ECONOMIC EVALUATION OF NIGERIA'S QUEST FOR NEW PETROLEUM REFINERIES

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Abstract
Numerous researches have shown that energy consumption has positive relationship with development. It is surprising that Nigeria, one of the largest crude oil producers, is periodically faced with scarcity of petroleum products which threatens its growth and achievement of its development targets. The Nigerian Government seeks to remedy this by building more petroleum refineries to augment the poor state of current refineries which has produced at an average utilization capacity of 24% leading the country to

import most of its refined product need. With the international refining industry facing a downturn as a result of overcapacity, tighter fuel specifications and competition from alternative sources. This study analyzes the economic viability of the refinery proposition by using a cost-benefit analysis as a background for further analysis to determine if the country should embark on new petroleum refinery projects. The study shows that building refineries is not economical as the analysis shows that there is no extra advantage gained by refining fuel in Nigeria. A positive net present value (NPV) is not enough rationale for embarking on such capital project considering the country's present subsidized pricing structure. The study further shows the impact of the costly subsidy program and recommends that it should be scrapped.

Keywords: Nigeria, petroleum refining, petroleum subsidy, cost benefit analysis

Introduction

Nigeria is presently in a deep mired paradox. It is a major Crude oil exporter but suffers from continual decline in its indigenous refining capacity to satisfy rising domestic demand. Subsequently, it depends on imports to supplement the pitiable domestic supply of refined petroleum products.

The oil refining industry is the cornerstone of a modern economy. All countries are subject to the vagaries of global oil prices, which have significant influence on local economies (Seneviratne, 2007). Furthermore, petroleum product consumption is found to have a positive direct relationship on economic growth (Zou & Chau, 2006). The scarcity of refined petroleum products in Nigeria usually comes with disruptions in the movement of goods and provision of services, leading to a hike in the prices of services and commodities, loss of productivity and a significant damaging effect on businesses and consequently the economy, with Arinze (2011) opining that it increases the level of inflation. With this in mind, it is important to evaluate if building new refineries as against depending on importation will solve the country's energy crisis and to identify the economic advantages potential refineries will confer on the country.

It is against this backdrop that this papers looks at the Nigerian refining industry, highlighting some of its activities and peculiarities. The paper also focuses on the factors that affect the domestic market and the impact of Nigerian petroleum policy on demand. It equally analyses the prospects and future directions of the Nigerian refining industry. This study analyses the economic viability of the Nigerian government's intention to invest and seek for investment in the refinery sector considering the state of the global refining industry and the slow growth predicted in the sector (Kearney, 2012). Nigerian policy makers argue that additional refining capacity will solve the problem of insecure supply of refined petroleum products in the country and the seeming assent of the idea by the generality of the populace.

More specifically, the study aims to critically evaluate the economic viability of the Nigerian government's proposition to build three new Greenfield refineries each of 250,000bbl/d under a partnership with Chinese investors. Further analysis will be done on the impact of Nigeria's petroleum policy on consumption of petroleum products particularly the effects of Nigeria's subsidy program.

This study is divided into five sections. After this introduction, the second section shows the methodology of the paper, looking at the peculiarities of the Nigerian industry, and the impacts of the country's energy policy on the industry as well as factors that could affect the growth and effectiveness of the industry by using Cost Benefit Analysis. The third section of the study reviews available literature concerning petroleum refining; describing some of its major activities and economics as well as the trends in the Global Refining Industry. The Fourth section uses the results obtained from the Cost Benefit Analysis as a foundation for analyzing the economic viability of building a new refinery. The results obtained will be compared against the other alternatives of providing petroleum products to the country. Further analysis will be done on the impact of Nigeria's petroleum policy on the refining industry. The fifth section summarizes the research, concludes and offers recommendations arising from the findings for future research.

Methodology

This Paper uses a Cost Benefit Analysis (CBA) to analyse the investment proposal to build a petroleum refinery in Nigeria. The figures obtained from tables will serve as background for further analysis with special focus on the effect of the country's petroleum policy on the downstream industry.

The CBA method assesses the cost versus benefit of an underlying project. The calculation is performed using the embedded MS excel data table available within MS Word. The analysis will provide the rate of return (ROR) of the cash flows and will provide the net impact on the economy as a final figure to assess the final and aggregate project value. The methods for ROR will incorporate the input costs in the form of the capital expenditure (CAPEX) and the output revenues in the form of cash flows per product. The revenues calculated for the new refinery will be based on the Petroleum Products Pricing Regulatory Agency (PPPRA) of Nigeria's pricing template. The template is based on prices of products from NWE Light Sweet Cracking center. The cost of oil per barrel is marked against the revenue generated per barrel multiplied by the total barrels of oil bought per year (includes unsold LIFO inventory).

Neste Oil refining margin data has the refining margin information starting on September 12, 2008 ($20.08), through mid-2013, when refining margins fall off dramatically (Neste Oil, 2013). Indian oil refineries report above $5/bbl gross refining margins on average with some variance depending on the type of crude being processed (Economic Times,

2013). There is also a report with gross refining margins recently reported to be averaging around $10.40/bbl (Economic Times, 2013).

Literature Review

The Nigerian Refining Industry

Prior to 1960, crude oil produced in Nigeria was exported while refined products supplies were mainly met through imports by multinationals such as Shell, BP, and Mobil. The quest for building a refinery was justified in 1959 when the nation's crude oil production reached 500,000bbl/day and supply of refined products could not meet demand (PPPRA, 2013). The first oil refinery built in the country is located outside Port Harcourt in the south. It started operations in 1965 with an initial installed capacity of 38,000bbl/d which was eventually increased to 60,000bbl/d. The Warri refinery with a total refining capacity of 125,000bbl/d was built in 1978. In 1980, Kaduna refinery with a total refining capacity of 110,000bbl/d was also built. Subsequently, a second 150,000bbl/d export refinery was built in 1988 and commissioned in 1989 (PPPRA, 2013).

Nigeria's four refineries have a combined capacity of around 445,000bbl/day. In 2011, the operational capacity of the refineries averaged 24%, slightly higher than the 22% in the previous year (Jaiyeoba, 2009). While domestic consumption reached approximately 286,000bbl/day, operating refinery capacity stood at 106,800bbl/day, according to EIA (2011) estimates, imports were used to augment domestic supply short falls to the tune of 165,700bbl/day of refined petroleum products.

Despite plans to improve operational efficiency of the four refineries, very little has been achieved. The Government is expected to inject funds running close to $3 billion on repairs for the four existing refineries to boost refining capacity. Turn around maintenance (TAM) is expected to kick off in the first quarter of 2013 to achieve a 90% operational refinery capacity by 2014 to feed domestic demand and regional exports (Nigeria National Petroleum Corporation [NNPC], 2013).

The refining market in Nigeria operates under a monopoly with the state, through the Nigeria National Petroleum Corporation (NNPC), managing and controlling all refining operations and pipeline network. The NNPC is the national oil company, but performs several other functions, serving as energy sector regulator, joint venture partner in all onshore operations and the nation's primary source of income (Petroleum Revenue Special Task Force, 2012)

Domestic Petroleum Policy

The policies formulated for the various areas of oil industry include indigenization and accelerated transfer of technology; coordinated national policy on energy; subsidy on petroleum products; special oil price to other African countries; oil pollution and counter

trade (Nwaobi, 2005). Although petroleum policies in Nigeria reflect the basic goals of its membership in the Organization of Petroleum Exporting Countries (OPEC), the country stresses policies that increase its oil reserves which has been rapidly depleted with little additions due to poor investment in exploration activities as a result of ethnic unrest, government underfunding especially inability of the NNPC to meet its funding obligations to joint ventures with foreign partners and border disputes as in the case of the Bakassi peninsula. It also focuses on polices that improve domestic consumption of refined petroleum products (Onyemaechi, 2012). As regards increase in the oil reserves, the Federal government and relevant authorities in the oil industry have articulated strategic policies aimed at expanding the nation's oil base.

Petroleum Subsidies

Theoretically, fiscal policies impact on the development of an economy either directly or indirectly. The direct impact is usually on the aggregate demand function, while such policies indirectly impact on development through their effects on the endogenous variables of consumption and production functions (Onyemaechi, 2012). Apart from production-related petroleum policies, the Nigerian government has instituted some consumption related policies, the most outstanding of which is the fuel subsidy. The goal of which is to encourage domestic consumption of petroleum products (Onyemaechi, 2012). Also, the Nigerian government uses petroleum product subsidies as a form of income distribution. Subsidies are not efficient in this regard as they are more beneficial to those that can afford to consume more and they promote wastage of a good that has negative environmental externalities (Nakhle, 2013). Contrary to popular belief, the rich, not the poor are the prime benefits of the subsidy program. With domestic fuel prices kept low as a result of subsidies, the poor population's per capita fuel consumption is lower than that of the rich, as a result, the more one consumes the more one benefits. Neighboring countries also benefit significantly from Nigeria's fuel subsidy through smuggling, further enriching the rich. Nwaobi (2005) found a direct positive relationship between petroleum products subsidies and consumption and suggests the gradual phase out of the policy.

The costs of subsidy have been growing exponentially as a result of rising costs of crude oil, which increased from a nominal price of $30.4 per barrel in 2000 to $94.9 in 2010, and increasing population over the same period by 35 million leading to increased demand (Moyo & Songwe, 2012). By 2011, fuel subsidy spending accounted for 30% of the Nigerian government's expenditure - about 4% of GDP. Fuel subsidy continues to eclipse other development spending. Nigeria's total allocation for education was about $2.2 billion in 2011 significantly lower than the 26% UNESCO recommended budgetary allocation for education. Similarly, healthcare allocation did not fare better as a result; Infant mortality in Nigeria remains unacceptably high at 90.4 per 1,000 live births. Generally, the $8 billion spent on subsidies in 2012 could have gone into capital

expenditure which the country is in need of. The artificially low domestic price of fuel gasoline in Nigeria costs $0.65 a litre compared to the West African average of $1.13 this has also discouraged investments in the downstream sector (Moyo & Songwe, 2012). Nigeria has issued about 20 licenses for the building of refineries yet not one has been built as a result of unstable fiscal policies and the difficulty in recouping investment under the current price structure.

Contribution of Africa to Global and Regional Refining Capacity and Growth

Currently, Africa has 42 refineries out of a global population of 689 refineries (7%). The average processing capacity of refineries in Africa is 70,000bbl/d lower than the world average of about 122,500bbl/d. Nigeria has four (10%) of African refineries. Over the past decade, its contribution to global refining capacity averaged 0.51% while contribution to Africa's refinery capacity averaged 14.2% (Richard, 2010).

According to the OPEC (2013), Africa had a refinery capacity of 3.3Mbbl/d, translating to 3.59% of the world total as at 2012. Refinery throughput was 2.2 Mbbl/d the equivalent of 2.89% of the world total. OPEC (2013) continues to emphasize the ongoing shift in future refining capacity from developed OECD regions to developing countries, especially those in Asia and the Middle East. There are more new refinery projects on the list than before, and overwhelmingly in developing countries. Most of these projects are concentrated in Asia as a result of increase in demand due to population and economic growth. While overcapacity in the refining sector persists globally, the prospect for demand increases in developing countries is attracting investor interest in building new capacity (OPEC, 2013). A review by (OPEC, 2013) estimates that around 7.5 Mbbl/d of new distillation capacity will be added to the global refining sector over the period of 2011-2015, with almost 50% coming from the Asia-Pacific and another 30% from the Middle East and Latin America.

With growing demand of around 1.5% per annum for refined products in Africa translating to a 2Mbbl/d increase by year 2035 over 2010 figures (OPEC, 2013), as well as the availability of local crude, which is being used to justify the campaign for more investments in Africa's refining industry, but due to local circumstances, only around 0.3Mbbl/d of new distillation capacity is estimated to be available by 2016, compared to the 2011 base. It is difficult to assess the prospects of the refining industry in Africa due to political and economic uncertainty in many African regions. The region's oil demand is growing and domestic crude oil is available in most countries that have announced refining plans. If all announced projects on the continent were counted, they would yield more than 7Mbb/d of additional distillation capacity. Nonetheless, there are not many projects that have a real chance for implementation within the next five-year horizon as a result of the uncertainties that typically surround investment proposals in the African region (OPEC, 2012).

Nigeria has sought partnership with Chinese investors to rehabilitate its refineries and to construct new grassroots plants. The initial plan called for three new refineries with a combined capacity of 750,000bbl/d. However, as of the completion of 2012, no final decision has yet been made regarding either capacity or timing (OPEC, 2012). Similarly, plans are underway to fully deregulate the downstream segment of the oil and gas industry while local investors are also eyeing the possibility of building their own refineries.

In absence of concrete data and reliable forecast, planned expansions for the country will amount to an additional 1.15Mbb/d of refining capacity for Nigeria based on NNPC and industry estimates. This, added to existing refining capacity and possible investment from the private sector, will result in approximately 2 million bpd of refining capacity for the country by 2016. In the worst case scenario, the NNPC plans to achieve an additional 1 million bpd of refining capacity by 2017. The lofty projections have however, been disparaged with the (IEA, 2013) reporting that significant increase in oil processing with the coming on of Asia and the Middle East as well as the current inefficiencies of the refining market and the present state of existing refineries will render the projections for 2017 unachievable.

Nigeria's contribution to regional and global refining capacity may thus remain static not only in absolute but also in relative terms even if capacity expansion forecasts are achieved. In view of additional investment in exploration-production and refining in 2012 capacity, medium-term operating capacity and projected oil demand, according to the IEA which foresees a downward trend in world oil demand over the long term, the situation is likely to continue to deteriorate until 2016 (Hureau, Serbutoviez, Silva, & Maisonnier, 2013). Table 1 shows proposed Nigerian refining capacity additions

Table 1: Proposed Refinery Capacity Additions

Nigeria's Refineries	Capacity (bpd) 2016
Dangote	400,000
Chinese Partnership	750,000
Greenfield Refineries	400,000
Existing Capacity	445,000
Total	**1,995,000**

Source: Computed from OPEC - WOO, 2012, IEA estimates, NNPC, Thisday Live, June 2012

Oil Products Demand and Supply Outlook to 2035

OPEC (2013) estimates that transportation will account for 61% of global oil use by the year 2035, petrochemical industry and other industries will account for more than one-quarter of all oil consumed, while households and agriculture, together with some consumption in the commercial sector, will contribute around 9%. A point further illustrated by table 2.

Table 2: Products Demand and Supply Outlook to 2035



Source: OPEC World Oil Outlook, 2013

Demand in Africa is projected to remain relatively strong over the entire forecast period, although increases in volume terms are less than 2 million bpd. Demand is expected to grow by 2.7% p.a. through to 2016, and then slow in the period thereafter. Meaning the average growth rate will fall to 1.2% p.a. between 2016 and 2035. Over the entire forecast period, growth will average 1.5% p.a (OPEC, 2012). Africa, however, currently

represents less than 5% of the global demand for refined petroleum products and, therefore, even at an above average growth rate, the annual average volume increases are below 0.1 million bpd. Total product demand will likely remain below 6 million bpd by 2035.

Gasoline and road diesel will continue to be the major demand drivers in Africa, followed by the use of LPG, mainly for cooking, and a still expanding demand for residual fuel oil. Indeed, Africa is the only region where residual fuel oil demand will not decline throughout the entire period, despite the effect of IMO regulations on marine bunkers (OPEC, 2012).

In 2005, it was estimated that households accounted for about 50% of the energy demand in Nigeria while the industrial and transportation sectors accounted for 30% and15% respectively. As the economy of the country grows and the country gets more industrialized, it is expected that the industrial sector will account for a larger percentage of the energy demand (National Technical Working Group on Energy Sector, 2009).
Odularu (2008) states that demand in Nigeria have been influenced by economic growth rate, increased vehicle activity and inadequate electricity supply. With a rapidly growing population, an affluent middle class, an upward trajectory in per capita car ownership growth and increasing demand for other means of transportation due to infrastructure developments and increasing industrial activities will push up demand for oil in Nigeria.
OANDO (2012), one of the major players in Nigeria's energy sector, forecast demand for light fuels in Nigeria to increase at around 3-4 percent per annum through to 2020. According to them, whilst this demand could theoretically be met by the nation's existing infrastructure and planned expansions, the result of current inefficiencies within the industry will result in continued heavy reliance on imports by the nation. The NNPC estimates that current daily demand for Petrol is about 30 million litres, Diesel 12 million litres, Kerosene/Jet fuel 10 million litres, Liquefied petroleum gas 192,000 Kg (NNPC, 2012).

Major Challenges Facing the Nigerian Industry

Odularu, (2008) argues that the oil sector has been plagued by various problems which undermined its development over the years. The author opines that public control and bureaucracy in the industry has resulted in inefficiencies, frequent delays in fulfilling payment obligations by government have discouraged funding of investments by oil companies which has also constrained adequate equipment maintenance and efficient refinery operations by the NNPC. Communal disturbances disrupt crude production as oil communities clamour for higher stake in oil operations. Smuggling and diversion of petroleum products across the borders in quest for foreign exchange and to take advantage of the lower domestic prices, as a result of subsidies vis-a-vis neighboring countries prices, fraudulent domestic marketing practices and product adulteration which

is largely encouraged by the price differential of some products and the proliferation of illegal sales outlets where some adulterations occur (Odularu, 2008). Similarly, inconsistent government policies and increasing social and political insecurity are major factors that hinder investment growth in the refining market.

The current inefficiencies within the refining industry will result in continued heavy reliance on imports by the nation. According to the World Economic Forum (2013), acute shortage of infrastructure, and low level of human development are factors that have contributed to Nigeria's relative lack of competitiveness in exploiting its resources. Nigeria also ranks low in terms of attractiveness to doing business, Property rights and Intellectual Property Protection. Favoritism in government decisions, and the high business cost of crime and violence are some of the areas which make Nigeria a relatively unattractive place for business.

Future Developments and Investment Opportunities

Still with an uncertain future, an important starting point for the refining market, according to the then country's minister for petroleum resources, (Madueke, 2013), will be the country's Energy Policy and the reform agenda for the oil and gas industry which is centered, though not exclusively, on the Petroleum Industry Bill. It is envisaged that over 80 regulations with differing complexity would be developed.

Another very important event in the horizon of the oil and gas industry is actually the direction the US shale oil and gas will take in the medium to long term. The impact of US shale oil can be seen in declining imports from Nigeria. This new realignment in the oil markets has not escaped the attention of the government of Nigeria, who has declared their commitment to finding new markets and processing most of local crude domestically to meet the growing demand for refined products. In other words, in the future, the Nigerian oil and gas industry may have to be domestically focused and the potential exists that, in order to meet domestic demand, all of governments equity crude will be dedicated to government refining and the only oil available for export (NNPC, 2012).

Further oil discoveries in the West African Region and other planned refinery investments in other parts of Africa are events that threaten the balance of Nigeria as an import dependent economy, increasing the likelihood of concentrating efforts on strengthening domestic demand and refining capacity while alternative energy is sought in LPG production through the implementation of the gas master plan.

Nigeria plans to upgrade existing refineries, build three new refineries, build new gas infrastructure (pipelines and central processing facilities), power plants, petrochemicals, fertilizer etc. in order to enhance linkages between the oil and gas sector and the wider Nigerian economy (Madueke, 2013). Media report of Dangote's plans to construct a

400,000bbl/d capacity refinery by 2016 is another possible medium term outlook for the sector. Companies with the technological know-how can undertake turn-around maintenance of refineries. Refineries consume a lot of chemicals and utilize a broad range of spare parts. There is tremendous scope for small scale joint venture manufacturing concerns with foreign technical partners. Such ventures can start warehousing arrangements that will ensure continuity of supply at competitive prices.

The Nigerian refining industry is inadequate to meet domestic demand. This can be traced to factors such as improper management of the state owned refineries, sabotage on feeder pipelines and also as a result of improper government policies leading to a dearth of private investment in the downstream sector. Although, attempt is being made to remedy this situation, it is doubtful if the lofty targets set by the Nigerian government can be achieved due to their poor implementation track record. Furthermore, in light of numerous objectives of the government, it remains to be seen if a new petroleum refinery is the step in the right direction towards meeting the country's developmental objectives.

Analysis and Interpretation

Findings in the previous sections have shown that despite Nigeria's 37 billion barrels proven crude oil reserves as at 2013, its population of around 170 million people (signifying potential high demand) the state of the downstream sector (especially the supply of petroleum products in the country as a result of earlier explained reasons) leaves a lot to be desired. This is particularly counterproductive to the developmental drive of the country as numerous studies have linked the consumption of energy to increased economic growth.

Assumptions of the CBA

The 2nd Port-Harcourt refinery principally process bonny light crude but is capable of refining more sulfurous and heavier crude varieties and allow for a daily refining capacity of 200,000bbl/d. The capacity figure was arrived at considering the 250,000bbl/d size of each of the proposed Greenfield refinery projects in partnership with China, Nigeria's 2012 refining capacity utilization, proposed TAM of existing refineries projected to increase utilization up to 90% and Nigeria's petroleum products demand. The oil refinery is the primary and highest input cost for the project. This research used already established cost of equipment, process utilities and calculation parameters of year 2005 posited by Gary, Handwerk, & Kaiser (2007) to estimate the cost in year 2012. This is made possible by the use of Nelson Farrar Cost Index. The annual cost index is published in the chemical engineering journals of each month. The Journal states that the plant cost index of year 2012 is 3.4% lower than it was in November 2011. According to Kaiser & Gary (2012) in the American Society for Testing and Materials (ASTM) (ASTM D2982, 2012) a crude oil refinery project for the European OECD region which this refinery project mirrors, is projected to cost around $15,000-$20,000 per bbl/d making the total

cost for the 200,000bbl/d refinery project to be around $3.5billion as the study used a mean of these figures, the total amount is comprised of engineering input costs (60%) and materials cost (40%) (Intergraph, 2011). The study assumed a Naira to dollar exchange rate of N158 to $1 and assumed a barrel contains 159 litres of liquid and assumed the kerosene yield is only for domestic purpose and that the refinery is treated as any corporate venture and so will be taxable. Tax is fixed at the corporate tax rate of 21%. The study also assumed the price of Bonny light to be $110 a barrel.

Main Findings and Analysis

The final product yield based on calculations from yield correlation graphs of Gary, Handwerk, & Kaiser (2007) after conversion from liters and expected revenue from the products using the unsubsidized product prices given by the Petroleum pricing (PPPRA, 2013) is given in table 3 below. The PPPRA prices are based on average Platts' prices for the month of August, 2013.

Table3: Calculation of Annual Income from Refined Product Using Unsubsidized prices

Product	BPD	BPY	$/barrel	$/year
TotalGasoline(PMS)	94,834	33191900	136.72	4537996568
Kerosene(DPK)	25,600	8960000	140.3	1257088000
Diesel(AGO)	40,800	14280000	144.21	2059318800
Light GasOil(LGO)	13,356	4674600	55.65	260141490
HeavyFuelOil(HFO)	4,284	1499400	126.35	189449190
LiquifiedPetroleumGas	7,357	2574824565	84.26	2169547179
Total	**186230 .64**	**65180724 .57**		**8520948766**
Crudeoilcost	200,000	70000000	110	7700000000
Operatingcost				232,649,890
Revenuefromsales				**588,298,876**

Source: Author's calculation; (Gary et al 2007), PPPRA

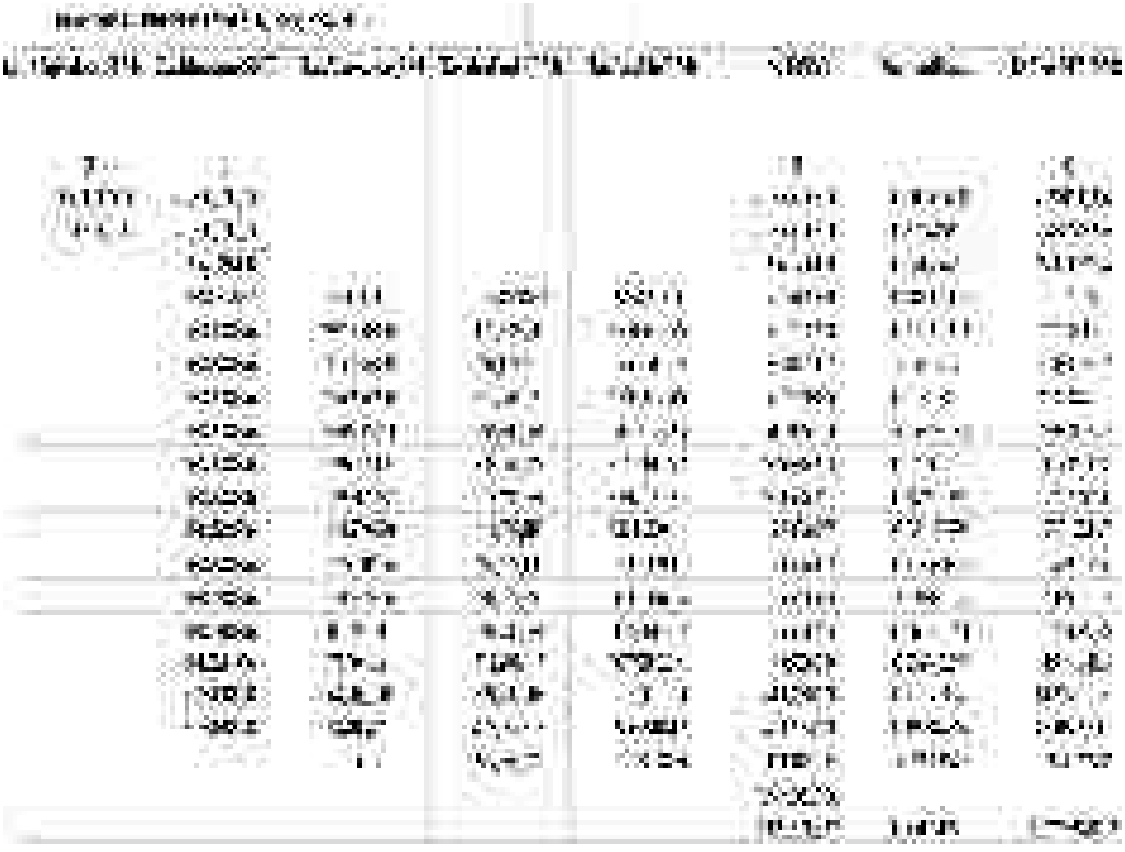
Table 4 on the other hand, shows expected returns using the subsidized price of petrol which are still enjoying subsidization.

Table4: Calculation of Annual Income from Refined Product Using Subsidized prices

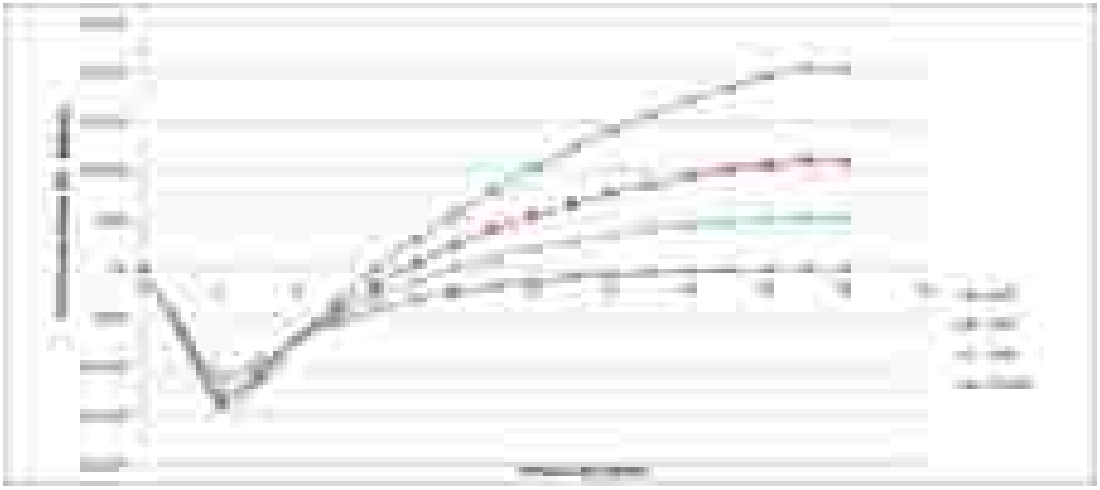
Product	BPD	BPY	$/barrel	$/year
TotalGasoline(PMS)	94,834	33191900	97.61	3239861359
Kerosene(DPK)	25,600	8960000	50.32	450867200
Diesel(AGO)	40,800	14280000	144.21	2059318800
LightGas Oil(LGO)	13,356	4674600	55.65	260141490
HeavyFuelOil(HFO)	4,284	1499400	126.35	189449190
LiquifiedPetroleumGas	7,357	2574824565	84.26	2169547179
Total	**18623 1**	**65180724 .57**		**6416592757**
Crudeoilcost	200,000	70000000	110	7700000000
Operatingcost				232,649,890
Revenuefromsales				**-1,516,057,133**

Source: Author's calculation; (Gary, Handwerk, & Kaiser, 2007), PPPRA

The NPV of the cash flows using a discount rate of 10% is $2.023 over the 18 year period. The cost of the refinery is $3bn. Net cash flow over the entire lifetime of the project is $3.89bn. The investor will receive a net positive economic benefit by developing a new 200,000 bbl/d capacity refinery at a cost of $3bn. The Discounted cash flow rate of return is obtained through trial and error method by working with different interest rate to bring the net present value (NPV) to zero is 28.52% per annum. The results of the cost benefit analysis show that it is profitable to build a refinery in Nigeria if products are sold at the international rates as given by the PPPRA. Selling at the subsidized prices will yield a negative net cash flow of $-1.247bn showing that it is not profitable to produce at subsidized rates. Figure 1 shows the effect of different interest rates on the NPV values of the project.



Source: Author's calculations.
Figure 1: Effect of different interest rates on NPV value



Source: Author's calculations.

However, it will be too simplistic to base such significant capital expenditure on positive/negative NPV or IRR figures. Summarily, the numbers show that there is no significant advantage to be gained from refining crude in Nigeria as the gross refining margins of around $7 is competitive with the global average of 6.3 for the past 10 years, meaning it will cost about the same to refine crude in Nigeria as obtainable in Europe. However, higher operating costs as a result of poor infrastructure will erode the advantages to be gained from the absence of shipping and associated costs of products from overseas refineries and make it significantly expensive. The investor also needs to solve the problems introduced by the supply infrastructure in the country. The easiest way this can be done is by using trucks to transport crude to the refineries. This situation will further raise the operating cost profile of the project.

Effects of Subsidy on Demand and Profitability

In deciding whether or not to embark on the project, the effects of subsidy on demand must also be evaluated. This is important as subsidies promote inefficient use of energy, leading to increased demand (Birol, Aleagha, & Ferroukhi, 1995). Perhaps, if removed, demand might be depressed enough that additional refining capacity will not be required.

Two characteristics of energy markets in developing countries, include oil exporting countries with high levels of subsidies on petroleum products and the low efficiency of energy use,"As a result, these countries have been witnessing a pronounced waste of their resources which are needed to fuel their development process (Birol, Aleagha, & Ferroukhi, 1995). Nigeria is no exception. Petroleum product subsidies are so high that they are beginning to threaten the fiscal stability of the Nigerian government (Aramide, et al., 2012). Losses related to fuel subsidies in 2011 was estimated at over $12.4 billion (Iba & Otti, 2011).

Nwachukwu and Chike (2011) found out that there is a positive direct relationship between fuel demand and fuel subsidies in Nigeria. Their research showed that fuel demand decreased by 0.886 units for every 1 unit increase in fuel price. This suggests that the demand for gasoline alone will be depressed by as much as 44% if fuel subsidies are removed. In real terms, the consumption reduction figures will be much higher, this is because Nigeria subsidizes petroleum imports at point of entry, as a result actual consumption figures remain cloudy as they are taken from amount of product that is imported. Whereas, about 8 million litres of refined products are actually not consumed domestically but lost to smugglers each day, who sell the products at higher rates to neighboring countries. According to (Jukwey, 2012); The implication of this reduction on consumption is that domestic production from refineries which has averaged around 20% capacity utilization over the past decade would be able to meet around 26% of consumption. If the proposed TAM is affected with refineries producing at around 90% of their capacity and subsidy removed, then domestic production will meet demand. This arguably is a more efficient use of resources; for one, the TAM is projected to cost around $3 billion against the 10 billion dollars the refinery project requires. Secondly, a new refinery project usually will take about 3 years to complete, meaning the country will still have to depend on imports pending its completion.

Subsidy also represents forgone revenue. The opportunity cost of subsidization is money that cannot be spent on other priorities. Petroleum product taxes form important revenue sources for other countries. Gasoline taxes have been such a success everywhere, because they answer all the requirements of efficient indirect taxation. Owing to the widespread use of the commodity it yields a magnificent return, and it does not kill the goose that lays the golden eggs. (Frankel, 1969). In fact taxes account for over 50% of the price paid for gasoline in the UK. Countries that subsidize not only lose the amount subsidized but also lose the additional revenue that would have accrued from taxes.

Other Factors Affecting Profitability

The supporters of the refinery project spearheaded by West (2012) argue that building a refinery is more economically efficient as it eliminates the middleman and its costs e.g transportation and other associated costs of petroleum products imported into the country and will guarantee security of supply of refined products. This argument is flawed; (Langlois, 2003) opines that it is always better to use markets when they are working well, arguing that it is better to let somebody specialize in what they do and trade with them. When markets for inputs are available, functioning and without high transaction costs or other problems, you're generally better off buying these inputs in markets than owning them yourself (Langlois, 2003). This is important as high oil prices affect the margins and profitability of oil refineries in a negative way eating into the margins of refiners. Owning a refinery would then increase the risk exposure of the country to oil prices. Other costs

that will be incurred that will come with the building of a new refinery comes with intangible variables such as experience. The experience curve posts some significant disadvantage to new entrants into the refining industry as unit costs tend to decline as the firm gains more cumulative experience in production (Porter, 1980).

Experience costs are nearly always greatest in the early and growth phases of a product's development, diminishing in later phases. In some ways, cost declines in the same manner as scale economies. Experience can lower costs in marketing, distribution and other areas as well as production or operations within production (Porter, 1980). Limited technical and managerial capability is partly to blame for the state of Nigeria's refinery with the NNPC's track record with existing refining infrastructure. It is doubtful if this situation will change with the building of a new refinery. One might argue that since Nigeria is a major crude oil producer, it can afford to provide crude below market rates to its refineries as voiced by West (2012). However, this is an economically sub optimum use of the resource as the country is better off selling at a higher price in the international market and buying the available cheap products. Furthermore, nothing stops the refiner from reducing utilization and selling the excess crude on the open market.

This section sought to analyze the key findings of the CBA to examine the economic viability of building new petroleum refineries in Nigeria to meet the shortfall in supply of refined products, although positive NPV values were obtained when the products are sold at competitive rates. On adjusting the product prices to reflect the actual pricing scheme in Nigeria, the project turns out not viable due to the negative NPV figures.

Based on the analysis, it is not economically viable for the Nigerian government to build a petroleum refinery. Although the investment will yield positive NPV figures, the opportunity cost of building a new refinery is in other infrastructural projects as the country's petroleum products supply is not threatened. Furthermore, when the product prices are aligned with the 2013 domestic prices in Nigeria, it becomes obvious that the subsidy policy has to be scrapped.

Conclusion and Recommendation

The research sought out to answer the question of the economic viability of a new Nigerian refinery to tackle problems of product supply. The research shows that a positive/negative NPV value is not enough to serve as sole decision criterion for the building of a new refinery. After comparing the costs per unit product of refining from the proposed refinery and the cost obtainable in the other refining centers, as well as other criteria such as the effects of the country's petroleum policy on demand and consequently consumption, it becomes obvious that the country is better off importing its refined product requirements since potential savings has been eroded by the higher refining costs due to inexperience.

Significant investment such as refinery stand to benefit the economy in numerous ways, for instance, a 450,000 refinery will create 9,500 direct jobs and 25,000 indirect jobs when completed (NNPC, 2012). However the costs of this project far outweigh the benefits especially as it is the consumption of energy that is important to economic growth and not the presence of a petroleum refinery. The subsidy program of the Nigerian government is unsustainable. Removal of subsidies will save the country over $10 billion which can be used to establish other infrastructural reforms that will spur economic growth and job creation in many ways the refinery will not. The country should also undertake massive improvement of its transportation infrastructure to improve product distribution of imported refined products.

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