor to essential goods and services or allocation of economic welfare. Much of public spending has redistributive drive and the general perception is that public provision or subsidisation of goods and services is welfare consistent and egalitarian in nature.

Governments are often required to subsidize services that the market will not provide, or provides insufficiently. Pure public goods, where the marginal cost of additional consumption is zero, usually call for full state financing. Other private goods and services may be subject to significant external benefits or costs, and thus merit some form of government intervention. Subsidies might also be justified because of failures in related markets. Left to themselves, markets would under-provide certain goods and services, resulting in sub-optimal resource allocations. Governments are therefore called upon to subsidize some commodities for efficiency reasons.

Equity is yet another fundamental rationale for government subsidies. The fact that the poor are disadvantaged in gaining access to important goods and services, which would help them escape from poverty, suggests that the state should seek to target the provision of these services to such groups. Governments subsidize certain goods and services because they want to improve certain critical outcomes among the population. Energy and energy services subsidies, for example, can be justified if they improve living standards, promote access and results in higher growth. Petroleum products' subsidies might be part of a program to nurture infant industries[19] or stimulated partly by attempt to protect the environment.

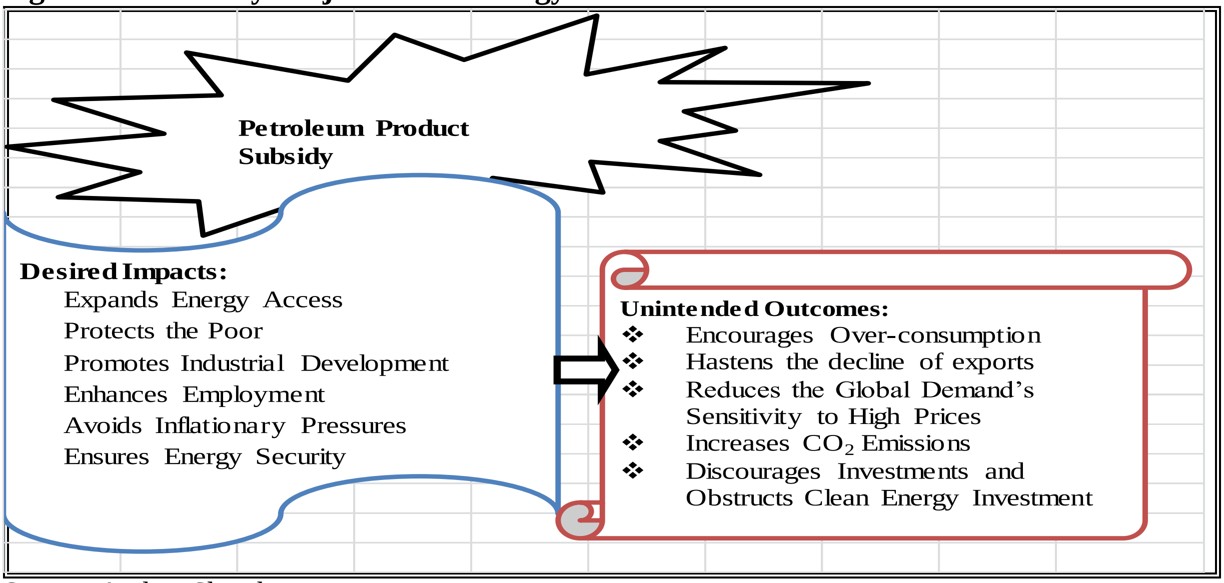
Facilitating the poor escape from poverty is a traditional responsibility of the state. In fact, one of the functions that people routinely expect governments to perform is to reduce inequality and poverty. This goal sits somewhat uncomfortably beside the more traditional concerns among economists for economic efficiency, including the provision of public goods.

[19] According to IEA, (2008) the Persian Gulf states attempted this by offering hydrocarbon feed stocks at prices that are somewhat below the opportunity cost in a rather successful but costly effort to attract petrochemical industries.

The provision and or subsidising of basic goods and services for the poor are one of the most effective instruments governments have to achieve these objectives.

To this end, energy subsidies exist and are found in practically every single country and going by the World Bank (2010), the scope can be large within a country perspective. The motives for providing subsidies vary quite frequently from one country to another. Nonetheless, the common rationalizations for energy subsidies embrace the need to expand energy access, protect the poor, keep employment, promote industrial development, avoid inflationary pressure, and enhance energy security as well as other political considerations, (Doug Koplow, 2004; World Bank 2010; Fattouh and El-katiri, 2012; and Bazilian and Onyeji, 2012).

Figure 2.1: Primary Objectives of Energy Subsidies and Some Unintended Outcomes



Source: Author Sketch

In spite of the above rationale, there are some 'bad' about energy subsidies which mostly arise in the form of unpremeditated adverse consequences. These effects can be categorized into three main groups namely the Economic, Social and Environmental. Energy subsidies may result in certain economic inefficiencies in resource allocation that may prompt sub optimal use of reserves in producing countries. When subsidies provide incentive for excessive use of energy, they may also generate unusually high consumption. Generally, inappropriate pricing often acts as disincentives for productivity improvements and discourages not only investments in modern and efficient technology but also investments in alternative energies (See Coady et al, 2006; Fattouh and El-katiri, 2012; and IEA, 2011).

Though, subsidies that lead to wide disparity in domestic fuel prices may encourage smuggling of fossil-fuel products to neighbouring countries but this has more to do with corrupt border officials in affected countries. Several studies including Gangopadhyay et al, 2005; Kpodar, 2006; and El Said and Leigh, 2006 have traced the social costs associated with subsidies to the regressive distributive nature which might further skew the prevailing income distribution in most countries. Yet, this does not remove the fact that energy subsidies establish important social safety net for the poor and can be very critical in addressing social equity and poverty reduction (See Lin & Jiang, 2011; Bazilian and Onyeji, 2012 and IEA 2011).

In recent time, the bulk of the negative side of subsidies comes from the costs it imposes on the environment in form of fuel combustion related emission and greenhouse gases. This effect arises when subsidies result in excessive fuel demand and energy conservation goal becomes vulnerable. Another explanation is that, as fossil-fuels enjoy high subsidies, investment in and the development of cleaner fuels such as renewable, solar and wind become unattractive. However, as Park and Kwon (2011) studies have shown in the case of Korea, fossil-fuel subsidies can encourage fuel switching from coal or biomass to cleaner fuels.

Experience abound that energy subsidies and their reform process can often turn out to be an ugly exercise. The ‘good’ and the ‘bad’ about energy subsidy above suggest that the need for subsidies may vary across countries based on pressing economic, social and developmental objectives and as such, reform process cannot be a one cap fits all. Mere adoption of pricing models or subsidy reforms by countries without comprehending the assumptions and the prevailing socio economic condition behind such models can exert greater negative impacts. A typical example of this policy adoption syndrome was attempt by Bolivia and Pakistan to reduce subsidies by raising energy prices in line with the Iranian "Targeted Subsidies Reform" adjudged as the first successful attempt by major oil producing and net oil exporting country to significantly replace massive indirect fuel subsidies with far-reaching dividend transfers to the population. The two countries had to abandon the efforts in the wake of massive public resistance. Basically, public expenditure decisions particularly on subsidies should reflect a sound understanding of the needs and preferences of the population at large because spending money on the provision of goods and services, without attending to the efficiency with which the spending generates access to these goods and services, the impact on the anticipated beneficiaries and to the cost-benefit effect on the aggregate economy, is not economically prudent.

The provision of public subsidies should be partnership between governments, on the one hand, and intended beneficiaries on the other. To make this collaboration effective, there must be a mutual flow of information, with the benefactor (i.e. governments) constantly 'listening' to the intended beneficiaries (i.e. target populace) and the beneficiaries in turn, being informed of government goals and their privileges under explicit agreement or pledge. The issue therefore is about the dimension of the information flow: how informed are governments about the desires and conduct of the people, especially the poor? How will the short run effects be cushioned? Are these well communicated and accepted to the people? In most cases, any breach in such information flow usually results in ugly picture[20].

Therefore, the ugly picture of subsidies arises along the path of reforms. Sometimes, the subsidies to be reformed are hardly properly researched to ascertain the underlying objectives

[20] Properly aligned and coordinated information contributed to the relative success of the December 2010 subsidy reforms in Iran compared to the poorly coordinated implementation of the gasoline rationing scheme in June 2007 where many officials made conflicting public statements about the timing and scope of the fuel rationing, which resulted in social tension and limited insurgences at some fuel stations. The importance of such information flow was recently demonstrated recently in the face off between the Nigerian government and the organised labour/civil society groups when the latter embarked on a week nationwide protests in reaction to the former's announcement of a total withdrawal of subsidy on petroleum products in January, 2011. The demonstration send a signal back to the government on the position of the people and this led to government shifting its earlier ground of 'total subsidy removal' to that of 'partial/gradual removal'

and present role of such subsidies. Quite often, the economic, socio and political rationale for reforms are not well established and adequately publicised. In fact, successful implementation may depend on appropriate timing, consistency and transparency.

Fig 2.2: Protesting Fuel Pricing and Consumption Reforms

Source: http://www.bbc.co.uk/news/world-africa-16390183 and http://www.sfgate.com/cgi-bin/article.cgi?f=/c/a/2007/06/28/MNGGIQN3RJ1.DTL

2.3 Empirical issues

The literature is replete with energy subsidy particularly, on petroleum product subsidy in developing and net oil-exporting countries. However, many of these studies are highly descriptive in nature while some have employed different econometric and statistical techniques to evaluate the distributional impacts and effectiveness of subsidies and subsidy policies on the welfare and expenditures of the intended beneficiaries.

The Department of Economic Affairs of the Ministry of Finance in 2004 assessed the impact of Central Government subsidies in India and found that the Liquefied Petroleum Gas (LPG) subsidy benefits mostly the upper income groups in the urban areas with a regressive distribution while in the case of kerosene, the urban areas receive a generously proportioned subsidy on a per capita basis. The study observed that in the rural areas, subsidy on kerosene is regressive as higher spending groups receive more subsidized kerosene than lower spending groups while the inadequate availability of subsidized kerosene accounted for its greater use in lighting as against cooking[21]. In the Indian case, it is the non-availability and not affordability that impeded the use of kerosene by the rural-poor. Hence creating a transparent and competitive market may in the long run, be sustainable in expanding access.

Pitt (1983) paper examined the two arguments usually used to rationalize the subsidy provided on kerosene which is the major commercial fuel consumed by the Indonesian household[22]. The results from the econometric analysis of a large cross-sectional household's data reveal that firewood-kerosene substitution is very restricted in regions with acute deforestation problem implying that subsidy is hardly effective in alleviating the problem of environmental externality. In addition, the results also established that the more affluent urban households (about 18.5% of all households) obtain a top-heavy share of total kerosene subsidy. While concluding that kerosene subsidy markedly benefits urban and richer households, the paper noted that poor families with little or no substitute for kerosene in lighting may bear a significant burden if all subsidies are totally faced out. The study suggests the use of other less costly technique to aid poor Indonesian households rather than subsidising goods consumed largely by richer household

In an attempt to quantify the size and distributional impacts of an increase in oil prices on the real income of households and also evaluate the usefulness of subsidies in protecting poor households, Kpodar (2006) employed an input-output approach to evaluate the

[21] The report noted that Kerosene subsidy is prone to abuse since about 50% of the subsidized kerosene supplies are diverted from reaching the anticipated groups which suggest that both the LPG and kerosene subsidies are unproductive in achieving their intended objectives. It therefore recommends a gradual but substantial removal of LPG subsidy but a more careful approach in the cutback of kerosene subsidies as over half of the rural households basically use kerosene in home lighting.

[22] One side of the argument is that the kerosene subsidy reduces deforestation externalities arising from fire wood gathering and usage while the other is the social equity rationale which hinges on the necessity that commodities such as kerosene are 'essential needs' for the people and must be subsidised. Gangopadhyay et al (2005) contended the social externality arguments that fuel subsidies are effective device to shifting fuel consumption pattern away from biomass to fossil fuels as it reduces the pressures for deforestation and air pollution associated with the use of biomass. He said the argument depends on the extent to which rural households that use biomass as a result of its lower price benefit from the subsidies.

distributional effects of rise in a variety of petroleum product prices in Mali.[23] The result shows that while escalating gasoline and diesel prices affect mostly non poor households, increasing kerosene prices are more detrimental to the poor households signifying that upper income households benefit exceptionally from price subsidies on any of the oil product considered. The implication of the outcome is that petroleum price subsidies are less effective instrument for shielding the income of poor households as against other well targeted subsidy

Assessing the impact of subsidy reduction on the energy consumption pattern and welfare of the poor is important given that the bulk of the core poor globally rely primarily on biomass energy for cooking and the use of modern fossil fuels is limited in many developing countries where access to electricity is less (see Barnes and Halpern, 2000; Barnes et al., 1997). Kerosene and LPG are widely used for lighting and cooking by Indian households and are highly subsidized historically but the reality of the present reform in the energy sector will translate to imminent reduction in these subsidies by government.

To this end, Gangopadhyay et al (2005) study examines the impact of reducing energy subsidies on the welfare of the Indian poor populace using data from nationally representative surveys of over a hundred thousand households and finds that LPG subsidy is regressive and can hardly exert much shifting effect on biomass use whereas kerosene is widely used and is not unlikely to displace the use of biomass. They conclude that subsidy is an ineffective means of the welfare of the poor but warned that any cutback in the subsidy must be supported by other poverty reduction policies that would limit the unfavourable impacts on the poor

El Said and Leigh (2006) study uses the estimated implicit import parity prices to evaluate the overall fiscal cost of subsidy[24] and also analyse the distributional impact of

[23] According to the author, Mali is typically poor and highly reliant on imported oil products. The paper noted that the main supplies of energy in the country are wood, charcoal and petroleum products and observed that implicit oil subsidy in Mali accounts for about 2% of GDP on the consumption of petroleum products whose share in the country’s total energy use is about 60%

[24] The author noted that fuel prices have remained mostly unaffected since 2002 in Gabon. Hence the full fiscal cost of the subsidies was estimated at over 3% of non-oil GDP in 2005.

implicit subsidies on fuel prices in Gabon using household survey data. The distributional impact of the subsidies was computed by simulating the effect of eliminating the subsidies on the real incomes of household across the income group using the 2005 EGEP household data set (Gabonese Survey for the Evaluation and Tracking of Poverty). The simulation entails raising the ex-refinery prices to import parity price levels with tax rates, fees, and margins remaining constant. The paper finds that it is the higher income households who actually benefits from fuel price subsidies in Gabon since the poorest 30% of the households receive about 13% of all the subsidies while about 35% of the subsidy accrues to the richest 10% of households. The paper concludes that fuel subsidies are not only ineffective but also a costly technique to shielding the real incomes of the poor. The authors suggest that the use of some of the existing programmes[25] can provide a more directed and economical way of mitigating the effects of energy price increases on the incomes of poor households.

The discovery that fuel subsidies are in favour of the rich in Gabon conforms remarkably with the results of the distributional impacts of fuel subsidies in many other countries. The cross country study by Baig et al. (2007) lend credence to this by observing a large dataset to explain the overall (direct and indirect) effect of various subsidy tradition on petroleum pricing around the globe. According to the paper, the all high international oil prices has made the domestic pricing issue a constant and major source of economic and general policy concerns for most countries. The analysis of the data shows that only half of the countries in the sample managed to execute a complete domestic pass-through of international price changes during the mid-2006. In all, the indirect effect is in general larger than the direct[26]. While the distribution of the total effect tends to be somewhat regressive,

[25] The authors belief that since the bulk of the fuel subsidies benefit the high income households, it is perhaps feasible to eradicate the subsidies and use part of the cost savings to fund better targeted programmes like augmenting spending on poverty alleviation projects; raising support for the country's existing welfare packages and reducing present social tariffs on water and electricity

[26] Since a significant share of most fuels are used in the making and distribution of commodities, the indirect effect results majorly from the pass-through of higher fuel prices to feeding and transport costs of households

that of the direct effect appears to be neutral. The authors recommend a practical approach to dealing with petroleum product pricing. For instance, during the period of rises in international oil prices, the prices of domestic petroleum products may be liberalised or introduce a healthy automatic adjustment procedure and merge each price increases with a transparent scheme and measures to lessen the impact of the price increase on the poor

The analysis of the welfare implication of petroleum product subsidy was extended to Iran–a typical net oil exporting country which has pursued a policy of energy products' subsidies for long in a bid to assist the poor and to exploit the relative oil advantages of the country. With the incessant call for the removal of energy subsidy on the ground of associated market distortion and loss of welfare, Saboohi (2001) carry out an assessment of the impact of energy subsidies reduction on households living expenses in Iran. He developed an analytic tool[27] with which the direct and indirect effect of removing energy products' subsidies on the household's living expenses is evaluated. The findings show that subsidies do not improve the welfare of the poor and should be gradually eliminated and substituted by a more progressive resource distribution and other pro-poor policies like social security financed by resources resulting from elimination of subsidies

Despite the fact that fuel price subsidies have unpleasant implications[28] for both government budgets and energy uses, they remain politically popular particularly in developing countries. Many governments in these countries are actually very reluctant to pass on to end users, any rise in energy price despite recent cases of constant volatility in world oil price. Coady et al. (2006) recognizes the critical issues that are germane when evaluating

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while the direct effect generally reflects the rise in the price of kerosene which often account for a large share of total consumption among the low income households

[27] To uncover the nature of resource distribution with subsidies, the paper estimated a Gini coefficient through the Lorenz curve for the whole households. Various Gini coefficients were calculated to capture the rich-poor, urban-rural dichotomy features in the population

[28] Huge volume of subsidies redirects public spending away from more priority sectors thus generating unsustainable fiscal deficits. Subsidised fuel prices will generally provide the households the incentives to be more inefficient in their consumption of energy which exacerbates the overall macroeconomic effect of higher world prices on the economy

the economic and social costs of fuel subsidies. Drawing relevant examples from recently undertaken analyses on some developing countries[29], they estimate the size of consumer subsidies and their budgetary implications. The result of the study shows that energy subsidies have significant socio economic costs and are quite often, poorly targeted in all of the countries.

There is an increasing criticism by oil industry stakeholders and analyst on the impacts that subsidies exert on government finances, oil companies financial performance and energy use pattern. In this regard, IEA (2006)[30] assesses the real magnitude of petroleum product subsidies in India and observed against common insight that India's retail prices for petroleum products are relatively high despite subsidies. The paper maintained that the government sustains the present pricing system because the revenue from product's taxes and surcharges surpasses subsidy spending. This is however at the detriment of oil companies' finances and constitutes a disincentive for private investment in the industry. The result is inconclusive on whether subsidy allows the poor access to petroleum product but the study suggests that a more reliable, transparent and realistic pricing system should be execute by the government

The study by Azis (2006) conducted a search on the relative merits of partial reduction as against the enormous cut in fuel subsidy due to the upsurge in the world price of oil which resulted in about 120% rise in average domestic fuel prices in Indonesia. Though the government action was necessitated by the need to reduce the mounting pressure on government budget due to rising expenditures related to all sorts of subsidies, the author believed that such a policy is misguided. Using a set of simulations on a financial general equilibrium model, it was found that cutting subsidies for the banking sector and using the

[29] These countries are Bolivia, Ghana, Jordan, Mali, and Sri Lanka

[30] This is a working paper by the International Energy Agency focusing on the Asia pacific. The paper contended that the sum of all government taxes and surcharges on petrol, kerosene and diesel products far exceed the annual budget subsidies for these products. Subsidy in the study is defined as the amounts listed officially as subsidies in the country's annual budget and or the difference between the actual retail price and the retail price based on import-parity formula called under recovery by the oil companies

savings judiciously on agricultural investment could produce a positive outcome on poverty reduction and income distribution without worsening the macroeconomic conditions. The paper concluded that the substantial reduction in fuel subsidies is needless given the negative socio-economic and political aftermaths.

Though the higher income segments of the population consume the bulk of petroleum products, it is however appealing to conclude in theory that these groups would bear the burden of further cutback in any subsidy. Truly, such conclusion would be hasty in view of the undulating effects of higher petroleum products prices on costs and output all over the whole economy. Hence, the paper by Clements et al. (2003) tries to investigate these linkages effectively and show that the effects of reduction in subsidy goes beyond the immediate short run effects on consumers using the computable general equilibrium (CGE)[31] model to assess how increase in petroleum prices will affect prices and incomes in all the sectors of the economy. The results of the simulation forecast a minor increase in price level but a slight decline in output and more essentially that urban households will be the mostly and significantly affected by any subsidy reduction[32].

An analysis of the economic impacts of tax system and energy subsidies on Indonesian economy was conducted by Lewis (1993). This study reveals the small impacts of tax or subsidies abolition on energy consumption. They contended that taxes or subsidies abolition affects consumption through income effect and the results show that the abolition of the gasoline type of tax gives the largest impact to the expanding of fuel consumption while the abolition of kerosene subsidy yields the largest impact to the lessening of fuel consumption.

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[31] They examine the impact of rising petroleum products prices on the aggregate inflation, real output and income distribution within a multi sector computable general equilibrium (CGE) model which was calibrated on data from the 1995 Indonesia Social Accounting Matrix

[32]These findings suggest that in the immediate, a decrease in petroleum subsidies will lead to a rise in the price level and a fall in household consumption. Though the high income groups suffer the most from reduction in subsidy but the poor are equally affected. However, the poor households could be protected with more focused social security nets using part of the budgetary savings created by subsidy reform. Given the role of subsidy reduction in budgetary and financial sustainability, increase petroleum prices are not likely to have adverse effect on the poor in the long run

The simulation results point to the conclusion that prevailing tax system and energy subsidies create a considerable distortion on economy and the level of welfare in Indonesia.

Negara (2000) employs a CGE model to study the impact of increasing energy price on macro-economic variables including economic growth, unemployment rate, saving rate, and income distribution in Indonesia. Negara argues that the policy to increase the fuel price is an effective tool to increase efficiency in energy consumption and strengthen the government budget. However this policy increases the level of unemployment.

Hartono and Resosudarmo (2006) analyse the impact of the fuel and electricity price appreciation on economic growth and income distribution with emphasis on the implications of subsidies reduction policy on economic growth and income distribution, the implications of energy utilization efficiency by households and industries and the appropriate policies on the Indonesia energy sector. Among the numerous conclusion of the dynamic CGE model[33] are that reducing the subsidies which is not followed by escalation in efficient energy use caused that GDP to increase by about 0.48-0.51% in 2010 compared to 2000 and income distribution will be spread evenly (Gini coefficient in 2010 will decrease 7.9% (compare to the base condition); Without income transfer to the poor, as a compensation to the decreasing of oil subsidy, most of the poor household incomes will be lower than the base scenario while reducing the fuel subsidy with compensatory income transfer will increase GDP and poor household incomes with the biggest percentages 0.06-1.33%.

[33] Three major scenarios experimented in the study include price changing scenario because of the decreasing of subsidies and implementation of compensation program which is not followed by escalation in efficient energy use; price changing scenario because of the decreasing of subsidies and implementation of compensation program which is followed by escalation in energy use efficiency by Industrial sector; and price changing scenario because of the decreasing of subsidies and implementation of compensation program which is followed by escalation in energy use by both the industry sector and household sector. In all the scenarios, price changing and the reduction in subsidies are only implemented on seven types of energy namely, gasoline, ADO, IDO, kerosene, refinery gas, MFO and electricity. The cut of subsidies on those types of energy is implemented step by step such that there will be no subsidies on them except kerosene and electricity for poor households in ten years forward

Some studies have developed special CGE model to suit specific analyses of the impact of energy taxes and subsidies on choice socio economic and environmental variables. Naqvi (1998) develops Energy CGE model called GE-PAK to analyse the economic impacts of energy subsidies in Pakistan. The model which was constructed using the Social Accounting Matrix (SAM) data with complete Input-Output (I-O)[34] table are based on a neo-classic assumption and has the potential to capture the relationships among the economy, energy and social equity.

Bohringer (1998) develops a completely different format of CGE model in order to capture the bottom up features of energy sector activities as against the top down characteristics of production function[35]. The simulation results show that tax increase by the government increases the activities of simple-technology based industries and decrease the activities of energy-intensive industries. There is also evidence that ad valorem tax policy will decrease the demand of electricity and reduces output.

PIE-DESDM (2001) develops the INDOCEM[36] CGE model for the Indonesian economy and uses Indonesian I-O table in 2000. The results show that the rise in fuel price causes 1.3/0.77% inflation rate if the rise in fuel price is followed/not followed by wage compensation respectively. In addition, this policy has a slight implication of about 0.27 to 0.026% for economic growth with the biggest effect falling on the communication and transportation sector. Oktaviani et al (2005) develop a recursive dynamic CGE by using both the Indonesian Input-Output and Social Accounting Matrix data in year 2000 to analyse the impacts of fuel price policy on the macro-economy, poverty, and the agricultural sector. The

[34]This Input-Output table use by Naqvi consists of income and expenditure data from 4 institutions with 131 commodities from 128 industries. These institutions are households, companies, government and the external institution

[35]This approach helps to improve credibility of energy CGE model and enhances the strength of policy recommendations. The study conducts simulations to analyse the impacts of ad valorem tax implementation which increase the price of energy as a primary input in electricity production by roughly 25, 50, 100 and 200 %

[36]INDOCEM is an acronym for Indonesian Comprehensive Energy-Economy Model. The uniqueness of the model lies in its flexibility to separate the negative effects of increase in fuel price and the positive impacts of the higher fuel price on the efficiency of energy use

results show that by increasing fuel price, output price of energy-intensive industries such as transportation and fishery are raised while peoples' real income and people welfare reduced. The study concludes that this policy in general, increases poverty level but does not affect the price of rice.

Bacon and Kojima (2006) in a review of existing experiences on fuel subsidies' phase out in developing countries argue that while the rise in global oil prices since January 2004 has had very high economic and financial costs for these countries through increase in public debt and limiting other government spending alongside other unintended consequences such as fuel adulteration, smuggling, and regressive benefits, phasing out these subsidies can be politically perplexing. This authors review some fruitful strategies for eliminating or reducing fuel price subsidies while shielding the poorest consumers and conclude that fuel subsidies benefit the poor, but at a huge cost to the economy. They recommend that governments should hurriedly as possible, replace fuel price subsidies with efficiently designed and well-targeted assistance to identified poor beneficiaries

Using the logic of survival, Victor (2009) demonstrates that the inability to understand the political economy of subsidy majorly accounts for the failure to reform subsidies. While subsidy can help to improve energy access to poor communities, redistribute income, alleviate poverty, nurture infant industries, and assist in addressing environmental degradation, when initiated and irrespective of its initial purpose, various interest groups[37] coagulate around the continuation of the policy and make change hard. The study contends that it is vital to study both the demand for and supply of subsidies and recommends that the genuine reforms depends more on the latter.

[37] The interest groups that seek subsidies are generally well structured, and the creation of the subsidy frequently makes these groups even extra conscious of their concern in upholding the subsidy policy. In addition, the body that deliver subsidies regularly find political gain in supplying this costly service. These are political corroboration that makes it mostly difficult to disconnect the purely interest induced political rationale of subsidy and the many genuine intentions for policy purpose

In reaction to recent agitations for countries to eradicate their subsidies on petroleum products, several countries have attempted to eliminate government support for the consumption and or production of fossil fuels with differing level of accomplishment. For instance, in late 2009, the policy makers from the Group of Twenty (G20) and the Asia Pacific Economic Cooperation (APEC) member countries agreed to phase out unproductive fossil fuel subsidies. However, experiences have shown that subsidies are generally difficult to eradicate. Exact information[38] of the intensity and category of subsidies is a good pre-requisite for this task

In September 2009 the G20 Leaders made commitment to streamline and eliminate wasteful fossil fuel subsidies that encourage wasteful consumption over the medium term based on the results of a joint study made by the OECD and the IEA using the OECD ENV-Linkages general equilibrium model. The study indicates that abolishing fossil fuel subsidies in a number of non-OECD countries could reduce global Greenhouse Gas emissions by 10% in 2050. The magnitude of these subsidies are huge going by the IEA estimation which indicate that total fossil fuel consumption subsidies in 37 non OECD countries as of 2008 amounted to USD 557 billion. Thus, Burniaux and Chateau (2011) deliberate the assumptions and data of the OECD-IEA analysis and examine both the environmental and economic implications of removing these subsidies and find that the full environmental benefit of this policy option can only be achieved with a comparable cap on emissions in OECD countries. The study concludes that while removing these subsidies is a global plus, the environmental and economic benefits are untrue for all countries and or regions

The emerging dilemma in the basic energy demand and supply management in the wake of continuous surge in energy prices and growing environmental concern has also engender

[38] Laan (2010) posits that consistent information will ease an evaluation the fiscal costs distributional impacts and effect of the subsidy as well as the development of efficient approaches for subsidy reform. At the global level, it will also provide the basis for observing the progress towards subsidy elimination

series of country specific research on the issue of energy subsidies. In a typical transitional economy like China, a reasonable level of energy subsidies may be sometimes justified as necessary for attaining social objectives. This and the important effects that energy subsidies pose for efficient energy use, fuel choice and sustainable development have stirred further investigation. Lin and Jiang (2011) adopt the price-gap method to quantify the size of energy subsidies and apply the CGE model to evaluate the economic impacts of energy subsidy reforms in China. The results show that China's energy subsidies summed up to about 356.73 billion Chinese Yuan in 2007 which equalled about 1.43% of the country's GDP. The analyses further revealed the consumption subsidies for oil products to be the largest relative to the electricity and coal sectors subsidies. Since the outcomes indicate that eliminating energy subsidies will result in a substantial fall in energy demand and emissions but with adverse effects on macroeconomic variables, the authors suggest the adoption of compensating policies where subsidy savings are moved to maintain other measures of sustainable development.

Larsen and Shah (1992) provide evidence on the level of global fossil fuel subsidies and their implications for CO_2 emissions under two scenarios. The study contends that considerable fossil fuel subsidies prevail in a few but large carbon emitting nations and that eliminating such subsidies could significantly reduce domestic carbon emissions in selected countries. The results show that global energy subsidies is in excess of US$230 billion with about US$20 billion as the associated welfare cost. The paper concludes that world carbon emissions could be reduced by 9% supposing there is no change in international fossil fuel prices and by about 5% if changes in fossil fuel prices are factored in.

The work of Bhattacharyya (1995) contends the general conclusion that energy prices are not efficiently set in developing countries and specific energy products are extremely subsidised by virtually all energy pricing studies. According to the paper, the measurement of subsidies and certain implicit approximations particularly on the use of one end-user prices of petroleum products as proxies for opportunity cost at end-user level in cross country studies can grossly affects the results and conclusions. Given that the price paid by a country depends on the differences in purchasing arrangement, and the considerably variations in the handling and local transportation costs across countries, the adoption of a single end-use level prices across all others can erroneously ignored countries' differences and diffuse the errors and deficiencies to all the others thereby rendering the inferences based on these results inaccurate. The author opines that country specific study can be more rigorous and may provide valuable information concerning actual price differentials. Therefore the study provides an estimate of petroleum products subsidies in India and demonstrates how different approximations affect the outcomes of subsidy valuations

In another dimension, Morris et al. (2010) contended that the problem of inefficiency and social losses[39] associated with the petroleum product subsidies is not subsidisation as such but as a result of using different retail prices to estimate subsidy arising from the structure of central taxes and the method of subsidisation through prices. They suggested that tax and subsidy cannot be tackled separately but simultaneously. Similarly, Coady et al. (2010) re-evaluate latest developments in subsidy levels[40] and contends that it is crucial to reform the policy instrument for setting petroleum product prices with a bid to reduce the financial burden of these subsidies and tackle climate change. Estimations of the size of consumer subsidies are based on a new database on domestic retail prices of petroleum product from 2003 to 2009. The unit subsidy per litre is calculated as the difference between

[39] Few among the social losses associated with subsidy include wasteful use, diversion, sullying, and preventable negative externalities of petroleum resources; tax arbitrage; distortion of consumption and production input choices; and product cross hauling. All these result in varying prices for the same or across product for different consumers

[40] According to the paper, while global ex-tax consumer subsidies for petroleum products is put at about $60 billion in 2003 and the estimate for 2010 at nearly $250 billion, the tax-inclusive subsidies are estimated to be in the realm of $740 billion in 2010 or about 1 % of world output

an appropriate standard price[41] and tax inclusive domestic retail prices. The study observed that the G-20 member countries account for more than 70% of tax-inclusive subsidies and conclude that these countries may well reduce anticipated fiscal deficits and greenhouse gas emission by about 17% and 15% respectively if subsidy is reduced by about 50%. Though, such subsidy reform scheme should incorporate measures to alleviate the shock of higher prices on the poorest households.

Arze del Granado et al (2010) appraise the available evidence on the effect of fuel subsidy reform on household welfare in developing countries. The review finds that the burden of subsidy reform is on average, neutrally distributed across income groups with a 25 cents reduction in the per litre subsidy resulting in a 6% fall in income for all groups and that well over half of this influence arises from the indirect impact on prices of other goods and services consumed by households. In addition, they contend that fuel subsidies are a costly method of protecting the poor due to significant benefit leakage to higher income groups as the top income quintile enjoys six times more in subsidies than the bottom on absolute basis. The study concludes by suggesting the need for a new approach to fuel pricing in many countries and offer insights into the critical issues that should be considered when carrying out subsidy reform including but not limited to adequately informing the prospective beneficiaries such as the consumers and taxpayers about the shortcomings of existing subsidies and the potential benefits of reform.

In spite of the large quantity of works on energy pricing, clear explanations of issues are lacking as most studies continue to place extra emphasis on economic efficiency as defined by the "laissez-faire" approach. Yet, the theory can hardly solve the multiplicities of socio economic and externalities issues that policy makers are normally confronted with.

[41] The standard price is taken as the international price in US$ for the relevant product at the nearest international nucleus adjusted by 10 cents per litre each to allow for the shipping and the distribution and retailing costs respectively. The relevant per litre domestic distribution and retailing costs are as reported in the Energy Information Administration (EIA) 2008

These and the complications imposed by the existence of the informal sector as well as the distorting role of traditional energies in energy pricing were the major issues addressed by Bhattacharyya (1996). The paper conducts a broad analysis of the several factors affecting energy pricing and contends that current economic theories offer little assistance in real-life determination of domestic energy pricing. The conclusions of the paper are that equity considerations which are highly essential for political acceptability of any pricing remedy has been lost in the quest for efficiency and that economic tariff in the energy sector are set in gross violation of economic prescription

Reforming fossil energy subsidies is no doubt an operational way to advance a better energy consumption arrangement but the uncertain impacts it will exert on the economy, society and the environment requires the reform to be evaluated carefully in advance. To this end, Liu and Li (2011) in their paper use the price-gap approach to assess the degree of fossil energy subsidies in China and later establish a CGE model with pollutant emissions and CO_2 emissions account to stimulate the fossil energy subsidies reform under varying assumptions. The study applies some environmental and economic analytical framework to monetise the pollutant reduction benefits and also analyse the likelihood and scope of enhancing the energy consumption pattern. The results confirm that removing coal or oil subsidies can improve in different magnitude the pattern of energy consumption with the effect of coal subsidy appearing more feasible than oil. The study also concludes by suggesting gradual rather than abrupt overall cut in subsidies.

The report by Burniaux et al (2011) draws on earlier OECD work to evaluate the influence of phasing out fossil fuel consumption subsidies in developing and emerging economies on international trade using the OECD's ENV-Linkages General-Equilibrium model combined with the IEA's price gap estimates of consumer subsidies. The results show that a coordinated mutual removal of fossil fuel consumption subsidies between the period of

2013 and 2020 would increase world trade volumes by a seemingly negligible 0.1% by the year 2020 though with observed large disparities across countries/ regions and products. While trade in natural gas would be most affected with a 6% fall by 2020, adjustments in trade flows would be most predominant in energy-intensive products and the input of oil exporting countries to global trade volumes would continue to be lesser in the long term.

A typical energy-poverty problem concerning how subsidy reforms can aid fuel switching among households was investigated by Park and Kwon (2011) for the Korean coal industry in the country's bid to transit to a low carbon policy. With the use of the 2007 census data on briquette consuming households, the study seeks to uncover the factors that influence households' fuel switching decision in line with the coupon program reform policy of the government to encourage fuel switching from anthracites to other clean energy. The paper found that the coupon program provides an adverse effect to switching fuels to clean energy and concludes that reform policy on consumer subsidy must be clearly packaged within the framework of a more comprehensive regional energy plans in order to address energy poverty concerns. According to Laan (2010), the present level of available information about fossil fuel subsidies is less pleasing. Hence, the study draws on existing body of knowledge on fuel subsidies to substantiate the position that useful and accurate information could effectively aid reform and suggests ways to accomplish this in good time and with least resources. The study concludes that enhanced transparency is crucial and involves improved reporting within nations and a new global order.

Following the major reforms in Iran on December 2010 which led to a rise of about twenty folds in the domestic prices of energy and agricultural products, Guillaume et al (2011) conduct a review of the economic and technical issues included in the planning and execution of the reform as well as the various compensatory transfers to households and many other factors that were essential to the realisation of the reform. The study submits that proper planning, information management, transparency and appropriate timing among others led to the success of what has turned out to be the first successful markedly implicit energy subsidies removal by a major net oil exporter.

In countries where government transparency is an issue, opinions tends to differ sharply on the existence of and even the magnitude of fuel subsidy which create stiff opposition in any subsidy reform process. In this kind of situation, there is the need to empirically examine these opposing claims to ascertain whether the existence of such subsidy is a fact or fallacy. In this regard, Nwachukwu and Chike (2011) sought to clarify this issue in Nigeria by employing linear regression to test the hypothesis that there is no significant relationship between fuel demand and fuel subsidy factors. The study provide empirical evidence that fuel subsidy is a fact and not a fallacy as the results suggest that there is a significant relationship between the fuel demand and fuel subsidy factors proxy with fuel subsidy and fuel price. The study advocate a gradually controlled withdrawal of fuel subsidy based on its finding that fuel subsidy factors account for about 50% of changes in demand for fuel.

Akpoghomeh and Badejo (2006) reviewed the supply and distribution systems of petroleum product in Nigeria among other objectives[42]. In addition, the shortage between the landed cost of imported petroleum products and their selling prices makes importations by government and other marketers highly unsustainable and unprofitable. All these, the study observes, are not unconnected with national government policy of subsidies on the price of petroleum products in the country and advocated for the privatization of domestic refineries and pipeline system, removal of government subventions as well as deregulation of the petroleum products' prices as feasible alternatives to attract the required private capital into the sector and end the fuel supply problems.

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[42] The major aim of this study was to establish the cause of the erratic petroleum products' supply system in a country which ironically ranks tall among the group of net oil exporting nations. Hence the study identified both the network density and distribution pipelines connectivity as low and inadequate in ensuring a proficient distribution system.

Adenikiju (2010) posits that elimination of subsidies usually generate violent resistance from those who benefits from them including fuel importers, government officials, labour union, and the richer urban elites; but arbitrary use of energy subsidies is costly not only for the economy but everybody in the chain. He suggested that the existing low pricing of crude oil should typically allow the economy to institute some type of taxes on fuel imports and use the proceeds to finance suitable and reliable compensatory programme for the truly vulnerable segments of the population.

It is important to point out that fossil fuel subsidies and their reform process have not given adequate attention to incorporate the peculiar socio economic environments of developing countries in the global call for subsidy reforms. While it may be true that price subsidy distorts price signals causing inefficient resource allocation and may sometimes disproportionately benefits people that are beyond the targeted poor, their reforms may also exert unintended consequences on the development of other sectors of the economy particularly in developing world. To this end, Bazilian and Onyeji (2012) contemplate the implications of fossil fuel subsidy reform policies for businesses within the context of acute shortage of power supply in Nigeria. Using the January 2012 petroleum product subsidy reform in Nigeria as a reference point, they contended that the reforms administrative process fails to properly factor in the veracities of institutional and infrastructural dearth. Hence, removal of subsidy in this and other similar economies put further pressure on the existing high cost of power supply thereby raising cost of doing business in general. Accordingly, the authors suggest that ineffective policies in developing countries (such as the failed subsidy removal in Nigeria) results from non-consideration of countries' specifics in formulation and implementation.

Similarly, Fattouh and El-Katiri (2012) realise that energy subsidies can truly achieve some countries' specific developmental objectives but contend that it may be a costly and inefficient approach. In a recent review of energy subsidies in Arab countries, they maintain that despite the associated negative impacts, energy subsidies represent a significant safety net for the poor populace in several Arab countries, such that reducing and or eliminating these subsidies without compensatory social programmes would further reduce households' welfare and grind down the competitiveness of some sectors. The likelihood of success for any subsidy reform according to the paper depends on the ability of policy makers in designing measures to cushion the adverse effects on the poor populace and other sectors of the economy in the long run. The paper concludes that while energy pricing reforms may offer some potential benefits and appear theoretically plausible, the prevailing peculiar geopolitical and economic climate of the Arab region will render implementation practically difficult or impossible.

2.4 Methodological Issues

First and foremost, a widely held opinion in the above literature review is that most governments subsidize the consumption of goods and services because they want to improve certain essential outcomes among the population[43], there is need to assess the effect of subsidy on these essential outcomes such as income distribution, fuel consumption efficiency, consumption of alternative fuels, production and other sectors of the economy, level of pollution, deforestation among others. Such investigation can be conducted using different approaches depending on the extent of investigation and the desired outcome. For instance, if the objective is just to answer the basic question '*To what extents do governments spending on subsidising goods and services improve the lives of the poor'*? A benefit incidence measure may be computed. This process is describe fully in chapter 3.

[43] Petroleum product subsidies, for instance, can be justified if they improve living standards through enhanced access, affordability and reduction in the consumption of hazardous and highly polluting fuels etc.

A number of studies have tried to examine energy subsidies from the perspective of development using methodology such as the social-cost-benefit (SCB)[44] analysis which assesses the impacts of changes in energy subsidies on social welfare. This method permits a socio economic appraisal of changes in policy and regulatory framework, identifying, measuring and then discounting future costs and benefits in order to calculate the net economic merit of a particular policy option.

Shafie-Pour Motlagh and Farsiabi (2007) employed a typical Environmental Cost-Benefit Analytical Model (ECBA) incorporating environmental damage costs of energy consumption to estimates the trend of total energy subsidies in Iran[45]. Generally, the ECBA model adopted internalises energy cycle externalities and computes the Cost/Benefit ratio for implementing price reform policy under different scenarios.

A major limitation of the social costs-benefits analysis is that the costs and benefits may apply to goods and services that have a simple and visible measure in a suitable unit such as prices in monetary terms which is seldom the case particularly in the case of the social and environmental impacts. Therefore, a number of empirical studies have employed macroeconomic models particularly those with optimising framework such as partial equilibrium analysis, non-linear dynamic optimization models or dynamic input-output models, computable general equilibrium (CGE) models to account for some elements of the welfare impact of subsidies or their removal.

Given the widespread opposition that subsidy reforms face, it is important that any method adopted to compute the effects of energy subsidies should not only be robust and

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[44] SCB analysis is a decision yardstick that is employed regularly by policymakers to determine whether a policy should be implemented. It tries to monetise the effects of a policy on individuals or groups and compare to the status quo or with other alternative policy measure.

[45] According to the authors, the model predicts that if subsidies continue, energy subsidies will rise from the present 0.17% of GDP in 2003 to about 0.2% of GDP by 2019. The results not only show that reducing energy subsidies for each energy form has considerably environmental benefits, but also has potential for income redistribution in the economy with long run improvement in government revenue and economic growth

relevant for policy use but must be as transparent as possible to permit effective communication with all stakeholders. To these end, several alternative approach have been adopted but there is none that is all encompassing in terms of in depth impact assessment and cross country comparisons. The price-gap method is one approach that has been used widely owing to its robustness and transparency but the method can only explain specific impacts of subsidies.

The theoretical foundation of the price gap methodology was established by Corden (1957) in calculating the cost of protection while McCrone (1962) applied the framework to study agricultural subsidies in the United Kingdom. A landmark effort at estimating global fossil fuel subsidy by Larsen and Shah (1992) adapted and publicised this price gap approach. Another comparative technique for estimating subsidies is the producer subsidy equivalent (PSE) or the consumer subsidy equivalent (CSE) method which assesses the impact of subsidies by considering the worth/value of the subsidies to the recipients[46].

The partial equilibrium models consider merely the energy product market where subsidy reform is taking place and based on simple economic assumptions attempt to estimate changes in fossil fuels price, demand and production as a result of subsidy removal. However, according to Von Moltke et al. (2004), the sizes of these changes will be reasonably influenced by the price elasticity of demand and supply and underlying assumptions. Though the use of partial equilibrium models can offer some valuable insights into the impacts of subsidy reform, they are very restrictive as regard information on other economic sectors with considerable use of energy as input as well as other macroeconomic effects about international competitiveness.

[46] Though the producer or the consumer subsidy equivalent approach can offer a practicable way to trail the extent of the impacts of subsidies with time, the exclusive calculation of the PSE would offer no information about the effects of subsidies on economic efficiency, implication for GHG emissions and energy security concerns. This is one major reason why the price-gap technique have enjoyed comparative acceptance as the best approach to a quantitative estimation of energy subsidies

General equilibrium models on the other hand provide more in-depth answers to macroeconomic questions by simulating defined set of equations which consider the linkages across several markets concurrently[47]. Though, the scope of statistical results from general equilibrium models is wider than those obtainable from partial equilibrium models, the data requirement for the former are much more substantial. As useful as these macroeconomic models are, their major drawback lies in the non-homogeneous nature of their theoretical foundation. Interestingly, the increasing consideration of the micro foundation of most macroeconomic models in recent time has reduced the clear cut demarcation between macroeconomic and General Equilibrium (GE) models. Though a GE model is in principle, a class of macroeconomic models whose theoretical foundation, traced to the application of an Arrow-Debreu general equilibrium framework, they are superior to traditional macroeconomic models when the structure of the overall economy matters for the analysis or when evaluating policies with a long time horizon

However, going by the essential role that energy plays in economic and social development, the analyses of the implications of energy subsidies should be analysed in a framework which investigates their links to each of the economic, social and environmental dimensions of sustainable development. This type of considerations highlights the considerable difference between a partial and general equilibrium analysis. Partial equilibrium (PE) models are more relevant in analysing the transition from an initial equilibrium to another while General equilibrium (GE) models mainly focused on long-run impacts. GE models can provide answers on economic effects of introducing new taxes or subsidies or changes in tax rates in a logical and reliable way and are very appropriate in answering important policy questions such as the impacts of structural adjustments, subsidy

[47] The precision of the results from general equilibrium modelling is also determined by the accuracy of the assumptions regarding the behaviour of economic agents, factors and markets as well as the data

and tax reforms. Although GE models cannot be used to forecast business cycles, they can indicate likely extents of policy induced changes from future baselines and are vital for ranking alternative policy measures.

Energy pricing policy usually imply significant costs on economic growth and income distribution with severe environmental concerns by causing changes in relative prices which often induce general equilibrium effects throughout the whole economy. The effect of such policy measures are better evaluated within a framework of a general equilibrium (GE) model. Although partial equilibrium models make it possible to estimate the costs of energy pricing policy measures particularly when feedback effects are not desired, GE models pay considerable attention to the net effect of the multitude of interdependencies and interactions among agents and sectors within the economy taking substitution processes in production and consumption as well as market clearing conditions into account[48].

The general view from the methodological review is that while the price gap and partial equilibrium models appear to be the a visible option for estimating the magnitude and evaluating socio economic impacts of subsidies comparatively across countries, detailed macroeconomic, welfare and environmental analysis are better assessed using general equilibrium framework. For these and many more reasons, applied general equilibrium models like the I-O and the CGE model have been widely used in assessing country specific cases. It is important to state that since each of the general equilibrium models has its own strengths and weaknesses based on several underlying assumptions, conclusions from their

[48] A typical example is to measure the effect of an emission tax on the performance of the economy. The tax raises marginal cost of production due to abatement cost and tax payments which make the firm to reduce output under the prevailing price level. If all firms in the industry react similarly, the market supply function shift backward and the market price increases. Firms will react by modifying their output decisions. The higher domestic price makes imports cheaper and exports dearer. Price increase in the energy-intensive industry encourages other markets and industries which produce substitutes or complements. In terms of factor input, firm will substitute labour, material and capital for the taxed energy input to cut costs and this will affect both the factor markets and factor prices.

outcomes should be considered in terms of those assumptions[49]. Though, the CGE method is currently in vogue essentially because of the model's ability to contain price variable adjustment which cannot be accommodated by other models, such as the Input-Output and the Social Accounting Matrix, it is however not a magic potion for solving policy and planning problems. First, the specification of CGE models rely heavily on judgement and inclinations of the model builder as he decides among other things, the variables to model, interactions to capture and the functional forms to adopt[50]. In fact, the heated debate about the ***closure*** for CGE models is far from been resolved. All these make results from CGE model highly sensitive to specification decision.

[49] Basically, the input-output model facilitates the calculation of the economy-wide changes that may result from sector specific exogenously shocks obtained from the solution of a set of simultaneous linear equations whereas CGE are sets of simultaneous non-linear equations model which accommodates price and quantity variables adjustment as input factor market or commodity market equalises to simulate the optimal condition of consumers and producers as well as government role as economic actor in an economy. According to Lewis (1993), CGE model comprehends all transactions in money cycle, commodity cycle and services cycle in economic mechanism

[50] Though prices are treated as endogenous in CGE models, this process requires that numerous elasticities must be estimated. Quite often, models resort to crude estimates of elasticity based on limited set of observation on representative values from other studies or informed opinion.

3 CHAPTER THREE: WHO BENEFIT MOST FROM FUEL SUBSIDIES? EVIDENCE FROM NIGERIA

3.1 Introduction

According to the International Energy Agency (IEA, 2014), the global value of subsidies for fossil fuel consumption grew from $312 billion in 2009 to $548 billion in 2013, representing about 0.53% and 0.73% of world GDP in the respective years. Petroleum products account for over half of the total subsidies. However, on average, a meagre 7% of the total fossil fuel subsidies reached the poorest 20% of the income group in low and middle income countries (IMF, 2013, p. 19). Thus, the concern is not only about the huge amount governments commit to subsidising fossil fuels but that the ultimate targets of these subsidies hardly benefits. Despite continuous efforts made by countries to reform these subsidies, fossil-fuel subsidies are notoriously complex to remove in most countries.

Nigeria has a long tradition of controlling fuel prices and is listed among the top 20 countries subsidizing fuel consumption by the IEA (2013). Subsidy payments by the government to national oil company and other marketers of petroleum products in Nigeria in 2010 was about US$4.6 billion compared to the total capital allocation of US$3.76 billion to priority sector such as defence and internal security, health and education, essential infrastructure, and agriculture and resource development in the 2010 annual budget. This amounts to about 4.4% and 3.6% of the GDP. With continued instability in international oil prices and the associated fiscal burden, the Nigerian government is determined to gradually phase out all fuel subsidies before 2015 as part of the on-going petroleum sector reforms. However, several reform attempts have been met with great opposition which often degenerates into intense conflicts leading to anarchy and loss of lives. Opponents of the reform include petroleum product marketers, labour unions, civil right groups, and sometimes the general public. They argue that the government may fail to provide adequate protection for the vulnerable income groups if the subsidies are removed[51]. For instance, Akosile (2012) reported that the United Action for Democracy (UAD), a civil right group, had canvassed indefinite mass protest against the 2012 petrol price increase on the ground that the move would cause social and economic hardship for the poor who were already burdened by high unemployment, decaying infrastructure, high cost of living, and deteriorating livelihoods[52]. Despite serious concerns over the efficacy of fuel subsidies, there is little empirical evidence, particularly in the case of Nigeria, on how the benefit of fuel subsidies are distributed among each income groups. To what extent has the government subsidy on petroleum products in Nigeria reached the targeted poor? This is the focus of this chapter.

As the subsidy on diesel oil prices has been gradually phased out since 2004, the paper investigates the benefit incidence of kerosene and petrol subsidies on Nigerian households. Specifically, the study uses data from a nationally representative household consumption expenditure survey to analyse the distribution of fuel subsidies in Nigeria. We first present a descriptive analysis of how the household expenditure on petrol and kerosene is distributed among different income groups. We then conduct a benefit incidence analysis (BIA) to examine how the fuel subsidy benefits accrue to each income groups. The results show that while the kerosene subsidy is more evenly distributed across income groups, petrol subsidy is concentrated to high income groups. In aggregate, the top 20% income group enjoys twice as much the benefit of fuel subsidies as the bottom 20% households.[53] Finally, we also examine the progressivity of fuel subsidies using a Gini coefficient and find that both fuel subsidies are more regressive than the per capita expenditure

[51] It must be noted that the opaqueness in subsidy fund management and the poor credibility of the successive governments with respect to subsidy lend support to this argument. At every point of domestic fuel price adjustments, government made promises on how the proceeds from the subsidy removal would be applied to improve the economy or raise the standard of living of the people. However, most times, government reneged on its promises and this has led to continuous resistance to attempts to remove subsidy.
[52] http://www.thisdaylive.com/articles/fuel-price-hike-uad-canvasses-indefinite-mass-action/106457/
[53] The result is based on the survey of the household sector only. As we noted in section 3, to the extent that the high income groups also likely benefit more from petrol subsidy to other sectors (e.g. public service and electricity), the aggregate results could underestimate the benefit accrued to the high income groups.

The economic rationale for government spending in any country rests on efficiency and equity considerations[54]. Therefore, identifying specific inefficient and poorly targeted fuel subsidies is important in many ways. First, subsidies can be quite expensive with serious fiscal implications. They can equally set countries on inefficient consumption and production paths by distorting price signals[55]. Moreover, poorly targeted subsidies are often characterised by high leakages as they tend to benefit groups other than those intended. Against this background, it is useful to conduct a case study in a country whose government finance is beleaguered by the burden of fuel subsidies to ascertain the extent to which fuel subsidy has benefited the poor and middle income groups. Given the pervasion of fuel subsidies in developing countries, the findings of this study could have implications beyond the country border.

The remainder of the chapter proceeds as follows. Section two reviews the literature. Section three provides background information about Nigeria refining industry and its pricing policies of petroleum products. Section four discusses the methods and data while Section five reports the results of the benefit incidence analysis, and evaluates the progressivity of fuel subsidies. The last section concludes with relevant policy suggestions.

3.2 Literature Review

The effect of fuel subsidy has been extensively studied by international agencies, analysts and policy makers. Broadly, there are two strands of literature. The first strand focuses on the impact of subsidy removal on welfare distribution and economic growth. For instance, using a micro econometrics simulation approach, Pitt (1985) established that the more affluent urban

[54] According to Rosario, *et al* (2007), such spending will promote efficiency when it corrects market failures and/or generate positive externalities and uphold equity by improving the access of the poor to essential goods and services.

[55] Fuel subsidies to consumers which lower end-use prices can encourage disproportionate consumption of energy services and cause indirect harm to the environment or act as disincentives to energy conservation. It can also discourage consumers from shifting to cleaner fuels while subsidies to producers can lock-in technologies to the production of certain fuels and exclude more promising and efficient fuels (see Bacon and Kojima, 2006 and World Bank, 2009)

households (about 18.5% of all households) obtain a top-heavy share of total kerosene subsidy in Indonesia. In spite of the regressive distribution, he noted that poor families with little or no substitute for kerosene in lighting may bear a significant burden if all subsidies are totally phased out. Kpodar (2006) employed an input-output approach to evaluate the size and distributional impacts as well as the usefulness of subsidies in protecting poor households in Mali. The paper finds that upper income households benefit exceptionally from price subsidies on all oil products considered. El Said and Leigh (2006) use the estimated implicit import parity prices (IPP) in Gabon to evaluate the overall fiscal cost of subsidy and to analyse the distributional impact of implicit subsidies on fuel prices by simulating the effect of subsidies on the real incomes of household across income groups. They find that it is the higher income households who actually benefits from fuel price subsidies in Gabon since the poorest 30% and richest 10% of households receive about 13% and 35% of the subsidy respectively. Investigating the distributive effects of liberalising fuel prices in Indonesia, Clements et al (2003) observed that both the rich and the poor households are affected, but the urban poor are more generally prone to the effects of any reduction in fuel subsidy. Siddig et al (2014) use MyGTAP model to investigate the impact of subsidy reduction in Nigeria under different policy scenarios. They find that accompanying subsidy reduction with a transfer of government revenue to rural households will not only increase the real income of poor households, but also alleviate the negative impacts of all households and promote economic growth, and increase the government revenue

The second strand of the literature studies the distributional effect of fuel subsidy across income groups. Using a large dataset to on petroleum pricing in 51 developing and emerging market, Baig et al (2007) find that fuel subsidies are in favour of the rich and the distribution of the total effect tends to be regressive while that of the direct effect appears to be neutral. In the case of Venezuela, Barreix et al (2007) find that the distribution of gasoline subsidy to end users strongly aid the high income households with about 65% and 5% of the subsidy benefits accruing to the top 20% and the bottom 40% respectively. Using the consumption expenditure data from the 2012 National Sample Survey, GSI (2014) assesses liquefied petroleum gas (LPG) subsidies in India and finds that the top 20% expenditure group of the population received about 60% of the total subsidy, while the bottom 50% and 20% groups received about 8% and 0.8% of the subsidy transfer respectively. The World Bank (2012) studies the distribution of gasoline subsidy in selected African countries and finds that benefits accruing to the poorest group ranges from 3% to 14% compared to the richest group with 30% to 71% and that the latter group benefits almost 12 times more from gasoline subsidy than the bottom group on average. The Indian Department of Economic Affairs of the Ministry of Finance (2004) and Gangopadhyay et al (2005) examine the distribution of subsidized fuel, namely kerosene and LPG, to evaluate how a reduction in fuel subsidies would affect the poor. They found that the LPG subsidy benefited mostly the upper income groups in the urban areas and whereas kerosene was widely used, the urban sector received a larger subsidy on a per capita basis[56].

In comparison, our study not only presents an analysis on the distribution of government subsidies across different income groups in an important developing country, but also examines the concentration of each fuel subsidy by calculating a Gini coefficient measure.

The benefit incidence analysis popularized by the innovative work by Meerman (1979) and Selowsky (1979) combines the cost of subsidizing goods with statistics on their consumption or usage to generate distributions of their benefit across target population. The BIA is a partial equilibrium analysis but unlike the behavioural method, its evaluation of

[56] The report noted that kerosene subsidy is prone to abuse since about 50% of the subsidized kerosene supplies are diverted from reaching the anticipated groups which suggest that both the LPG and kerosene subsidies are unproductive in achieving their intended objectives. It therefore recommends a gradual but substantial removal of LPG subsidy but a more careful approach in the cutback of kerosene subsidies as over half of the rural households basically use kerosene in home lighting

current benefits is neither based on individual valuations nor on the behavioural responses of households to changes in government spending. This approach has been used widely in public sector studies to evaluate the benefit incidence of government spending on education and health for Malaysia (Meerman, 1979), for Ghana (Demery et al, 1995), for the Philippines (Cuenca, 2008), and cross-country study by Davoodi et al, 2010). Hammer, et al (1995) applied the same method to analyse the incidence of water supply and sanitation on Malaysia's households while the World Bank (1994) Colombian poverty assessment study applied the BIA to estimate the benefit incidence of subsidies on electricity and other sources of power in Colombia.

3.3 Nigeria Refining Industry and Pricing Policy: An Overview

3.3.1 Refining and Marketing Industry

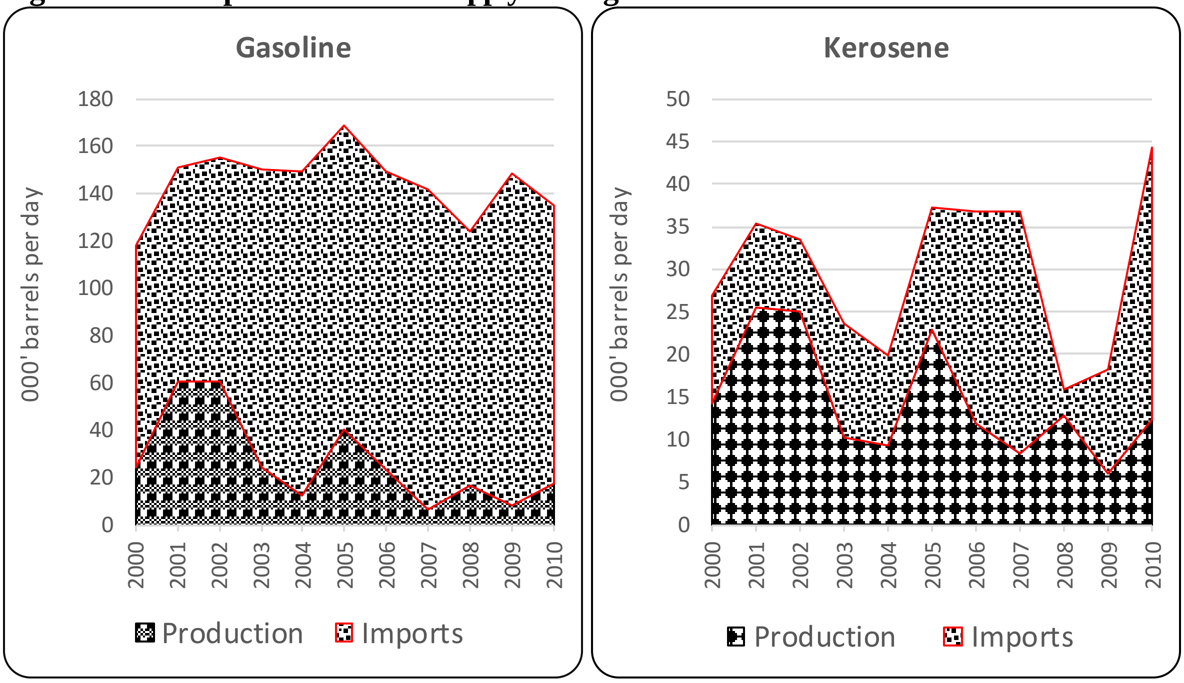
Nigeria is the largest oil producing country in Africa. As the end of 2012, the country has an estimated 37.1 billion barrels of proven oil reserve which are found majorly along the country's Niger River Delta and offshore in the Bight of Benin, the Bight of Bonny, and the Gulf of Guinea. Its oil production in recent years averaged about 2.3-2.5 million barrels per day (BP, 2014).

In the downstream refining sector, Nigeria has four refineries (Port Harcourt I and II, Warri, and Kaduna) with a total petroleum refining capacity of 445,000bpd and if operated at full capacity, the refineries would have the capability to produce 251.6 thousand barrels of petrol, 62.9 thousand barrels of kerosene, 56.42 thousand barrels of diesel, 3.9 thousand barrels of liquefied petroleum gas (LPG) and 14.53 thousand barrels of fuel oil per day. These quantities can, to a large extent satisfy domestic demand[57]. The crude oil is to be allocated by

[57]According to OPEC Annual Statistical Bulletin (2012), Nigeria's consumption of main petroleum products (including gasoline, kerosene, distillates, residuals and others) averaged 270,600 b/d and 267,100 b/d respectively in 2010 and 2011.

the Nigeria National Petroleum Corporation (NNPC)[58]. However, all the refineries have been operating grossly below their installed capacity in the last decades. For instance, the overall utilization rate of Nigeria refineries were 22% and 24% in 2010 and 2011, respectively (EIA, 2012). Consequently, the country has relied on importation to meet its increasing local demand. As shown in Figure 3.1, in 2010 imports account for 85.5% and 67.4%, respectively, of petrol and kerosene consumption in Nigeria.

Figure 3.1: Composition of fuel supply in Nigeria 2000 – 2010



Source: computed using IEA (2012) data

The importation of petroleum products into the country is managed by the government through the NNPC as well as other major and independent marketers such as African Petroleum PLC, Agip PLC, Texaco PLC, and Total PLC. The volumes of importation by these major marketers account for about two third of the industry total. These marketers, which are registered with the Petroleum Products Pricing Regulatory Agency (PPPRA) purchase the

[58] Despite the low refinery utilization rate, the government continues to allocate 445,000 b/d of crude oil to NNPC. However, according to NEITI (2013), on average, only 90,202 b/d of crude oil were delivered to the refineries between 2009 and 2011, which represents 20.27% of the total allocation. NNPC claims that that it refines the balance through SWAP/Offshore processing arrangement in exchange of refined products

refined products in North-west Europe and sell to the public at the fixed domestic price. As the domestic retail prices for petrol and kerosene are lower than the purchase prices, the difference (i.e. the subsidy) is drawn from the Petroleum Support Fund (PSF) within the custody of the Central Bank of Nigeria (CBN).

To participate, a registered marketer must give notification and receive approval to import from the PPPRA based on the available domestic supplies and other applicable factors determined by the agency. The discharge of all imported cargoes must be witnessed and confirmed by the staff of the agency alongside that of the Department of Petroleum Resources (DPR) and the Nigerian Navy at the jetties and an independent surveyors. The PPPRA and the DPR certify and process the import documents when the fuel discharge is confirmed to determine the amount due to the marketers and submits the verified documents and subsidy claims to the Federal Ministry of Finance (FMF) for internal auditing, processing and approval. The Ministry of Finance will then issue authorization to incur expenditure to the Accountant General of the Federation who will in turn issue the payment mandate to the CBN. Finally, the PPPRA will issue cheques to the marketers on the basis of the auditor's report as soon as the CBN has credited the PSF with the sum of the subsidy claims.

3.3.2 Petroleum Pricing and Subsidy Policies in Nigeria

To better understand the historical background of fuel subsidies in Nigeria, we provide a brief review of the fuel pricing policies starting the first "oil shock" of 1973.

A formal control of petroleum products pricing by the Nigerian government commenced in 1973 via the introduction of uniform crude pricing in the nation irrespective of the associated transportation and cost differences. The main objectives of this policy were (a) to foster industrialization, (b) to promote regional development, and (c) to control inflation [59]

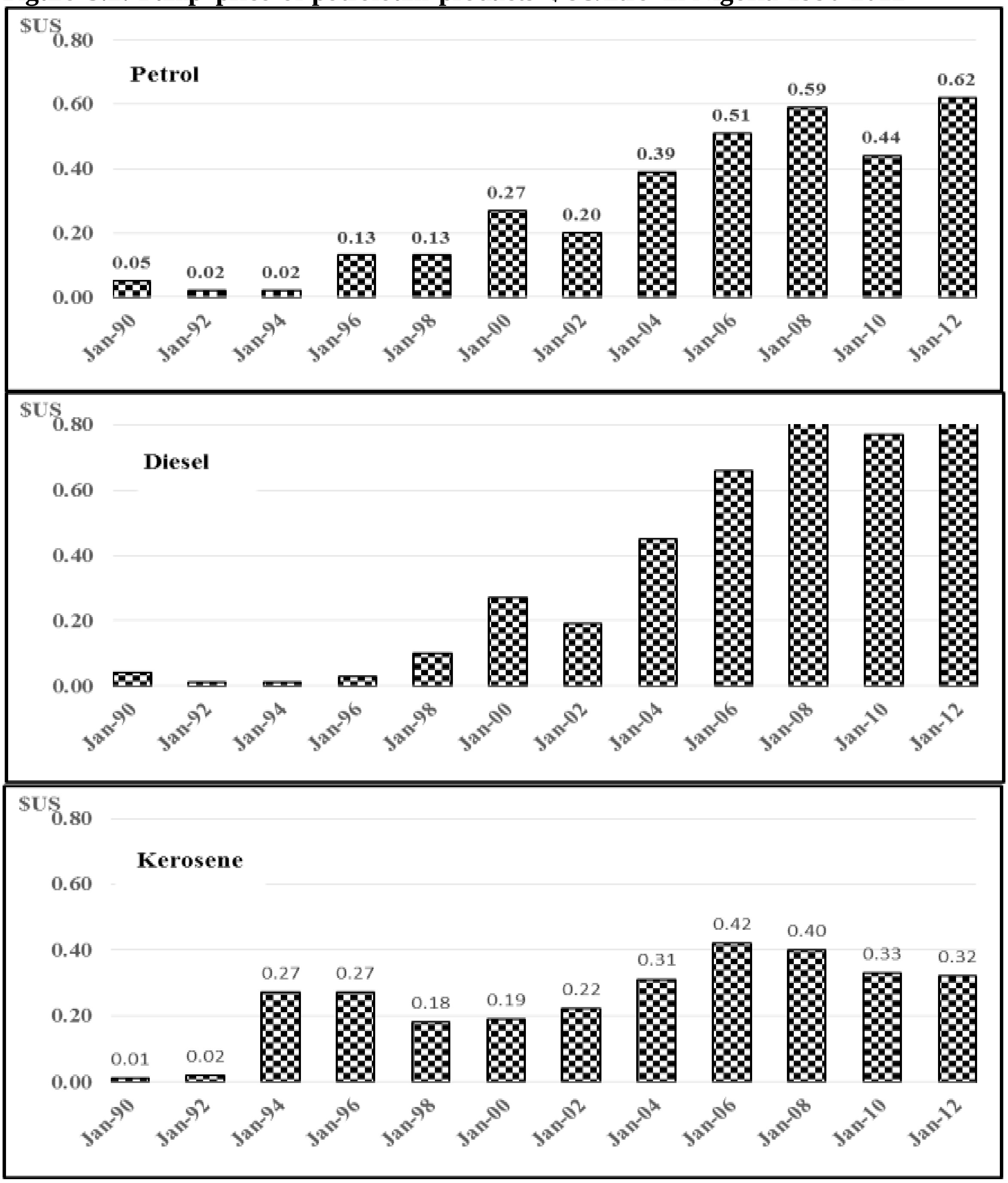
[59] Unfortunately, as argued by Adenikinju (2012), the evidence over the years suggests that these policy goals are largely not achieved.

(Adenikinju, 2012). When the policy commenced in 1973, the government provided a subsidy of 35.7% by fixing the prices of crude oil at $1.93 dollars per barrel in the domestic market whereas the international price of crude oil (i.e. the opportunity cost) was $3.00 per barrel (Adeyeye, 1991). The subsidy element was reduced drastically to 2% in 1978 when the international price of crude oil rose to $14.10 per barrel while the government increased the price of crude oil to domestic refineries to $13.80 per barrel. However, as the international price of oil rose to $40/b in 1980 and there was no corresponding adjustment in the prices to local refineries, the subsidy element amplified to 65.5%. As the export price of crude crashed to $15.11 per barrel in 1988, the price of crude to local refineries was dropped to $2.0 per barrel. In that way, the subsidy element increased to 86.8%.

Between 1960 and 1978, the pump price of petrol remained unchanged at 0.088 Naira/litre. The first attempt to increase the price of petroleum products (petrol in particular) dated back to October 1st, 1978 when General Olusegun Obasanjo raised the price by 73.9% to 0.153 Naira/litre. In April 1982, the price was increased to 0.20 Naira/litre by President Shehu Shagari. The military government in 1986 declared that owing to the devaluation of the Naira within the framework of the country's Structural Adjustment Programme (SAP), the unreasonably cheap domestic price of fuel had become a burden to the federal government's revenue and resolved to raise the price of petroleum products. This led to the then military government of General Ibrahim Babangida increasing the price of petrol four times between 1986 and 1993: from 0.20 to 0.395 Naira/litre in 1986, 0.42 Naira/litre in 1988, 0.60 Naira/litre in 1989 and 0.70 Naira/litre in 1993. These represent 97.5%, 6%, 43%, and 16.6% increases respectively.

For the same reason of budgetary burdens due to the further devaluation of the Naira, President Ernest Shonekan increased the price of petrol in 1993 to 5.00 Naira/litre. With the return of the military in November 1993, General Abacha in a bid to gain public support reduced the price of petroleum products (petrol) by 35% to 3.25 Naira/litre. However, a year later in 1994, the same government announced a sharp increase in the price of petroleum products with petrol sold for 11.00 Naira/litre. General Abdulsalami who ascended power upon the death of General Abacha increased the price to 25.00 Naira/litre but was later reduced to 20.00 Naira/litre in January of 1999 as a result of public outcry and labour resistance.

Figure 3.2: Pump price of petroleum products $US/litre in Nigeria 1990-2012



Source: World Bank data

A new democratic government brought retired General Olusegun Obasanjo to power in May 1999 and his government increased the price of petroleum products four times within 8 years all in the name of eliminating waste, freeing government funds, and encouraging foreign and local investment in the country's downstream sector. During the 8-year period, the price of petrol went from 20.00 Naira/litre to 22.00 Naira/litre in 1999; 34.00 Naira/litre in 2003; 40.00 Naira/litre in 2006, and finally increase to 75.00 Naira/litre as a parting gift in 2007. The next President Yar'dua who succeeded Obasanjo reduced the official price of petrol to 65.00 Naira/litre in 2008. In January 2012 President Goodluck Jonathan increased the price of petrol from 65.00 Naira/litre to 120.00 Naira/litre. The price was however reduced to 97.00 Naira/Litre after serious nationwide strike and protests by the organised labour and civil society groups. The top panel of Figure 2 shows the average pump price of petrol for the period of 1990-2012.

Unlike petrol whose subsidy level has been reduced, kerosene is still highly subsidised at the price of 50.00 Naira/litre for kerosene is the domestic fuel for the poor. However, while a large chunk of NNPC's subsidy claims is on kerosene, the fuel is often not accessible in retail outlets at the subsidised price because kerosene are mostly vended in tanks, kegs, cans, and bottles by petty retailers and they charge a price higher than the official prices of 50 Naira/litre.

A recent report by a committee set up to verify the arrears of 2011 subsidy claims observed that two-thirds of the kerosene sold by NNPC between 2010 and 2011 was sold to both depot owners and middle men while the middle men sold the product to owners of retail outlets at inflated prices of about 115.00 to 125 Naira/litre which leaves the consumers to pay prices higher than the 50 Naira/litre set by the government[60].Our field observation reveals that the product is available at the official retail price of 50.00 Naira/litre at most filling station but

[60] See http://www.thisdaylive.com/articles/sustaining-the-scam-on-kerosene-subsidy/122819/

with long queues. To avoid the long queues, many consumers patronise private vendors who charge higher prices.

The price of diesel has been deregulated since 2004 and is no longer subsidized. As shown in Figure 3.2, diesel prices are 75-90% higher than that of petrol in recent years.

3.4 Data and Methodology

3.4.1 Methodology

The BIA involves a three-step process. The first step is to obtain estimates of the unit subsidy of providing a particular product usually based on official public spending on subsidising the product. The second stage is to identify the various households or individuals who consumes the product and in effect, enjoy the transfer in kind. It is the distribution of this transfer across the population that the BIA seeks to measure. The last stage entails aggregating the households (or individuals) into sub-groups of the population so as to evaluate how the subsidy is distributed across different welfare groups. The common grouping is by income, or a related measure of the welfare of the individual e.g. expenditure. Apart from analysing the distribution and incidence of subsidy benefits, BIA can offer insight into the concepts of targeting and progressivity of social welfare spending by allowing government to concentrate the benefits of social assistance programs on the poorest segments of the population. BIA assesses how tax policy or government subsidy affects the distribution of welfare in the population by evaluating the distribution of government subsidies among different groups in the population (Cuenca, 2008).

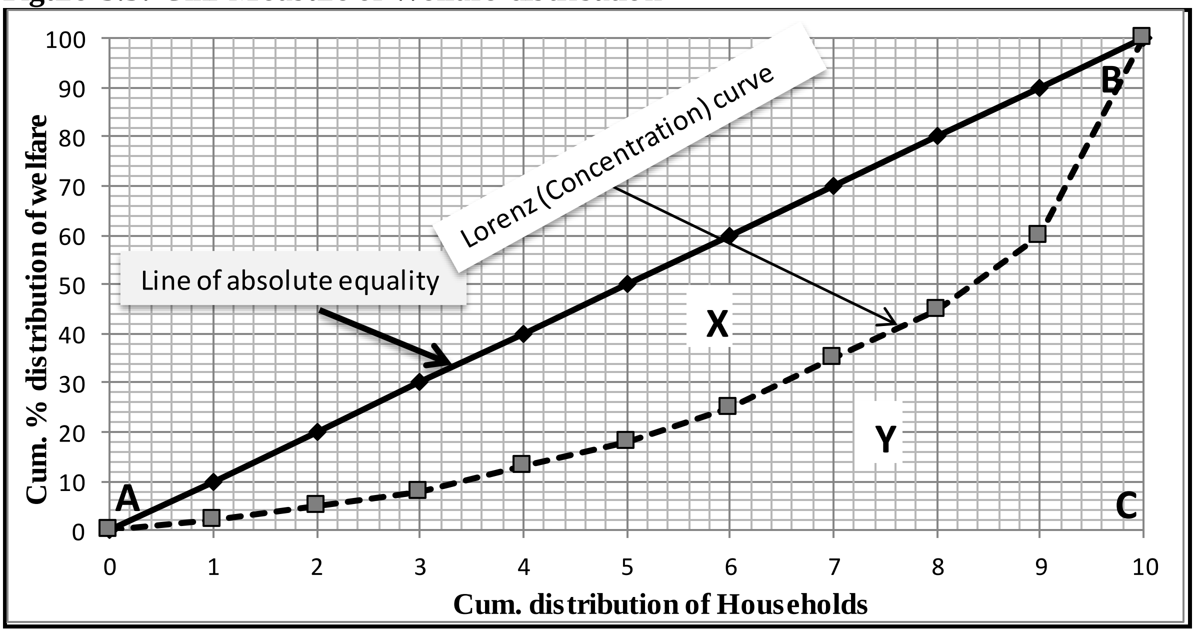
Benefit incidence hinges on both the household behaviour of consuming the subsidised goods and the composition of government spending by assigning benefits to the consumers of the good ranked by specific measure of current welfare indicator. Following Demery (2000) and Cuenca (2008), the study employs the following equations[61]

$$X_j \equiv \sum_{i=1}^{n} E_{ij} \frac{S_i}{E_i} \equiv \sum_{i=1}^{n} \frac{E_{ij}}{E_i} S_i \qquad (1)$$

$$X_j \equiv \sum_{i=1}^{n} \frac{E_{ij}}{E_i} S_i \equiv e_{ij}\, s_i \qquad (1.1)$$

where X_j is the amount of subsidy that benefits group j, S and E refer to the government subsidy and household expenditure on goods or services respectively. The subscripts (*i)* denotes the category of goods/service (in this case, fuel type – petrol and kerosene). Equation 1.1 suggests that the amount of benefits accruing to welfare group *j* depends on two factors (i.e. the e_{ij} 's, and s_i 's). The e_{ij} 's are the shares of each expenditure group in total expenditure for fuel *i* while the s_i 's are the share of subsidy spending across various fuels. To compute the incidence of fuel subsidy accruing to group X_j, we use equation (1.1) above.

Figure 3.3: Gini Measure of Welfare distribution



Source: graphical sketch by the Author

[61] Readers are advised to see Demery (2000) and Cuenca (2008) for detailed methodological notes on BIA computations, applications and other developments and extensions

We further calculate a concentration ratio, similar to the Gini coefficient, to measure the extent of the inequality in the distribution of the subsidies and compare to that of the income distribution. Mathematically, the Gini (concentration) coefficient is the ratio of the area bounded by the diagonal and the Lorenz (concentration) curve (represented by X) to the total area below the diagonal (i.e., triangle ABC or Area Y) which is illustrated in figure 3.3. In Figure 3.3, the horizontal axis represents the cumulative distribution of the population sorted in an ascending order of household income. The vertical axis represents the cumulative distribution of welfare. In this study, the welfare is measured by the amount of the relevant subsidy enjoyed by each household. For any welfare measure of y between 0 and 1 on the vertical axis, the Lorenz curve indicates it as the fraction of the total welfare enjoyed by that corresponding bottom fraction of the population. From figure 3.3 therefore, the Gini or the Concentration coefficient is computed as follows:

$$Gini = Area\ of\ X / Area\ of\ Triangle\ ABC \qquad (2)$$

Since the area of *Triangle ABC* = 0.5, the Gini Coefficient = 2 * *Area of X* (2.1)

Let *N* denote the number of equal divisions and A_i as the percentile of the welfare measure, the area of X is given as:

$$\frac{1}{2} - \left[\frac{1}{N}\sum_{i=1}^{N-1} A_i + \left(\frac{1}{N}\right) A_N\right];\ A_N = 1.^{62} \qquad (2.2)$$

Since there is no reliable government spending data on fuel subsidy from official sources in Nigeria[63], the study resort to estimating the subsidy amounts using the price gap model. The method is appropriate as Nigeria has relied on imports for the supply of petroleum products.

[62] Here we use the formula of Cuenca (2008). Alternative formulae for calculating the Gini coefficient can be found in Lubrano (2014).
[63] For instance, the Presidential Committee on Verification and Reconciliation of Fuel Subsidy Payments in 2011 led by Mr Aigboje Aig-Imoukhuede revealed in its report that 197 subsidy transactions worth N232bn were illegitimate http://saharareporters.com/news-page/31-billion-stolen-under-president-jonathan-nigeria-%E2%80%93punch

The implicit subsidy *(S)* for the consumption *(C)* of any petroleum products *(i)* at any time (t) is calculate as follows

$$S_{i,t} = C_{i,t} \cdot (Y_{i,t} - X_{i,t}) \quad (3)$$

and $$Y_{i,t} = P_{i,t} + M_{i,t} + T_{i,t} \quad (3.1)$$

where:

S, C, and all lower case scripts are as defined above;
Y is the reference price and X is the retail price;
P is the international border price for each fuel;
M is the marketing, distribution costs and all other applicable charges; while
T represents all applicable consumption taxes.

3.4.2 The Data

The study uses the Harmonized Living Standard Survey of 2009/10 (HNLSS 2010 henceforth), which is a blend of the Nigeria Living Standard Survey (NLSS) and the World Bank's Core Welfare Indicator Questionnaire (CWIQ). The survey covered 34,770 households (about 1.1% of the total population households) in 774 Local Government Areas (LGAs) of all 36 States and the Federal Capital Territory (FCT). The data was collected on a quarterly basis between November 2009 and October 2010. All monetary units are in Nigerian Naira. A careful look at the HNLSS data reveals that it was most likely contaminated with errors arising from misreporting or recording, which is not unusual for survey data[64]. Following Cowell, F. A. and Victoria-Feser (1996, 2006a), we two-tail trimmed the data by 5% (top and bottom each 2.5%), thereby reducing the coverage to 32,921 households.

[64] For example, in the original dataset, 15 household have an expenditure of over 1 billion naira which is simply impossible. Our personal communications with the National Statistics office (NBS) confirms that it is most likely due to typographic errors.

3.5 Results and Discussion

3.5.1 Household Fuel Consumption Patterns

Table 1 reports the summary statistics of household size, total household expenditures and household expenditure on fuels stratified by expenditure quintile groups. Quintiles are defined in terms of expenditures rather than income throughout the analysis. In the survey, expenditures greatly exceed income for many 'hard to track' groups like self-employed and social income recipients. Therefore, expenditures appear to be a better means of describing the well-being of the households than the reported income as they shed more light on poverty status (also see World Bank, 2011)[65]. We use expenditure and income interchangeably in this paper. There are 6,584 households in each quintile group. The number of people in a household appears to be inversely related to the income level, with a mean of 4.4 people in a household. The total expenditure of an average household in the poorest quintile is 20,968 Naira per annum, 29% of an average household in the richest quintile. The average household expenditure in the median quintile is 38, 969 Naira per year, which is slightly lower than the grand mean expenditure for the survey, indicating the income distribution is slightly skewed to the right.

As for expenditures on fuels, the table reveals two interesting patterns. First, the expenditure on kerosene are more evenly distributed among different income groups than the expenditure on petrol. An average household in the poorest quintile spent 1824 Naira per year on kerosene, which is about 86.4% of that in the richest quintile. In comparison, the household spending on petrol is concentrated to the richest quintile. The average household expenditure on petrol in the first four quintiles is respectively 7.5%, 19.5%, 35.5%, and 61.6% of that of

[65] The World Bank (2011) submitted that consumption is a better indicator of welfare than income because it is more closely related to household's well-being in terms of meeting current basic needs. It is believed that income is limited as it cannot address the questions of access, availability that may ultimately determine consumption.

the highest income group. Second, all but the richest household group spend more on kerosene than petrol. Because of the low electrification rate and poor state of nature gas pipelines, kerosene is still one of the main fuels for cooking and lighting among the Nigerian households in both urban and rural areas. As shown in Table 2, 66% of households use kerosene throughout the country and there is little variation in kerosene usage among different income groups. According to National Bureau of Statistics (2011), the share of households using kerosene for cooking and lighting is respectively 22.8% and 57.8%. In essence, kerosene is still a necessity good for the majority of households in Nigeria.

Table 3.2 presents the share of households using petrol and kerosene across expenditure groups. As aforementioned, 66% of households in Nigeria use kerosene. This is compared to only 6% of households consume some amount of petrol. From the fuel expenditure and average price, we computed the average household fuel consumption for each income group. The result is shown in the last two columns. While there is little variation in kerosene consumption across income groups[66], petrol consumption differs dramatically. The richest 20% households consume nearly 30 times more petrol than the poorest quintile.[67] Also shown in Table 2 are the budget shares of the two fuels. The budget share of petrol is increasing with income whereas the share of kerosene is inversely related to total household income. On average, a household in the poorest group spent 8.7% of its total expenditure on kerosene while a household from the richest group only spent 2.9% of their income. Clearly, the poorest group will feel a heavier burden of any increase in the price of kerosene if the subsidy is removed.

[66] As income increases, the share of inferior fuel like kerosene in the fuel mix should decline. However, limited access to quality substitutes such as LPG and electricity keeps consumers from shifting away from kerosene
[67] It is notable that the households in the bottom quintile also consume a minimum amount of petrol. This is probably because the use of motorcycles which are petrol-fuelled.

Table 3.1: Distributions of H/hold expenditure, Size and Fuel expenditures by Quintiles

Household Expenditure Quintiles		Number of people in household	Total household expenditure	Per capita household expenditure	Annual expenditure on Petrol	Annual expenditure on Kerosene
1 (Poorest)	Mean	6.38	20968	3331	188	1824
	St. dev	2.14	8086	761	1525	2056
	Minimum	1.00	1956	1827	0	0
	Maximum	10.00	45838	4585	38933	14600
2	Mean	5.29	30708	5841	489	2024
	St. dev	2.10	12484	753	2840	2192
	Minimum	1.00	4747	4587	0	0
	Maximum	10.00	71537	7203	44895	14600
3	Mean	4.38	38969	8954	890	2087
	St. dev	2.08	18823	1105	4485	2287
	Minimum	1.00	7219	7204	0	0
	Maximum	10.00	110290	11033	79083	14600
4	Mean	3.53	49715	14280	1542	2126
	St. dev	2.03	29080	2176	7611	2344
	Minimum	1.00	11038	11034	0	0
	Maximum	10.00	177373	18708	146000	14600
5 (Richest)	Mean	2.45	72497	30837	2505	2111
	St. dev	1.91	61302	10806	12068	2355
	Minimum	1.00	18709	18708	0	0
	Maximum	10.00	604037	64601	194667	20197
Total	Mean	4.41	42571	12648	1123	2034
	St. dev	2.46	36730	10992	6891	2252
	Minimum	1.00	1956	1827	0	0
	Maximum	10.00	604037	64601	194667	20197

Note: This table presents the descriptive statistics by expenditure quintiles from the HNLSS 2010 survey. There are 6584 households in each quintile group for a total of 32921 households in the sample

3.5.2 Benefit Incidence of Fuel Subsidies in Nigeria

Table 3.3 reports the summary of the total expenditure and total subsidies on both petrol and kerosene from 2009 to 2011 using the price-gap model. Data on spot price, retail prices are in national currency, daily consumption and official exchange rates where applicable are obtained from OPEC Annual Statistical Bulletin, 2012. Unit subsidy is calculated by subtracting the retail price from the reference price which is the sum of spot price at Rotterdam, freight, insurance, domestic cost elements and distribution margin. The applicable cost elements (lightering expenses, port authority charges, financing, jetty depot throughput and storage charge) and distribution margin (retailers, transporters, dealers, bridging fund, marine transport average and admin charges) are obtained from the Nigerian Petroleum Products Pricing and Regulatory Agency (PPPRA) template and measured in Naira/Litre.[68] From the table, Nigeria spent 584.90 billion naira, or about 3.7% of GDP and 17.9% of government revenue subsidizing petrol and kerosene subsidies in 2010[69].

Table 3.2: Percentage of H/holds using fuels, Fuel Budget and Consumption in Nigeria

Household Exp. Quintiles	% of Households using fuels		Fuel Budget Share (%)		Fuel Consumption (litres)	
	Petrol	Kerosene	Petrol	Kerosene	Petrol	Kerosene
1 (poorest)	2.2	62.4	0.9	8.7	120.0	1162.3
2	4.2	65.6	1.6	6.6	311.7	1289.6
3	6.1	66.6	2.3	5.4	566.9	1329.6
4	7.4	67.6	3.1	4.3	982.0	1354.1
5 (Richest)	8.7	68.0	3.5	2.9	1596.1	1345.0
Total	5.7	66.1	2.6	4.8	3576.6	6480.6

Data source: HNLSS 2010 survey data. Fuel consumption is calculated by dividing the average expenditure on a particular fuel by the retail price of 2010 of that fuel.

Table 3.4 presents the distribution of subsidies across income groups based on the survey data. The first two columns depicts the shares of each expenditure quintiles in total petrol **(e_{pj})** and kerosene **(e_{kj})** expenditures respectively. Column (3) and column (5) show the total subsidy accrued to each expenditure quintile while columns (4) and (6) are the shares of subsidy enjoyed by each income group for petrol and kerosene, respectively. The subsidies are

68 From PPPRA historical data, the cost element and distribution margin as a percentage of cost plus freight in 2011 are 8.71% and 11.07% respectively for petrol and 7.95% and 11.72% for kerosene respectively. The study applies these percentages.

69 Our estimate of total subsidy spending is likely underestimating the total government expenditure on subsidy. A report by the Nigeria Extractive Industries Transparency Initiative (NEITI) noted that in 2010 the total subsidy recorded by PPPRA and OAGF were N694.51 billion and N744.78 billion respectively (NEITI, 2013) However, it also noted the discrepancy should ordinarily not occur since the OAGF manages and controls the PSF and only the amount processed for payment by PPPRA is paid by OAGF. The significant difference between our estimate and the PPPRA and OAGF figures lies mainly in the consumption where we use OPEC data and the PPPRA data is aggregated from independent marketers. Our benefit incidence analysis in subsequent sections does not rely on the total subsidy spending figures. A detailed comparison between our estimates and the PPPRA figures as reported by NEITI is available from the authors upon request

calculated by multiplying the sum of fuel consumption for each group by the unit subsidy as detailed above. Finally, column (7) and (8) summaries the total amount of subsidy and the share accrued to each income group.

Table 3.3: Fuel Consumption, Price and Subsidy in Nigeria

	Spot Price	Official Retail Price	Unit Subsidy	Annual Consumption (litre)	Total Subsidy Spending (N'b)
Petrol (Naira/Litre)					
2009	65.98	65.00	19.2	9,760,631,580	187.4
2010	87.3	65.00	43.8	11,111,238,000	486.67
2011	116.46	65.00	77.53	12,496,209,115	968.77
Kerosene (Naira/Litre)					
2009	65.96	50.00	31.12	1,468,074,030	45.68
2010	85.83	50.00	55.28	1,776,786,840	98.22
2011	122.38	50.00	99.63	2,532,393,000	252.31

Note: Unit subsidy is calculated by subtracting retail price from the reference price as defined in the text. Total subsidy spending is calculated by multiplying the unit subsidy with annual consumption.

As one would expect, the petrol subsidy benefits more the upper income groups while the kerosene subsidy are more evenly distributed across income groups. From the results, the ratio of petrol subsidy captured by an average household in the first four quintiles is 7.6%, 19.5%, 35.4%, and 61.7% of the highest income group respectively, the first three quintiles captured 86.7%, 95.7% and 98.6% of the kerosene subsidy benefited by the richest quintile. This shows that the relative welfare gain for each quintile groups is more even for kerosene as against petrol. In terms of the total subsidy, whereas the poorest quintile gained just 14% of the total fuel subsidy, the richest group benefited a disproportional of 27.1%. The ratio of total fuel subsidy enjoyed by an average household in the first four quintiles is 51.7%, 62.4%, 70.8%, and 83.8%, respectively, of the highest income group. A caveat here is that the results are calculated from the household survey data only. As shown in Table 3.3, the government spent five times more in subsidizing petrol than subsidizing kerosene, yet, from the HNLSS survey data, total subsidy on petrol is less than 40% of that on kerosene. The discrepancy is likely because petrol is used not only by the household sector, but also by industry, government and commercial sectors. To the extent that the richer households also benefit more from the services provided by these sectors, the results in table 3.4 will underestimate the benefit enjoyed by the richer households and consequently the inequality in benefit distribution. Second, considering the fact that kerosene is often not available to end-users at the subsidized price of 50 Naira/litre, the results could on the other hand overestimate the benefit enjoyed by the low income groups. Taken together, both caveats imply that the actual inequality in subsidy distribution is likely worse than the results shown in this analysis.

Table 3.4: Benefit Incidence Estimates in Nigeria

Exp. Quintiles	Expenditure shares (%)		Subsidy benefits (Millions of Naira)					
	Petrol (e_{pj})	Kero (e_{kj})	Petrol (s_{pj})	(%)	Kero (s_{kj})	(%)	Total	(%)
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
1 (poorest)	**3.4**	**17.9**	1.01	0.9	14.7	13.1	15.7	**14.0**
2	**8.7**	**19.9**	2.60	2.3	16.3	14.6	18.9	**16.9**
3	**15.8**	**20.5**	4.71	4.2	16.8	15.0	21.6	**19.2**
4	**27.5**	**20.9**	8.20	7.3	17.2	15.3	25.4	**22.7**
5 (Richest)	**44.6**	**20.8**	13.31	11.9	17.1	15.3	30.4	**27.1**
Total	100.0	100.0	29.83	**26.6**	82.14	**73.4**	112.0	100.0

Data source: HNLSS 2010 survey.

3.5.3 Analysis of concentration of fuel Subsidies in Nigeria

To further analyze how well-targeted and progressive is the distribution of fuel subsidies relative to that of household expenditure, we calculate the Gini coefficients for the total household expenditure, petrol subsidy, kerosene subsidy and the total fuel subsidy and the results are reported in Table 3.5. All the estimated Gini values are significant at the conventional levels. The estimated Gini coefficient for household expenditure (42.83%) is fairly close to the World Bank Gini index of (42.95%) for Nigeria in 2010[70]. The welfare

[70] http://povertydata.worldbank.org/poverty/country/NGA

(measured by household expenditure) are more equally distributed than that of the fuel subsidies as the Gini coefficients of both fuel subsidies are significantly higher than that of the household expenditure. This suggests that fuel subsidy is not alleviating but exacerbating the welfare inequality and will not be an efficient policy tool for income redistribution in Nigeria. Given that only 6% of the households use some amount of petrol, it is not unexpected the Gini coefficient for petrol subsidy is close to one. It is also worth noting that even though the kerosene subsidy appears more evenly distributed, the Gini coefficient measure for kerosene is also significantly higher than that of the household expenditure.

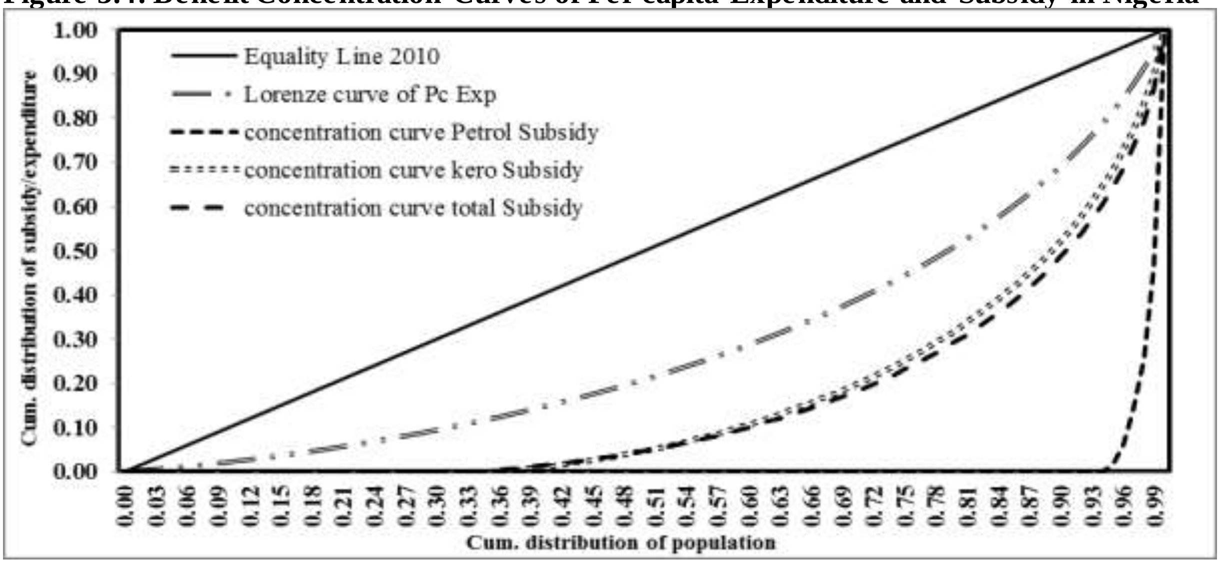
Table 3.5: Gini/Concentration Coefficient of Household Expenditure and Subsidy

	Household exp.	Petrol Subsidy	Kerosene Subsidy	Total Fuel Subsidy
Estimated Gini coefficient	0.4283	0.9741	0.6747	0.7081
Std. error (*SE*) of Gini	0.0253	0.0052	0.0222	0.0011
Sample standard deviation(*SD*)	0.2529	0.0516	0.2216	0.2062
No of Households	32921			

Note: (*SE*) and (*SD*) represent standard deviation of the mean and the sample respectively. While the *SE* expresses the precision of the $\bar{x}$ as an estimate of μ, the *SD* defines the spread of the sample values

Figure 3.4 plots the concentration curves of household expenditure, total fuel subsidy and subsidies of petrol and kerosene from the 2010 HNLSS data. The distribution of fuel subsidy shown in the concentration curves can be interpreted in two different ways – absolutely and relatively. First, by comparing the concentration curves with the 45^{o} diagonal, the distribution is progressive in absolute terms if the curve lies above the diagonal because in that case the poorest quintiles gain proportionally more from the subsidy than the richest quintiles. Second, comparing the concentration curves, a concentration curve lying above the welfare Lorenz curve but below the 45^{o} diagonal are progressive relative to the welfare (expenditure in our case), which implies that if beneficiaries were given income instead of the in-kind subsidy transfer, income distribution would become more equitable. From the figure, the expenditure Lorenz curve and the subsidy concentration curves all lie below the diagonal. So, in *absolute* terms, the distribution of both petrol and kerosene subsidies are regressive and poorly targeted as the poorest 20% of the population captures less than 20% of the benefits. Using the *relative* criteria, a benefit concentration curve situated above (*below*) the Lorenz curve of welfare implies that the subsidy benefits is progressive (*regressive*) relative to the welfare measure. The results indicate that the distribution of both petrol and kerosene subsidies are more regressive than income distribution[71]. This suggests that if the benefits from the subsidy on either fuel are converted to its income equivalent, the post fuel subsidy distribution of income-cum-benefit would be less equitable than the original distribution of income. The concentration curve of the aggregate fuel subsidy lie above the petrol curve but below kerosene and household expenditure curves corroborating the results of the Gini coefficients. In general, the research findings show clearly that government expenditures on fuel subsidies has no redistributive impact in Nigeria.

Figure 3.4: Benefit Concentration Curves of Per capita Expenditure and Subsidy in Nigeria



Source: Computed with the HNLSS (2010/).

[71] A progressive distribution benefits the lower income groups more than the higher income groups (i.e. pro-poor distribution) while regressive distribution is pro-rich and implies benefits in favour of higher income groups

3.6 Conclusions and Policy Implications

The study combines estimates of fuel subsidy with household expenditure data contained in the HNLSS 2009/10 survey to examine the distribution of fuel subsidy benefits across different income groups in Nigeria. Fuel subsidies are supposed to benefit the low-income and poor segment of the population who otherwise cannot afford to consume these fuels. The results show that fuel subsidies are poorly targeted as they benefit rich more than the poor. The survey shows that the top 20% households enjoy twice as much the benefit of fuel subsidies as the bottom 20% households. While the kerosene subsidy is more evenly distributed, petrol subsidy is heavily concentrated to the high income groups. The paper also evaluates the extent of concentration and progressivity using Gini coefficient measures and the Lorenz concentration curves and find that both fuel subsidies are more regressive than total household expenditure. The policy implications from this study can be summarized as follows.

First, as we demonstrated in this paper, fuel subsidy is not only costly to the government but also poorly targeted as it benefits the rich more than the poor. Thus, as a policy goal, the government should continue its effort to remove the subsidy by liberalizing the price or by setting a robust price adjustment mechanism that reflects changing market conditions. [72] Meanwhile, to make the reform acceptable to the public, the government must ensure that the proceeds from the removal of the subsidy will actually be used for the benefit of the broad population (IMF, 2013).

Second, since petrol subsidy is concentrated only to six percent of total households and kerosene is more widely used, one policy option for the government to reduce the growing financial burden of fuel subsidies is to gradually remove subsidy on petrol. As kerosene is used

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[72] For example, since 2013 China has established a price-setting mechanism by which the prices of petroleum products are adjusted according to the moving average of international benchmark crude oil prices of the previous two weeks. Turkey had an automatic mechanism involving a 3 percent small band (1.5 percent above or below the existing price), frequent price adjustments, and a smoothing mechanism based on weekly averaging (Baig *et al*, 2007).

by two thirds of Nigerian households for lighting and cooking purposes and has environmental and health benefits particularly to the poor and women, subsidy on kerosene should be retained in the short- to medium-run. However, as the current implementation of kerosene subsidy is creating room for corruption and distortions, the system should be redesigned to ensure that the fuel is available at the subsidized price for the targeted households.[73]

Third, considering the widespread protests following the increase of petrol price in January 2012, radical price increases, particularly in times of rising international oil prices, is not advisable. From international experience, a pragmatic approach to phasing-out the petrol subsidy is to choose the right timing. For example, China had planned to increase the fuel consumption tax and reform the price-setting mechanism of petroleum products since 1998, but waited until the end of 2008 when the international oil price plummeted to finally implement the reform (Mu, 2015). Recently, in January to February 2015, China again increased the fuel tax three times in the background of a much lower international oil price. After consumers experienced periods of high oil prices, a policy of increasing fuel tax or decreasing fuel subsidies is likely to be more acceptable, although a gradual approach does imply a higher fiscal cost.

Fourth, since kerosene is used for both lighting and cooking by many households, the long term option is for government to encourage LPG use among the rural poor and improve its rural electrification projects to deliver reliable electricity for the country's lighting needs. Without reliable electricity for possible substitution in lighting, reducing or eliminating kerosene subsidies will cause severe burden for the poor households.

[73] For example, in an interview to the Punch, Professor Adeola Adenikinju argued "we need to redesign the system that will cut off the middlemen and the politically-connected people that are currently benefitting from the present system." (Punch, 2014)

4 CHAPTER FOUR: ECONOMIC EFFECT OF GASOLINE SUBSIDY REMOVAL IN NIGERIA

4.1 Introduction

The impacts of fuel subsidies in an economy are quite enormous. In fact, the consequences of subsidies on economic growth go beyond aggravating fiscal imbalances and public debt (Kumar and Woo, 2010) to depressing private investments, crowding out priority public spending and hastening the depletion of the particular resource endowments (IEA, 2011 and IMF, 2013). Yet, the size of subsidies on petroleum products is growing among oil exporting countries. For instance, according to IMF (2013), the post-tax subsidy on petroleum products in 2011 is as high as 13.27% of its GDP in Saudi Arabia and 30.89% of government revenue in Iran[74]. Worst still, as shown in the previous chapter, these subsidies are often poorly targeted as each consumer enjoys per unit subsidy on any quantity consumed with low expenditure groups capturing the least benefit, thereby reinforcing rather than correcting inequality.

Nigeria is among the top 25 countries that heavily subsidize petroleum products (World Energy Outlook, 2014). Until the recent collapse in international crude oil prices, the low prices of petroleum products within the country combined with the rapid increase in international oil prices have widened the gap between reference and retail prices (see figure 1). This has resulted into higher government spending on fuel subsidies and the resultant financial burden severely constrains government investments in other essential sectors of the economy. For instance, the Nigerian government spent US$3.89 billion subsidising petroleum products compared to US$3.76 billion on priority sectors in 2010.

[74] See http://www.eia.gov/beta/international/rankings/#?prodact=53-1&cy=2011&pid=53&aid=1&tl_id=1-A&tl_type=a for the ranking of countries by petroleum exports

Motivated by the increasing financial burden of fuel subsidy, several heads of Nigerian governments have enforced a number of arbitrary upward adjustments in the domestic prices of petroleum products in a bid to bring it closer to the opportunity cost of the products. In January 2012, the Nigerian government raised the domestic pump price of petrol by 49.23 % (from N65/litre in 2011 to N97/litre) in what became the most resisted fuel price review in the country. While the government argues that the reform is on-going and is committed to full eradication of petrol subsidy in Nigeria by 2015, the civil society and organised labour in the country has vowed to resist further subsidy removal. The expected reforms like prior domestic fuel price increases will, through its sectoral linkages affect not only the household but also firms' production and investment decision as well as other macroeconomic aggregates.

In this paper, I employ an input-output model to study the economic effect of fuel subsidy removal of 2012. To examine the effect on various economic sectors and households, I augment the input-output analysis with the 2011 Social Accounting Matrix (SAM) and other relevant macroeconomic indicators such as government and private consumption expenditures, imports, exports, and investments. The results show that while the increase in gasoline price increase could result in a marginal decline of 0.013%, 0.005% and 0.2% in GDP aggregate investments and government revenue respectively if the savings from the subsidy reduction is not reinjected to the economy, economic growth, investment and government revenue can improve by 1%, 0.53% and 12.4% respectively when subsidy saving is reinjected.

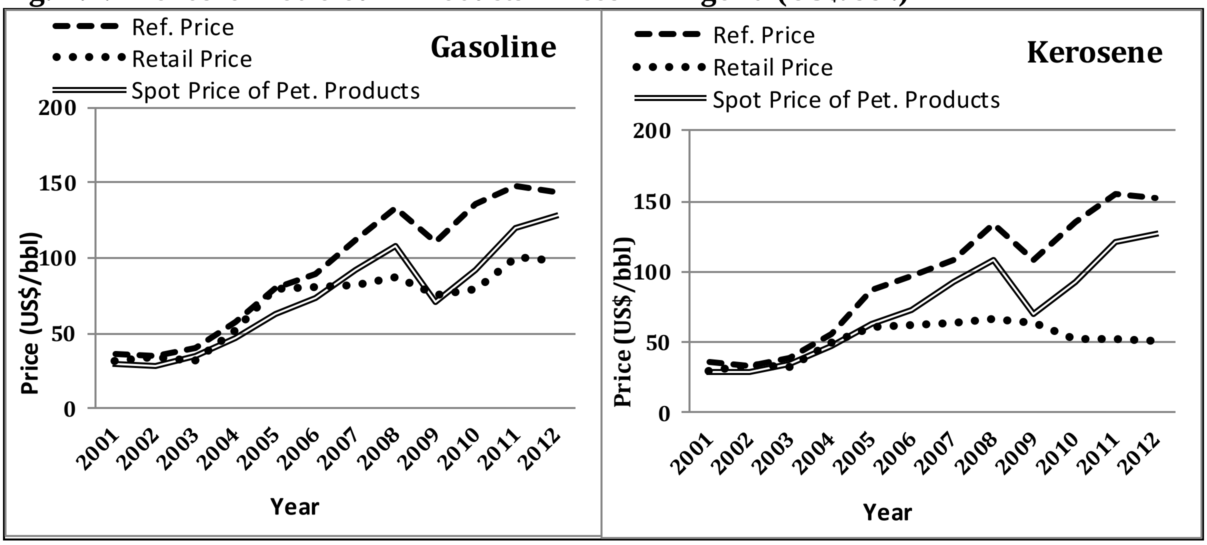
This analysis is important in two ways. First, given the world faced with rapid change in oil prices and a number of domestic fuel price increases in Nigeria over the last few years, the economy and the various economic agents will be impacted directly or indirectly[75]. Yet, no study on the sectoral analysis of the economic effects of these fuel price reforms in Nigeria has

[75] For instance, between 1993 and 2012, domestic price of petrol has been reviewed upward about eighteen (18) times from as low as N5/litre in 1993 to N65/ litre in 2009. Yet, no effort has been made to quantify the micro and macroeconomic effects of any of these past price adjustments in Nigeria

been documented till date. Second, previous attempts to assess the economic impacts of fuel price increases have been limited by the slight attention paid to sectoral analysis which gives ambiguous results as to its micro effects. By assessing the impacts of a reference case of gasoline subsidy reduction and the reinjection of the saving therefrom in Nigeria using the recent year 2011 base data will capture the current structure of the economy and the conclusion of this analysis, arguably, conveys the actual effects better than potential impacts obtained in previous studies, This will no doubt add value to existing knowledge and also provides a guide for evaluating other fuels' subsidy policy in the future based on current economic structure.

The chapter is organised into five sections. Section 2 provides the background with a brief review of relevant literature while the methods, model and the data used are presented in Section 3. The result is discussed in section 4 and section 5 concludes with the policy inferences

Fig. 4.1: **Trends of Petroleum Products Prices in Nigeria (US$/bbl.)**



Data Sources: Data on spot and retail prices and official exchange rate are obtained from OPEC Statistical Bulletin, 2014. Reference prices is the sum of the international border price (c.i.f.) plus marketing, distribution and other applicable charges

4.2 Related Literature

Given the multi-prong nature of the fuel subsidy issues, the literature is replete for studies on the analysis of the economic effects of fuel price increases. For instance, Adam and Lestari (2008) use econometric analysis to investigate the influence of an increase in fuel price on social welfare in Indonesia and find that increasing the price of fuel without a compensatory fund for the households exerts adverse effect on households. Nwanfor *et* al (2006) conducted a computable general equilibrium (CGE) simulation to study the effects of fuel subsidy removal on households' welfare and poverty in Nigeria. The study shows that the effects of fuel price increase on households' welfare depend largely on the corresponding fiscal policy of the government. While the removal of subsidy without spending the savings would increase the aggregate level of poverty, a noninflationary income transfer to households reduces poverty the most. Bazilian and Onyeji (2012) consider the implication of the 2012 gasoline subsidy reduction for businesses in Nigeria and argue that raising fuel prices will likely reduce firms' cost competitiveness in electricity-constrained nations and suggest that the country should ensure key building blocks in place prior to removing or reducing fuel subsidies. Lin and Jiang (2011) study the impacts of subsidies removal on energy consumption in China and find that eliminating energy subsidies will result in a substantial fall in energy demand and emissions but with adverse effects on macroeconomic variables and suggests the adoption of compensating policies where subsidy savings are moved to maintain other measures of sustainable development. Hartono and Resosudarmo (2008) use SAM to assess the implications of subsidy reduction on energy efficiency and income of Indonesian households and find efficiency improvement superior to energy conservation policy. While constraining energy use lowers households' income, efficiency improvements resulting from subsidy reduction increases income for most groups. The simulation results further suggest that subsidy reduction with efficient use of energy produces the best results on households. Negara (2000) considered the impact of increasing energy price on macroeconomic variables including economic growth, saving and unemployment rate, and income distribution. The study concludes that increases in fuel price could effectively enhance efficiency in energy consumption and strengthen the government budget but increases the level of unemployment in Indonesia. Recently, an IMF study (2013) analyses the incidence of subsidy distribution on different income groups and discussed the effect of reforming energy subsidy on economic growth in a sample of 176 countries.

Particular efforts focusing on the use of SAM multiplier analysis in developing countries for evaluating the price and quantity effects on the economy are also well documented. Thornback and Jung (1996) decompose their SAM to see how the economic growth in different sectors in Indonesia impact on poverty alleviation and observed that growth in the services and agriculture sectors enhance poverty alleviation better than industrial sector. Khan (1999) replicates the Thorbecke and Jung (1996) technique to assess the economic sectors-poverty link in South Africa. They identified three principal sectors, namely agriculture, mining and general services, where growth can translates into highest benefits the South African rural and urban poor.

Recent literature tend to argue that partial equilibrium is naturally less ideal compared to a multi-sectoral method since the latter provides better understanding of the intricate economic linkages particularly when a general equilibrium feedback effects are expected (Nganou et.al, 2009). In fact, applied general equilibrium analysis can in principle, be conducted using econometrics but the data required are substantial and rarely unavailable even in developed countries. To bypass the data limitation problems, studies on developing economies have relied more on general equilibrium models such as the Input-Output and SAM using a recent annual data as the basis. By transforming the Input-Output and the SAM data to general equilibrium representations, they produce static simulations relating to the values of the initial year which can be used to evaluate the economic effects of exogenous shocks say, an increase in the prices of gasoline (arising from subsidy removal) on endogenous accounts. Though, the general equilibrium models usually include some underlying assumptions, their strengths trace to their ability to account for multiplier effects among the principal actors in the economy. In contrast, the partial equilibrium models simply consider the energy product market where subsidy reform is taking place.

Although partial equilibrium models can offer valuable insights into the direct impacts of subsidy reform, the usefulness of these models in assessing policy interventions is often limited as only the direct effect of the shocks can be accounted for in a partial equilibrium framework. This consideration is crucial given the fact that petroleum products constitute an important intermediate goods in the economy such that changes in their prices have direct and indirect effects on other sectors and agents in the economy. This has led to the wider usage of applied general equilibrium methods like the Input-Output models, SAM multiplier models, and CGE modelling in country-specific studies[76]. Though, the CGE models make possible the simulation of complex interrelationships and can provide a structure with which the numerous dynamics under study can be accounted for in complex policy issues, it is however not a magic potion for solving policy and planning problems. First is that the assumption of general equilibrium limits the use of these models for practical policy analysis[77]. Second, the specification of CGE models relies heavily on the modeller's judgement about sector decomposition, elasticities of demand and supply, and the functional forms to adopt[78]. All these make results from CGE model highly sensitive to model specifications and are not adopted in this study. It should be noted however that the SAM method has its own weaknesses. First, it is a static model whereas the structure of an economy changes over time. This implies that in

[76] Basically, the input-output model facilitates the calculation of the economy-wide changes that may result from sector specific exogenously shocks obtained from the solving of set of linear equations simultaneously whereas CGE are sets of simultaneous non-linear equations that can accommodate adjustments in price and quantity as both factor and commodity market equalises to simulate the optimal condition of consumers and producers as well as government role as economic actor in an economy

[77] In fact, CGE not only assumed that all markets find their equilibrium but also that nothing happens until equilibrium is attained. This is a better way to say that no transaction takes place in disequilibrium implying that all economic agents delay their actions and decisions until equilibrium is found. For many types of policy issues, the main point is actually the situation of persistent disequilibrium

[78] Though prices are treated as endogenous in CGE models, this process requires that numerous elasticities must be estimated. Quite often, models resort to crude estimates of elasticity based on limited set of observation on representative values from other studies or informed opinion

reality, the parameters of the model may change and reduces its potential for long run projection. Second, the Leontief technology assumption of fixed technical coefficients suggest further that production technologies remain constant for a particular time frame as in the base year which may not usually be the case. Nevertheless, SAM typically offers the basic taxonomy of the CGE modelling and according to Thorbecke (2000), CGEs can only supplements the SAM framework by capturing the behaviours of the main actors in response to price changes. The outcome of the Bautista et al, (2001) study clearly indicates that Input-Output models and SAM multiplier analysis can, despite its limitations yield results similar to that of CGE. They perform simulations on Indonesia using both the CGE and SAM and obtained identical results.

Many studies have actually combined the SAM techniques with the I–O models to analyse energy policy. Tarancon et al. (2010) use a cross country I–O models to analyse the electricity demand of 18 manufacturing sectors in 15 European countries. The simulation results show that while some manufacturing sectors are more vulnerable to electricity price increase across countries, rise in electricity prices will affect most sectors substantially in few countries namely Hungary, Italy, Slovakia, and Spain. Ter-Minassian et al (2008) employ the SAM method to assess the impact of a rise in the price of fuels and foods on major macroeconomic variables across several countries globally. Akkemik (2011) adopts the SAM based price model to appraise the potential influence of variations in the price of electricity on economic sectors and households' cost of living in Turkey. The simulated price multipliers show that while households' costs of living are slightly affected, prices are mostly affected in the energy producing and energy-intensive sectors including mining, iron and steel and water. Nganou et al (2009) evaluate the impact of an oil-price increase on households grouped (by gender and poverty status of the household's head) in Kenya. The results indicate the likelihood that poorer households particularly those with female heads bear more burden by a hike in oil price than the richer group due to differences in consumption patterns.

4.3 Data and Methodology

This study employs the input-output and SAM multiplier method. This will on the one hand, keep the analysis as simple and transparent as possible for the various stakeholders in the subsidy reform debate. Less complex models clarify underlying judgements, introduce fewer *ad hoc* restrictions and ease the task of unravelling economic interactions to understand how results are produced. On the other hand, the data requirement is lesser compared to that of CGE and like other modelling techniques, data problems can influence the model specification and the numerical outcomes of models. Moreover, SAM multiplier method has an advantage over the simple Input-Output analysis as survey data on household income and consumption can be incorporated into the investigation.

Typically, the interdependence among the production sectors of any economy can be established by simple I–O table analyses. However, SAM are superior to the input-output analysis in that they augments the basic I–O multipliers with additional multiplier effects engendered by the circular flow of income among activities, factors and economic agents (such as the government, the households, the firms, and the foreign sector) of the economy. Predominantly, data is structured in SAM as a square matrix recording transactions (expenditures or payments in columns and incomes or receipts in rows) of all economic agents in double entry manner. Thus, it is a suitable template for exploring the impacts of any change on all actors and sectors in the economy. SAM multiplier models by their very nature, rest on certain assumptions. First, prices and technology coefficients are fixed and the average propensity to spend are constant for all actors in the economy (see Akkemik, (2011). Second, accounts are segregated into endogenous and exogenous components and exogenous shocks are assumed to cause changes in the level of endogenous accounts by means of the multiplier process (see Miller and Blair, 1985; Nganou et al, 2009). Despite these simplifying assumptions, the SAM multiplier method is a very useful and appropriate policy analysis tool as it can show the impact of exogenous changes like the increase in petroleum product prices on other economic sectors and agents in a disaggregated manner and provide transparent and traceable transmission paths. As a traditional double accounting system, SAM is a partition matrix which records transactions between sectors within production (activity and commodities) blocks, factors (labour and capital) blocks and institutions (households and government) blocks in the economy

4.3.1 Input-Output and SAM Framework

The theoretical framework of I–O analysis hinges on Leontief Input-Output techniques and SAM-Based Multipliers. The analytical framework of the I–O as a typical applied general equilibrium model traced to the seminar work of Leontief (1951a; 1951b; and 1953). Though, there have been several developments and extensions, the key concepts lay down by Leontief constitutes the major wheels of the most I–O based economic analysis. The simple mathematical relationships stem from the concept of inter-industry transactions table anchored on the notion that the production by sector (i) in a given economy depends on the transactions between pairs of sectors plus the final demand by exogenous sectors such as households, government and foreign sectors which can be expressed as:

$$q_i = z_{i1} + z_{i2} + \cdots + z_{ij} + \cdots + z_{in} + f_i = \sum_{j=1}^{n} z_{ij} + f_i \qquad (1.1)$$

Where (q_i) and (f_i) are the output and final products demand of sector i respectively while (z_{ij}) is the intermediate purchases from sector i by all sector j including itself – all in monetary values[79]. The unique solution (see appendices 4A) can be obtained by applying standard matrix algebra as:

$$q = (I - A)^{-1} f = \boldsymbol{L} f \qquad (1.2)$$

[79] Note that the volume of final demands (F_i) is net of competitive imports for product (i)

Given that:

(q) = the gross output vector
$(I - A)$, *and* $(I - A)^{-1}$ = Leontief matrix and the corresponding inverse respectively
I = Identity matrix
A = Technical coefficients or I–O coefficients matrix
f = Final demand

While the I–O table contains detailed statistics about the production structure of an economy, the SAM framework gives a broader view of the economy by combining the I–O tables in a structure with transactions between other economic agents to produce a model where the effects of exogenous injection or withdrawal on endogenous variables (production, factors and institutions are examined.. The role of I–O table is vital in the construction of SAM framework. By modelling the entire circular flows of income, the SAM framework extends the basic I–O model which is based on inter-industry transactions. Hence, the SAM multiplier augments the I–O multipliers by the extra multiplier effects prompted by the endogenous activities, factors and institutions in the circular flow of income. To ensure that transactions in the SAM are balanced, the row total must equals the column total. In deriving the basic SAM multiplier, the first decision is to determine the endogenous accounts (items 1 – 5) and the exogenous accounts (items 6 – 8) as illustrated in table 4.1 below[80]. Suppose the highlighted 5 by 5 cells in table 4.1 is the matrix of endogenous transactions (T_n), the matrix can be defined akin to the Leontief's I–O model in terms of its corresponding matrix of column shares (A) as[81]:

$$T_n = Aq_n \tag{1.3}$$

[80] It is sufficient for simplicity sake to aggregate all exogenous accounts as one with records of the aggregate set of injections to and leakages from the system whereas the endogenous transactions are defined in a way that will showcase the basic interaction between 2-agents (production activities and households) and 2-markets (factors and commodities)
[81] The matrix (T) is a summary representation of the endogenous transactions matrix which defines the matrix of column shares (A). Therefore, (A) is simply the elements in each column divided by the corresponding total of column (T) in the lower segment of figure B.1 in appendices B (i.e. $A_{12} = T_{12}/q_2$; $A_{31} = T_{31}/q_3$; and so on).

Table 4.1: Abridged depiction of Social Accounting Matrix

		Expenditures						
		Endogenous Accts.					Exogenous Accts	Total
		Activities	Commodities	Factor: Labour	Factor: Capital	H/holds		
		(1)	(2)	(3)	(4)	(5)	(6, 7, 8)	
	Activities (1)		T_{12}				x_1	q_1
	Commodities (2)	T_{21}				T_{25}	x_2	q_2
	Factor: Labour (3)	T_{31}					x_3	q_3
	Factor: Capital (4)	T_{41}					x_4	q_4
	Households (5)			T_{53}	T_{54}		x_5	q_5
	Exog. Accts (6, 7, 8)	E_1	E_2	E_3	E_4	E_5		q_n
	Total	q'_1	q'_2	q'_3	q'_4	q'_5	q'_n	

Source: Author's Sketch

Since q, and x are the vector sum of endogenous accounts and exogenous injections respectively in table 4.1 above, the endogenous row accounts in the table can be presented and solved as a series of linear identities as

$$q_n = Aq_n + x \quad (1.4)$$

$$q_n = (I - A)^{-1}x$$

$$q_n = Mx \quad (1.5)$$

Where $M = (I - A)^{-1}$ can be defined as the multiplier obtained from the SAM matrix. Note that the SAM matrix (M) will be fixed as long as (A) (i.e. the coefficients of expenditure plus distribution) remains constant. Consequently, equation (1.5) defines the set of withdrawals/injections (x) that is consistent with total equilibrium outputs and income (q_n).

4.3.2 Model Specification

In a usual production process, transactions of all economic agents ordered in an I–O table form the basis for the Leontief Material balance equation for each sector (i.e. the flow of outputs and inputs to and from one industry to other industries and vice versa. The derived multiplier of the SAM matrix $\{(M = (I - A)^{-1}\}$ from the basic SAM framework depicts the whole impacts of the changes in a given sector in the economy on others, hence:

$$q_j = \sum_{j=1}^{n} a_{ij} q_j + x_i \qquad (1.6)$$

The variables q and x are as earlier defined. Equation (1.6) is in fact, the total effects (direct and indirect) on the whole economy of any sectoral change in total output of final demand. However, the direct effects (α_j) of a unit change in final demand on (j_{th}) sector can be obtained from equation (1.6) above as:

$$\alpha_j = \left(I - \sum_{j=1}^{n} a_{ij}\right) \qquad (1.7)$$

The equilibrium prices of commodities and services can be solved for from the revenue function of each industry at equilibrium by expanding vertically on the primal I–O table. The equilibrium revenue function is given as:

$$p_j q_j = \sum_{i=1}^{n} p_i q_{ij} + w_j L_j \qquad (1.8)$$

Where (p_j) is the price of product j and (w_j) is the price of primary input L used by sector (j). Solving for (p_j) by dividing equation 1.8 by (q_j) yields:

$$p_j = \sum_{i=1}^{n} p_i a_{ij} + v_j \qquad (1.9)$$

Where $(v_j = w_j L_j / q_j)$ is the value added per unit of product (j) and the technology coefficients of the endogenous sectors (q_{ij}/q_j) is signified by (a_{ij}). Applying matrix notation to equation (1.9), SAM multiplier approach posits that product's price is the sum of all inputs' cost from the remaining sectors and the per unit value addition to output. Hence, costs is related to prices by the equation (2.0) below

$$p = A'p + v \qquad (2.0)$$

Where p and v are vectors representing sectoral prices and per output value added respectively. With price assumed constant in relation to output, sectoral prices can be articulated in terms of the I–O and the per output value added coefficients[82]

$$p = \{I - A'\}^{-1} * v \tag{2.1}$$

Equation (2.1) is the basis for our analysis on how the change in the coefficients of value added impact on sectoral prices[83]. If we denote the initial and the final value added coefficients as $v(0)$ and $v(1)$ respectively and the initial prices and final output prices as $p(0)$ and $p(1)$ respectively, the link between the change (δ) in gasoline subsidy and changes in the prices of output can be expressed as:

$$\delta p = \{I - A'\}^{-1} * \delta v \tag{2.2}$$

The usual I–O table treats all inputs per unit of output as expenditures and the final price changes can be expressed as a change in relation to the initial year in percentages by setting the base set of each output prices to one. Therefore, the increment in aggregate prices (p) is obtained by combining changes in sectoral price with budget shares in total expenditure of consumer as:

$$\delta p = \sum \delta p_i k_i \tag{2.3}$$

Where:

(k_i) = budget share of good (i)'s to aggregate expenditure ratio

Note that the above model presumes that reducing subsidy on a particular fuel (gasoline in this case) increases cost of all relevant intermediate inputs to the fuel production which further increases the fuel price since we assume wage and profit per output to be fixed.

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[82] The assumption that the price is constant in relation to output infers that profit, wage and indirect tax per output, are fixed

[83] From equation (2.1), any potential or actual reduction of gasoline subsidy is akin to indirect tax levy per output or negative subsidies on the gasoline sectors which can instantly be added to the product's prices through the Í-Ò structure, then to those of the products which directly uses gasoline as input, and subsequently to indirect users and so on. It should be noted also that prices are taken as endogenous in equation (2.2), hence the value added vector is the only source of shocks.

4.3.3 The Data

The base data for the analysis in this study is the 2011 I–O Table of Nigeria provided by the Nigerian Institute of Socio-Economic Research (NISER)[84]. The various households and the 2011 I–O activity sectors classification used in the SAM model is presented in figure 4.2 below. Of the 34 activities, 4 are agricultural (items 1-4) while 7 are in the energy sector category (items 5-11) of which three are petroleum products namely premium motor spirit (gasoline), dual purpose kerosene, and automotive gas oil (diesel) as items 8, 9, and 10 respectively. Items 12-14 and 15-17 are industrial activities and public utilities respectively. Items 18-22 are in the transport sectors while last 12 items are essentially in the private and public service categories.

Table 4.2: Activity Sectors Classifications of the Nigerian I-O Table

Sector Classification			
1	Crop Production	18	Water Transport
2	Livestock	19	Air Transport
3	Forestry	20	Transport Services
4	Fishing	21	Telecommunications
5	Crude Petroleum	22	Post
6	Natural Gas	23	Distributive Trade (Wholesale & Retail Trade)
7	Solid Minerals	24	Hotels & Restaurants
8	Premium Motor Spirit	25	Financial Institutions
9	Dual Purpose Kerosene	26	Insurance
10	Automotive Gas Oil	27	Real Estates
11	Cement	28	Business Services (Not Health or Education)
12	Other manufacturing	29	Public Administration
13	Electricity	30	Education
14	Water	31	Health
15	Building & Construction	32	Private Non Profit Organisations
16	Road Transport	33	Other Services
17	Rail Transport & Pipelines	34	Broadcasting

Source: compiled from the I-O table; Nigerian Institute of Socio Economic Research (NISER)

The 34 by 34 sectors input-output table is complemented by additional relevant and current macroeconomic indicators such as imports, exports, value added, savings, investments, consumption expenditures, and capital flows. These data are sourced from the Nigeria's National Bureau of Statistics. Central Bank Report and IMF's Financial Statistics for 2011. In the SAM preparations, the underlying input-output table come with two components

[84] The surveillance and forecasting department of NISER has produced the Nigerian Í-Ò Table biennially since 1999 and the 2011 version is the most recent made available in May, 2013 is used in this study.

(commodity use and supply tables) which conventionally distinguish production activities from commodities. This study adopts the NBS's classification of the country's household into 6 main socio–economic groups i.e. 3 income groups (non-poor, moderately poor and the poor) by 2 locations (the urban and rural Nigeria). The main simulation scenario of the study is the actual reduction of gasoline subsidy that led to a rise of 49.23% in the price of gasoline. The detailed macro SAM which is available on request cannot be included here due to space. However, the aggregate SAM is presented and discussed in the next section.

4.3.4 SAM and Scenarios

Table 4.3 below shows the aggregate picture of the Nigerian macroeconomic structure in year 2011 as the starting point. From the table, the total receipts amount to ₦58.71 trillion (net producer of government services) and is equal to total expenditure. The receipts comprised sales of domestic commodity supplies (₦36.592 trillion) and exports plus export subsidies of ₦22.12 trillion. The expenditures consist of total intermediate inputs (₦21.86 trillion); wages and salaries (₦12.47 trillion); depreciation allowance and operating surplus (₦24.21 trillion); and indirect taxes less subsidies (₦0.17 trillion). Total absorption in the economy is ₦43.18 trillion which, at the expenditure side, is composed of total intermediate inputs (₦21.86 trillion); private consumption expenditure (₦15.23 trillion); government consumption expenditure (₦2.50 trillion); and investment (₦3.58 trillion). On the income side, total absorption is made up of domestic commodity supplies (₦36.59 trillion) plus tariffs and total imports (both competitive and non-competitive) of ₦6.59 trillion.

We use the 2011 Nigeria I-O table and build a SAM to study the effect of fuel subsidy removal on sectoral output, inflation, investment (capital accounts), and household income. In

January 2012, the Nigeria government increased the price of petrol (premium motor spirit in the list of activity sector) by 49.23% from N65 to N97[85].

Table 4.3: 2011 Social Accounting Matrixes of Nigeria (units: ₦'trillions)

	`	Expenditures								
		Activities	Commodities	Factor: Labour	Factor: Capital	Inst: H/hold	Inst: Govt.	Capital Acct or Invt.	Rest of the World	Total Receipts
Receipts	**Activities**		36.59						22.12	**58.71**
	Commodities	21.86				15.24	2.50	3.58		**43.18**
	Factor: Lab	12.47								**12.47**
	Factor: Cap	24.21								**24.21**
	Inst: H/hold			12.47	24.21					**36.68**
	Inst: Govt.	0.17				1.25				**1.42**
	Capital Acct					20.20	-16.6			**3.58**
	Rest of the World		6.59				15.53			**22.12**
	Total Exp.	**58.71**	**43.18**	**12.47**	**24.21**	**36.68**	**1.42**	**3.58**	**22.12**	**202.37**

Source: Author's computations

The study considers two scenarios for the analysis. In the first scenario, the savings from the subsidy reduction is not reinjected to the economy[86]. In the second scenario, the savings from petro subsidy reduction is reinjected to the economy and used in education, health, public administration, and road transport sectors. The results are presented in the section below. While the technology coefficients are value-based, the results can be interpreted as physical units since the model normalizes all prices in the base year to 1.

[85] Though the domestic price of gasoline was raised from N65/litre to N97/litre, the fuel was still much subsidised as the open market price was N146/litre in January 2012

[86] While the best option is for subsidy saving to be reinvested back into the economy, the saving may sometimes be used to repay debts where such debts have become an economic burden. However, lack of transparency and accountability by governments in third world countries raise the possibility of embezzlements and mismanagements. Whatever the case, this is the first time the Nigerian government will appropriate subsidy saving as budgetary expenditures into the economy

4.4 Results and Discussion

4.4.1 Effects of Subsidy Reduction – Base case scenario (BS)

4.4.1.1 Sectoral effects (BS)

The value of output in the gasoline sector increases the most with the reduction in gasoline subsidy. Other sectors whose output increase slightly are the road transport, crude petroleum and the electricity sectors in decreasing order. All the remaining sectors experienced a decline in gross output due mainly to the input price rise brought about by the reduction in gasoline subsidy. This is anticipated as road transport is a major component in the overall services sector which in Nigeria depends heavily on this product so much that their production costs are directly affected in different degrees[87]. As intermediate inputs cost increases, production costs are directly affected through the reliance on the services sector then indirectly through the use of other oil products. On the whole, total gross output declined marginally by 0.013% which implied that if the price of gasoline is doubled, gross output will decline by a meagre 0.03%. This result conforms to the findings of Choucri and Lahiri (1984) for Egypt and Nwanfor et al (2006) for Nigeria.

Apart from health sector with 5% rise in prices and 7 other sectors with less than 20% price rise, 23 of the 34 sectors experience price increases of more than 20%. Of these, 4 sectors are in the oil and gas manufacturing, 3 sectors are in the agriculture and the industrial sectors while the remaining 13 sectors are in the services category. Five sectors namely crude petroleum; natural gas; crop production; water transportation; and real estate are the most affected with price increases of more than 40%. While the crude petroleum and the natural gas sectors are important as productive sectors, the other three sectors are purchased directly by households and the effects will be easily visible as their costs enter directly into household

[87] The increase in road transport is more of truck transport rather than personal cars or public commuters which is occasioned by the need to distribute additional fuel imports to the economy

budgets. The largest increase in producer prices aside the refined petroleum product sectors, occurs in the service sectors which is anticipated as the service sector relies to a large extent on the use of gasoline in Nigeria. More importantly, apart from the crude petroleum, solid minerals and the petroleum products' sectors, all other sectors that experience price increases are substantially non-tradable sectors and dismisses the threats of possible loss in export markets or foreign competitiveness. In all, the effect of the reduction in gasoline subsidy on the aggregate price level is 23.6% which translates to a rise of 0.48% in producer price index for every 1% rise in the price of gasoline[88]. This result indicate clearly that gasoline prices is a key driver of the inflationary impacts in the country given that gasoline account for 4.6% and 2.5% of aggregate intermediate inputs and total domestic demand respectively

Only 4 sectors of the economy experienced positive stimulus in investments and boost in export with the reduction in gasoline subsidy, these are however prime sectors for the policy. As expected, the greatest impact occurs in the gasoline sector itself (see table 4). The results show that a 1% rise in gasoline price results in 0.79%, 0.06%, 0.02%, and 0.01% increase in investment in gasoline, crude petroleum, road transport, and electricity sectors respectively. This, and the fact that these sectors also experience substantial increases in GDP/value added indicate that the reduction in gasoline subsidy raises the attractiveness of these sectors to investors.

With the fixed international price of oil, the 0.11% rise in crude petroleum export despite a 23.63% increase in producer prices will imply a reduction in the sector's surplus[89]. Though, this will however be offset with the rise in government revenue resulting from the reduction in gasoline subsidy. The fuel price increase also increases both import and exports in the road transport by 3.06% and 2.99% and in the electricity sectors by 0.06% and 0.07% respectively.

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[88] This can be referred to as the elasticity of producer prices to gasoline price

[89] The increase in domestic fuel price resulting from subsidy reduction encouraged oil marketers to buy more crude and refined abroad. Hence, the increase in crude petroleum exports

Table 4.4: Effects of Petrol Subsidy Removal in Nigeria

Activity Sectors	Gross output	Producer prices	Invt.	export	Import	Expenditure		Income	
						H/hold	Govt.	Labour	Capital
Crop Production	-0.26	43.14	-0.24	-0.15	-0.70	-0.34	-1.81	-0.53	-0.56
Livestock	-1.01	28.70	-2.09	-2.06	-2.14	-0.57	-2.15	-1.42	-1.20
Forestry	-1.01	24.08	-1.29	-0.43	-1.68	-1.39	-1.25	-0.91	-1.34
Fishing	-0.01	10.70	-0.04	-1.78	-2.09	0.10	-0.08	-0.35	-0.41
Crude Petroleum	0.41	46.06	3.04	0.11	3.54	13.98	0.00	-0.03	-0.01
Natural Gas	-0.15	46.22	-0.73	-0.03	-0.52	-0.47	-1.02	-0.39	-0.43
Solid Minerals	-1.32	21.90	-2.90	-0.17	-2.85	-2.74	-2.89	-1.23	-0.99
Premium Motor Spirit	15.71	19.23	39.23	35.47	47.72	21.05	4.66	40.83	41.54
Dual Purpose Kerosene	-0.86	14.22	-1.97	-0.72	-1.01	-0.82	-0.31	-2.04	-2.20
Automotive Gas Oil	-0.63	24.39	-1.97	-0.78	-1.01	-0.42	-0.31	-2.10	-2.26
Cement	-0.26	-5.70	-0.14	-0.37	-0.68	-0.20	-0.16	-0.84	-0.83
Other manufacturing	-1.30	12.55	-1.63	-0.87	-0.99	-1.10	-1.34	-1.63	-1.65
Electricity	0.17	29.76	0.33	0.07	0.07	0.55	0.40	-0.21	-0.14
Water	-0.10	22.57	-0.06	-0.78	-0.78	0.03	-0.12	-0.43	-0.53
Building & Construction	-0.45	24.97	-0.63	0.00	-0.13	-0.52	-0.16	-0.64	-0.71
Road Transport	1.03	16.46	1.00	2.99	3.06	1.55	0.70	0.86	0.73
Rail Transport & Pipelines	-0.01	18.16	-0.42	0.00	-0.18	-0.16	0.00	-0.46	-0.51
Water Transport	-0.96	43.69	-2.11	-0.47	-1.65	-0.83	-1.61	-1.60	-0.92
Air Transport	-0.18	24.48	-0.17	-0.03	-0.34	-0.04	-0.28	-0.88	-0.81
Transport Services	-0.13	28.37	-0.11	-0.15	-0.15	0.01	-0.09	-0.66	-0.52
Telecommunications	-0.31	21.76	-0.39	-0.67	-0.78	-0.12	-0.30	-1.05	-1.15
Post	-0.08	25.05	-0.06	-0.65	-0.65	0.05	-0.10	-0.43	-0.66
Distributive Trade (Wholesale & Retail)	-0.78	32.48	-1.77	-1.00	-1.22	-0.41	-1.60	-1.12	-0.91
Hotels & Restaurants	-0.01	37.37	-0.11	0.00	-0.18	0.10	-0.01	-0.33	-0.37
Financial Institutions	-0.49	39.48	-0.19	-0.91	-1.01	-0.41	-0.65	-0.53	-0.69
Insurance	-0.13	-20.33	-0.09	0.00	-0.95	-0.16	-0.03	-0.55	-0.51
Real Estates	-0.41	45.20	-1.02	0.00	-0.37	-0.17	-0.67	-0.49	-0.63
Business Services (Excl. Health & Education)	-0.35	18.54	-0.05	0.00	-1.68	-0.56	-0.09	-0.93	-1.10
Public Administration	0.00	37.67	0.00	0.00	0.00	0.11	0.00	-0.32	-0.35
Education	-0.82	35.34	-0.59	0.00	-2.14	-0.71	-0.50	-0.60	-1.49
Health	-0.03	5.11	-0.01	0.00	-2.28	0.07	-0.02	-0.39	-0.47
Private Non Profit Org.	-0.10	-26.85	-1.48	0.00	-2.15	0.05	0.00	-0.39	-2.27
Other Services	-0.36	25.31	-0.16	0.00	-1.11	-0.39	-0.17	-0.49	-0.73
Broadcasting	-0.11	33.31	-0.05	0.00	-1.07	-0.03	-0.05	-0.38	-1.02
Total	**-0.01**	**23.63**	**-0.01**	**0.08**	**0.95**	**0.33**	**-0.18**	**-0.29**	**-0.34**

Source: Author's simulation results

The highest level of imports as a result of the gasoline price increase occurs in the gasoline sector itself with about 0.96% rise in import per 1% increase in price. Though the country relies on imports to meet local demand for the products even before the price increase owing to inadequate refinery capacity, the increase in price and the resultant rise in domestic production costs might have contributed to favour the high importation.

Factor incomes reduce in most sectors and with the rise in producer prices and the consequent higher input costs in these sectors, the reduction in factor incomes implies that the rise in producer prices do not totally make up for the increase in costs of production. In addition, the share of income received by labour appears smaller compared to income payments to capital. This points to the facts that the petroleum sectors in general exhibits a lower employment potential and that it provides jobs and income to a very small number of households. Government expenditures declined in all but gasoline, road transport and electricity sectors while households experience expenditure increase in the utility sectors (electricity, water, health, transport, and post) as well as in other private service sectors (see table 4). The increase in gasoline price reduces government expenditures in terms of subsidy spending while the expected fall in gasoline consumption will make more crude petroleum available for exports which increases foreign earnings and revenue. More so, the marginal rise in foreign savings by 0.3% if gasoline price is doubled implies that the increase in exports more than compensates for the increase registered in imports.

4.4.1.2 Effects on Household Income and Expenditure (BS)

The results shows that all but the poor households in both urban and rural Nigeria suffered a decline in income as a result of subsidy removal. Two factors may contribute to this. First, unlike the rural households who are engaged mainly in agricultural activities and earn income from these activities/sectors, urban households earn labour and capital income more from non-agricultural sectors than agricultural sectors. From the simulation results, all these sectors recorded noticeable decline in labour and capital income and also experienced decline in output. Second, the non-poor households essentially consume more gasoline compared to their poor counterparts in both urban and rural areas which may either be due to more cars in their possession or the need to power their gasoline-fuelled electricity generators. This result compares remarkably with (Nganou, 2009) but contrast sharply with Fetini and Bacon (2000) and Nwanfor et al (2006). The result as also shows that both the urban and rural non-poor households suffer dissaving as a result of the subsidy reduction. This is essentially because this group uses more gasoline compare to the poor counterpart in both urban and rural areas due to possession of more cars. On the whole, the January 2012 reduction in gasoline subsidy in Nigeria increased average households' expenditure by 0.33 but reduces income by -0.32. This translates to an aggregate dissaving of about 0.97 for an average representative household[90]

Table 4.5: Effects on subsidy reduction on H/hold Income and Expenditure (BS)

NBS CLASSIFICATION OF HOUSEHOLD	Income	Expenditure	(Dis)saving
Urban Non Poor	-2.05	15.81	-0.13
Urban Moderately Poor	-0.62	-5.09	0.12
Urban Poor	2.27	4.98	0.46
Rural Non Poor	-0.32	2.58	-0.12
Rural Moderately Poor	-2.00	-15.81	0.13
Rural Poor	1.17	5.29	0.22
Total	-0.32	0.33	-0.97

Source: Author's computations

4.4.2 Effects of reinjecting the Subsidy saving-Alternative Scenario (AS)

The planned reinvestment and empowerment programme of subsidy saving in key sectors of the economy by the Nigerian government kicked-off with the subsidy reduction exercise in 2012[91]. A sum of ₦180 billion were appropriated as subsidy saving in the 2012 budget and injected into five main sectors namely Road transport, Health, Education, Public Admin, and Other Services in the ratios 83%, 8.9%, 4.8%, 2.8%, and 0.6% respectively. The results of the simulation show that the saving reinjection impact on most sectors and households.

[90] The sectoral analysis of the impacts on households' income of increasing gasoline prices can be accurately evaluated if the income accruing to individual household can be trace to the particular sectors where they are employed. In the absence of such data as the case with Nigeria, it is only logical to report the impact on the aggregate household on the assumption of *representative household*

[91] The reinvestment and empowerment programme of subsidy saving is tagged ***SURE-P.***

4.4.2.1 Sectoral effects (AS)

Gross output has improved positively in all sectors with the aggregate GDP increasing by about 1% as a results of reinjecting the subsidy savings. This is a significant improvement given that the gross output is valued in constant prices and the I–O model is a fixed price model. The level of investments has also increased substantially in all sectors including the livestock, solid minerals water transport sectors which suffered the most decline as a results of the subsidy reduction. This appear remarkable as only 4 sectors initially experienced positive investment when the gasoline subsidy was removed. On the whole, the reinjection of subsidy saving raised aggregate investment by 12.35% after the reinjection of the subsidy saving.

The factor incomes which fall in most sectors as a result of the subsidy reduction witnessed significant increase due to the reinjection of subsidy saving. The reinjection of the entire subsidy saving constitutes a large increase in government expenditure which stimulates the economy thus increasing both the effective demand and output in most sectors. Though, the rise in government expenditure creates demand and also leads to inflation which increases the cost of inputs but since the greater population engaged in primary sectors e.g. agriculture which are less capital-intensive, labour factor incomes tend to rise faster than capital income. In addition, the share of income received by labour now appears greater compared to payments to capital. This points to the fact that the target sectors of subsidy reinvestment and empowerment program (SURE-P) have high employment potential and create jobs and income to a large number of households. At the macro level, government revenue (particularly from import duties, petroleum profit tax and VAT) has increased about three folds while foreign sales of crude oil also rose by about 37%. With the reinjection of the subsidy savings, household income increased by 0.2% which resulted in aggregate saving of about 0.59 for an average representative household compared to an earlier aggregate dissaving of about 0.97.

Table 4.6: Sectoral Effects of Reinjecting Petrol Subsidy Saving in Nigeria

Activity Sectors	Gross output	Producer prices	Invt.	Export	Import	Expenditure		Income	
						H/hold	Govt.	Labour	Capital
Crop Production	-0.17	43.14	0.50	-0.15	-0.70	-0.34	-1.75	0.00	-0.06
Livestock	-0.46	28.70	8.07	-2.06	-2.14	-0.57	-2.08	-0.89	-0.69
Forestry	-0.37	24.08	5.93	-0.43	-1.68	-1.39	-1.17	-0.38	-0.83
Fishing	-0.01	10.70	0.17	-1.78	-2.09	0.10	-0.08	0.18	0.10
Crude Petroleum	0.48	46.06	7.01	0.11	3.54	13.98	0.00	0.50	0.50
Natural Gas	0.05	46.22	6.90	-0.03	-0.52	-0.47	-0.98	0.14	0.08
Solid Minerals	-1.11	21.90	-1.15	-0.17	-2.85	-2.74	-2.88	-0.70	-0.49
Premium Motor Spirit	17.76	19.23	79.22	35.47	47.72	21.05	- 31.90	41.58	42.26
Dual Purpose Kerosene	0.70	14.22	24.82	-0.72	-1.01	-0.82	-0.29	-1.52	-1.70
Automotive Gas Oil	0.51	24.39	24.82	-0.78	-1.01	-0.42	-0.29	-1.58	-1.76
Cement	0.14	-5.70	1.25	-0.37	-0.68	-0.20	-0.15	-0.31	-0.32
Other manufacturing	0.06	12.55	12.10	-11.33	-0.99	-1.10	-1.25	-1.11	-1.15
Electricity	0.24	29.76	1.41	0.07	0.07	0.55	0.41	0.32	0.37
Water	0.01	22.57	0.42	-0.78	-0.78	0.03	-0.12	0.10	-0.02
Building & Construction	0.44	24.97	8.26	0.00	-0.13	-0.52	-0.09	-0.11	-0.20
Road Transport	9.27	16.46	61.98	2.99	3.06	1.55	0.74	1.40	1.24
Rail Transpt & Pipelines	0.01	18.16	6.44	0.00	-0.18	-0.16	0.00	0.07	0.00
Water Transport	0.09	43.69	17.35	-0.47	-1.65	-0.83	-1.55	-1.08	-0.42
Air Transport	0.21	24.48	2.38	-0.03	-0.34	-0.04	-0.26	-0.35	-0.31
Transport Services	0.20	28.37	1.85	-0.15	-0.15	0.01	-0.08	-0.13	-0.01
Telecommunications	0.09	21.76	3.88	-0.67	-0.78	-0.12	-0.28	-0.53	-0.65
Post	0.02	25.05	0.49	-0.65	-0.65	0.05	-0.09	0.10	-0.15
Distributive Trade (Wholesale & Retail)	0.72	32.48	24.88	-31.62	-1.22	-0.41	-1.53	-0.59	-0.41
Hotels & Restaurants	0.00	37.37	0.51	0.00	-0.18	0.10	0.00	0.20	0.14
Financial Institutions	-0.10	39.48	1.21	-0.91	-1.01	-0.41	-0.56	0.00	-0.18
Insurance	0.00	-20.33	0.49	0.00	-0.95	-0.16	0.01	-0.02	0.00
Real Estates	0.44	45.20	12.60	0.00	-0.37	-0.17	-0.09	0.04	-0.12
Business Services (Excl. Health & Education)	-0.32	18.54	0.02	0.00	-1.68	-0.56	-0.09	-0.40	-0.59
Public Administration	1.43	37.67	0.00	0.00	0.00	0.11	3.82	0.21	0.16
Education	1.70	35.34	12.11	0.00	-2.14	-0.71	-0.37	-0.07	-0.99
Health	8.04	5.11	0.08	0.00	-2.28	0.07	40.08	0.14	0.04
Private Non Profit Org.	-0.03	-26.85	3.41	0.00	-2.15	0.05	0.00	0.14	-1.77
Other Services	0.49	25.31	1.63	0.00	-1.11	-0.39	0.82	0.04	-0.22
Broadcasting	0.05	33.31	0.44	0.00	-1.07	-0.03	0.00	0.15	-0.52
Total	**1.00**	**23.63**	**12.35**	**0.08**	**0.95**	**0.33**	**0.12**	**0.24**	**0.17**

Source: Author's simulation results

4.4.2.2 Effects on Household Income and Expenditure (AS)

With the reinjection of the subsidy saving, income increased for all except for the urban and rural poor households. This may be due to several reasons. One is that the four main agricultural sectors experienced decline in output going by the reinjection scenario analysis (see table 6 above) and as noted earlier, these rural households are engaged predominantly in agricultural activities. Another important reason is that typical Urban impacted policy like gasoline subsidy may not affect the poor who mostly dwells in the rural area as much given that cooking and heating in rural Nigeria are done mostly with firewood while kerosene (via kerosene lantern) is relied on for lighting. The design of the SURE-P is an additional factor. About 97% of the fund was channelled to road construction, health and tertiary education which are often accessed mostly by the non-poor and urban dwellers. With the reinjection of the subsidy saving, there is a decline in the expenditures of the poor and the non-poor in both the rural and urban Nigeria. Usually, the change in household expenditure depends on the large extent to which the households spend on the sectors that are affected greatly by the policy. The general increase in prices occasioned by the subsidy removal implies that expenditure should fall. Interestingly, only the non-poor household now suffer dissaving after the reinjection. The increase in the aggregate household income from -0.32% to 0.2% combined with expenditure changes to transform the 0.97% aggregate dissaving to 0.59% saving for the average representative household.

Table 4.7: Effects of Reinjecting Subsidy saving on H/hold Income and Expenditure (AS)

NBS CLASSIFICATION OF HOUSEHOLD	Income	Expenditure	(Dis)saving
Urban Non Poor	2.29	-13.37	-0.17
Urban Moderately Poor	0.82	5.71	0.14
Urban Poor	-2.03	-4.43	0.46
Rural Non Poor	0.52	-2.19	-0.24
Rural Moderately Poor	2.25	9.18	0.24
Rural Poor	-0.96	-4.71	0.20
Total	0.20	0.33	0.59

Source: Author’s computations

4.5 Conclusions

From the findings in this study, it is obvious that an important step in implementing a fuel subsidy removal is to know how the removal of such sub-optimal fuel subsidy will impact on economic sectors and agents as well as the macro economy at large. Motivated by the various stakeholders concern about the recent 49.23% increase in gasoline price in Nigeria, the study explores the economic effects of the subsidy reduction and the reinjection of the subsidy saving with the I–O model and the SAM multiplier method. The simulation results clearly indicate that not only does fuel subsidy removal affects all economic sectors but quite enormously and disproportionately across sectors consistent with the extent of each sector's dependence on the gasoline sector too. Aside the directly affected gasoline sectors, particular effects were observed in the crude petroleum, road transport and the electricity sectors. The refined petroleum products sectors experience increase in nominal output but these sectors have low employment potentials and provide income for a very small number of households. The rise in foreign savings despite the country's heavy reliance on imported refined petroleum to meet domestic gasoline consumptions shows that raising gasoline price can make more crude petroleum available for exports which ultimately increases foreign earnings and revenue.

The simulation results from the reinjection of the saving generally affirm that reforming fuel subsidies can be a win-win approach for all the economic sectors and agents in a country. Removing fuel subsidy and reinvesting the saving in key sectors as conceived in the Nigerian Subsidy Reinvestment and Empowerment Programme led to significant increase in GDP and investment in all sectors; increases government revenue and foreign saving; raised factor incomes; and led to higher aggregate household saving. These inferences highlight that the success of reforming fuel subsidies depends largely on what governments does with the subsidy saving. Hence, reform programme can be more beneficial when accompanied with a well-structured and targeted reinvestment plan.

However, the Nigerian subsidy reinvestment programme appear hastily designed as a quick response to the nation-wide strike action and mass protest against the subsidy removal. The fact that most of the road and rail projects predates the reinvestment and empowerment programs affirm the likelihood that they are, a mere scaling up the existing budgetary capital expenditure projects. Therefore, the programme needed to be reworked with better specifics and clear targets. The implementation should be timed and adequately monitored.

In conclusion, there is need for governments planning reforms to addresses as pre-subsidy reform programmes critical areas like transportation, power and food which were directly impacted by the removal. It may also be necessary to develop an efficient social protection policy measures with better targeting to ensure social safety nets for the poor who are seriously hurt by fuel price increase as the results indicated.

5 CHAPTER FIVE: ESTIMATING THE EFFECT OF SUBSIDIES ON FUEL CONSUMPTION, CO_2 EMISSION AND SOCIAL WELFARE IN OPEC

5.1 Introduction

In the previous two chapters, we have provided empirical evidence on the poor targeting of fuel subsidies and estimated the economic impact of removing subsidies using input-output table from Nigeria. In this chapter we will investigate the effect of subsidies on fuel consumption, CO_2 emissions and welfare in OPEC countries. The predominance of fuel subsidies in OPEC cannot be overemphasised. From the IEA's World Energy Outlook 2014 estimates of global fossil fuel subsidies, all the twelve OPEC member countries are among the top 25, five of which are among the top 10. OPEC member countries account for about 51% of the estimated US$295 billion global petroleum product subsidies in 2013.[92]

As shown in Chapter 4, the effects of fossil fuel have been extensively studied in the literature. However, certain gap still exists which provides motivation for this effort. First, while there has been considerable efforts to evaluate the magnitude of fuel subsidies, the effects of subsidies on consumption, carbon emission and social welfare have attracted less attention at global and regional level. Since the pioneering work of Larsen and Shah (1992) on the global estimates of fossil fuel subsidies, the associated CO_2 emission and social welfare impact, only a handful of studies have conducted similar investigation with recent data[93]. Without current estimates, reform policies may be impaired.[94] Second is the dearth of effort on OPEC[95]. With

[92] The estimate of global fossil fuel subsidies in 2013 is US$548 in line with (WEO, 2014). Out of this total, 54% (US$295) are on petroleum products

[93] As at 2010, only five of these studies are available on records and they include, Burniaux et al., 1992; IEA, 1999; Saunders and Schneider, 2000; OECD, 2000; and Burniaux et al., 2009. For additional details on the outcome of these studies, see Ellis, (2010)

[94] For instance, Larsen and Shah (1992) estimated that phasing out petroleum product subsidies can reduce global CO_2 emissions by up to 7.1% and attributes the bulk of the savings to the former USSR. These estimates are less relevant given the recent rate and direction of changes in the structure of fuel consumption globally

[95] Organisation of Petroleum Exporting Countries founded in September 1960 presently with twelve members. These are Algeria Angola Libya Nigeria from Africa; Iran, Iraq, Kuwait, Qatar Saudi Arabia, United Arab Emirates from the Middle East; and Ecuador and Venezuela from South America

the exception of Gürer and Ban (2000), no other study has been documented on the analysis of fuel subsidies in OPEC as a group[96], even as member countries are known to subsidise petroleum products' prices for political, social and economic reasons[97]. Though the role of OPEC in the global oil market dynamics has been well researched, little effort has been given to the analysis of petroleum products pricing within the members' domestic markets. Third is on the measurement of subsidy and certain implicit approximations in virtually all regional and global fuel subsidy studies. A typical example is the use of one end-user prices (typically in the U.S.) of petroleum products as proxies for opportunity cost at end-user level whereas the prices paid by countries depend on the differences in purchasing arrangement, and the considerable variations in the handling and local transportation costs across countries[98]. Adopting a single end-user level price across countries can ignore countries' differences, grossly affects the results, and render the inferences based on such outcomes inaccurate

Member countries of OPEC are major oil exporters accounting for an average of 43.4% world crude oil production in 2013[99]. Yet, very few econometric studies have examined domestic petroleum product demand for this group of countries. International Energy Agency (2005) and Bhattacharyya and Blake (2009) focussed on MENA countries while Chakravorty et al. (2000) examined some OPEC countries[100]. Dahl (2012) provided a comprehensive review of studies on demand elasticities of petroleum products for 124 countries from 240 gasoline studies and 60 diesel studies to establish the pattern of price and income elasticities for countries in different income bands and fuel prices. She concludes that while low income

[96] There are several studies on some of the member countries or and one particular product.
[97] The work by Gürer, Nadir and Jan Ban published in OPEC Review 2000 focussed on the economic cost of low domestic product prices in member states using 1990 to 2000 data. No effort was made to quantify either the environmental or the welfare effects of these subsidies
[98] The much-cited paper by Larsen and Shah (1992) uses United States pre-tax end-user prices of petroleum products as proxies for opportunity cost at end-user level for all sampled countries.
[99] OPEC Statistical Bulletin 2014
[100] While the IEA study is basically from perception of countries' export potential, the Bhattacharyya and Blake study employed a single equation dynamic model with lagged endogenous variable. Above all, data employed by the most recent of these studies dated 2005.

countries have lower price elasticities but higher income elasticities for gasoline, price elasticities of gasoline and diesel are generally lower in countries with low price regimes.

The present analysis differs from the existing literature in two ways. First, while many studies have modelled OPEC behaviour as net oil exporting countries by analysing oil production and pricing policy of OPEC as a cartel, very few studies have investigated the demand for oil products within member countries. Studies that have modelled petroleum product demand for OPEC have either concentrated on aggregate products (e.g. Al-Janabi, 1979) or considered a subset of OPEC members alongside other sub groups like Middle East and MENA (e.g. Bhattacharyya and Blake, 2009; Narayan and Smyth, 2007; Al Yousef, 2013). Several other studies have focused on individual OPEC countries (e.g. Al-Sahlawi, 2003; Al-Mutairi and Eltony, 1995; Iwayemi et al, 2010). No previous studies have examined OPEC **fuel demand** as a group. Second and more importantly we adopt a new econometric method in estimating the fuel demand elasticities. To our knowledge, no previous studies have analysed the fuel demand with panel data using the common correlated effects mean group (CCEMG) estimator developed by Pesaran (2006). Unlike the fixed and random effect and other generalised least square models which typically assume independence in the error terms and homogenous slopes across sections but only allows heterogeneity in intercepts, the CCEMG estimator models cross-sectional correlation of errors in panel data while allowing country-specific slopes, and can yield consistent estimates when there exists cross-sectional dependence (see Pesaran, 2006). In analysing cross-country panels for typical heterogeneous group like OPEC, it is important to control for the differential effects of unobserved common factors by using the aggregates of the cross sections to filter the individual specific regressors. In addition, we also employ the cross-sectionally augmented Im, Pesaran, and Shin test and a new error correction-based panel cointegration test developed by Westerlund (2007) to respectively test for panel unit roots and cointegration in the data. Unlike the commonly used cointegration tests such as the Engle-Granger tests or Johnansen procedure, the Westerlund test is centred on structural instead of residual dynamics and does not impose common-factor restriction between the long-run parameter in levels and short-run parameter in differences[101]. Consequently the Westerlund tests has more power to reject the null hypothesis of in-cointegration.

Therefore, the objective of this chapter is twofold. One is to analyse the fuel consumption pattern of OPEC member countries and also determine the magnitude of the fuel subsidies. The other is to estimate the effects on fuel consumption, carbon emission and social welfare.

The rest of the paper is organised as follows. Section 2 provides a general background about fuel pricing and subsidies in OPEC member states. The estimation methods and data are described in section 3 while the results are presented and discussed in section 4. Section 5 will contain some concluding remarks.

5.2 Background: Subsidies in OPEC

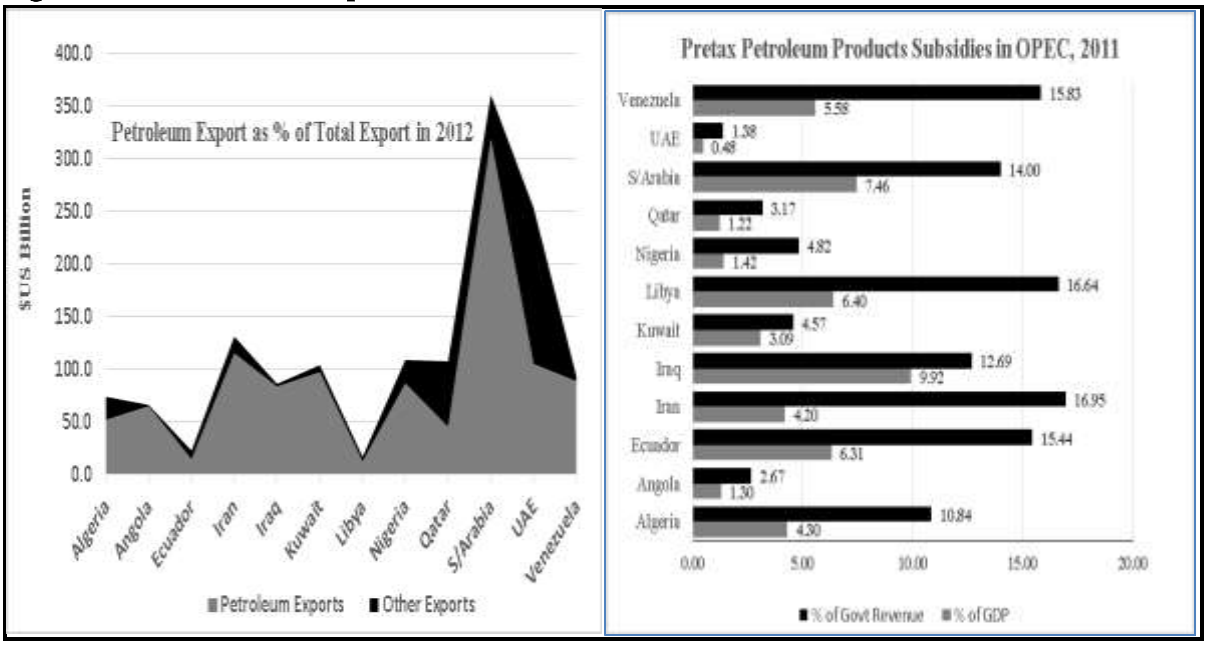
The general drive for fuel subsidies in subsidising countries according to Adenikinju (2012) and IEA (1998) is to guarantee social stability, augment the economic development of certain sectors or areas, protect employment and respond to equity worries. However, while subsidies are allegedly aimed at protecting consumers, the least benefits are enjoyed by low-income household groups. In fact, the much acclaimed logic behind the fuel subsidisation policy as a pro-poor measure has received little or no support in most documented empirical investigations (see Baig, et al, 2007; IMF, 2013; Soile and Mu, 2015 among others).

In OPEC member countries, subsidies are often designed to alleviate energy poverty by enabling access to reasonably priced energy products. Hence, petroleum products' subsidies and their reform process should be cautiously examined within each country's economic, social

[101] A common-factor restriction in a residual based co-integration tests requires the long-run parameters of variables at levels to equal the short-run parameters of the variables in differences (Banerjee, et al, 1998). Persyn and Westerlund (2008) contend that such failure can cause a significant loss of power in a typical residual-based cointegration tests.

and political context, particularly in line with their goals relating to economic growth, poverty reduction, and pollution control. It follows therefore that national environments should form an important components of analysing fuel subsidies in these countries.

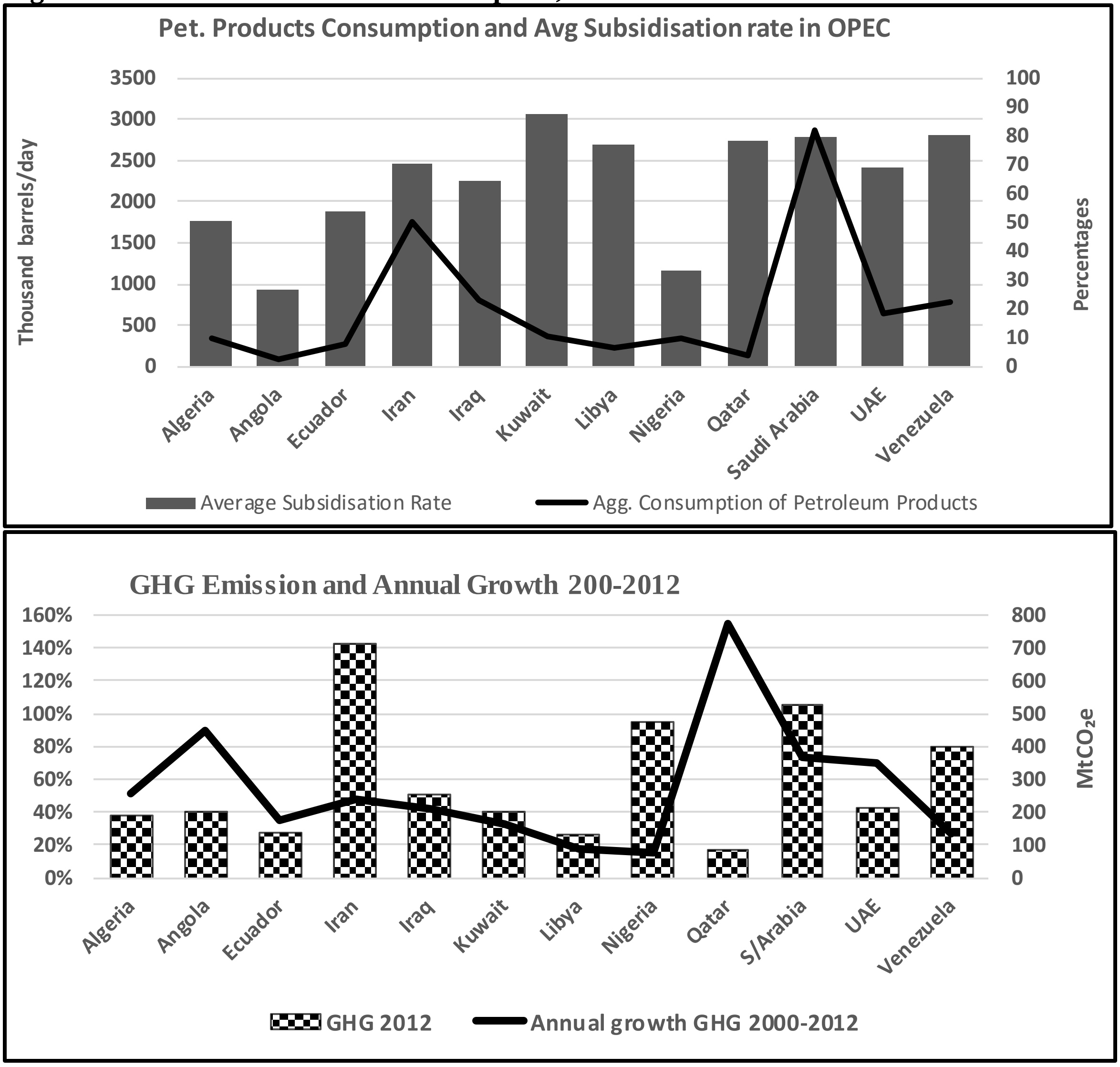
Figure 5.1: Petroleum Exports and Pre-tax Petroleum Products Subsidies in OPEC



Sources: Data are sourced from OPEC statistical bulletin. Pre-tax petroleum products subsidies are compiled from IMF (2013).

The prevalence of petroleum products subsidies in most oil producing non-OECD countries, particularly among OPEC members calls for concern for a number of reasons. First, petroleum is the major export commodity of OPEC and thus constitute a significant proportion of the revenue available for the governments of these countries. Second, for historical reasons, traditionally domestically-sold crude and refined petroleum products are heavily subsidized in OPEC countries thereby increasing domestic demand for these products as well as the associated greenhouse gas emission. For instance, available evidence (presented in figure 5.1 above) shows that petroleum subsidies account for over 10% of government revenue in seven of the current twelve OPEC member countries by 2011 estimate. Similarly, petroleum accounts for over 70% in total exports revenue in nine of the twelve countries

Figure 5.2: Petroleum Products Consumption, Subsidisation Rate and GHG Emission in OPEC



Source: Consumption data from OPEC Statistical Bulletin, 2013; Average Subsidisation rates from IEA 2012 and GHG Emission from World Resources Institute, 2015.

Figure 5.2 above shows on the upper panel the average subsidisation rate as a proportion of supply costs and aggregate domestic consumption of petroleum products in 2012 and on the lower, the GHG emission in 2012 and the average annual growth in total greenhouse emission from 2000 to 2012 among OPEC members. The average subsidisation rate is highest in Kuwait and lowest in Angola while Saudi Arabia has the highest consumption of petroleum products. Not only is this subsidisation trend financially worrisome, the associated welfare and environmental implications are grave. For instance, GHG emission grew at an average of about 80% in Angola, Saudi Arabia and UAE and about 150% in Qatar between 2000 and 2012.

5.3 Methods and Data

5.3.1 Fuel Consumption Model

Except for inferior goods, standard (micro) economic theory relates demands for a particular product as a function of price, income, and other determinants. Following this underlying framework, energy demand literature regards consumption of petroleum products as a positive function of real income and negative function of own price (Al Yousef 2013, Narayan and Smith 2007, Dahl 1994). In line with this convention, we specify petroleum products consumption for OPEC countries as follows:

$$Q_{it} = f(y_{it}, \mathrm{x}_{it}) \qquad i, \dots, N; t, \dots, T \qquad 3.1$$

Where Q_{it} is per-capita fuel consumption, y_{it} is real gross domestic product per-capita, x_{it} is real fuel price for country (i) at time (t).

5.3.1.1 The CCEMG Model

Econometric specification of the above functional equation is written below:

$$q_{it} = \Phi_i + \beta_i{}' x_{it} + \varepsilon_{it}\ , \ t = 1, \dots, T \quad i = 1, \dots, N \qquad 3.2$$

Where q_{it} the logarithm of vector of dependent variables in equation 3.1; x_{it} is the logarithm of kx1 set of regressors as set out in equation 3.1; Φ_i is a country-specific intercept, and ε_{it} is the error term. Allowing cross section dependence in the model, this study assumes that errors in equation 3.2 have the following multifactor structure:

$$\varepsilon_{it} = \lambda' f_t + e_{it}\ , \qquad 3.3$$

in which f_t is the (mx1) vector of unobserved common effects and e_{it} is a country-specific error assumed to be independently distributed. From (3.2), correlation arises because the response to common external forces or perturbations is similar, though not identical, across countries. It should be noted that common factors induce a correlation between pairs of statistical units that do not depend on how close they are in the geographical space. In model (3.2), we allow x_{it} to be correlated with the unobserved effects f_t as suggested by Pesaran

(2006). Therefore, common factors can impact consumption of petroleum products not only directly via the factor structure (3.3), but also indirectly by affecting the regressors.

In line with Pesaran (2006), the estimation and testing procedure to equation (3.2) with multifactor errors (3.3) is based on the Common Correlated Effects (CCE) method where unobserved effects f_t can be well approximated by the cross section averages of the dependent and explanatory variables. Technically, this can be specified as:

$$q_{it} = \beta'_i x_{it} + \Phi_i + g'_i \bar{z}_t + \varepsilon_{it} , \quad 3.4$$

where $\bar{z}_t = (\bar{q}_t, \bar{x}'_t)$ with $\bar{q}_t$ and $\bar{x}_t$ being the cross section averages of the dependent variable and regressors respectively. Computation of CCE Mean Group (CCEMG) estimator for the mean of the slope coefficients (Pesaran, 2006) will be presented. Heterogeneity is captured by the individual specific fixed effects Φ_i, and the loadings g_i. The fixed effects (FE) regression method will also be computed for comparison purpose. It can be observed that the CCEMG and the FE frameworks differ in that the latter assumes that g_i is zero, and the β'_is are the same.

5.3.1.2 Fixed Effects and Random Effects Models

Fixed effects specification for our model is relayed in equation (3.8) below:

$$q_{it} = \beta' x_{it} + \Phi_i + \varepsilon_{it} , \quad t = 1, \dots , T \quad i = 1, \dots , N \quad 3.5$$

where the variables are as defined before except that β is a vector of coefficients for the vector of variables x_{it} that is invariant by country. Also, Φ_i is assumed to be fixed parameters to be estimated while the remainder disturbance ε_{it} is assumed to be stochastic with $\varepsilon_{it} \sim IID(0, \sigma_\varepsilon^2)$. Equation (3.5) represents a one-way fixed effects error component model. Another way of presenting model (3.5) above is through Least Square Dummy Variable Regression Model (LSDV). In the LSDV model country-specific effects is represented through the differential intercept dummies. More appropriately, LSDV is specified below:

$$q_{it} = \phi + \beta' x_{it} + Z_a a + \varepsilon_{it} , \quad 3.6$$

where Z_a is a matrix of intercept dummies. The model assumes identifying restrictions $\sum_i^N a_i = 0$. This may be achieved by using $N-1$ individual dummies and an "inhomogeneous" intercept. In order to ascertain whether country-specific intercept a_i can be allowed to be correlated with remainder disturbance ε_{it}, random effects model of the equation (3.7) type will also be estimated and Hausman test performed.

Unlike fixed effects (FE) model where unobserved effects as represented by country-specific effects are assumed to be fixed and might be correlated with the regressors, Random Effects (RE) model however, treats unobserved effects as a random error component that is assumed to be independent of regressors. Specification of the one-way random effects model is related as:

$$q_{it} = \beta' x_{it} + a + z_t\ , \quad t = 1, \dots, T \quad i = 1, \dots, N \qquad 3.7$$

where $z_t = (v_i + \varepsilon_{it})$; $a_i = a + v_i$; v_i and ε_{it} are independent and identically distributed random component with mean zero and variance σ_v^2 and σ_ε^2 respectively. In addition, vector of regressors x_{it} are independent of v_i, and ε_{it} in the model.

We employ the Hausman test to determine whether a fixed effects or random effects model is more appropriate for our data. The null hypothesis underlying the Hausman test is that the FE and RE estimators do not differ substantially. The test statistic developed by Hausman has an asymptotic $\chi 2$ distribution. If the null hypothesis is rejected, the conclusion is that RE estimator is not appropriate and that we should use the FE estimator.

5.3.2 Unit Root and Cointegration Tests

5.3.2.1 *Panel Unit Root Tests*

The study applies the most recent cross-sectionally augmented Im, Pesaran, and Shin Panel unit root testing (see, Pesaran, 2007; Banerjee and Carrion-i-Silvestre, 2011). We begin with the idea of Common Correlated Effects in testing for panel unit-root with cross-section dependence in the panel series. The idea is to augment variable to be tested with its cross-section averages as proxies for the unobserved common factors, in the context of a Dickey-Fuller regression. Consider the p^{th} order Augmented Dickey-Fuller regression below:

$$\Delta q_{it} = \alpha_i + b_i q_{i,t-1} + \sum_{j=1}^{p} d_{ij}\, \Delta q_{i,t-j} + \mu_{it} \qquad 3.8$$

where q_{it} is either the logarithm of demand for petroleum products, the logarithm of the j^{th} regressor $x_{j,it}$, or regression residuals from equation (3.2). μ_{it} are errors that we assume to have a single factor structure. The null hypothesis of unit root in equation (3.8) is:

$$H_0\!: b_i = 0;\;\; i = 1, \dots, N; \qquad 3.9$$

With the alternative hypothesis that

$$H_1\!: b_i < 0;\;\; i = 1, \dots, N_1;\;\; b_i = 0;\;\; i = N_1 + 1, \dots, N; \qquad 3.10$$

Where N_1 is such that N_1/N is nonzero and tends to a fixed constant as N goes to infinity. Pesaran (2007) proposes to test (3.9) against (3.10) by computing the simple average of the t-ratios of the ordinary least squares estimates of b_i in equation (3.14), as follows

$$CIPS = N^{-1} \sum_{i=1}^{n} \tilde{t} \qquad 3.11$$

Where $CIPS$ is cross-sectionally augmented Im, Pesaran, and Shin, and $\tilde{t}_i$ is the ordinary least squares t-ratio of b_i in the following Dickey Fuller regression augmented with the cross section averages $\bar{q}_{t-1}$ and $\Delta\bar{q}_{t-j}$, for j = 0, …, p

$$\Delta q_{it} = \alpha_i + b_i q_{i,t-1} + \sum_{j=1}^{p} d_{ij}\, \Delta q_{i,t-j} + g'_i \bar{z}_t + e_{it}\ , \qquad 3.12$$

where $\bar{z}_t = (\bar{q}_{t-1}, \Delta\bar{q}_t, \Delta\bar{q}_{t-1}, \dots, \Delta\bar{q}_{t-j})'$.

The CIPS test has been designed for testing the unit root hypothesis with various sources of cross sectional dependence and it is widely accepted as the most recent Panel unit root testing. (Pesaran, 2007; Banerjee and Carrion-i-Silvestre, 2011).

5.3.2.2 Pre and Post Cross section Dependence Tests

As a pre-estimation test, we will utilize Pesaran (2004) cross-section dependence (CD) test to determine the direction, magnitude and significance of correlation among cross-sectional unit of our panel series. It is a statistic that captures the overall amount of cross section dependence in the data. Below specifies average pairwise correlation coefficient $\bar{\rho}$.

$$\bar{\rho} = \frac{2}{N\,(N-1)} \sum_{i=1}^{N-1} \sum_{j=i+1}^{N} \rho_{ij} \,, \qquad 3.13$$

Where ρ_{ij} is given by

$$\rho_{ij} = \frac{\sum_{t=1}^{T} e_{it}\, e_{jt}}{\sqrt{(\sum_{t=1}^{T} e_{it}^2)}\ \sqrt{(\sum_{t=1}^{T} e_{jt}^2)}} \qquad 3.14$$

where e_{it} are regression residuals from equations (3.2) or (3.11).

Post-estimation cross section dependence test based on the pairwise correlation coefficients above will also be determined. Specifically, we consider CD_{LM} test based on Lagrange Multiplier statistic

$$CD_{LM} = \sqrt{\frac{1}{N\,(N-1)}} \sum_{i=1}^{N-1} \sum_{j=i+1}^{N} (\,T\rho_{ij}^2 - 1) \qquad 3.15$$

Under the null hypothesis of cross section dependence, the CD_{LM} tends to a N(0, 1) with $T \to \infty$ and then $N \to \infty$.

5.3.2.3 Cointegration Test

In order to determine whether long-run relationship exists between demand for petroleum products and the considered determinants, we employ the four panel cointegration tests developed by Westerlund, 2007; Persyn and Westerlund, 2008)[102]. This structure-based cointegration tests have good small-sample properties and high power relative to popular residual-based panel cointegration tests (e.g. Pedroni, 2004). Furthermore, asymptotic and bootstrap p-values are computed, the latter making inference possible under very general forms of cross-sectional dependence. The tests are designed to test the null hypothesis of no cointegration by testing whether the error correction term in a conditional error correction

[102] See Westerlund (2007) for further details about the tests' equations and statistics as well as the new Stata command description by Persyn and Westerlund (2008)

model is equal to zero. If the null hypothesis of no error correction is rejected, then the null hypothesis of no cointegration is also rejected.

5.3.3 Estimating Fuel Subsidies

Three main methodologies for estimating fuel subsidies have been identified in the literature. These are the effective rate of assistance (ERA), the producer subsidy equivalent (PSE), and the price gap (PG) methods. By design, the ERA is generally broad in scope which perhaps, is the bane of its practical relevance[103]. The PG contrast sharply with the OECD developed PSE in two unique ways. First, while the PSE provides the means to assess the extent of subsidy impacts on recipients over time, the price gap estimates on subsidy impact are static based on the assumption of 'all else held constant'. Second, the PG method considers consumption subsidies with a specific focus on end users whereas the PSE on its part, measure subsidies' impacts as the value to the recipients.

Given that subsidies on petroleum products in OPEC member countries are on fuel consumptions and directed to end users, the study adopts the price gap method. The price gap method originally advanced by Corden (1957) defines price gap as the difference between the reference and the end user retail price of a product. Ever since, the technique has been embraced more than any other in estimating consumption subsidies (see McCrone, 1962; IEA, 2008; Liu and Li, 2011; Coady et al, 2010; and Lin and Jiang 2011 etc.). In particular, the method is conceptually and analytically simple to apply.

In order to obtain our estimate of subsidies (S_{ij}) - the product of price gap $(P_{gp_{ij}})$ and quantities of product consumed (C_{ij}), we first compute the price gap as reference price (P_{rf}) minus retail price (P_{rt})[104]. In arriving at the reference price for each fuel, the study adopts the

[103] As noted by Lin and Jiang (2011), the ERA is hard to employ in practice due to the challenges to acquire the necessary level of consistent data

[104] While the retail price is the prevailing subsidised consumer price of a fuel, the reference price relates to what a product will cost in a country without subsidy. It is defined as the border price (i.e. international spot price minus (plus) freight cost for net exporter (importer) plus the costs of domestic transport and distribution and value added tax where applicable.

spot prices of petroleum products (gasoline, diesel and fuel oil) in the three major markets-US Gulf, Rotterdam and Singapore and spot freight rates to major export destinations. Both the spot price and the freight cost are adjusted for each country's petroleum product exports trade pattern (i.e. each country's petroleum product exports by destination). Price of kerosene is taken as the average of the three major fuels. These data are for 2013 and sourced from the OPEC Annual Statistical Bulletin, 2014. The price gap are expressed in the equations below.

$$S_{ij} = C_{ij} * P_{gp_{ij}} \quad 3.16$$

$$P_{gp} = P_{rf} - P_{rt} \quad 3.17$$

$$P_{rf} = P_{bdr} + Z_c + VAT \quad 3.18$$

Where:

(i) denotes relevant product while (j) is the particular OPEC country

VAT = value added tax

Z_c = the applicable costs of domestic transport and distribution

P_{bdr} = the border price

5.3.4 Subsidy Impact on fuel consumption and CO_2 emissions

In assessing how subsidy impacted on fuel consumption, the study applied the method explained in IEA (1999). We follow Liu and Li (2011) and Lin and Jiang (2011) by specifying an inverse demand function with constant elasticity (CEI)[105]. Using q, P and ϵ as demand, price and long run price elasticity respectively, the CEI demand function for fuel (i) is expressed as follows:

$$q_i = P_i^{\epsilon} \quad 3.19$$

In log linear form, equation 4 becomes

$$lnq_i = \epsilon \, lnP_i \quad 3.20$$

[105] The preference for this type of function is anchored on the fact that the elasticity of demand remains invariable within a range of likely values. More so, it is compatible with limited data

The price change (δP_i) due to price gap removal can be expressed as

$$\delta P_i = lnP_1 - lnP_0 \qquad 3.21$$

From equation 5 and 6, we can infer that:

$$lnq_i = \epsilon * (lnP_1 - lnP_0) + lnq_0 \qquad 3.22$$

The impact on consumption is the resultant change in demand (δq_i) which can be expressed as follows:

$$\delta q_i = q_0 - q_i \qquad 3.23$$

Given the carbon emission factor (CEF)[106] of fuel i, the environmental impacts of subsidy on CO_2 emission is estimated as:

$$\delta CO_2 = \delta q_i * CEF_i \qquad 3.24$$

5.3.5 The welfare impact of fuel subsidy

The study estimates the welfare effects of subsidising petroleum products in OPEC and member countries by adapting the Larsen and Shah (1992) framework[107]. Welfare is defined as the addition of both consumer and producer surplus at the subsidised price of respective petroleum products. Taken $d \; and \; s$ as our inverse demand and supply functions and $Q^p \; and \; Q^c$ as domestic production and consumption respectively, welfare can be expresses as:

$$\delta W = WP_{rf} - WP_{rt} \qquad 3.25$$

$$\delta W = \left[-\int_{{Q^c}_{P_{rf}}}^{{Q^c}_{P_{rt}}} d\delta Q^c + P_{rf}\left({Q^c}_{P_{rt}} - {Q^c}_{P_{rf}}\right) - \int_{{Q^p}_{P_{rt}}}^{{Q^p}_{P_{rf}}} s\delta Q^p + P_{rf}\left({Q^p}_{P_{rf}} - {Q^p}_{P_{rt}}\right) \right] \qquad 3.26$$

Equation 11 can be expressed as the sum of the % change in consumption due to subsidy removal multiplied by total subsidies and the % change in production due to subsidy removal assuming a linear demand and supply functions, constant world price and that the removal of subsidy will prompt no supply response in subsidising countries.

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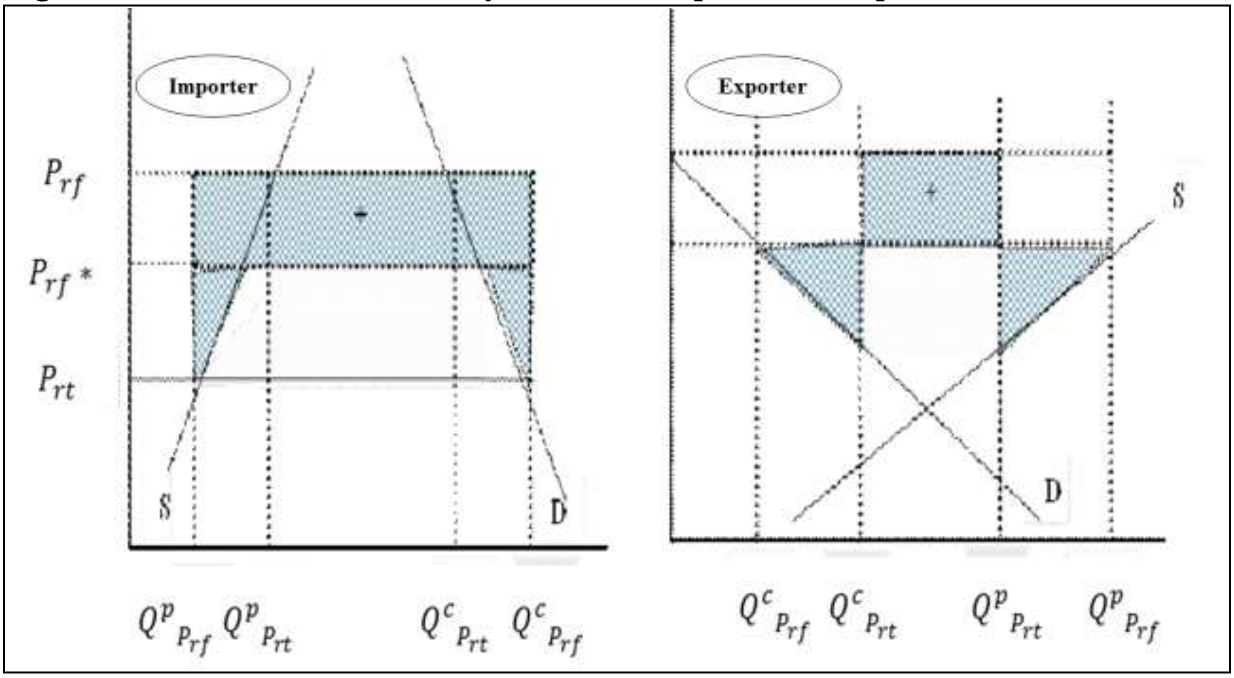
[106] http://www.eia.gov/oiaf/1605/coefficients.html

[107] The estimates provided in this study represent the net-welfare effects as most of the countries consumed more than their output of one fuel or the other and conversely.

$$\delta W = 0.5\left(Q^{c}{}_{P_{rt}} - Q^{c}{}_{P_{rf}}\right)(P_{gp}) + 0.5\left(Q^{p}{}_{P_{rf}} - Q^{p}{}_{P_{rt}}\right) \quad 3.27$$

The welfare impacts associated with subsidy removal for net exporting and importing counties is illustrated graphically in figure 2 below[108].

Figure 5.3: Welfare effect of subsidy removal – Importers & Exporters



Source: adapted from Larsen and Shah (1992).

5.3.6 Data

This study analysed demand for petroleum products in 9 of the 12 OPEC member countries[109]. The three countries excluded due to lack of reasonable data are Iraq which has been affected by war; Ecuador has been in and out of OPEC; while Angola is a new member of OPEC and was in civil war for a long time. In order to have a detailed analyses on the issue as well as to obtain robust empirically-validated estimates, we will adopt Panel Fixed Effects (FE) or Random Effects (RE) regression and the most recent Common Correlated Effects (CCE) Mean Group Estimators. The techniques coupled with other tests to be carried out will

[108] Positive (+) sign represents a welfare gain

[109] The OPEC countries considered include Algeria, Iran, Kuwait, Libya, Nigeria, Qatar, Saudi Arabia, United Arab Emirate (UAE) and Venezuela

be performed on STATA 13. The *a priori* expectation of the coefficients of the variables selected as determinants of demand for petroleum products are: INC (+), GP (-), DIP (-), KP (-), FOP (-). Descriptions of variables are presented in table 5.1.

The countries' time series data on fuel consumption, prices and income covering the period of 1980 to 2013 used for this study are sourced from OPEC Statistical Bulletin 2014 with the exception of CPI (2005=100) obtained from the Federal Reserve Bank data[110]. All consumption variables are calculated in litres per capita while income per capita and prices are in real 2005 $US. We expressed all variables in natural logarithm for easier measurement of direct elasticity of coefficient estimates. Table 5.1 below presents the definition as well as panel composition of variables for quick reference. The panel has ***N***=79 and ***T***=297

Table 5.1: Description of Variables

Variable	Description	N	T
GC	*Gasoline consumption*	*9*	*33*
GP	*Price of gasoline*	*9*	*33*
DIC	*Diesel consumption*	*9*	*33*
DIP	*Price of diesel*	*9*	*33*
KC	*Kerosene consumption*	*9*	*33*
KP	*Price of kerosene*	*9*	*33*
FOC	*Fuel oil consumption*	*8*	*33*
FOP	*Price of fuel oil*	*8*	*33*
INC	*Income per capita*	*9*	*33*

5.4 Results and Interpretation

5.4.1 Fuel Consumption Estimation Results

This section presents the estimation results of demand for petroleum products in OPEC countries. Specifically, the analysis is broadly divided into two parts, namely: descriptive and inferential analyses. The former mainly describe the variables of interest based on the minimum, maximum, the mean and the standard deviation. The inferential analysis comprises

[110] http://research.stlouisfed.org/fred2

correlation, cross section dependence test, cross-sectional augmented Im-Pesaran-Smith unit root test (CIPS), Westerlund cointegration test, fixed effect, and common correlated effect panel data estimates. Besides the aggregate estimates, the inferential analysis also focuses on the country-specific estimates.

5.4.1.1 Descriptive Analysis of the Variables

Table 5.2 shows the summary statistics of the log of all variables used in the analysis. The gasoline consumption (GC) has a mean of 1.49 litre per day with a standard deviation value of 0.97 litre while the price of gasoline (GP) has a mean of 11.42 and a standard deviation of 42.04. Also, the mean value of the diesel consumption (DIC) in OPEC countries is 1.68 litre with a standard variation of 1.31 litre while the mean price of diesel (DP) is 5.41 with a standard deviation of 19.24. In the case of kerosene, the mean value of consumption (KC) is 0.74 with a standard deviation of 1.24 litre while the price of kerosene in OPEC has a mean and standard deviation of 8.11 and 30.21 respectively. Similarly, the fuel oil consumption (FOC) has a mean value of 2.75 and a standard deviation of 3.76 litre while the mean of fuel oil price is 3.91 with a standard deviation of 13.98. The income variable measured by per capita income for OPEC countries ranges between US$494 to US$81,947 with a mean value of US$14,212.

Table 5.2: Descriptive Analysis of the Variables

Variable	Obs.	Mean	Std. Dev.	Min	Max
Gasoline consumption	306	1.494	0.971	0.090	3.690
Diesel consumption	306	1.675	1.310	0.030	5.670
Kerosene consumption	306	0.739	1.239	0.030	6.720
Fuel oil consumption	272	2.745	3.761	0.010	17.150
Price of gasoline	306	11.421	42.039	0.010	293.870
Price of diesel	306	5.407	19.243	0.008	118.460
Price of kerosene	306	8.112	30.210	0.008	198.610
Price of fuel oil	272	3.906	13.976	0.003	109.190
Income per capita	306	14212.080	16944.610	494.240	81947.240

Computed by the Author using STATA 13

5.4.1.2 Results of Correlation Analysis

Table 5.3 presents the correlation analysis for each model[111]. The model for gasoline shows that while gasoline consumption is negatively and significantly correlated with price, it is linearly positive and significantly related to per-capita income with correlation coefficient values of -0.02 and 0.862 respectively.. A cursory look at the relationship between the price of gasoline and per capita income shows that there exists a negative and significant relationship between the two variables. In the model for diesel, it was found that consumption is linearly negative and significantly correlated with the price of diesel, and positive and significantly correlated with per-capita income. The model also shows positive but insignificant association between the price of diesel and per-capita income.

Similarly, the kerosene model results show that consumption is negatively and significantly correlated with the price of gasoline and significantly positive with per capita income with correlation coefficient values of -0.162 and 0.664 respectively. However, there is a positive and significant association between the price of kerosene and per capita income with correlation coefficient value of 0.046. Finally, the model for fuel oil shows that fuel oil consumption is negative and significantly correlated with the price of fuel oil with correlation coefficient of 0.043 while there is a positive and significant association between the consumption of fuel oil and the per-capita income with correlation coefficient of 0.867. The empirical results also show positive and significant association between the price of fuel oil and per capita income with correlation coefficient of 0.046.

[111] Models for gasoline, diesel, kerosene, and fuel oil consumption

Table 5.3: Correlation Analysis of Petroleum Products Consumption in OPEC

	Gasoline Consumption	Gasoline Price	Per Capita Income
Gasoline Consumption	1		
Gasoline Price	-0.020**	1	
Per Capita Income	0.8625***	-0.102***	1
	Diesel Consumption	Diesel Price	Per Capita Income
Diesel Consumption	1		
Diesel Price	-0.177***	1	
Per Capita Income	0.823***	0.002	1
	Kerosene Consumption	Kerosene Price	Per Capita Income
Kerosene Consumption	1		
Kerosene Price	-0.162***	1	
Per Capita Income	0.664***	0.046	1
	Fuel Oil Consumption	Fuel Oil Price	Per Capita Income
Fuel Oil Consumption	1		
Fuel Oil Price	-0.043	1	
Per Capita Income	0.867***	0.046	1

Computed by the Author using STATA 13
Note: *, **, and ***, denote significance at 10%, 5%, and 1%

5.4.1.3 Results of the Cross-Section Dependence Tests

Following section (5.3.2), the result of cross-section dependence is presented in Table 5.4 below. From the table, it can be observed that both the consumption of kerosene (KC) and diesel (DIC) and their prices (DP) and (KP) do not reject the null hypothesis of cross-section independence at levels. The cross-section dependence statistic (CD_{LM}) for other level variables are all significant at 1%. The average pairwise correlation coefficient $\bar{p}$ ranges between 0.274 and 0.512 for level variables, and 0.089 and 0.220 for variables at first difference. At first difference, income per capita (INC) is the only variable that rejected the null of cross-sectional independence at conventional level of 5%. It is important to recall that cross-section dependence tests are performed on the error terms obtained from the regression of each variable on the intercept term.

Table 5.4: Pre Cross-section Dependence Test

Variable	$\bar{p}$	CD_{LM}	Variable	$\bar{p}$	CD_{LM}
GC	0.310	4.47***	**Δ GC**	0.148	1.68*
DIC	0.512	1.280	**Δ DIC**	0.143	0.310
KC	0.438	-1.480	**Δ KC**	0.138	-0.130
FOC	0.302	5.15***	**Δ FOC**	0.137	-0.540
GP	0.317	5.80***	**Δ GP**	0.140	0.080
DP	0.274	-1.470	**Δ DP**	0.115	-0.500
KP	0.304	-0.320	**Δ KP**	0.089	0.750
FOP	0.463	7.05***	**Δ FOP**	0.108	0.810
INC	0.468	10.88***	**Δ INC**	0.220	6.42***

Computed by the Author using STATA 13
Note: *, **, and ***, denote significance at 10%, 5%, and 1%
Δ represents First Difference. Null Hypothesis assumes cross-section independence

5.4.1.4 Panel Unit Root Results

Though we conduct three unit-root test for individual countries' time series for comparison and robustness check[112], the panel unit root test are more powerful in two ways. First, unlike the time series unit root test for each country with nonstandard limiting distribution, the distribution of the panel unit root tests are asymptotically standard normal. Second, in addition to the power of large observations, panel unit root tests capture variation across countries and across time to produce extra accurate parameter estimates (see Sarno and Taylor, 1998)

The results of the unit-root test for individual countries are contained in appendices 1. Table 5.5 presents the results of cross-sectionally augmented IPS (CIPS) unit root as advanced by Pesaran (2007). Under the approach, the null hypothesis that all series in the panel are non-stationary is tested against the alternative hypothesis that some series in the panel are stationary. We report only the case of deterministic intercept with a maximum of 3 lags[113]. The results show that most of the variables are not stationary at levels at all lag length considered. The only two variables that rejected the null of non-stationarity at levels are price of diesel (DP),

[112] The three tests include Augmented Dickey Fuller (ADF), Phillips-Perron (PP) and Kwiatkowski-Phillips-Schmidt-Shin (KPSS)
[113] Since the CIPS tests has no information criteria for lag length selection, we experiment with several lags and even allowed for deterministic trends. None of these trials changes the results significantly

and price of Kerosene (KP). While price of diesel reject the null at 1% and 10% at first and second lags significant level, the price of kerosene do so at 5% level of significance at both first and second lag. However, all the variables reject the null of unit-root at first difference at all lag specification.

Table 5.5: CIPS Panel Unit Root Test Statistics

Lags	0	1	2	3
GC	-0.672	-0.973	-0.092	0.355
DIC	1.634	1.296	0.79	0.277
KC	1.012	0.078	1.393	1.678
FOC	-0.717	-0.668	0.542	0.52
GP	0.457	-0.815	0.446	1.50
DP	-1.388*	-2.804***	-1.555*	0.767
KP	-0.778	-2.308**	-1.994**	-0.141
FOP	0.695	0.188	-0.999	-0.309
INC	0.115	-0.762	0.865	0.663
Δ GC	-10.450***	-6.776***	-4.457***	-1.685**
Δ DIC	-10.436***	-6.495***	-3.484***	-3.181***
Δ KC	-10.314***	-6.999***	-4.707***	-3.211***
Δ FOC	-9.137***	-5.953***	-3.556***	-1.805**
Δ GP	-9.275***	-7.599***	-5.919***	-3.234***
Δ DP	-10.386***	-7.469***	-6.355***	-3.907***
Δ KP	-9.909***	-6.689***	-5.499***	-5.023***
Δ FOP	-10.171***	-5.267***	-3.893***	-2.703***
Δ INC	-9.669***	-6.514***	-3.438***	-2.374***

Computed by the Author using STATA 13
Note: *, **, and ***, denote significance at 10%, 5%, and 1% respectively
Δ represents First Difference

5.4.1.5 Westerlund Cointegration Results

Below is the results of the panel cointegration analysis based on the strategy proposed by Westerlund and Persyn (2007) described briefly in section 3.2. In table 5.6 below is a display of Westerlund cointegration results for consumption of gasoline, diesel, kerosene, and fuel oils. In the table, reports of group-mean statistics (Gt) and (Ga) are presented[114]. Since evidence of cross-section correlation among our panel series surfaces in the cross-section dependence tests performed in section 4.4, we deem it fit to obtain robust p-values in our cointegration test

[114] Note that we also perform for panel statistics (Pa) and (Pt). However, the decision on cointegration results was not different from that of Ga and Gt reported. Evidence on that is available on request.

through bootstrapping techniques. From the result, we cannot reject the null of no cointegration for all the models. By implication, the relationship between demand for petroleum products and its determinants are temporary and not error-correcting.

Table 5.6: Westerlund Cointegration Results

	Model 1 (GD)		Model 2 (DID)		Model 3 (KD)		Model 4 (FOD)	
Statistic	Gt	Ga	Gt	Ga	Gt	Ga	Gt	Ga
Value	-1.767	-5.805	-2.023	-6.715	-1.400	-4.626	-1.666	-5.656
Z-value	0.872	1.558	0.038	1.152	2.067	2.152	1.134	1.564
P-value	0.809	0.944	0.515	0.875	0.981	0.984	0.872	0.941
Robust P-value	0.640	0.660	0.260	0.370	0.860	0.920	0.660	0.610

Computed by the Author using STATA 12; Null Hypothesis assumes no cointegration.
Note that the value Gt and Ga reported represent Westerlund group-mean error-correction statistic

5.4.1.6 *Panel Estimation Results for Petroleum Products Consumption in OPEC*

Having determined the existence of no cointegration among the variables of interest in all the models selected to capture demand for petroleum products in OPEC, we proceed to carry out panel data analysis based on fixed or random effects estimate and common correlated effects mean group (CCEMG). In line with the overall objective of study, estimates measuring demand for petroleum products in OPEC countries are presented in Table 5.7 below. The results represent aggregate view on demand for petroleum products in OPEC. Country-specific estimates are presented in Table 5.8.

From Table 5.7, under CCEMG income per-capita (INC) exerts positive and statistically significant influence on gasoline consumption (GC), diesel (DIC), kerosene (KC), and fuel oil (FOC) with elasticity of 0.19, 0.29, 0.33, and 0.25 respectively. More appropriately, a 1% increase in per-capita income will lead to about 0.19%, 0.29%, 0.33%, and 0.25% increase in gasoline consumption, diesel, kerosene, and fuel oil respectively. However, price of petroleum products are not statistically significant in all the models under CCEMG. All the fuel prices exert negative influence on demand. However, the Wald Chi-Square Statistic shows that income and price are jointly significant in explaining consumption of gasoline, kerosene and fuel oil under CCEMG method.

The decision on which of the two models to use with respect to the Fixed or Random Effects regression estimates, Hausman test is employed. From the Hausman test statistic, it is observed that the null hypothesis of random effects cannot be rejected for all fuels. Hence we report only the Random Effects (RE). In all the four models, income per capita exerts positive and significant influence on consumption of gasoline, diesel, kerosene and fuel oil with elasticity of about 0.07, 0.1, 0.29, and 0.25 respectively. All the fuel prices except kerosene has the expected inverse relationship with demand but all are statistically insignificant. Also, income and prices of petroleum products are jointly significant in explaining petroleum products consumption going by statistical significance of Wald chi-square in all the models considered.

Table 5.7: Empirical Results on Demand for Petroleum Products in OPEC Countries

	CCEMG RESULT				RANDOM EFFECTS			
	GC	DIC	KC	FOC	GC	DIC	KC	FOC
	Model 1	Model 2	Model 3	Model 4	Model 1	Model 2	Model 3	Model 4
Constant	0.001 (0.27)	0.001 (0.12)	0.004 (0.33)	-0.007 (-0.48)	0.010** (1.96)	0.008 (0.94)	0.014 (0.89)	-0.021 (-1.21)
ΔINC	0.188*** (2.84)	0.290** (2.10)	0.332** (2.28)	0.249** (2.04)	0.065** (2.42)	0.097** (2.18)	0.299*** (4.17)	0.248** (2.52)
ΔGP	-0.038 (-1.48)				-0.014 (-1.50)			
ΔDP		-0.007 (-0.21)				-0.002 (-0.11)		
ΔKP			-0.039 (-1.31)				0.031 (1.27)	
ΔFOP				-0.134 (-0.79)				-0.006 (-0.27)
RMSE	0.071	0.099	0.189	0.184	0.089	0.148	0.236	0.292
No of Obs.	297	297	297	264	297	297	297	264
No of groups	9	9	9	8	9	9	9	8
F-Stat/Wald Chi^2	41.13***	4.41	13.60***	21.08***	8.21**	4.78*	18.67***	6.43**
Hausman Chi^2					1.08	0.43	1.29	0.19
CD_{LM}	-3.54***	-3.05***	-3.17***	-3.13***	1.19	0.93	0.16	0.84

Note: *, **, and ***, denote significance at 10%, 5%, and 1% respectively
In Parenthesis ( ) are values of z-statistics.
The CD_{LM} here is the post cross-section dependence statistic
RMSE is the Root Mean Square Error. Δ denotes First Difference

Source: Estimation results using STATA 13

5.4.1.7 OPEC Country-Specific Results Using CCEMG

As aggregate analysis tends to obscure relative effects, we carried out country-specific analysis to explore the behavioural effects exhibited by each country as regards the fuel consumption. As noted earlier, the uniqueness of the CCEMG estimation techniques is that it treats each country's peculiarities as unique. Table 3.8 below displays country-specific results on consumption of petroleum products in sampled OPEC countries. As can be observed in the table, income is a significant determining factor in explaining variations in gasoline consumption in Iran, Kuwait, and Venezuela with elasticity of 0.47, 0.11, and 0.39 respectively. The price of gasoline has negative impact on gasoline consumption in all the countries except UAE and Venezuela but it is only statistically significant in Iran, Nigeria and Saudi Arabia. Thus, a one percent increase in the price of gasoline will result in 0.03, 0.132 and 0.130 percent decrease in gasoline consumption in Iran, Nigeria and Saudi Arabia respectively.

The results of country-specific analysis on diesel fuel using CCEMG show that per capita income has a positive impact on diesel consumption in most of the OPEC countries except Qatar and Saudi Arabia. Specifically, if per capita income increases by one percent, diesel consumption will increase by 1.05 percent, 0.31 percent, 0.56 percent, and 0.78 percent in Algeria, Kuwait, the UAE and Venezuela respectively. With respect to the effect of diesel price on diesel consumption in OPEC countries, there are mixed results. While the price of diesel has a negative impact on diesel consumption in Algeria, Kuwait, Nigeria, Qatar, Saudi Arabia the United Arab Emirate, and Venezuela, it has a positive effect on diesel consumption in Iran and Libya. However, the effects are significant only in Algeria, Kuwait and Saudi Arabia. Specifically, an increase in the price of diesel by one percent will result in reduction in diesel consumption by 0.12, 0.22 and 0.11 percent in Algeria, Kuwait and Saudi Arabia respectively.

Table 5.8: Country-Specific Results for Petroleum Product Demand using CCEMG

S/N	Country	Income	Z-Statistic	Price	Z-Statistic
Gasoline					
1	Algeria	0.205	0.42	-0.016	-0.22
2	Iran	0.467**	2.07	-0.029*	-1.87
3	Kuwait	0.106***	2.76	-0.058	-0.63
4	Libya	0.084	1.53	-0.005	-0.06
5	Nigeria	-0.002	-0.01	-0.132**	-2.73
6	Qatar	0.067	0.76	-0.091	-0.61
7	Saudi Arabia	-0.066	-0.44	-0.130***	-3.59
8	UAE	0.439	1.16	0.109*	0.38
9	Venezuela	0.394***	4.43	0.003	0.41
Diesel					
1	Algeria	1.046***	2.90	-0.118***	-2.61
2	Iran	0.009	0.05	0.014	1.24
3	Kuwait	0.313**	2.69	-0.215*	-1.73
4	Libya	0.035	0.43	0.059	0.47
5	Nigeria	0.017	0.04	-0.036	-0.54
6	Qatar	-0.001	0.00	-0.057	-0.48
7	Saudi Arabia	-0.146	-0.79	-0.105**	-2.33
8	UAE	0.559**	2.83	-0.032	-0.50
9	Venezuela	0.780***	2.63	-0.003	-0.15
Kerosene					
1	Algeria	0.507	0.87	-0.069*	-1.66
2	Iran	0.309	0.95	-0.061***	-2.89
3	Kuwait	0.695**	2.49	-0.117	-0.29
4	Libya	0.169	1.37	0.078	0.38
5	Nigeria	-0.024	-0.05	-0.053	-0.72
6	Qatar	0.067	0.19	-0.057	-0.17
7	Saudi Arabia	-0.137	-0.20	-0.179	-0.98
8	UAE	0.130	0.34	-0.013	0.07
9	Venezuela	1.267**	2.13	0.115***	2.89
Fuel Oil					
1	Algeria	0.511	0.30	-0.004	-0.05
2	Iran	0.177	0.53	0.001	0.06
3	Kuwait	0.235	0.84	-0.446	-0.69
4	Libya	0.119**	1.82	0.001	0.02
5	Nigeria	0.160	0.22	-0.013	-0.15
6	Saudi Arabia	0.419	1.21	0.492***	2.69
7	UAE	0.317	0.85	-1.139	-1.56
8	Venezuela	0.053	0.08	0.033	0.89
*, **, and ***, denote significance at 10%, 5%, and 1% respectively					

Source: Computed by the Author using STATA 13.
Note: Qatar is omitted in the consumption of diesel equation due to several missing data on fuel oil consumption and price

The results of kerosene consumption indicate that per capita income has positive effect on kerosene consumption in all countries but Nigeria and Saudi Arabia. However, statistical significance of the effects is only recorded in Kuwait and Venezuela. Going by this, a one percent increase in per capita income in Kuwait and Venezuela will lead to increase in kerosene consumption by 0.69 percent and 1.27 percent respectively. From the result, the price of kerosene also has negative effect on kerosene consumption in all the countries except Libya and Venezuela. However, this effect is only significant in Algeria and Iran where the elasticity estimate is about 0.07 and 0.06 percent respectively. Price of kerosene is positively and significantly related to the kerosene consumption in Venezuela. Specifically, while an increase in the price of kerosene in Algeria and Iran by one percent will lead to a decline of 0.07 and 0.06 percent respectively in kerosene consumption, a similar increase in the price of kerosene in Venezuela will increase kerosene consumption by 0.12 percent

The fuel oil consumption results using CCEMG for each OPEC member countries show that per capita income is positively related to fuel oil consumption all the countries considered. However, the positive effect of per capita income on fuel oil consumption is only statistically significant in Libya. We can infer from the results that an increase in per capita income in Libya by one percent will increase for the consumption of fuel oil by 0.12 percent. In the case of price effects of on fuel oil consumption, the results show that the price of fuel oil has negative impact on fuel oil consumption in Algeria, Kuwait, Nigeria, and the United Arab Emirate while it exhibits positive effect on the fuel oil consumption in Iran, Libya, Saudi Arabia and Venezuela. However, the effect of fuel oil price is only statistically significant consumption in Saudi Arabia with elasticity of 0.49.

5.4.2 OPEC fuel subsidies and their impacts

Four petroleum products considered in this study include gasoline, diesel oil, kerosene and fuel oil. The respective retail price per barrel contained in the OPEC statistical bulletin for member countries are adopted as the end user consumer price[115]. In arriving at the reference

[115] The retail prices are available in national currencies and were converted to US dollars for ease of comparison using each country's annual average exchange rate

price for each country, we consider the spot price of petroleum products in the three major markets-US Gulf, Rotterdam and Singapore and the spot freight rate to major export destinations. Both the spot price and the freight rate are adjusted for each country's oil trade pattern and partners. We also consider both the production and consumption data of each products in all countries to determine net exporter/importer by fuel type rather than aggregates. For instance, while most of the countries are net exporter of oil products on the aggregate, all OPEC countries are net importer of one product or the other.

The study estimates the size of petroleum products subsidies in OPEC member countries based on 2013 data. The consumption elasticities[116] obtained from section 5.3:4-5 were used to compute products' consumption without the price gap and we estimate the differences in consumption and CO_2 emissions at subsidised and non-subsidised prices. With these estimates, the study calculates the impacts of subsidies on consumption, emissions and welfare for each products in OPEC and the 9 countries considered supposing these subsidies are removed. The aggregate statistics and product specific details are contained in table 5.9 and 5.10 below respectively.

Table 5.9: Petroleum products' subsidies and impacts of removal in OPEC 2013

					Potential Effects of Subsidies on		
	Subsidies $USb	Country % of OPEC	Subsidy % of GDP	Health exp % of GDP	Consumption (M'bbl)	Emission (M'ton)	welfare ($USb)
Algeria	10.96	6.04	4.90	4.92	17.72	7.50	46.28
Iran	55.39	30.49	15.12	2.73	39.67	16.67	17.45
Kuwait	8.93	4.91	4.85	2.39	38.53	16.33	8.33
Libya	8.92	4.91	12.09	3.02	6.36	2.69	26.58
Nigeria	5.39	2.97	1.04	1.02	5.22	1.99	0.98
Qatar	4.80	2.64	2.37	1.83	8.13	3.31	5.51
S/Arabia	49.81	27.42	6.68	2.03	132.87	54.83	13.35
UAE	11.48	6.32	2.90	2.25	83.37	35.48	1.96
Venezuela	25.97	14.30	6.94	0.98	16.51	6.49	25.03
OPEC	181.64	100.00	5.89	NA	348.38	145.29	145.48

Source: Author's computation, *NA – not applicable

[116] We apply the respective fuel elasticity of each in each country to arrive at new consumption values. Few of the country's fuel elasticity with wrong signs are substituted with OPEC estimates. The substitutions do not however exert significant change on the results

The results indicate that consumption subsidies on petroleum products in OPEC sum up to $US 181.64 billion which is about 6% and 8.8% of GDP and government revenue respectively[117]. Two striking features can be observed from the OPEC aggregate subsidies. First, about 74% of the subsidies are on gasoline and diesel oil whereas subsidies on kerosene and fuel oil account for about 7% and 19% of the total respectively. As a percent of GDP, OPEC subsidies on gasoline, diesel oil, kerosene, and fuel oil estimates are about 1.7%, 2.7%, 0.4%, and 1.1% of GDP. Second, and more interesting is the fact that just three-member countries namely Iran, Saudi Arabia and Venezuela in descending order of magnitude make up 72.2% of the total subsidies for OPEC. Qatar has the least subsidy estimates followed by Nigeria with about $US 4.8 and $US 5.4 billion – about 2.4% and 1% of GDP respectively. Except in Algeria, government in all the countries considered expend more on health than fuel subsidy as at 2013. Our subsidies estimates are quite similar with the IEA 2013 oil subsidy estimates for Libya, Nigeria, Saudi Arabia, and Venezuela but contrast with estimates for other countries particularly Iran and UAE[118]. Several factors including the exchange rate adopted and what makes up 'oil' in the IEA's fossil fuel classification may account for these differences. The average subsidisation rate (ASR) is least in UAE and Nigeria with about 40% and 45% respectively and most in Venezuela with 92.6%[119]. On the whole, the ASR value ranged from 74% to 89% for the other countries.

Theoretically, demand will vary inversely with price[120]. Hence, demand for petroleum products is expected to reduce in the absence of price gap[121]. From table 4.1, the aggregate petroleum products consumption for OPEC will decrease by 348.38 million barrels – about

[117] The calculations are based on 2013 statistics and the nine (9) member countries that were considered
[118] See IEA's World Energy Outlook, (2014) chapter 9 Pp 321.
[119] The ASR is the ratio of price gap to world reference price. The single value reported for each country is the average of all products for the country
[120] This is based on the assumption that demand elasticities are negative. The results in section 3 show that one or more products in few countries have positive elasticities coefficients, so we replaced such elasticity values with that of OPEC which are all negative and significant.
[121] Higher prices of petroleum products will lower demand/consumption that there is no fuel substitution.

17.5% of total consumption. Owing to the differences in demand elasticity for each product, the prospective saving from oil consumption amounts to 8.1%, 11%, 22%, and 42% for gasoline, diesel oil, kerosene, and fuel oil respectively. Fuel oil has the highest saving potentials followed by kerosene. While it might be delicate to raise the price of kerosene in some of the countries as the product is often consumed by low income households, reforming fuel oil, diesel and gasoline which are significantly price inelastic may be a welcome policy option. These reduction in consumption is expected to reduce fuel related CO_2 emission. As a result, the would-be CO_2 emissions reduction for OPEC is 145.29 million tons which translates to about 13.13% of total CO_2 emission from oil consumption. Diesel and fuel oil jointly accounts for about 79.6% of this potential emission saving while gasoline accounts for about 14.2% of oil consumption related CO_2 emission in OPEC

Combining the estimates of percentage change in production and that of consumption with and without the price gap gives the welfare gains[122]. The welfare gains, assuming there is no change in international prices amount to an average of $US 145.48 billion for OPEC (about 4.7% of GDP). The highest gain of $US 54.5 comes from fuel oil followed by kerosene, diesel oil and gasoline in descending order respectively. These potential gains account for about 0.52%, 0.9%, 1.6%, and 1.8% of GDP for gasoline, diesel, kerosene and fuel oil respectively.

[122] The estimates in table 4.1 are the net of gains and losses depending on whether a country is a net importer or exporter of a product.

Table 5.10: Impacts of Subsidies by Products 2013

Countries	Fuels	Consumption litres/day millions	Retail Price $US/ltr	Subsidy $USb	Emission Saving (Mt)	Potential welfare gain $USb	Saving as % of Consumption
ALGERIA	Gasoline	12.83	0.18	2.62	0.25	1.58	2.26
	Diesel	32.92	0.11	7.75	6.59	2.97	20.44
	Kerosene	1.80	0.01	0.44	0.40	22.91	23.31
	Fuel oil	0.72	0.02	0.15	0.27	18.82	38.72
IRAN, I.R.	Gasoline	62.73	6.12	9.62	1.10	0.52	2.03
	Diesel	98.55	0.82	30.74	1.88	7.87	1.95
	Kerosene	16.61	0.82	4.34	2.34	6.60	14.94
	Fuel oil	54.64	1.63	10.69	11.35	2.47	21.23
KUWAIT	Gasoline	10.45	0.25	2.15	0.59	1.11	6.57
	Diesel	9.01	0.19	1.99	2.31	1.56	26.24
	Kerosene	3.07	0.19	0.60	0.42	1.39	14.41
	Fuel oil	20.95	0.06	4.18	13.01	4.27	63.42
LIBYA	Gasoline	14.07	0.12	3.47	0.11	2.85	0.95
	Diesel	15.59	0.13	3.83	0.19	2.50	1.25
	Kerosene	1.50	0.06	0.35	0.13	5.07	8.97
	Fuel oil	6.16	0.02	1.26	2.26	16.15	37.49
NIGERIA	Gasoline	43.55	0.62	3.85	1.60	0.20	4.28
	Kerosene	8.47	0.74	1.54	0.39	0.78	4.88
QATAR	Gasoline	4.71	0.25	0.92	0.40	1.05	9.80
	Diesel	6.30	0.27	1.46	0.41	1.15	6.59
	Kerosene	9.14	0.11	2.42	2.51	3.30	29.17
S/ARABIA	Gasoline	80.21	0.14	14.47	12.29	1.76	17.83
	Diesel	116.01	0.07	24.52	24.08	4.34	21.21
	Kerosene	11.13	0.12	1.81	2.58	1.92	24.60
	Fuel oil	57.89	0.04	9.02	15.88	5.33	28.04
UAE	Gasoline	21.30	0.45	2.34	0.35	0.33	1.93
	Diesel	14.69	0.62	0.78	0.10	0.12	0.67
	Kerosene	16.34	0.49	1.08	0.19	0.18	1.21
	Fuel oil	46.19	0.16	7.29	34.85	1.32	77.09
VENEZUELA	Gasoline	47.56	0.01	13.15	3.89	6.47	9.53
	Diesel	39.60	0.01	10.94	0.30	6.26	0.78
	Kerosene	1.04	0.70	0.26	0.09	6.21	9.63
	Fuel oil	7.70	0.01	1.61	2.20	6.10	29.22
OPEC	Gasoline	331.38	----	52.58	20.58	15.89	8.05
	Diesel	391.05	----	82.00	35.86	26.77	11.01
	Kerosene	82.80	----	12.86	9.03	48.37	13.88
	Fuel oil	233.56	----	34.20	79.83	54.45	41.99

Source: Author's estimation

Note: While fuel oil is not consumed in Qatar since 2005, Nigeria only subsidise gasoline and kerosene having deregulated diesel prices since 2004.

5.5 Conclusion

In this paper, we conduct an analysis of domestic demand for petroleum products and by extension, estimate the magnitude of fuel subsidies, the embedded economic costs, and the associated environmental and welfare effect of these subsidies in OPEC member countries. Both the panel and country specific results show that historical prices in OPEC member countries have been consistently too low to impact a significant effect on demand. However, this should not be misconstrued to imply that raising the domestic end user prices of these petroleum products cannot bring about significant reduction in excess demand for these products.

Overall, two things can be inferred from the results. First, all petroleum products considered are in general, highly price inelastic. The indication from these is the potential for price reforms as most of the countries studied presently maintain high subsidies on fuel prices. The low sensitivity of demand to changes in their prices suggests that price reforms and fuel taxes can on their own achieve a win-win solution to improved revenue, energy conservation and CO_2 emission reduction. Second, the price elasticity values are generally lower compared to what obtained in the literatures, Bhattacharyya and Blake (2009) reported between (0.008 &-1.064) and (-0.033 & -2.694) while Dahl (2012) estimates ranged between (-0.11 & -0.33) and (-0.13 & 0.38) for gasoline and diesel fuel elasticities respectively[123]. Our estimated values ranges between -0.003 & 0.29; -0.006 & -0.19; -0.05 & -0.26; and -0.01 & 0.39 for gasoline, diesel, kerosene and fuel oil respectively. This may be due to the structure-based cointegration approach employed in the study as against the levels-based approach commonly employed by previous studies.

[123] The Bhattacharyya and Blake (2009) study covers MENA countries while Dahl (2012) developed his elasticities from wide-reaching historical studies

The nine OPEC member countries considered in this study account for about 70% (36%) of the IEA estimated global oil (fossil fuel) consumption subsidies for 2013. Our findings show that removing these subsidies can reduce oil consumption and CO_2 emission by as low as 5.2 million barrels and 1.99 million tons in Nigeria to as high as 132.9 million barrels and 54.8 million tons in Saudi Arabia respectively. The associated aggregate welfare gains amounts to about 4.7% of member countries' GDP. The import of these is that OPEC member countries need to reform these oil subsidies to check inefficient consumptions and minimise CO_2 emissions. However, the differences in products' elasticities implied that countries need to consider each fuel individually and design subsidy reform policy in line with country's peculiarities and social objectives.

In conclusion, OPEC member countries need to urgently address these inefficient fuel subsidy by putting in place a well-designed subsidy reform and fuel tax policies within the context of their national macroeconomic policy. This will in addition to resolving the fiscal burden associated with subsidies, assist member countries to meet their emission reduction targets and improve social welfare.

6 CHAPTER SIX: CONCLUSION AND RECOMMENDATIONS

6.1 Summary

Major efforts are currently on in several countries globally to cut or abolish end users fuel subsidies which do not only creates huge fiscal burden and encourage wasteful fuel consumption but also results in welfare loss and exacerbates carbon pollution. Fuel subsidies are very predominant in OPEC with member countries accounting for about 51% of the estimated global petroleum product subsidies in 2013. Therefore, this study assesses the scope of fuel subsidies and evaluates the economic, environmental and welfare effects in oil exporting countries. Following a specific to general approach, the investigation focus on Nigeria and later extends to OPEC. The first two chapters covers the introduction and general literature while the three major research question of the thesis are addressed in chapters three, four and five respectively. In spite of the numerous call for the elimination of fuel subsidies globally, my general conclusion is that subsidies may persist for a long time than anticipated. While there are enough arguments in favour of fuel subsidy removal, the literature is also rich with equally compelling opinions against cutting subsidies. However, not only has this study lends a voice to the most contentious areas of the fuel subsidy debate, it has applied unique and robust methodology to add value and provide new evidences. Based on the analysis conducted in the study, the following conclusions can be drawn from the results.

In chapter three, the study investigates how the benefits from fuel subsidies accrue to each household group using the Nigerian household group using the 2009/10 World Bank Harmonized Living Standard Survey. Two conclusions can be drawn from the findings. First, we have evidence to conclude that fuel subsidy is inefficient mechanism to assist the poor since income transfer equivalent to subsidy on either fuel will be less equitable than the original distribution of income. Second, while fuel subsidies may be poorly targeted and benefit the rich more, the outcome may be fuel specific. In the Nigerian case, kerosene subsidy is more evenly distributed across income groups while petrol subsidy is concentrated to high income groups.

The recent reduction of gasoline subsidy in January, 2012 and the resolve of the Nigerian government to continue form the focus of the question addressed in chapter four where we examine the economic effects of the removal and also simulate the impact of reinjecting subsidy saving back into the economy using the Input-Output and SAM multiplier approach. We can conclude from the results that fuel subsidy removal exerts disproportionate effects across sectors consistent with the extent of each sector's use of gasoline. It is also important for countries to have well-structured and targeted plan on the re-injection of the subsidy saving before subsidy removal. While subsidy removal may increase government revenue, poor households may suffer if saving are not reinjected back into the economy. However, reinjecting subsidy saving ultimately led to significant increase in GDP and investment in all sectors; increases government revenue and foreign saving; raised factor incomes; and lead to higher aggregate household saving.

Chapter five employed 1980-2013 panel data on fuel consumption, prices and income to estimate fuel elasticities and subsidies and evaluate the effects on consumption, pollution and welfare for OPEC as a group and member countries in specific. Three conclusions can be drawn from the results. First, the results show that fuel subsidy estimates are large and growing particularly in OPEC countries and the need to intensify reform process is now. Second, though the historical fuel prices in countries studied appear excessively low to impact significantly on fuel consumption, this however does not imply that raising the domestic prices of these fuels cannot bring about substantial reduction in consumption. Third, the petroleum products generally have low price elastic in OPEC countries which suggests that reforming fuel prices and taxes can assist member countries to improved revenue, reduce wasteful fuel consumption and reduce CO_2 emission.

6.2 Recommendations

6.2.1 Policy Recommendation

The main recommendations of this study are summarized as follows.

- Countries need to intensify their efforts to remove fuel subsidy by liberalizing the price or by setting a robust price adjustment mechanism that reflects changing market conditions.
- Subsidies on fuel consumed majorly by the poor (e.g. kerosene) should be retained pending the provision and access to alternatives like LPG. This is not only because of the likely burden on the poor but due to its environmental advantages over biomass.
- To address public hostilities to fuel subsidy reforms, governments must ensure that subsidy removal must be gradual and appropriately timed on the one hand and on the other, be certain that proceeds from the removal of the subsidy are reinjected back into the economy or are actually used for the benefit of the broad population.

6.2.2 Suggestion for future Research

While the study has investigated a range of issues on fuel subsidies from specific to general, additional efforts are required to generalise on some of the study conclusions. First, the evidence on the distribution of fuel subsidies focussed on Nigeria due to the household survey date required to apply the BIA methodology. It will be important to conduct similar investigations for other highly subsidising countries to generate new evidence and enhance further application of the method to the distribution of fuel subsidy benefits. Second, the evaluation of the socio-economic effects of subsidy removal focussed on gasoline in Nigeria due to data on countries' input-output table and SAM. The analysis may be extended to other fuels particularly in many large subsidising countries that have been reducing or eliminating fossil fuel subsidies in the last few years. The outcome from the Nigerian gasoline subsidy experience can also be verified with the application of other advance general equilibrium models.

6.3 Contribution of the Thesis

This investigations conducted in this thesis are unique in many ways.

First, the specific analysis on Nigeria is distinctive and very motivating based on the application of the BIA approach. While studies have examined the distribution of fuel subsidy benefits in several countries, none has applied the Benefit Incidence Analysis (BIA) approach. This method have been used extensively by economists to analyse the benefit incidence of government subsidy on health, education and other social services and also to electricity and other sources of power in Colombia by the World Bank in 1994, this will be the first attempt to examine the distribution and incidence of petroleum subsidies with the BIA method.

Second, despite the numerous and constant downward review of fuel subsidy by the Nigerian governments, available records indicate that no attempt has been made to evaluate the effects of a single attempt on both the people and the economy. Between 1978 and 2012, end user price of gasoline was adjusted 20 times on the ground of huge financial burden and the need to stimulate investment in the oil sector of the country. This is the first study on record to assess a reference point of subsidy removal and saving reinjection in Nigeria and provides detailed economic impact on economic sectors, agents and the macro economy at large.

Third and final, despite the rich literature on fuel demand, this is the first attempt to apply the CCEMG estimation technique to study fuel consumption generally and for OPEC in particular. While the possible impact of fuel subsidy have been examine for many of the OPEC countries individually, going by available records, this will also be the first study to document evidence on the effects of OPEC fuel subsidies on fuel consumption, emission and welfare.

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APPENDICES

Appendices 4A Deriving the Leontief Equation

The simple mathematical relationships of the I–O model can be expressed as

$$q_i = z_{i1} + z_{i2} + \cdots + z_{ij} + \cdots + z_{in} + f_i = \sum_{j=1}^{n} z_{ij} + f_i \qquad \text{.........A.1}$$

Where (q_i) and (f_i) are the output of sector i and final demand for sector i's products while (z_{ij}) is the intermediate sales by sector i to all sector j including itself – all in monetary values[124].

It follows therefore that an economy with n sectors will have similar n-equations classifying the sales of output of each sector as:

$$q_1 = z_{11} + z_{12} + \cdots + z_{1j} + \cdots + z_{1n} + f_1$$

$$\vdots$$

$$q_i = z_{i1} + z_{i2} + \cdots + z_{ij} + \cdots + z_{in} + f_i$$

$$\vdots$$

$$q_n = z_{n1} + z_{n2} + \cdots + z_{nj} + \cdots + z_{nn} + f_n \qquad \text{...............A.2}$$

Applying matrix notations, the systems of equations in (A.2) can be shortened as (A.4) where:

$$q = \begin{pmatrix} x_1 \\ \vdots \\ x_n \end{pmatrix} ; Z = \begin{pmatrix} z_{11} & \cdots & z_{1n} \\ \vdots & \ddots & \vdots \\ z_{n1} & \cdots & z_{nn} \end{pmatrix} \; and \; f = \begin{pmatrix} f_1 \\ \vdots \\ f_n \end{pmatrix} \qquad \text{...............A.3}$$

$$q = Z_i + f \qquad \text{..............A.4}$$

The associated technical coefficient, defined as the ratio of input to output turn out to be:

$$a_{ij} = \frac{z_{ij}}{q_j} = \frac{value\ of\ input\ i\ bought\ for\ production\ of\ j}{value\ of\ output\ j\ produced} \qquad \text{..............A.5}$$

Though, it is logical that additional production will require more inputs, the Leontief production function fundamentally differs from the classical and other production functions in that its technical coefficient (a_{ij}) is regarded as quantifying fixed relationship between a sector's output and its inputs as depicted in simple geometry in figure 3 below[125]. Since $a_{ij} q_j = z_{ij}$ from (A.5), the Leontief model invariably becomes[126] $q_j = \frac{z_{1j}}{a_{1j}} = \frac{z_{2j}}{a_{2j}} = \cdots = \frac{z_{nj}}{a_{nj}}$. It is obvious from figure 3 that once the ratio of inputs 1 to 2 combination is known (say, z_{2j}/z_{1j}),

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[124] Note that the volume of final demands (F_i) is net of competitive imports for product (i)

[125] The notion that the set of technical coefficients are fixed has two implications. First, inputs are used in fixed proportions by sectors and the second is that the Leontief Í-Ò model discounts economies of scale in production and assumes constant returns to scale.

[126] Usually, the Í-Ò model will specify the production function q_j as min $(\frac{z_{1j}}{a_{1j}}, \frac{z_{2j}}{a_{2j}}, \dots, \frac{z_{nj}}{a_{nj}})$ where min (a, b, c) implies the smallest of the numbers a, b and c. The main reason is that when a specific input (i) is not used in the production of (j), (a_{ij}) will be equal zero and $(\frac{z_{ij}}{a_{ij}})$ becomes infinitely large

(q_j) can only be increased by added quantities of '***both***' and NOT '***either***' of input 1 and 2 as they are used in fixed proportion.

Substituting equation (A.5) in (A.2), we obtain (A.6):

$$q_1 = a_{11}q_1 + a_{12}q_2 + \cdots + a_{1i}q_1 + \cdots + a_{1n}q_n + f_1$$

$$\vdots$$

$$q_i = a_{1i}q_1 + a_{i2}q_2 + \cdots + a_{ii}q_{\mathrm{i}} + \cdots + a_{in}q_n + f_{\mathrm{i}}$$

$$\vdots$$

$$q_n = a_{n1}q_1 + a_{n2}q_2 + \cdots + a_{ni}q_{\mathrm{i}} + \cdots + a_{nn}q_n + f_{\mathrm{n}} \qquad \text{……………A.6}$$

Since $f_1, \dots, f_{\mathrm{n}}$ are known values and the coefficients a_{ij} are also known, the unknown $q_1, \dots, q_n$ can be found by making all q terms the subjects in their respective equation and representing them compactly in matrix form. This will yield the ***Leontief Matrix*** as:

$$q = \mathcal{A}q + \mathfrak{f} \qquad \text{……………A.7}$$

$$q(I - \mathcal{A}) = \mathfrak{f} \qquad \text{……………A.8}$$

The existence of a unique solution to equation (A.8) depends on whether or not $(I - \mathcal{A})$ is singular i.e. the existence or otherwise of the inverse $(I - \mathcal{A})^{-1}$. Once $|I - \mathcal{A}| \neq 0$, then $(I - \mathcal{A})^{-1}$ = $[(1/|I - \mathcal{A}|)\{adj(I - \mathcal{A})\}]$ and the unique solution to (A.8) can be obtained by applying standard matrix algebra as:

$$q = (I - \mathcal{A})^{-1}f = \boldsymbol{L}f \qquad \text{……………A.9}$$

Equation (A.9) is a summary whose details can be written as:

$$q_1 = l_{11}f_1 + l_{12}f_2 + \cdots + l_{ij}f_{\mathrm{j}} + \cdots + l_{1n}f_n$$

$$\vdots$$

$$q_i = l_{i1}f_1 + l_{i2}f_2 + \cdots + l_{ij}f_{\mathrm{j}} + \cdots + l_{in}f_n$$

$$\vdots$$

$$q_n = l_{n1}f_1 + l_{n2}f_2 + \cdots + l_{nj}f_{\mathrm{j}} + \cdots + l_{nn}f_n \qquad \text{……………A.10}$$

The detail equations provided in (A.10) shows clearly that each of the gross outputs depends on the value of each of the final demand. For instance, it is obvious that $dq_i/df_j = l_{ij}$ by applying partial derivatives in calculus

Appendices 4B: The Simple SAM Framework[127]

				EXPENDITURES								
				Production		Factors		Institutions		Capital account	Rest of world	Total Receipts
				Activities	Commodities	Labour	Capital	Household	Government			
				1	2	3	4	5	6	7	8	
RECEIPTS	Production	Activities	1		Domestic supply (gross output less export)						Export	Gross input
		Commodities	2	Total intermediate input				Private consumption	Government consumption	Inventory and investment		Total Absorption
	Factors	Labour	3	Wages and Salaries								Total Wage income
		Capital	4	Operating surplus + Consumption of Fixed capital								Total capital income
	Institutions	Household	5			Wages and salaries	Operating surplus + depreciation					Total h/hold Expenditure
		Governmentt	6	Indirect tax –subsidies				Direct tax				Total Govt. expenditure
	Capital account		7					Private savings (Total Factor Income - direct tax - Private consumption)	Government savings (net tax- government consumption –reserves)			Total investment
	Rest of world		8		Total Imports (competitive and non-competitive)				Reserves (Export - total imports)			Foreign exchange
	Total Expenditure			Gross output	Total Absorption	Total wage income	Total capital income	Total h/hold income	Total government income	Total Savings	Foreign exchange	

[127] the SAM is a modified version of Round (2003) by the authors in line with the structure of the Nigerian SAM used in this study

Appendices 5A: Individual Countries' Unit Root Test Statistics

		ADF		KPSS		PP	
		Intercept	Intercept & Trend	Intercept	Intercept & Trend	Intercept	Intercept & Trend
Critical Values	Levels	-2.957	-3.553	0.463	0.146	-2.954	-3.553
	First Difference	-2.957	-3.558	0.463	0.146	-2.957	-3.558
				ALGERIA			
GC	Levels	-1.5513	-0.7224	0.2273**	0.1167**	-1.5074	-1.5267
	First Difference	-2.2748	-2.5119	0.2137**	0.2064	-5.6315**	-5.6701**
GP	Levels	-2.1693	-2.0254	0.5982	0.1434**	-2.1031	-2.3149
	First Difference	-4.5879**	-4.4918**	0.2327**	0.0462**	-4.5850**	-4.4904**
DIC	Levels	1.3094	-0.2366	0.5757	0.1773	4.1426	0.9037
	First Difference	-4.3347**	-4.8365**	0.3228**	0.1109**	-3.4801**	-5.0636**
DP	Levels	-2.1913	-2.8397	0.6334**	0.0740**	-2.2463	-3.0828
	First Difference	-5.1905**	-5.0760**	0.1777**	0.1279**	-6.5270**	-6.2629**
KC	Levels	-2.7133*	-2.5789	0.2179**	0.1621	-2.9877**	-2.3562
	First Difference	-5.2118**	-5.2923**	0.3716**	0.5000	-5.5514**	-7.1619**
KP	Levels	-1.4211	-2.5087	0.6441**	0.0941**	-1.3216	-2.3530
	First Difference	-5.1714**	-5.0885**	0.1698**	0.1641	-5.8223**	-5.7224**
FOC	Levels	-2.0323	-1.8273	0.5153	0.1733	-2.0162	-1.7180
	First Difference	-4.8310**	-4.8486**	0.2061**	0.1696	-4.7589**	-5.4545**
FOP	Levels	-1.6588	-2.0894	0.2615**	0.1470	-1.7732	-2.1941
	First Difference	-4.9841	-5.0291	0.1582**	0.0608**	-4.9828	-5.0318
PCI	Levels	-0.5088	-0.6057	0.3567**	0.1604	-0.2598	-0.9928
	First Difference	-3.0164**	-3.1999	0.2725**	0.1006**	-3.0818**	-3.1688
				IRAN			
GC	Levels	-0.5616	-3.0207	0.6344	0.0934**	-0.6477	-1.8331
	First Difference	-4.3822**	-4.2807**	0.1128**	0.1136**	-4.4465**	-4.3816**
GP	Levels	-2.5406	-2.7411	0.3012**	0.1139**	-2.6084	-2.7924
	First Difference	-5.4551**	-5.3839**	0.1795**	0.1796	-6.5633**	-6.9733**
DIC	Levels	-0.9390	-2.7404	0.6796	0.0987**	-0.9646	-2.7366
	First Difference	-6.9956**	-6.9552**	0.0895**	0.0774**	-6.9931**	-6.9502**
DP	Levels	-4.4787**	-4.4274**	0.0932**	0.0809**	-4.4147**	-4.3533**
	First Difference	-7.7381**	-7.6118**	0.5000	0.5000	-20.5473**	-21.2212**
KC	Levels	-1.5313	-1.6816	0.2098**	0.1999	-1.6002	-1.4760
	First Difference	-6.0470**	-6.8192**	0.3433**	0.5000	-6.0442**	-8.5920**
KP	Levels	-3.9996**	-3.9435**	0.1034**	0.0834**	-4.0085**	-3.9525
	First Difference	-7.5961**	-7.4690**	0.3542**	0.3803	-12.5682**	-12.3932**
FOC	Levels	-1.8182	-3.1363	0.7188	0.1023**	-1.7567	-3.1363
	First Difference	-6.5869**	-6.5383**	0.1228**	0.0819**	-6.9147**	-7.0975**
FOP	Levels	-2.0937	-2.4814	0.2988**	0.1370**	-2.1950	-2.5329
	First Difference	-5.5605**	-5.4441**	0.2799**	0.3161	-6.1785**	-7.0644**
PCI	Levels	-0.5087	-0.6057	0.3566**	0.1605	-0.2598	-0.9927
	First Difference	-3.0164**	-3.1999	0.2725**	0.1006**	-3.0817**	-3.1688
				KUWAIT			
GC	Levels	0.2254	-2.3623	0.6447	0.1641	1.18690	-1.9125
	First Difference	-5.3989**	-5.6695**	0.2830**	0.2605	-5.2485**	-8.3595**
GP	Levels	-1.7279	-2.2209	0.7231	0.1012**	-1.7209	-2.3293
	First Difference	-4.7774**	-4.8616**	0.1415**	0.1002**	-4.7774**	-4.9117**
DIC	Levels	-2.1494	-2.1075	0.1627**	0.1607	-2.1034	-2.0586
	First Difference	-6.3009**	-8.5548**	0.1028**	0.0932**	-6.4359**	-6.4427**
DP	Levels	-3.4688**	-3.6104**	0.7133	0.0806**	-3.4276**	-3.6083**
	First Difference	-4.2674**	-4.6090**	0.3089**	0.1034**	-4.2771**	-4.6961**
KC	Levels	2.6598	2.1147	0.3662**	0.1492	9.4681	5.5152
	First Difference	0.5198	0.1236	0.3436**	0.1323**	0.5198	0.1236
KP	Levels	-3.2593**	-2.5183	0.6944	0.0988**	-3.1001**	-2.5250
	First Difference	-3.7129**	-4.2588**	0.2691**	0.1016**	-3.8504**	-4.4254**
FOC	Levels	-0.7992	-1.8836	0.5599	0.1353**	-0.7580	-1.9199
	First Difference	-5.7197**	-5.5914**	0.1322**	0.1267**	-5.7193**	-5.5849**
FOP	Levels	-2.0119	-0.9908	0.5825	0.1476	-1.4091	-2.2843
	First Difference	-2.0572	-0.8395	0.0941**	0.0905**	-5.1936**	-5.0959**

PCI	Levels	-2.4574	-3.1019	0.3649**	0.0830**	-3.8669*	-2.6906
	First Difference	-5.0054**	-4.6561**	0.1788**	0.1252**	-9.3786**	-9.6382**
LIBYA							
GC	Levels	2.9315	-.03049	0.6618	0.2005	5.4652	-0.4157
	First Difference	-1.5748	-3.7015**	0.4125**	0.2724	-6.2822**	-13.2265**
GP	Levels	-1.1740	-2.7684	0.4612**	0.1343**	-0.6077	-2.1716
	First Difference	-3.7951**	-3.8371**	0.1937**	0.0976**	-3.6244**	-3.6592**
DIC	Levels	-1.1579	-2.7811	0.5797	0.1079**	-0.7372	-2.1455*
	First Difference	-6.041**	-5.8813**	0.2002**	0.2138	-5.4780**	-5.4165**
DP	Levels	-1.4933	-1.7816	0.2138**	0.1331**	-1.6649	-1.9161
	First Difference	-4.4057**	-4.4008**	0.1587**	0.0901**	-4.4246**	-4.3689**
KC	Levels	-0.7629	-1.4705	0.6902	0.1199**	-1.4421	-4.1877**
	First Difference	-7.2889**	-7.1079**	0.2114**	0.1177**	-10.3991**	-9.2886**
KP	Levels	-0.8813	-1.9754	0.4281**	0.1540	-1.0559	-2.0390
	First Difference	-4.5269**	-4.6022**	0.2033**	0.0908**	-4.5270**	-4.6205**
FOC	Levels	-2.7826	-1.4895	0.4422**	0.1916	-2.6958	-2.1461
	First Difference	-8.4301**	-8.8857**	0.3786**	0.2841	-8.6116**	-12.1408**
FOP	Levels	-0.7481	-1.7773	0.5952	0.1018**	-0.7456	-1.8274
	First Difference	-5.6071**	-5.5128**	0.1191**	0.1191**	-5.6071**	-5.5127**
PCI	Levels	-5.1708**	-4.5336**	0.2976**	0.1517**	-5.4122**	-4.7455**
	First Difference	-6.4436**	-6.5217**	0.3923**	0.1148**	-6.4980**	-6.6309**
NIGERIA							
GC	Levels	1.1925	-1.1821	0.7459	0.1699	1.9337	-1.1349
	First Difference	-3.5688**	-3.9058**	0.3331**	0.0932**	-3.5286**	-3.2465**
GP	Levels	-1.1843	-3.7029**	0.4319**	0.1011**	-1.4693	-2.1585
	First Difference	-4.4465**	-4.4417**	0.1164**	0.0546**	-4.4465**	-4.4613**
DIC	Levels	-2.4224	-2.5809	0.2518**	0.1125**	-2.4892	-2.6631
	First Difference	-4.9386**	-4.7565**	0.0942**	0.0923**	-4.6594**	-4.4334**
DP	Levels	0.1646	-1.7933	0.6291	0.1589	0.1646	-1.7933**
	First Difference	-4.5973**	-4.7678**	0.2313**	0.0412**	-4.5973**	-4.7136**
KC	Levels	-2.5393	-3.3617	0.5423	0.1208**	-2.5393	-3.3617
	First Difference	-8.0009**	-4.4267**	0.2284**	0.2163	-9.8479**	-10.4073**
KP	Levels	-2.1693	-1.8262	0.5390	0.1497	-2.1592	-2.9581
	First Difference	-4.9538**	-5.0455**	0.2294**	0.2291	-8.5863**	-8.0005**
FOC	Levels	-1.8910	-3.6852**	0.5889	0.0965**	-1.8739	-3.6852**
	First Difference	-6.8884**	-6.7708**	0.4127**	0.3377	-8.3517**	-8.2510**
FOP	Levels	-0.0973	-1.4690	0.5333	0.1160**	0.0969	-1.4705
	First Difference	-6.2515**	-6.6296**	0.2699**	0.0885**	-6.2389**	-6.6937**
PCI	Levels	0.3533	-2.4458	0.4507**	0.2026	-0.1534	-2.4322
	First Difference	-4.8098**	-5.7419**	0.6578**	0.0837**	-4.8164**	-5.8389**
QATAR							
GC	Levels	3.3282	0.7147	0.7015	0.1922	1.8322	-0.4565
	First Difference	-63051**	-5.9443**	0.4898	0.0452**	-6.3169**	-7.6876**
GP	Levels	1.5828	-1.3489	0.7589	0.0901**	-1.2515	-2.4649
	First Difference	-1.0217	-2.6785	0.1115**	0.1086**	-4.8349**	-4.7728**
DIC	Levels	-0.4056	-1.8312	0.5772	0.1784	0.2268	-1.3230
	First Difference	-3.4860**	-3.5979**	0.2802**	0.0870**	-3.4860**	-3.5578**
DP	Levels	-1.6434	-2.7934	0.6873	0.0749**	-1.5019	-2.6857
	First Difference	-4.4217**	-4.3496**	0.1211**	0.1186**	-3.6819**	-3.4331**
KC	Levels	-1.1246	-0.3794	0.3131**	0.1287**	0.4578	-0.3794
	First Difference	-0.0086	0.2975	0.3265**	0.1320**	-0.0086	3.0623
KP	Levels	-2.7010*	-2.9638	0.4157**	0.1566	-8.9294**	-6.7074**
	First Difference	-3.8468**	-4.0862**	0.3492**	0.1104**	-3.6757**	-4.0792**
PCI	Levels	-0.5025	-2.6453	0.4979	0.1864	-0.0246	-1.9922
	First Difference	-3.0447**	-3.3151*	0.3518**	0.1207**	-3.1105**	-3.3593*
SAUDI ARABIA							
GC	Levels	0.3878	-0.6398	0.6208	0.1637	-0.1408	-1.2335
	First Difference	-4.5256**	-4.7751**	0.1628**	0.0939**	-4.5505**	-4.7751**
GP	Levels	-1.7325	-1.6114	0.1573**	0.1392**	-1.8741	-16843
	First Difference	-5.4786**	-5.5011**	0.1385**	0.1446**	-5.4798**	-6.0833**
DIC	Levels	2.2072	0.1759	0.7467	0.1876	2.8971	0.4766
	First Difference	-4.5124**	-5.2608**	0.4909	0.1432**	-4.4503**	-5.3502**
DP	Levels	-1.5511	-1.3606	0.4864	0.1429	-1.5511	-1.4024
	First Difference	-5.5271**	-5.5635**	0.1568**	0.0831**	5.5271**	-5.5630**

KC	Levels	-6.2620**	-1.4008	0.3960**	0.1706**	-1.9877	-1.5434
	First Difference	-3.4116**	-4.6394**	0.2195**	0.0635**	-4.5115**	-4.6394**
KP	Levels	-2.1139	-2.2216	0.2883**	0.1114**	-2.1831	-2.2216
	First Difference	-5.6463**	-5.5753**	0.0949**	0.0985**	-5.8313**	-5.7850**
FOC	Levels	-2.3686	-1.8943	0.6463	0.1739	-2.3121	-2.1129
	First Difference	-4.4361**	-4.4208**	0.2936**	0..0978	-4.4579**	-4.3939**
FOP	Levels	-6.6383**	-2.1394	0.3838**	0.1184**	-1.3255	-2.1246
	First Difference	-4.4695	-4.6926**	0.1923**	0.0812**	-4.4695**	-4.7161**
PCI	Levels	-2.8150*	-3.2884*	0.1823**	0.1825	-2.7096	-3.3022
	First Difference	-2.7912*	-4.2376**	0.5269	0.1131**	-2.6701*	-4.4204**
UAE							
GC	Levels	-2.2723	-2.0976	0.1288**	0.0925**	-2.6137	-2.4812
	First Difference	-6.9390**	-6.9255**	0.0966**	0.0556**	-6.9390**	-6.9255**
GP	Levels	-2.1116	-1.1629	0.3312**	0.1475	-1.3255	-1.1629
	First Difference	-3.1154**	-3.0711	0.1216**	0.0826**	-3.3349**	-3.2260**
DIC	Levels	-0.6336	-3.2317	0.6540	0.0697**	0.3518	-4.0765**
	First Difference	-5.1362**	-4.8950**	0.1765**	0.1053**	-5.1849**	-4.9212**
DP	Levels	-1.6739	-1.8599	0.2125**	0.1751	-1.6003	-1.6874
	First Difference	-5.7243**	-5.7517**	0.2866**	0.5000	-5.9502**	-9.6064**
KC	Levels	-1.2090	-1.7740	0.2045**	0.1705	-1.6063	-1.7746
	First Difference	-2.9876**	-3.2392*	0.3179**	0.1074**	-3.0168**	-3.2387*
KP	Levels	-1.7912	-1.7831	0.1634**	0.1593	-1.4770	-1.3037
	First Difference	-4.0002**	-3.9380**	0.1936**	0.0717**	-3.9876**	-3.9164**
FOC	Levels	-0.8142	-1.4486	0.2700**	0.1743	-1.1696	-1.5141
	First Difference	-4.4997**	-4.8942**	0.2769**	0.0952**	-4.5986**	-4.8939**
FOP	Levels	-5.6813**	-3.1167	0.7050	0.1938	-18.8777	9.6257**
	First Difference	-1.6210	-3.5684**	0.6313	0.1799	-4.5567**	-5.9416**
PCI	Levels	-2.6540	-3.2675	0.6386	0.1045**	-2.3473	-2.5254
	First Difference	-3.6494**	-3.7765**	0.2153**	0.1437**	-3.6618***	-3.8421**
VENEZUELA							
GC	Levels	1.4776	-3.5468*	0.6638	0.2032	1.1052	-3.4176
	First Difference	-9.2250**	-9.6472**	0.3935**	0.3962	-10.520**	-29.553**
GP	Levels	-1.2401	-2.4359	0.4432**	0.0960**	-1.5192	-2.6299
	First Difference	-4.9577**	-4.9794**	0.1130**	0.0627**	-4.9662**	-4.9990**
DIC	Levels	2.9991	-0.3536	0.5767	0.2067	3.1839	-0.2346
	First Difference	-6.8927**	-6.4731**	0.7383	0.5000	-6.8524**	-18.443**
DP	Levels	-1.3323	-1.6033	0.2124**	0.1551	-1.5429	-1.7008
	First Difference	-4.3452**	-4.3569**	0.1549**	0.0825**	-4.1995**	-4.2743**
KC	Levels	-1.5285	1.4753	0.5718	0.1573	-1.5434	-2.0048
	First Difference	-2.3569	-2.8779	0.4612**	0.1715*	-2.4127	-2.9381
KP	Levels	-2.2700	-2.2813	0.1398**	0.1377**	-2.2498	-2.2347
	First Difference	-6.6582**	-6.6555**	0.1273**	0.0759**	-6.7756**	-7.0503**
FOC	Levels	-1.7809	-2.4352	0.2629**	0.1792	-1.8844	-1.9564
	First Difference	-3.8518**	-3.6513**	0.1004**	0.1006**	-3.8599**	-3.6513**
FOP	Levels	-2.2345	-2.4423	0.2009**	0.1393**	-2.3346	-2.4766
	First Difference	-6.8609**	-6.8697**	0.1101**	0.0460**	-6.8422**	-6.9478**
PCI	Levels	-1.8670	-2.1546	0.1671**	0.1374**	-1.8670	-2.2238
	First Difference	-4.4260**	-4.5411**	0.2435**	0.0912**	-4.3113**	-4.8848**