Ph.D. Dissertation in Engineering

Performance Measure on Factors Influencing Production Capacity in Natural Gas Industry with Comparison to Gas Exporting Countries [GEC]

August, 2015

Ali Garba Ali

Technology Management Economics and Policy Program
College of Engineering
Seoul National University

Performance Measure on Factors Influencing Production Capacity in Natural Gas Industry with Comparison to Gas Exporting Countries [GEC]

지도교수 허 은 녕

이 논문을 공학박사 학위논문으로 제출함

2015 년 07 월

서울대학교 대학원

협동과정 기술경영경제정책전공

Ali Garba Ali

알리갈바의 박사학위 논문을 인준함

2015 년 08 월

위 원 장 ___________(인)

부위원장 ___________(인)

위　　원 ___________(인)

위　　원 ___________(인)

위　　원 ___________(인)

Abstract

Performance Measure on Factors Influencing Production Capacity in the Natural Gas Industry with Comparison to Gas Exporting Countries [GEC]

Ali Garba Ali

Technology Management, Economics and Policy Program

College of Engineering

Seoul National University

This research seeks to examine the productivity of Nigerian national gas company in comparison with the performance of other gas exporting/producing countries; Diamond, DEA and Regression model analysis was used to evaluate factors influencing production capacity of the sample countries [Algeria, Angola, Nigeria, UAE & Qatar] used in this research for comparative analyses, towards enhancing efficiency and performance in terms of production capacity, consumption capacity, net exports/imports, gas facility types and gross domestic product as a process of creating shared value [CSV] of investment opportunities, strengths, weaknesses and threats as shown around the four angles of diamond model

The approach of this research was modeled in three different concepts; **(i) Diamond** model was modeled towards sampling out the countries ranking in relation to all the factors used in the research analysis (dependent variable

[production capacity] and independent variables [consumption capacity, net export/imports, gas processing facility types and economic growth]) according to Porters diamond model analysis and approach, (2001) and also Porter & Kramer in (2006) & (2011) respectively. (See Table 6 & figure 27.2)

(ii) Efficiency amongst the gas exporting countries (GEC), relative to countries gas producing companies; is measured and captured using DEA (data envelopment analyses) as the process is charted using Malmquist index analysis where efficiency/inefficiency is captured according to ***Victor's , (2007)*** *approach****;*** ***DEA*** was used to analyze the performance of NOCs and that of IOC's empirically; using macro-level data and various performance indicators, 25 oil companies was introduced by Victor, (2007); with regards to his findings, IOC's tended to have higher production to reserves ratio. Eller et al. (2009 & 2010), he applied both DEA and stochastic frontier estimation (SFA) to a panel of 78 firms over three (3) years (2002-2004) to present empirical evidence for the revenue efficiency of NOCs and IOCs. His findings also justifies Victors findings, that NOCs are less efficient than IOCs, and in addition, that much of the inefficiency can be explained by the differences in the structural and institutional features of the firms, which may arise due to different firms' objectives.

This recent research findings also validates the findings of the previous literatures (Victor, 2007 & Eller, et. Al 2009-2010); with more emphasis on gas production capacity and with the view on both gas exporting countries and national gas companies, as such from the DEA scores obtained in this study, the IOGCs were found to be clustered near the frontier, with an average DEA efficiency score of 0.95 to 1.1, while the NOGCs, although dispersed throughout the study, tended to be clustered farther away from the frontier and with a score of 0.28, and the Nigerian National Gas Company (NGC) with a score of 0.25 [in the 4th Quadrant of the Malmquist Index analyses, see figure 29].

(iii) Regression model [panel data analyses] correspondingly review the value chain by analyzing the interdependence of the Oil and Gas industry in relation to gas production capacity and the impact of the value chain with regards to influencing factors (consumption rate/quantity, net exports/imports, gas processing facility types and economic growth) as independent variables. According to Hoff, (2007) regression analyses [panel data estimation] was used as an alternative paradigms for evaluating the economic consequences of production-related decisions with respect to the efficiency/inefficiency of companies. Hoff (2007) claimed that the Tobit and OLS approaches sufficiently represented DEA second-stage analysis in a case study for the Danish fishery. Banker and Natarajan (2008) also argued that OLS yields consistent estimates when the DEA scores are regressed on the variables influences. Simar and Wilson (2011), however, made some observations surrounding the restrictive assumptions underlying the reliance on these proposed methods and the data generating process for DEA second-stage analysis. Barros and Dieke (2008) measured the economic efficiency of airports and concluded that the second-stage regression proposed by Simar and Wilson (2007) better describes the efficiency scores. These two arguments notwithstanding, using panel data is expected to mitigate the negative concerns and to yield consistent estimates after carrying out the necessary, appropriate statistical tests. [45]As cited in Simar and Wilson (2011)

The steps outlined by Dougherty (2007) were followed in selecting the appropriate panel regression model. In this research analyses the selection of appropriate panel regression model was achieved using Hausman test accordingly. Were observations made in this study are said to be those of diamond model sampling and ranking procedure, from all the gas exporting countries (GEC) used in the diamond model I, which leads to efficiency measurement by using DEA model II. The 23 companies used for DEA analyses, were drawn from the gas exporting countries (GEC), that has similar production tendencies but different operational processes, as well as production capacities and capabilities; and they fairly represent the top and major players in the world's gas industry. Therefore, the fixed- and random-effects regression models were used. The Durbin-Wu-Hausman test was carried out to discriminate between the two models, and based on its results, the random-effects model III was provisionally selected for this research analyses. (See figure 32 & 33)

The data used in this research analyses was modified into all the three models consequently. Data was collected from the secondary sources largely through the use of electronic medium. Data was also conferred from various articles, journals and publications others include annual reports of International Oil & Gas Companies (IOGC's) operating in Nigeria and globally for genuineness.

The data collected was analyzed using the relevant statistical procedure, the use of coefficient, probability, chi square value, significant, means ($\bar{X}$) statistics, simple ratio and percentages in analyzing the data. Natural gas industry/country data for a span of 15 years [1999 -2014] was analyzed; the data was sourced from Nigerian National Petroleum Corporation [NNPC], in case of Nigeria and other countries data was generated from; IEA, EIA and World Bank data are equally utilize. Similarly; the data used are adapted to fit all the three (3) research models and analysis. (See figure 10)

The result vary among countries, which indicates a significant & insignificant relationship that has influence on the production efficiency of Nigerian national gas company as well as other gas exporting/producing countries [GEC] impacting on their economic growth and development of the gas sector (see figure 35, 36, 37 & 39). The consequences of this research findings can be employed to provide useful implications that can guide government's efforts of providing sound policies, conducive secured business environment and regulatory framework for energy efficiency and sustainable economic growth and development of gas exporters/producers.

The development of the value chain of the gas industry, extremely depends on Policy decisions such as Taxation, Licensing and Petroleum and Gas Contracts, Depletion Policy and Industry Participation; also Companies' vertical and horizontal integration choices are affected by country-level industrial policies and the related legal and regulatory frameworks. By creating shared value (CSV) a peaceful and harmonious business environment can be achieved hence, productivity will increased. One of the first steps of creating shared value is for the companies to define their core competence; by doing this they can fully exercise their strength towards value sharing with the society. Secondly government interference, politically or other-wise, should be highly mitigated towards more strategic and systematic approach.

Nigeria's attractiveness, when compared to other members of GEC is below average, this is largely due the weak business environment and related insecurity issues and weak or few supporting and related industries in the Nigerian gas sector. Another major factor that is keeping away FDI's is the delay in passing Petroleum Industry Bill (PIB) as a new fiscal framework of the gas industry by the government also contributes grossly to the inefficiency of NNGC, as analyzed using the research models in this study. Nigeria has the largest market size within the sampled countries but nevertheless this size is unable to translate to enhance value creation on the primary artifact, this is evident to non-participation of IOGC's in Midstream and Downstream of the gas sector.

Infrastructural development and Good Governance are the key factors for economic growth in developing countries and also through Bilateral and Multilateral co-operations as well as cohesive collaboration amongst the gas exporting countries/firms (GEC) and consumer countries can reveal great accomplishment.

Keywords: Economic Growth, Production Capacity, Export, Collaborative System (CS) amongst the Gas Exporting Countries (GEC) & Consumers

Student Number: 2012 – 30753

Abbreviations

Abbreviation	Meaning
CBN	Central Bank of Nigeria
CSR	Corporate Social Responsibility
CSV	Creating Shared Value
CCS	Corporate Collaboration System
CGS	Corporate Governance System
GDP	Gross Domestic Product
IOGC	International Oil & Gas Companies
NDDC	Niger Delta Development Commission
NNPC	Nigerian National Petroleum Corporation
NGC	National Gas Company
GEC	Gas Exporting Countries
SOE	State Own Enterprises
UNCTD	United Nations Conference on Trade and Development

Contents

Abstract..……………………………..…………………….………………..……....…....i

Abbreviations ………………………………………………………………….......…viii

Contents..……………………………..…………………….………………..……....…...ix

List of Tables ..…………………………...……………………...……………….......xii

List of Figures. ………………………….....……...………………...……………..…xiii

Chapter 1: Primer. ……………………………..……………………..………… 17

1.1 Background Motivation……………………...……………………... …………17

1.2 Problem Describtion 21

1.3 Research

Objectives... 22

1.3.1 Research Questions..23

1.3.2 Research Hypothesis. 25

1.4 Methodology…………………………....……………………...…………….. 25

1.5 Contribution…………………………....……………………....……..……...25

1.6 Overview of the Study.. 28

1.7 Overview of Gas Exporting Countries [GEC] 31

1.8 Natural Gas Production Prospects amongst the GEC...33

1.9 Nigerian Gas Sector and Economic Growt..35

Chapter 2: Literature Review................................. 48

2.1 Diamond Model ……………………………..……………………..…………48

2.2 DEA…………………………...……………………...…...………………… .. 67

2.3 Econometric Analysis……………………...……………………. …...…...71

Chapter 3: Diamond Model.............................. 79

3.1 Model Approach. …………………..……………………...………….....……... 79

3.2 Model Analysis………………...……………………...……………..……...…79

3.3 Model Result Analysis………………...……………………...………….……..82

3.4 Model Result Summay.............................. ....…........86

Chapter 4: Econometric Analysis 87
4.1 Analyses Using Panel Data Approach 87
4.2 Model Approach 89
4.3 Model Modification & Specification 90
4.4 Three (3) Postulated Models 99
4.5 Result Summary 106
4.6 Auxiliary Discussion 107
Chapter 5: DEA [Data Envelopment Analysis] 110
5.1 DEA Model 110
5.2 Model Modification & Equation 111
5.3 Data Describtion 117
5.4 Result Analyses 118
5.5 Result Summary 122
Chapter 6: Comparative Analyses 123
6.1 Global Analyses of the Energy Industry 123
6.1.1 LNG Export Trend to Europe & Asia 125
6.1.2 Utilization Ratio amongst GEC 127
6.2 Global Gas Market Analysis 128
6.3 Analysis of the Oil & Gas Industry Value Chain of Nigeria 130
6.4 Financial and Production Linkages 156
6.5 Algeria 165
6.6 Angola 171
6.7 Nigeria 176
6.8 Qatar 186
6.9 UAE 192
6.10 Comparative Analyses of Countries Result 198
Chapter 7: Summary & Policy Implications 203
7.1 Summary 203
7.2 Recommendation 208

7.3 Policy implications ……...……...........…………………………….……...………….210
7.4 Suggestion for Future Research Focus……...……...........…...........…...……….212
7.5 Research Limitation ……...……...........……..........……………………….……….212
Bibliography......…………………...…....….....................….....……………………...…...**213**
Appendices.........…………………….......……………………....…...……….…..…………..**235**
Appendix A-1 Regression Analysis ….. ….............235
Appendix B-2 DEA ....……...…………………….. …………243
Aknowlegdment..….............**244**
Dedication...……...……**245**
Abstract in Korean (초 록)...**246**

List of Tables

Table 1: Diamond Model on African Producers...............……............……......84

Table 2: Summary of Diamond Model Score & Ranking.....................................86

Table 3: Regression Independent Variable............................. ....…...................94

Table 4: Lessons on Literature Review................................ ....….................95

Table 5: Comparison of Estimated Result...106

Table 6: DEA Model Sample...................................... 120

Table 7: All Categories Mean% on DEA Analyses..120

Table 8: Mean %of Each Category of DEA Analyses............ 121

Table 9: Export Elasticity to Europe & Asia......................... 127

Table 10: The Key Stakeholders in Nigerian Oil and Gas Sector..........................132

List of Figures

Figure 1: Global Gas Producers [GGP]..20

Figure 2: World Gas Volume in Cubic Meters.......... 20

Figure 3: Gas Pipeline Network in Sub-Saharan Africa..21

Figure 4: Dissertation Structure...31

Figure 5: Raw GEC Data Chart..32

Figure 6: LNG Import Quantities to China…. 33

Figure 7: LNG Pricing on GEC Countries .... .34

Figure 8: Corporation Classification 53

Figure 9: Improving Business Environment: The Diamond…...............................58

Figure 10: Enablers and Indicators of Competitiveness..............................…........59

Figure 11: Determinants of Competitiveness....................................…..................59

Figure 12: Stages of Competitive Development………........………….........….60

Figure 13: Diamond Model...…...80

Figure 14: Porters National Diamond...80

Figure 15: Diamond Model on GEC Ranking I............................…....................82

Figure 15.1: Diamond Model on GEC Ranking II 83

Figure 15.2: Diamond Model on GEC Variables ....…....83

Figure 16: Diamond Model on GEC African Producers 84

Figure 16.1: Single Diamond Model on Nigeria ....….................84

Figure 16.2: Double Diamond Model on Nigeria ....….....85

Figure 16.3: SWOT Analyses on Nigeria.......................................…...... …..............85
Figure 17: Literature on OLS, SFA & DEA............ …......................…...............89
Figure 18: Panel Data Approach............................ …......................................…...93
Figure 19: Modelling Procedure...............................…...............................…...94
Figure 20: Lessons from Previous Empirical Studies..…...................................…...95
Figure 21: Variables Selection................................. …..................................…...96
Figure 22: Typical Production Fracture...........................….........................…......96
Figure 23: Economics of Scale...................................….........................…......97
Figure 24: World LNG Exporters...................................….........................…......97
Figure 25 Productivity Possibility Curve/Create..............….................................98
Figure 26: Productivity Possibility Curve/Create............. ….................................98
Figure 27: Summary of OLS Model ....…...................….......99
Figure 28: Fixed Effect Estimation ....….............…......100
Figure 29: Random Effect Estimation ....…..........…......100
Figure 30: Panel Data Test...…...............…......101
Figure 31: Hausman Test for Fixed & Random Effect Estimation ....…...........101
Figure 32: Summary of Fixed & Random Effect Estimation...............….....….......102
Figure 33: Random Effect Estimation Model II ....…........…....102
Figure 34: Estimation Graph of Major Exporters of GEC...............….........…....103
Figure 35: Estimation of Algeria & Nigeria............................…..........................103
Figure 36: Minor Producers of GEC...…......104
Figure 37: Summary of Major and Minor Producers of GEC..........................…....104

Figure 38: Final Diagnostic Checking on Random Effect 105
Figure 39: Estimation of Model Elasticity Effect ....….......105
Figure 40: CCR & BBC Models...112
Figure 41: Out Put & Input Ratio...…......115
Figure 42: DEA Malmquist Catch Up...….......116
Figure 43: DEA Malmquist Index Graph ....….......119
Figure 43.1: DEA Static Mean Score Chart...….121
Figure 43.2: DEA Static Mean Spread Chart 122
Figure 44: Transmission Pipeline Network...128
Figure 45: Global Natural Gas Major Trade Movement...............................129
Figure 46: Petroleum Value Chain 140
Figure 47: Porters Value Chain.......................................…......................159
Figure 48: Drilling Rig in Algeria...................................….......................165
Figure 49: Dry Natural Gas in Algeria..169
Figure 50: Algeria's Natural gas Export..171
Figure 51: Angola's Natural Gas 174
Figure 52: Total Primary Energy ....…..178
Figure 53: Natural Gas Production 180
Figure 54: World Top Natural Gas Flaring Countries 182
Figure 55: Nigerian LNG Exports...................................…....................183
Figure 56: West African Gas Pipeline..185

Figure 57: Qatar's Natural Gas Flows...188

Figure 58: GEC Natural Gas Exports...192

Figure 59: Top 10 Natural Gas Re-injecting Countries...............................194

Figure 60 UAE Natural Gas Flows...195

Figure 61 UAE Natural Gas Production...196

Figure 62 UAE Natural Gas Imports & Exports.......................................198

List of Eqautions...viii

Equation 4.0 110

Equation 4.1 111

Equation 4.2 112

Equation 4.3 112

Equation 4.4 113

Equation 4.5 114

Equation 4.6 114

Equation 4.7 114

Equation 4.8 114

Equation 4.9 114

Equation 4.10 114

Equation 4.11 114

Equation 4.12..114

Equation 4.13..115

Equation 4.14..116

Chapter 1. Primer

This dissertation deals with an econometric specification and the estimation of dependent and independent variables using three (3) different model approach; namely: Diamond Model I, DEA Model II and Regression Model III. This Chapter introduces to the bibliophile a general overview of this dissertation. It starts with an introduction related to some major Gas Exporting/Producing Countries [GEC] and Nigeria's global energy requirements and objectives; and then explicitly states the problem and purpose of the research.

1.1 Background Motivation

The current drastic decline of **oil price** to less than ***$50 per barrel*** globally (from 27th of November 2014 to date [9th of January 2015]), has made it essential for the gas exporting/producing countries [GEC] to wake up to the challenge and clearly distinct **gas price** form oil price; as it is acknowledged that oil price determines the gas price.

The above mentioned basic fact has add up to this ***research motivation, towards analyzing and comparing the countries results obtained from this study; in relation to the factors that influence the production capacity in some major gas producing nations like Algeria, Angola, Nigeria, Qatar and United Arab Emirates***. Where most of this countries used in this research study are also amongst the OPEC countries.

Nigeria's objective is aligned with global energy requirements and enhancing gas production, transmission and distribution network globally and across the sub-Saharan African nations. Therefore, focuses on delivering significant capacity additions in utilizing gas domestically and mitigating CO_2 for clean environmental concerns to meet domestic and international demand growth economically. Specifically, the target is to create as much revenue from the use of fossil fuels within the decade, and to leverage natural gas as fuel [due to its clean natural form] to power and catalyze sustainable economic growth and development; Whilst addressing environmental issues, developing the domestic gas market structure and stimulating industrial synergies both locally and internationally.

Natural gas will remain the fastest growing major energy source, overtaking coal as the second-largest global energy source behind oil, serving as a reliable, affordable and clean fuel for a wide variety of needs with less CO_2 emissions. **[EIA 2014 & BP Outlook 2014]**

Natural gas is promptly gaining in geopolitical significance which is use as substitute by manufacturing industries for cleaner environment. Gas has developed from a negligible fuel consumed in regionally disconnected markets to a fuel that is transported across great distances for consumption in many different economic sectors. Increasingly, natural gas is the fuel of choice for users seeking its relatively low environmental impact, especially for electric power generation. As a result world gas consumption is projected to more than double over the next three decades, exceeding coal and other sources of energy, as the world's second energy source and potentially surpassing oil's share in many enormous industrialized economies.

Currently, most natural gas is transported by pipeline networks in North America and Europe, which connect consumers to production areas and provide an important clean source of energy. It is postulated that demand for natural gas for power generation is expected to rise by **85% from 2005 to 2030** when natural gas will provide more than a quarter of the world's electricity essentials. Natural gas demand is rising in every region of the world, particularly **China**, where demand in 2030 will be approximately six times what it was in 2005. Which brings about the need for China to acquire more gas from **Russia** through the current gas supply transmission pipeline of about **38bcm/y**, deal agreement in **May 21st 2014**.

Gas price aggressions as experienced in the former Soviet Union and the recent nuclear disaster in Fukushima Japan has made it imperative for the Gas Exporting Countries (GEC) to take decisive actions towards integration of the gas production capacity, market structure, performance and conduct, as well as its sustainable stability, economic growth and development. **[Doha submit Nov. 2011]**

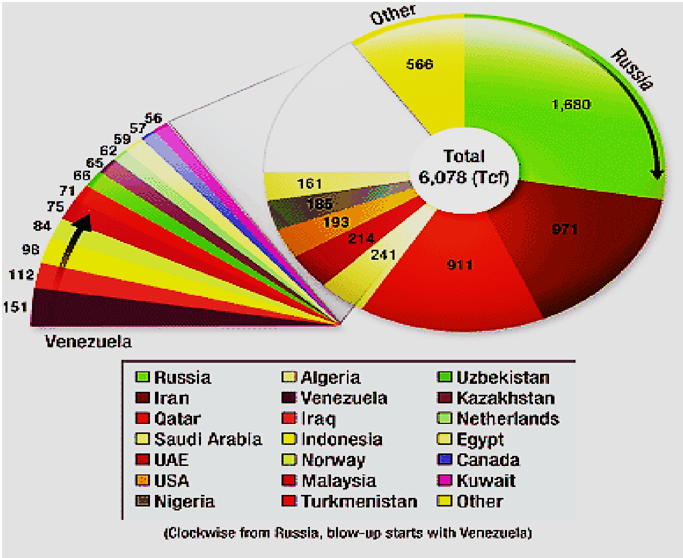


Figure 1: Global Gas Producers [GGP].

(Source EIA)

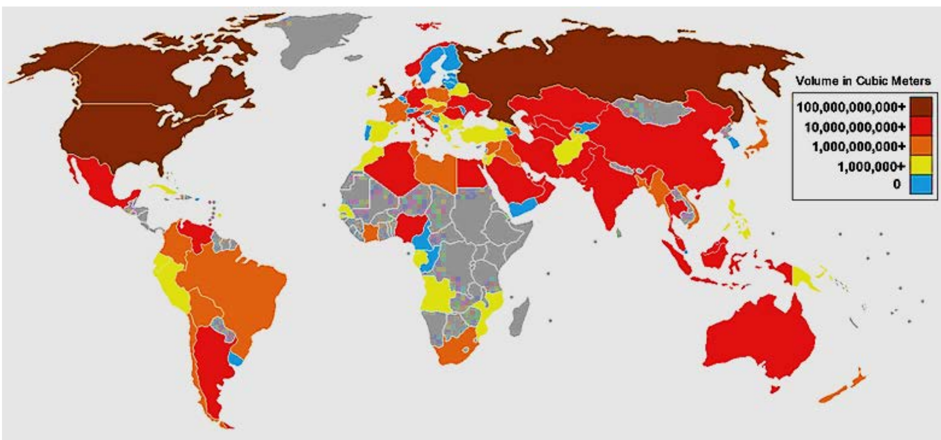


Figure 2: World Gas Volume in Cubic Meters

(Source EIA & GEC)

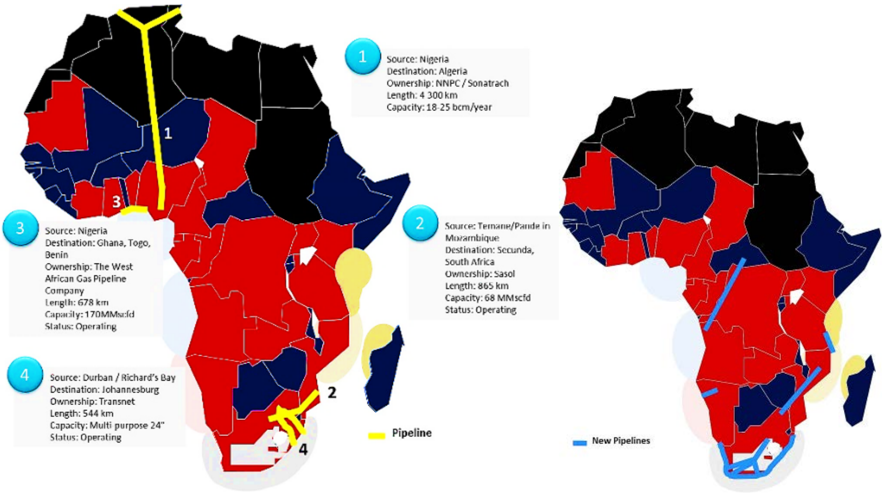


Figure 3: Current & future activities of the Sub-Saharan African Gas Pipeline Networks

(Source SAOGA)

1.2 Problem Description

The steady increase in the demand for energy leads to an increase in energy production ratio to meet up with the global essential requirements for energy processes. According to EIA, IEA BP Exxon Mobil and GECF (2014), it is estimated that the global growing demand for natural gas will increase by 60% to 75% higher by 2040 than it was in 2010. Taking into consideration of the energy demand increase globally, as one reason amongst numerous other motives, should direct and focus the attention of gas exporting/producing countries [GEC], industry players and stakeholders towards redirecting production related concerns, procedures and policies; with the view to boost production ratio with keen interest on the gas price with reference to ***OPEC recent***

decision on agreeing to oil price decline and maintaining or increase production rate (28th November 2014), presently the oil production rate is higher than the demand in the market share.

The decision makers within the GEC need to understand that the importance of energy in the residential sector, service sector, industrial sector and all other sectors of the economy, necessitates vital production increase to meet-up with their demands, which can give the GEC an innovative progression of assessment and formulating measures that can overcome production related influencing factors.

Similarly the GEC ought to be considerate in determining the gas price. Not the contrary [oil price determines the gas price]. It is also essential to acquire knowledge about the energy demand and its physiognomies, such as the potential substitutability between energy and other factors of production related influencing factors. (Dargay, 1983; Koetse, de Groot, & Florax 2008)

1.3 Research Objectives

- To determine which factor have significant influence on the production performance amongst different challenging factors

- To determine the relationship between dependent and independent variables and to empirically investigate the influence of gas production capacity on economic growth.

- To link recognized slit in the literature by examining influencing factors of production performance among the influencing factors used in this study, from the perspective of developing countries with the view to compare and analyzed among the GEC and likewise recommend policy implications that can guide informed policy making in the GEC.

1.3.1 Research Questions

Based on the above-mentioned concerns, the study endeavors to come up with answers to the following research questions;

1. How can efficiency level of gas producers be measured in terms of their contribution to the economic growth and development of the country?

2. How efficient is Nigerian National Gas Company [NGC] compared to other state-owned companies in the gas exporting countries [GEC]?

3. How has NGC developed dynamically through the years with respect to efficiency and productivity?

4. What possible policies can be prescribed to enhance NGC's efficiency and productivity?

5. What are the unique competitive position of Nigeria given its location, legacy and existing /potential strengths?

6. What are the effects of Creating Shared Value on National Competitiveness and Value chain?

1.3.2 Research Hypothesis

- Efficient Production rate will yield more benefits to the national effectiveness of all the gas exporting countries, and also attract FDI to invest in the gas sector.

- Factors enhancing production efficiency has positive significant effects on the economic growth and development of gas exporters/producers.

- Domestic gas production and utilization has significant effects on the growth of Nigerian economy and other gas producers/exporters.

1.4 Methodology

This research technique adopted three (3) stage approach for the study; namely ***Diamond Model I, DEA Model II and Regression Model III***; which follows the approach of previous literatures (Porter & Kramer [2006 & 2011], Victor [2007], Al-Iriani and Al-Shami [2011], Mercer-Blackman (2010), & Hoff [2011]); there-by each model estimated results and comparative analyses is explained and discussed in detailed with regards to previous literatures. (See Chapter 2 Literature Review, Chapter 3 Methodology Approach & Data Analyses and Chapter 4, 5 & 6 Result Analysis).

1.5 Contribution

Energy is regarded as an essential commodity in the global perspectives, specifically as the major driver of the creative or in other words innovative economy. It is also an important factor in the production process, as it can be used directly to produce final goods and services. The intensity of energy use in the modern production technology is a critical issue, as the modern production technology is often using energy in an intensive dynamic system (Stern, 2011; Zahan & Kenett, 2013).

Input factors of production in economic theory are often divided into two main components. The primary components, or so called production factors, which consist of factors of production that are Land, Capital & Labor inputs, while the secondary production factors are resource inputs and supplied services, which are what is used in the production process in order to produce output that is finished goods. The amounts of the various inputs used, determine the quantity of output according to a relationship called the production function. Energy as an intermediate input factor influences changes in productivity, while the efficiency of energy use will impact both single and multiple, or total factor productivity (Dimitropoulos, 2007).

The Contribution of this quantitative research is to examine the different input factors in the production process for Nigeria in Comparism to Algeria, Angola, Qatar and UAE as gas producing nations. A special emphasis is placed on the relationship between production capacity, consumption capacity, net exports/imports, gas facility types and economic growth [GDP] as well as the influence of this relationship on production capacity growth of all the sample countries used in this study. The elasticity of inputs factors and estimated outputs are pragmatic and studied using panel data approach with descriptive statistics to identify and define the specific independent variables that significantly relate to the dependent variables (Kander & Schon, [2007], Hoff, [2007] Gibson, & Kim, [2008], Mercer-Blackman [2010], Al-Iriani and Al-Shami, [2011]).

This research can be useful to assess and determine the level of production growth and increase, and also to identify the level of impact of the influencing factors used in this study, either significant or insignificant; as well as in decision making processes by the gas exporting countries [GEC].

To date, only Eller et al. (2009), Xun et al. (2011), Ike C. & H. Lee, (2013), have used the DEA method to evaluate the efficiency of the differences between IOCs and NOCs. Eller et al. (2010) obtained consistent results with another method (SFA), while Xun et al. focused on the NOCs in their study, and Ike & Lee focus on both 38 NOC's and IOC's in similar approach.

In the same manner of approach from previous literatures, the present research sought to apply the DEA and Regression method to an efficiency comparison of IOGCs and NOGCs by splitting them into four categories, as will be explained in the "Results" fragment. Therefore, the present research builds on previous research literatures; but differs from them in many respects.

First, as of present this is the only research focusing specifically on the Gas Exporting/Producing Countries [GEC] in relation to efficiency and significance of the influencing factors to production capacity amongst the gas producers in the GEC used in this current research study. The main purpose of this research was to derive procedure and recommendations, especially for NNGC/NGC. Therefore, rather than just focusing on the efficiency score or estimated effects, and the position of the DMUs, more attention was also given to the qualitative explanations of the reasons behind the observed efficiency and inefficiency as well as the influencing factors used in the research for investment decision making, (Porter & Kramer 2006 & 2011) and Eller et. al., (2009 & 2010), where he added that the measure of inefficiency scores from the DEA and Regression analyses of the NOC's compared to IOC's can be explained by the differences in the structural and institutional features of the firm's which may arise due to different firms objectives.

Secondly, this appears to be the first Diamond, DEA and Regression time series analysis of NOGCs and IOGCs using very recent data, thereby providing more useful insight regarding the matter. Although Eller et al. (2010) had three-year data (2002-2004), while the current research used fifteen (15) years data (1999-2014), they studied only the efficiency of each firm for each year, and they computed the averages; they did not consider the production changes from one firm to another, neither do they compare the production capacity among or between firms and they did not make a comparative analyses between the observed companies as well.

Finally, this research uniqueness is relating the four essential factors of diamond business model (Porter 1990) with statistical econometric models DEA and Regression analysis empirically, (Victor, (2007) and Hoff, (2007)). Even though the study has an international outlook, the research comparative analysis and outcome are more relevant at the national level. While the previous researches focused their results interpretation on the general understanding of the oil industry, (instead of gas industry as it is used in this research), using the DMUs in their sample; however the present research sought to focus more on production capacity and the influencing factors, with regards to natural gas producing nations/firms and to provide details on NNGC/NGC's performance, among the GEC DMUs.

1.6 Overview of the Study

This dissertation is structured into seven chapters. It is organized as a monograph consisting of chapters that are interrelated and sequentially developed into a final product. Following this primer chapter which provides a general introduction of this research, in which background motivation, problem statement, research objectives, questions and hypothesis, as well as slit of the research methodology, contribution of the research and overall outline of the research structure, natural gas industry in Nigeria and economic growth, why invest in the Nigerian gas industry and related concerns are articulated in the primer chapter.

Chapter two reviews an in-depth relevant literature pertaining to this dissertation. It is divided into three different literatures and their development over time, focusing on production performance related approaches that where applied in this study. It also includes the historical review of developing the three models used in this research. This chapter significantly supports this research in identifying the contribution made in this current study and finally ascertains the significance of the research in relation to the research objectives, questions and hypothesis to be tested.

Chapter three deals with the raw data and provides the methodology applied in this dissertation.(Diamond Model) The general theoretical model is specified with regards to sampling strategy, ranking and scores of the GEC raw data and research equations. It then analyzes the production capacity in relation to validation of the results and co-linearity amongst all the countries in the GEC with regards to each model approach. The algorithm for the estimation of the models (Diamond, DEA & Regression Analyses [Panel data]) is then presented in chapter four of this study.

Chapter four econometric analyses presents the econometric specifications of the estimation results from all the three (3) models used in this research; specifically DEA and Panel data approach using random effect model estimation, elasticity estimation and cross sectional correlation amongst the countries and variables used in this research analyses, it will also respond to the research questions and hypothesis to be tested, accordingly. As postulated at the initial stage of this research analyses as the input components that are used to develop the entire research concepts and techniques in relation to previous literatures, studies and their methodology approach respectively.

Chapter five analyze the DEA model used in this research, performance of the NGC's in comparison to IOGC's is measured in terms of efficient and inefficient oil and gas companies operating in the GEC. It also indicates the scores of each company category amongst the GEC used for this research study.

Chapter Six identifies the comparative result analysis of all the GEC countries used in this study and also specifies each country analyses with regards to natural gas industry, production, consumption, exportation and reserves ration; as well as the natural gas market structure, current and future projects in the natural gas sectorial developments and procedures in the natural gas industry over time.

Chapter Seven shows the summary of all the results from the three models used in this study, which are presented and discussed in this chapter of the study. It is also the final chapter of this dissertation effort. It provides summary of this research, by summarizing the estimated models and discussing the relevant implications based on the estimated results of this study. In addition, policy recommendations and suggestions for further and future research are proposed, (*Figure 4 shows the summary of the dissertation structure*).

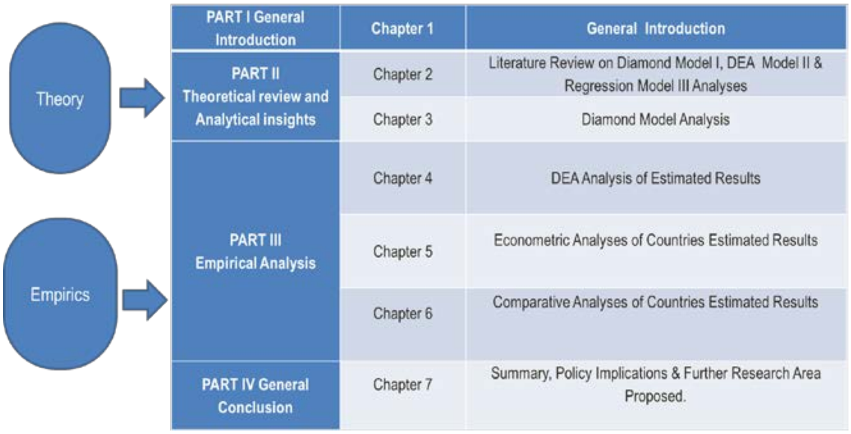


Figure 4: Dissertation Structure

1.7 Overview of Gas Exporting Countries [GEC]

- The Gas Exporting Countries Forum (GECF) is a gathering of the world's leading gas producers and was set up as international governmental organization with the objective to increase the level of coordination and strengthen the collaboration among Member countries (See Tbl 1 & Fig. 5).
- GECF also seeks to build a mechanism for a more meaningful dialogue between gas producers and gas consumers for the sake of stability and security of supply and demand in global natural gas markets.
- The 2nd Ministerial Meeting (02/01/2002) in Algiers emphasized the importance of dialogue and co-operation between producers and consumers to ensure the development of the gas industry, to meet the requirements of the world markets

under the best possible conditions without any prejudice to the interest of any of the parties.

- ❖ Additionally the GECF Expert Meeting was instructed by the Ministers to develop a database of gas projects and contracts terms & conditions as well as specific studies such as new gas utilizations and associated costs.
- ❖ The GECF constitutes of 12 member countries of the forum, which are: Algeria, Bolivia, Egypt, Equatorial Guinea, Iran, Libya, Nigeria, Qatar, Russia, Trinidad and Tobago, United Arab Emirates and Venezuela. While, Kazakhstan, Iraq, Netherlands, Norway and Oman have the status of Observer Members. [source: 2014 Gas Exporting Countries Forum]

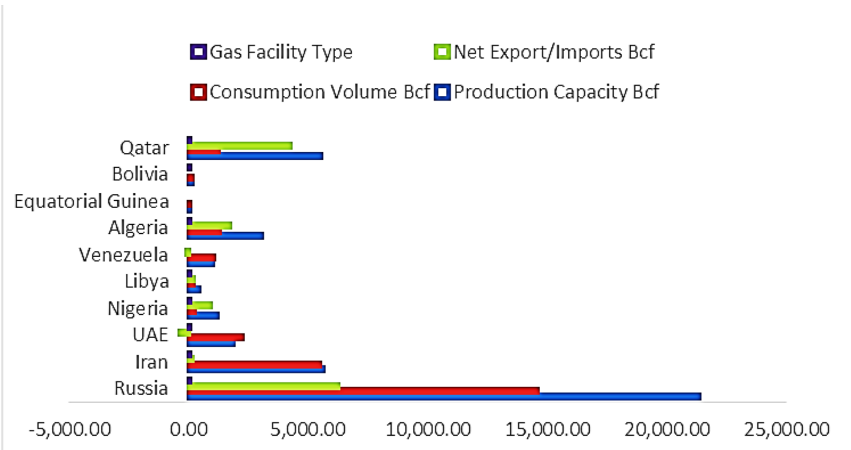


Figure 5: Raw GEC Data Chart

1.8 Natural Gas Production Prospects amongst the GEC

At present, China has 10 major LNG receiving terminals in operation, namely, the Guangdong Dapeng, Fujian, Shanghai, Zhejiang, Zhuhai, Tianjin FSRU, Jiangsu Rudong, Dalian, Tangshan and Hainan receiving terminals. Together these terminals have a regasification capacity of about 35 MTPA. In 2013, China's largest LNG suppliers were Qatar, Australia, Malaysia and Indonesia. Set out below is the breakdown of LNG imports supplied from various countries in 2013[6]. Almost all the countries that supply LNG to China are members of the GEC.

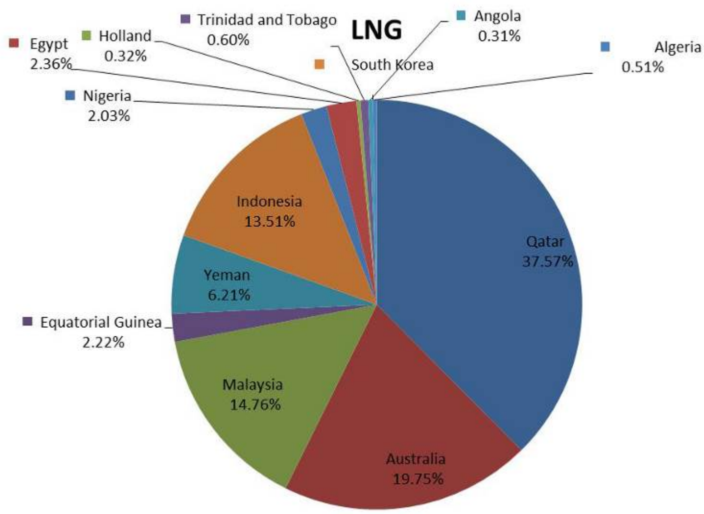


Figure 6: LNG Import Quantities to China

[Source: China's Maritime Customs Data 2014]

Pricing Pipeline Gas and LNG

In 2013, the average price of LNG imports into China was reportedly US$ 13.8 per MmBTU. The cheapest LNG cargoes were Australian and Indonesian LNG cargoes with an average price of US$ 3 to 4 per MmBTU. In contrast, the average price of cargoes from Qatar (which was China's biggest LNG supplier in 2013) was US$ 17.32 per MmBTU. In this respect, one reason for the pricing divergence is that Australian and Indonesian LNG are likely supplied under earlier and more advantageously priced long-term SPAs (*i.e.*, supplies from the Australian North West Shelf project and the Indonesian Tangguh projects [7]).

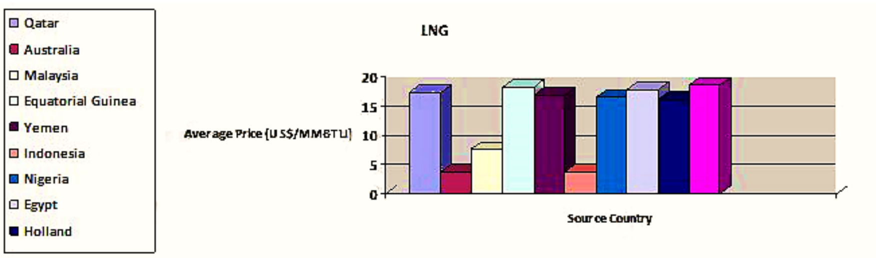


Figure 7: LNG Pricing

[Source: China's maritime customs data 2014]

1.9 Nigerian Gas Sector and Economic Growth

The current estimated gas reserves of 187 trillion cubsic feet, Nigeria holds the ninth (9^{th}) largest gas reserves in the world and the largest in Africa. Despite these vast gas reserves, the domestic gas market is generally under-developed and a significant percentage of available natural gas is either exported as liquefied natural gas [LNG], re-injected to enhance oil recovery (where gas is found in association with oil) or simply flared.

The Nigeria economy which is heavily dependent on oil revenue has had a disproportionate low contribution to GDP (30%) and economic development as the industry has hitherto not driven commensurate economic activity. Addressing this disconnect therefore became essential. In 2008, the Federal Government of Nigeria (FGN) issued the Nigeria Gas Master Plan (the Plan) to address impediments to the development of the domestic gas sector, engender the monetization of gas, reduce gas flaring and assure long term gas security for Nigeria.

The Plan seeks to achieve these objectives through a roadmap for transformation of the Nigerian domestic gas market into a full market driven industry by year 2015 through the overhaul of the regulatory regime, the development of sustainable commercial frameworks and the procurement of essential infrastructure.

As part of the Plan, the FGN issued the National Gas Supply and Pricing Policy and the National Domestic Gas Supply and Pricing Regulations. The Policy and the

Regulations provide for the imposition of a Domestic Gas supply Obligation (DSO) on all gas producers, requiring them to set aside a predetermined portion of their gas production for supply to the domestic market.

The Policy categorizes the domestic gas market into three broad groups requiring special regulated pricing regimes, to wit: (i) power subsector, (ii) strategic industrial subsector, that use gas as feedstock (e.g., methanol and fertilizer producers); and (iii) strategic commercial sub-sector (e.g., cement and steel manufacturers). Different regulated pricing frameworks apply to each of these categories, with the expectation that there will be eventual graduation to a pricing regime led by market forces. Suitable policies and regulations can also provide the establishment of an aggregator responsible for determining aggregated gas prices to be paid to gas producers for gas supplied to the domestic market.

The aggregator will also manage the operationalization of the DSOs [domestic supply obligations] by ensuring the allocation of gas supplied under the DSO regime to the various sectors of the domestic market and ensuring that minimum aggregate domestic gas price that tracks the transition to export parity is achieved; serve as an intermediary between domestic off-takers and gas producers by managing the receipt of revenues from the various sectors receiving gas supplied and effecting payment of the aggregate domestic gas price to the gas producers, and manage the implementation of all revenue securitization arrangements.

The Plan also consists of a Gas Infrastructure Blueprint (the Blueprint), which details proposals for private sector participation in the development of infrastructure required to support the domestic market. Under the Blueprint, Nigeria is divided into three franchise areas, within which franchises will establish central processing facilities (CPFs), transmission and interconnection infrastructure for distribution of gas to off-takers in the domestic market.

As part of the roadmap issued by the FGN in August 2010 for reforms in the decrepit power sector, the FGN intends to develop policies and provide incentives for the exploitation of stranded gas locked up in various fields and for the development of gas transportation infrastructure, thereby tackling bottlenecks in the fuel-to-power end of the electric power sector value chain.

Tremendous progress has been made in the gas sector in the last few years. Nigeria is growing LNG capacity rapidly and on course to having about 30% of total Atlantic LNG capacity by 2019. The Nigerian LNG capacity additions are expected to increase to about 30mtpa by 2018.

In the same vein, Brass LNG project with 10mtpa capacity is going on satisfactorily with the Final Investment Decision (FID) planned for the 1st quarter of 2012 while the 1st cargo is billed for the 4th quarter of 2016. Similarly, progress is being made on the Olokola (OK) LNG project which is expected to deliver 22 mtpa LNG capacity to global gas market from 2019 and subsequently an additional 11 mtpa. Additionally, gas is being leveraged as the fuel to power Nigeria’s economy.

Already, 15 new gas fired power plants are near completion and will add over 12 GW of electricity to the national grid. Consequently, power sector growth is expected to translate into an increase in gas demand from less than 1 bscf/d in 2005 to about 3.5

bscf/d in 2015 representing about 30% annual growth. Furthermore, the government has embarked on a “Gas Revolution Agenda”, aimed at aggressive industrialization and creation of jobs. The gas initiative would generate over 100,000 engineering design-related jobs, as well as about 500,000 direct and indirect jobs in construction, logistics fabrication and agriculture for the benefit of the economy and other stakeholders. On the regional front the oil and gas industry has completed the

West African Gas Project (WAGP) and planned to progress the Trans-Saharan Gas Project to Europe via Algeria and Gas supply to Equatorial Guinea. The WAGP which is 630 km pipeline delivers gas to Benin, Ghana and Togo. The project ultimately monetizes 580 mscf/d and has provided a platform for regional cooperation and economic growth. More importantly, the gas sector is attracting new players which will increase competition and stimulate more gas supply and utilization system in Nigeria.

“National prosperity is created, not inherited. It does not grow out of a country’s natural endowments, its labor pool, its interest rates, or its currency’s value, as classical economist insists. A nation’s competitiveness depends on the capacity of its industry to innovate and upgrade” Hence, a nation’s competitiveness is the degree to which it can, under free and fair market conditions, produce goods and services that meet the test of international markets while simultaneously expanding the real incomes of its citizens. Competitiveness at the national level is based on superior productivity performance (Porter, 1990).

Nigeria is a country endowed with abundant natural resources with the Multinational oil companies being increasingly active in the Nigerian oil and gas sector.

The country receives the largest amount of FDI in Africa, standing at over $11 billion in 2009, and ranked 19th greatest recipient of FDI in the world (UNCTAD, 2011). But the level of productivity has remained very low due to non-linkages and absent of value chain.

The dearth of linkages between the oil sector and the other sectors of the Nigerian economy is a critical developmental problem, despite huge investments made by the Federal Government of Nigeria in the oil and gas sector of the economy, an average of $10 billion per annum, and its contribution to GDP growth has been minimal. This is largely due to low Nigerian Content in the industry; evident from the over 80% of work value is carried out abroad. This has led to a dearth in jobs, skills development, capacity building/ utilization and lack of sustained national economic development (NNPC, 2009).

Nigeria's economic aspirations have remained that of altering the structure of production and consumption patterns, diversifying the economic base and reducing dependence on oil, with the aim of putting the economy on a part of sustainable, all-inclusive and non-inflationary growth. The implication of this is that while rapid growth in output, as measured by the real gross domestic product (GDP) is important, the transformation of the various sectors of the economy is even more critical. This is consistent with the growth aspirations of most developing countries, as the structure of the economy is expected to change as growth progresses (Sanusi, 2010).

Successive governments in Nigeria have since independence in 1960, pursued the goal of structural changes without much success. The growth dynamics have been propelled by the existence and exploitation of natural resources and primary products. Initially, the agricultural sector, driven by the demand for food and cash crops production was at the center of the growth process, contributing 54.7 per cent to the GDP during the 1960s (National Bureau of Statistics, 2009). The second decade of independence saw the emergence of the oil industry as the main driver of growth. Since then, the economy has mainly gyrated with the boom burst cycles of the oil industry.

As Michael Porter (1990) argues that “nation’s competitiveness depends on the capacity of its industry to innovate and upgrade” it is noticeable in the Nigerian sphere that the present of Multinational oil companies has remained that of primary product exploitation without value addition and with inherent environmental degradation resulting to negative productivity in Agricultural sector.

Although the Multination oil & gas companies heavily involve in Social corporate Responsibility (SCR) either to be in good relationship with the society or based on regulatory responsiveness, nevertheless this has not improve their productivity performance to aid improve national competitiveness. Oil & Gas companies have therefore been criticized, particularly by NGOs and local communities for not taking due account of the developmental impact of their extraction of resources over the years and their corporate social responsibility (CSR) has been seen criticized as ineffective in addressing the accumulated social and economic distress of the gas producing region, partly due to excessive corruption, mismatch of priorities, and inefficient and ineffective CSR approach and the means of delivery. To which gas companies should operate on the contrary.

Hence the need for a paradigm shift from the conventional CSR of which the society issues are periphery to a robust approach that will connect companies' values as well as societal values cannot be over emphasis. (Naif 2013)

Creating Shared Value (CSV) has the potential to promote the national competitiveness and Industrial transformation for the socio-economic development of the nation. "The concept of shared value which focuses on the connection between societal and economic progress has the power to unleash the next wave of global growth" (Porter and Kramer 2011).

On this premise, Michael E. Porter and Mark R. Kramer through their various works dating back from 1999 to 2011 come up with the concept of creating shared value (CSV) as an alternative concept to corporate social responsibility (CSR). Therefore the concept of shared value can be defined as "policies and operating practices that enhance the competitiveness of a company while simultaneously advancing the economic and social conditions in the communities in which it operates" (Porter and Kramer 2011). *Shared value creation focuses on identifying and expanding the connections between societal and economic progress.*

Related Concerns

"Harnessing the power of business to improve social and environmental conditions across the world has thus become a priority for policymakers and other stakeholders, and it represents a central aim of the corporate social responsibility (CSR) movement. An organization's performance in relation to the society in which it operates and to its impact on the environment has become a critical part of measuring its overall performance and its ability to continue operating effectively"(Porter and Kramer, 2011).

Multinational oil companies and oil service firms are increasingly active in Nigeria. The country receives the largest amount of Foreign Direct Investment (FDI) in Africa. According to UNCTAD (2011), "FDI inflows have been growing enormously over the course of the last decade: from USD1.14 billion in 2001 and USD2.1 billion in 2004, Nigeria's FDI reached USD11 billion in 2009, making the country the nineteenth greatest recipient of FDI in the world".

Nigeria's most important sources of FDI have traditionally been the home countries of the oil majors. The USA, present in Nigeria's oil sector through Chevron Texaco and Exxon Mobil, had investment stock of USD3.4 billion in 2008, The UK, one of the host countries of Shell, is another key FDI partner – UK FDI into Nigeria accounts for about 20% of total foreign investment. As China seeks to expand its trade relationships with Africa, is becoming one of Nigeria's most important sources of FDI; Nigeria is China's second largest trading partner in Africa, next to South Africa. From USD3 billion in 2003, China's direct investment in Nigeria is reported to be now worth around USD6 billion. The oil and gas sector receives 75% of China's FDI in Nigeria. Other significant sources of FDI include Italy, Brazil, the Netherlands, France and South Africa (CBN, 2009).

The present of this oil companies and FDI flow into the country one will tend to believe the economy is booming but with inherent developmental issues particularly on the socio-economic status of its citizenry which remain doubtful due to disconnect between the oil companies and the society which is evident through the non-value addition of their activities and non-creation of linkages with other economic sectors of the nation, thus the national competitiveness and industrial transformation remains far away from reality.

Nigeria’s oil production is currently at around 2.4 million barrels per day, Business is thriving. At the same time, the country faces a prevailing humanitarian and political crisis after nearly 56 years of oil exploration. Despite being a resource rich country with average of 5% GDP annual growth per year, the development impacts of the activities in the oil sectors have had a limited effect on the rest of the economy and poverty is widespread. Inflation is very high 10% to 15% (National Bureau of Statistics, 2009), and the country has been able to develop hardly any local industry.

According to the Governor or Central Bank of Nigeria Sanusi Lamido Sanusi (2010), “The Nigerian economy has grossly underperformed relative to her enormous resource endowment and her peer nations. It has the 6th largest gas reserves and the 8th largest crude oil reserves in the world. It is endowed in commercial quantities with about 37 solid mineral types and has a population of over 150 million persons. Yet economic performance has been rather weak and does not reflect these endowments. Compared with the emerging Asian countries, notably, Thailand, Malaysia , China, India and Indonesia that were far behind Nigeria in terms of GDP per capita in 1970, these countries have transformed their economies and are not only miles ahead of Nigeria, but are also major players on the global economic arena”. This further buttress the Porter’s 1990 view on “National prosperity being created, not inherited”.

The major factors accounting for the relative decline of the country's economic fortunes are easily identifiable as political instability, lack of focused and visionary leadership, economic mismanagement and corruption. Prolonged period of military rule stifled economic and social progress, particularly in the three decades of 1970s to 1990s. During these years, resources were plundered, social values were debased, and unemployment rose astronomically with increase in crime rate. Living standards fell so low, to the extent that some of the best brains with the requisite skills to drive the developmental process left in droves to other nations, and are now making substantial contributions to the economic success of their host countries.

The oil and gas industry in Nigeria is characterized with corporate social responsibility (CSR) which is geared toward regulatory responsiveness, hence the companies are far away from the societal value which is detrimental to growth, for example the companies have to fund a poll of fund for oil producing communities with 2% of their profit which is being operated by a government agency (NDDC) and highly associated with corruption, sentiments and misappropriation of the funds.

Oil and Gas contract are associated with investment in infrastructure, but when oil companies pay such monies it goes to the government which now have to decide on what to be done, also the CSR activities of the IOC's are not in line with their core competence.

"The impact of hydrocarbon exports on the real exchange rate presents a classic case of Dutch disease. Before the buildup of oil and gas exports that began in the early 1970s, Nigeria had a diversified economy with substantial agricultural production and exports. By 2005, however, oil and gas accounted for about one-third of the country's GDP, 70 percent of budget revenues, and 95 percent of total exports. Exchange rate appreciation has made local agricultural commodities and manufacture goods uncompetitive" (Sanusi, 2010). And also partial deregulation of the downstream sector of the oil and gas with heavy subsidy regime on domestic consumption, eats up the revenue accrued from the sale of crude which up to be reinvested in other productive sector that can diversify the economy and reduce the over reliance in the oil industry.

Every nation strives for development, economic progress is merely a component of development but development goes beyond pure economics. In an ultimate sense, development must encompass more than the material and financial side of people's lives. Development is therefore, a multidimensional process involving the reorganization and reorientation of the entire economic and social systems. In addition to improvements in incomes and output, it typically involves radical changes in institutional, social and administrative structures, as well as in popular attitudes and in many cases even customs and beliefs.

Although; there are three causal pathways through which transformation could enter into long term strategic R&D decision of the private sector (1) Anticipatory action (2)Technological opportunism and (3) Regulatory responsiveness. This research focuses more on the regulatory responsiveness in such a way that the regulators can drive the concept of CSV to the private sector for diversification and provision of linkages rather than the current relationship.

Why Trade or Invest in Nigeria?

There are many great prospects for any interested Small and Medium Enterprise (SME) to take advantage of investing in Nigeria, Niger, Benin, Togo, Ghana and other West African countries. Despite the Euro-zone crisis and the visible decline in growth in some other parts of the world, Nigeria shows strong indicators for growth into the future. Along with the promising outlook; Nigeria's imports are already in the region of $14.54 billion USD, a very nice market to be part of. Import commodities include machinery, chemicals, transport, equipment, manufactured goods as well as live animals.

Whether you are exporting or importing goods and services, the abundant opportunities in Nigeria will ensure the growth of your market share. SMEs are a large part of business globally, but in Nigeria they make up 75% of the economy. Nigeria as a Country, due to the wealth in its economy, is the recognized regional leader of the Economic Community of West African States (ECOWAS) sub region in Africa. Having SMEs across the globe and Nigeria connect through trade and investment, will create bridges for building wealth, creating employment and promote growth.

Currently Agriculture contributes 40% to GDP in the non-oil sector of the economy. In order to encourage trade and investment in this area, the Federal Government of Nigeria has introduced several incentives including zero duty on agricultural machinery, pioneering status incentive (three years tax holiday) for agro-processing industry, and several export incentives for manufacturers in the agriculture sector.

Africa is the next frontier in global trade. Nigeria, as a destination, is second only to South Africa in Sub Saharan African and the premier destination in ECOWAS. SMEs in Nigeria have their hands stretched out ready to shake yours.

Nigerian Investment Opportunities

- **Abundant Resources:** Nigeria has enormous mineral resources, most of which are yet to be fully tapped.

- **Large Market:** Nigeria offers the largest market in sub-Saharan Africa, with a population of about 170 million people. The Nigerian market potential also stretches into the growing West African sub-region.
- **Political Stability:** Nigeria offers stable political environment. Since the return of democracy in 1999, Nigeria has successfully conducted 3 elections. The last one was hailed by international observers as the most transparent in its history.
- **Free Market Economy:** The Government is encouraging foreign direct investment and trade.
- **Free Flow of Investment:** Exchange control regulations have been liberalized to ensure free flow of international finance. There is now unrestricted movement of investment capital.

Chapter 2. Literature Review

2.1 Diamond Model

Based on the conventional perspective of Adam Smith, (2012) there is one and only one social responsibility of business to use it resources and engage in activities designed to increase its profits so long as it stays within the rules of the game, which is to say, engages in open and free competition without deception or fraud (Friedman, 1970) His arguments are based on the view that social and economic objectives are distinct.

Other scholars like Frynas (2005) argues that Multi-National Companies [MNC's] that benefit from social initiatives might be due to bringing managers closer to political decision-makers, while appearing to be socially responsible. In another study, they argue that MNCs operating in the developing world are ill-equipped to tackle development issues because there is confusion between philanthropy and real contribution to local development and lack of internalization of negative externalities within their core business activities (Bloweld and Frynas, 2005). Dahlsrud (2006) argues that MNCs do not approach CSR in a holistic, systematic manner. But rather enhancing business efficiency, fulfilling expected or current regulatory requirements and/or international agreements/commitments or responding to stakeholders concerns[1].

[1]Hopkins, M. 2007. *Corporate Social Responsibility and International Development: Is Business the Solution?* Sterling, VA: Earthscan.

The views expressed by the above-mentioned scholars reflect that corporate executive would be spending someone else’s money for a general social interest, reducing returns to stockholders, raising the price to customers (since the expense of social responsibility has to be paid by customers not by corporations), and lowering the wages of some employees (since profit does not go to them, but to society). These arguments are based on the view that social and economic objectives are distinct, meaning a corporation’s social spending comes at the expense of its economic results, and on the assumption that corporations, when they address social objectives, provide no greater benefit to the society than is provided by individual donors. These assumptions hold true when corporate contributions are unfocused and piecemeal (Porter and Kramer, 2002). In fact the prevailing practices of CSR are very fragmented and disconnected far from business and profit (Porter and Kramer, 2006).

Many scholars and entrepreneurs have perceived corporations and society as contradictory agents. In this light, most corporate philanthropy and CSR have been viewed as philanthropic donation at best and exhaustive expenditure at worst.

Nevertheless, several companies engaged in philanthropic activities more strategically such as to improve their reputation. Some others tried to use their charitable efforts to improve their competitiveness. Porter and Kramer (1999) indeed this thoughts are meaningful as the first step in achieving the integration of social and corporate benefits at the same time, and introduced business strategic philanthropy. So far, charity foundations have not been fulfilling their purposes in leading social progress.

Foundations have been just donors rather than value creators with their resources at their disposal. In response Porter and Kramer (1999), have suggested four ways of strategy for philanthropy, to achieve greater social impact and value with the same monies spent; (i) selecting the best grantees, (ii) signaling other funders, (iii) improving the performance of grant recipients, and (iv) advance the state of knowledge and practice. They went on explaining that the more corporate philanthropic activity relates to a company's business, the more it leads to economic benefits (Porter and Kramer 2002).

Using Porter's (1990) diamond model, Porter and Kramer demonstrated the four elements of competitive context. They argued that these four strategies are crucial to enhancing the competitiveness of developing countries, and improving them through corporate philanthropic activities can bring enormous social gains to the world's poorest nations. Here, Porter and Kramer perceive that social and economic objectives or benefits are not independent but related, and corporations and society are not contradictory but rather complement each other (Moon etal. 2012).

Prior to discussing the concept of creating shared value for both corporations and society, Porter and Kramer (2006) initially explored and linked CSR activities to firm's value chain in order to gain the best outcome. Also, when a company uses the value chain to chart all the social consequences of its activities, it has, in effect, created an inventory of problems and opportunities mostly operational issues that need to be investigated, prioritized, and addressed (Porter and Kramer, 2006).

Using this concept, companies can avoid short-term behavior that is socially detrimental or environmentally wasteful in order to achieve long-term economic performance. Also, they categorized CSR into two, responsive CSR and strategic CSR, by its attributes. Responsive CSR comprises two attributes: a good corporate citizen attuned to the evolving social concerns of stakeholders and a troubleshooter mitigating existing or anticipated adverse effects from business activities. Strategic CSR, on the other hand, is about choosing a unique position doing things differently from competitors in a way that lowers costs or better serves a particular set of customer needs (Porter and Kramer, 2006). They called this a "corporate social integration (CSI)" which links the company's value chain to social competitiveness context.

Finally, in 2011, Porter and Kramer conceptualized the term of CSV as "a more sophisticated form of capitalism," in which the ability to address societal issues is integral to profit maximization instead of being treated as outside the profit model (The New York Times, 2011b). According to their article, shared value can be created in three ways (re-conceiving products and markets, redefining productivity in the value chain, and enabling local cluster development), particularly highlighting the importance of cluster development (Porter and Kramer, 2011). Regarding this approach, they emphasized that CSV is not social responsibility, philanthropy, or even sustainability, but is a new way to achieve economic success, and that it gives rise to the next major transformation of business thinking.

To sum up, Porter and Kramer's (2011) ways to create shared value are classified as follows. First of all, they argued for redefining productivity in the value chain. The value chain depicts all the activities a company engages in while doing business (Porter and Kramer, 2006), and when societal progress and productivity in the value chain are congruent, the shared value is far greater than traditionally believed. Porter and Kramer then suggested Re-conceiving products and markets. They pointed out that there are greatest unmet needs in the society, and emphasized that equal or greater opportunities arise from serving disadvantaged communities and developing countries. Meeting the needs of underserved markets often requires redesigned products of different distribution methods, in which these requirements can trigger fundamental innovations of the products.

Finally, they emphasized enabling local cluster development, indicating that the productivity and innovation are strongly influenced by cluster or geographic concentration of firms, related business, suppliers, service providers, and logistical infrastructure in a particular field. When a firm builds clusters in its key locations, it can amplify the connection between its business success and the community success.[2]

The concept of CSV was innovative and incisive in the business sphere but was not free from limitation and constructive criticism this came in through an article by (Moon etal, 2012) the paper highlights the importance of internationalization of CSV,

---

[2]Moon etal., 2012 An Extension of Porter and Kramer's Creating Shared Value (CSV):
Reorienting Strategies and Seeking International Cooperation JOURNAL OF INTERNATIONAL AND AREA STUDIES Volume 18, Number 2, 2011, pp.49-64

unlike Porter and Kramer's emphasis on domestic clusters and demonstrates the usefulness of explaining CSV activities in real world. There are two contributions in this paper; corporation classification into (1) Stupid Corporation, (2) Selfish Corporation, (3) Good Corporation, and (4) Smart Corporation. (See figure 8)

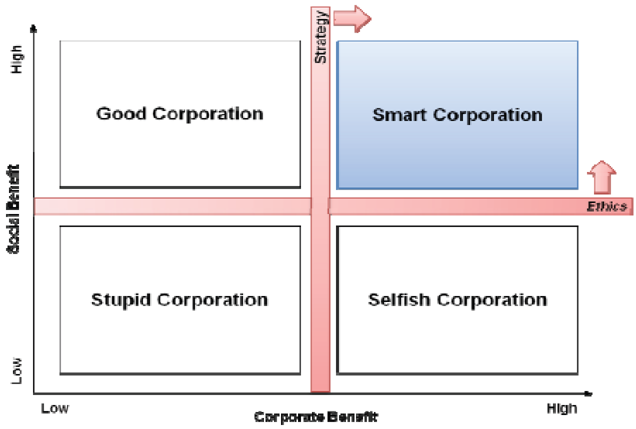


Figure 8. Corporation Classification

(Source Moon etal. (2012)

And the extension of Porter's model by providing four distinctive strategies in order to effectively create shared values; (i) Defining core competence (Newly Added), (ii) Reconceiving comprehensive targets (re-conceiving products and markets), (iii) Redefining productivity in value chain, and (iv) Enabling local or global cluster development (enabling local cluster development).

Overview on National Competitiveness

National Competitiveness is defined by the world economic forum (WEF) Global competitiveness report 2010-2011 as the set of institutions, policies, and factors that determine the level of productivity of a country. The level of productivity, in turn, sets the sustainable level of prosperity that can be earned by an economy. In other words, more competitive economies tend to be able to produce higher levels of income for their citizens. The productivity level also determines the rates of return obtained by investments (physical, human, and technological) in an economy. Because the rates of return are the fundamental drivers of the growth rates of the economy, a more competitive economy one that is likely to grow faster in the medium to long run. The concept of competitiveness thus involves static and dynamic components: although the productivity of a country clearly determines its ability to sustain a high level of income, it is also one of the central determinants of the returns to investment, which is one of the key factors explaining an economy's growth potential.

However, this has been criticized as being only a "poetic way of saying productivity has nothing to do with any actual conflict between countries" (Krugman, 1996). In other words, it is important to focus on the determinants of competitiveness, not merely on one of its manifestations.

Most analysts of competitiveness focus on structural factors affecting long-term economic performance, and tend to be concerned with productivity, skills and innovation (Fagerberg, 1996). The International Institute for Management and Development uses this approach. This definition is criticized on the grounds that it repudiates the basic theory of comparative advantage, since when economies trade with each other they do not as firms do compete in a confrontational manner. Rather they engage in a non-zero sum game that benefits all parties. While the notion of a competitive company is clear, the notion of a competitive nation is not and that ultimately, competitive advantage rests at the industry level. Thus, many researchers examine firms and industries to determine what gives certain countries advantages in certain industries and what policies government can pursue or change to give their domestic industries a competitive edge.

To avoid vain searches for the competitiveness of countries, Porter (1990), suggests that it is best to focus on people and their productivity. Indeed, the World Bank choice to define national competitiveness in terms of national productivity.

Twelve Pillars of Competitiveness[3]

Global Competitiveness Report (2010 Edition) of the World Economic Forum consider 12 pillars as determinants of a country's competitiveness. These are clustered under three sets of factors namely:

Basic requirements (Key for Factor Driven Economies)

• Institutions

• Infrastructure

[3]World Economic Forum, The Global Competitiveness Report 2011-2014

• Macroeconomic environment

• Health and primary education

Efficiency enhancers: Key for efficiency driven economies:

• Higher education and training

• Good market efficiency

• Labor market efficiency

• Financial Market development

• Technological readiness

• Market size

Innovation and sophistical factors: key for innovation driven economies

• Business Sophistication

• Productive innovation and Creative economic growth

There is a long history of efforts to explain the determinants of competitiveness. Ricardo's theory on comparative advantage was indeed an early attempt to understand how nations compete. The Ricardian model assumes that countries differ in their production technologies such that each country enjoys a comparative advantage in the production of at least one good, the exploitation of which would maximize world output. Competitiveness would thus be a function of production technology.

In the 1920s, Heckscher and Ohlin postulated that patterns of trade depend on the relative abundance of factor endowments. Applying the theory of comparative advantage, countries would benefit from trade by exporting the good that is intensive in its abundant factor. Competitiveness would in this case depend on production factor availability. However, economists later came to realize that facts regarding production alone could not explain everything.

During the twentieth century, other well-known economists contributed to a better understanding of competitiveness. Schumpeter emphasized the key role that entrepreneurship played, serving as an engine for development. Robert Solow, MIT economist and Nobel Prize winner, studied the growth factors that drove the US economy between 1948 and 1982 and demonstrated the fundamental importance of technological innovation and increased know-how in an economy[4].

Porter (1990) proposed the "diamond approach" which illustrates the systemic relationship between factors of competitiveness. The four areas that make up the diamond are factor conditions, demand conditions, context for firm strategy and rivalry, and related and supporting industries. Porter describes how each point on the diamond

---

[4]Van der Linde, C. 2000. *The State and the International Oil Market: Competition and the Changing Ownership of Crude Oil Assets*. Boston: Kluwer Academic Publishers.

and the diamond as a system – affects the essential factors for achieving international competitive success. (See figure 9 & 10)

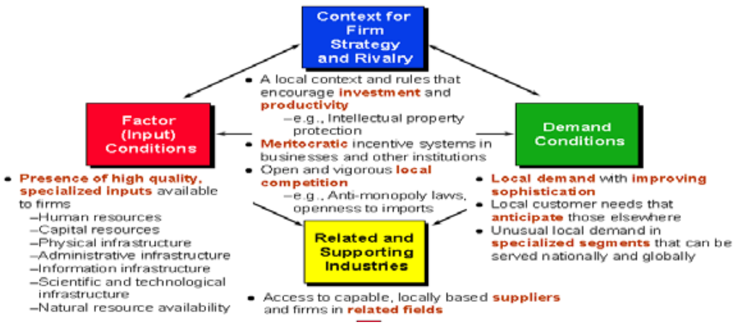


Figure 9. The Diamond Improving Business Environment

(Source: Porter (1990))

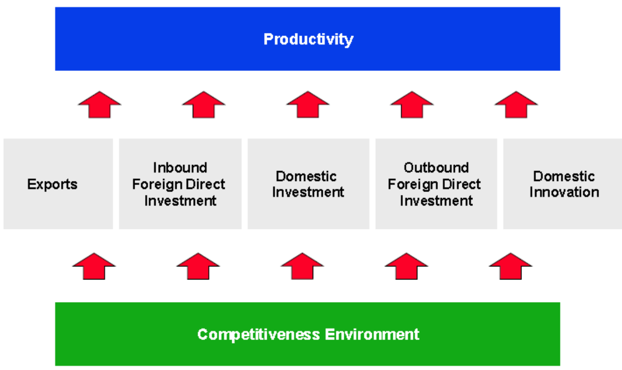


Figure 10. Enablers and Indicators of Competitiveness

(Source: Porter (1990))

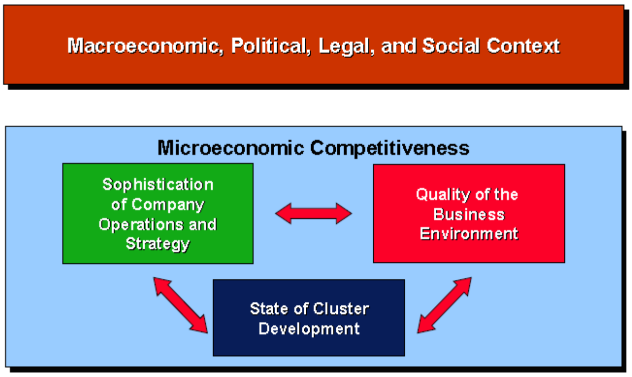


Figure 11. Determinants of Competitiveness

(Source Porter (1990))

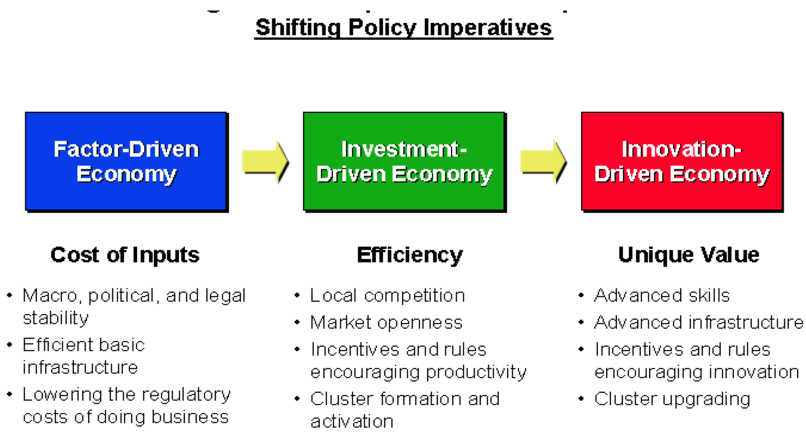


Figure 12: Stages of Competitive Development

(Source Porter (1990))

Theories of National Competitiveness

In management literature, different usages of competitiveness are influenced by the level of analysis. McFetridge (1995) identified competitiveness at three levels: firm, industry and national. One usage is to view competitiveness at the level of the individual firm (Porter, 1990) and of individual sectors within a country (Toyne, Arpan, Barnett, Ricks and Shimp, 1984). According to Kurdrle (1996), "a firm is holding or expanding its share while maintaining satisfactory profits, the firm can be considered competitive".

A second usage is that of industry competitiveness. Porter (1990) simply defines an industry as competitive if its trade balance is positive and if the industry's export share exceeds the national average. Kurdrle (1996) regards an industry as competitive if it maintains a steady or growing market share and satisfactory profits for all firms in the industry. He, however, indicates that the definition of an industry is problematic due to heterogeneity (e.g. product line diversity, national ownership) and generalizations about industry performance based upon firm data. Others, notably Rugman (1987) and Porter (1990), appear to equate the competitiveness of entire countries to that of firms or industries.

A growing body of literature has emerged that views national competitiveness as distinguishable from competitiveness at the industry or firm level (Boltho, 1996; Strange, 1998). National competitiveness may be viewed from a narrow or a broad perspective. The narrow definition views relative factor costs (e.g. exchange rates, relative unit costs, and land costs) as the determinants of national competitiveness (Manzur, Wong and

Chee, 1999; Carlin, Glyn and Van Reenen, 2001). An example of this approach is Porter's (1998) definition of national competitiveness as the value of output produced by a unit of labor (e.g. productivity).

For many business scholars, national competitiveness tends to be more broadly conceived as a complex of institutional and political-economic issues and the ways in which these affect the microeconomic activities of firms within their competitive environments. For instances, Luo (2001) argues that both currency crises and abrupt institutional changes affect the competitive environment in emerging economies. Zinnes, Eilat and Sachs (2001) regard national competitiveness as an input into a country's production process that generates the wealth of a nation. Their definition stresses the importance of synergies among firms and among firms, markets and governments, and above all, the crucial role of well-functioning institutions. In similar vein, Kao et al. (2008), describe national competitiveness as a measure of the relative ability of a nation to create and to maintain an environment in which enterprises may compete so that the level of prosperity may be improved.

The broader definition of national competitiveness weds standard growth theory (i.e. growth results from changes in production factor accumulation and in total factor productivity) and new institutional economics theory (i.e. the role of institutions and "rules of the game"). (North, 1994; Picciotto, 1997) The definition of national competitiveness as used in the Global Competitiveness Report may be regarded as a benchmark of this broader definition, i.e. the ability of a national economy to achieve sustained high rates of economic growth based upon sustainable policies, institutions and other economic characteristics that promote such growth(World Economic Forum, 1997-12).

As a benchmark of national competitiveness, Thompson (2004) found that indices of four annual rankings of countries, i.e. World Competitiveness Yearbook compiled by the International Institute for Management, Global Competitiveness Report of the World Economic Forum, Economic Freedom of the World by the Fraser Institute, and An Index of Economic Freedom by the Heritage Foundation and the Wall Street Journal, are closely correlated. All these rankings use political economic and institutional indices in line with the broader definition of competitiveness.

The Single Diamond Framework

Porter's (1990) study of a hundred industries in ten nations challenged existing theories of international trade by explaining why a nation achieves international success in a particular industry. (Davies and Ellis, 2000) Porter's (1990) Diamond Model of National Competitiveness consists of four country specific determinants and two external variables. The first category of determinants is factor conditions which include human, capital and physical resources as well as the physical and knowledge infrastructure of a country. Category two is demand conditions such as the structure of demand in the home market; the size and growth rate of home demand; and the processes through which domestic demand is internationalized, e.g. "pull" factors which avail a nation's products and services in foreign markets. Factor three refers to related and supporting industries.

This entails the clustering of suppliers, knowledge-input institutions and end-users in close proximity which stimulate innovation and competitiveness. The fourth category is firm strategy, structure and rivalry. This includes the ways in which firms are managed and choose to compete as well as the ways national and firm cultures shape education and the pool of employer talent.

Porter (1990) also identifies two exogenous forces that, although not direct determinants, may influence the competitiveness of nations: chance and government. The role of chance, which may impact on competitiveness, includes macro-political, macro-economic and technological factors. Examples are political decisions by foreign governments, technological breakthroughs, significant shifts in international financial markets and exchange rates, wars and oil shocks. The second exogenous force includes the various roles of government in the competitiveness arena. Examples are protectionist measures, competitive regulations, procurements of goods and services, and tax laws.

Grant (1991) correctly assessed that Porter’s diamond encouraged a surge of further theoretical and empirical research into the role of national environments in determining international competitive advantage”. Broadly speaking, the application of Porter’s “Diamond” falls into two categories. There are studies that replicate Porter’s single “Diamond”: Jasimuddin’s (2001) analysis of competitive advantage in Saudi Arabia; Turner's (1994) study of Japanese financial services organizations; Chobanyan and Leigh's (2006) case study of Armenia; and Chen and Ning’s (2002) study of e-commerce in China. The second category of studies extended or adjusted Porter's

"Diamond" to a "Double Diamond" framework of analysis. The thrust of this approach is that national and international competitiveness are increasingly linked in a globalized economy.

The "Double Diamond" Framework of National/International Competitiveness

Dunning (1993, 2003) suggested various improvements to adjust Porter's "Diamond" to the dynamics of international competitiveness. The framework should include both domestic and international influences on national competitiveness as well as the interaction between such domestic and international influences. If countries are part of regional economic integration systems, national "Diamonds" have to be replaced by supranational "Diamonds". The contribution of multinational enterprises to competitiveness must also be placed in proper perspective. The advantages of MNEs over cross-border market transactions include the ability to arbitrage factor or intermediate product markets, to reap economies of scale or scope benefits, to diversify country risks, and to exploit better the gains of the common governance of related value-added activities.

Furthermore, inward foreign direct investment (FDI) flows are beneficial even though the host country or its people must trade a degree of economic sovereignty for economic progress. Firms increasingly procure assets and intermediate products from outside national boundaries which mean that the determinants of national competitiveness are both national and international. Finally, successful government may be a necessary condition for the competitive advantage of a country; it is not a sufficient condition because successful firms are also required to insure national competitiveness.

Rugman and D'Cruz (1993) demonstrate that Porter's "Diamond" model, if based on the operations of triad-MNEs, are not necessarily applicable to smaller, open, trading economies. They argue that the Canada-US Free Trade Agreement dictates that the Canadian "Diamond" needs to be considered jointly with the US "Diamond". Canadian competitiveness operates in a "Double Diamond" called the North American "Diamond". Hodgetts (1993) concurred by pointing out that the competitiveness of Mexico's leading clusters (petrochemicals and automobiles) are considered within the North American "Diamond". The subsequent formation of NAFTA confirms the relevance of the North American "Diamond" to understand competitiveness in the US, Canada, Mexico and even in Central America and parts of Latin America. Unfortunately, both these studies did not deal adequately with the impact of Porter's exogenous variables (chance and government) on North American competitiveness.

Bridwell and Kuo (2006), in discussing the computer industry in China and Taiwan, outlined a single "Diamond" for each country, but also a "Double Diamond" for the greater China, i.e. "two countries or one nation with two interconnected regions." In a study of three industries (software, dairy, music) in Ireland, O'Connell, Clancy and Van Egeraat (1999) criticized Porter's "Diamond" on two grounds. Demand may be initially domestic, but on balance, influential customers, competitors and suppliers are located abroad rather than in Ireland. Secondly, domestic clustering was also not a requirement for the increase in Ireland's national competitiveness.

The study of Moon and Lee (2004) applied Porter's paradigm to compare the competitiveness of two firms, Samsung Electronics and Sony. The authors concluded that "the paradigm of the generalized double diamond model, which extends Porter's single diamond model, offers a more comprehensive framework to explicitly explain multinational activities.

2.2 DEA Model

The question of the productivity and efficiency of state-owned enterprises (SOEs) has recently been largely studied, with many concluding that SOEs are less efficient than private, for-profit enterprises. For this reason, there has been a rising case for SOEs to be fully or partially privatized. Even though this may seem economically good, there is still the other side of the argument: the existence of a strong case for the government to provide goods and services under certain conditions and in certain situations. In his study, Sleifer (1998) points out four situations that he believes make up a good case for the government to engage in the production of goods and services. These situations are (i) when the opportunities for cost reductions that lead to the non-contractible deterioration of quality are significant; (ii) when innovation is relatively unimportant; (iii) when the competition is weak and the consumer choice is ineffective; and (iv) when the reputational mechanisms are also weak (Shleifer, 1998). The first case is justified when private firms supposedly compromise on quality delivery to cut costs, which may not be likely if they were SOEs. Generally, it is unlikely that the cause of the low quality of the goods and services provided by SOEs will be cutting costs but other issues like corruption and managerial incompetence. The latter involves the fact that the government and private ownership have negative and positive effects on innovation, respectively, and as such, when innovation is not important, there will be not much need for goods and service provision through private enterprises. The third scenario shows that when there is clear evidence of market failure, like the monopoly effect, SOEs become more desirable. The last scenario is related to the third in that SOEs will be preferred to private enterprises when the latter provide goods and services in an environment where they do not have a reputation to protect, which is more like a monopolistic characteristic.

Boardman and Vining (1989) tested the property rights theory by comparing the performance of 419 private corporations (PCs), 58 SOEs, and 23 mixed enterprises (MEs)19, among the 500 largest non-U.S. industrial firms, using multivariate OLS regression analysis20 and controlling for several factors.21 They found out that large industrial MEs and SOEs perform substantially worse than similar PCs, and that MEs perform no better and often worse than SOEs, suggesting that partial privatization may be worse, especially in terms of profitability, than complete privatization or continued state ownership (Boardman & Vining, 1989). Their study, however, gave little attention to the petroleum sector. (Boardman & Vining, 1989).

From a broader perspective, Al-Obaidan (2002) empirically studied the magnitude of the macroeconomic effect of privatization in 45 developing countries, using the concept of frontier production function, to estimate the efficiency differences between countries with differing degrees of private-sector contribution, and found that *ceteris paribus*, developing countries can increase the utility of their national resources by approximately 45% simply by making their economies market-based (Al-Obaidan, 2002). In the study, a higher private-sector contribution of more than 60% of the total country investments indicated a market-based economy; otherwise, it indicated a state-administered economy. In other words, SOEs dominate the market in a state-administered economy (less privatization) and are less prominent in a market-based economy (more privatization). The study results simply imply that countries stand to gain more by converting their SOEs into private enterprises, which are more efficient.

From the foregoing, it may seem conclusive that *ceteris paribus*, SOEs will always be less efficient than private enterprises, but some SOEs can be said to be "efficient enough" and comparable to private enterprises. Hertog (2010) suggested a theoretical approach to explaining how some SOEs in a number of Gulf states have performed far above the expectations by studying the SOEs operating in selected resident states[22], arguing that the combination of the following two factors explains the aforementioned outcome: the absence of a populist-mobilization history and substantive regime autonomy in economic policymaking (Hertog, 2010). This further point out the effect of politics on SOEs and gives some insight into why SOEs will remain in business despite the seemingly wide acknowledgement of their inefficient and unproductive behaviors.

As with many other developing countries, the productivity and efficiency of Nigeria's SOEs have come under scrutiny in the past three decades. As pointed out in the introduction, scholars have argued that most of the SOEs in Nigeria have been used as avenues for sharing the "national cake" among the citizens, using political and non-commercial criteria. Nigeria's SOEs have not enjoyed any amount of autonomy in economic and commercial decision making, unlike those in some Gulf States, as noted by Hertog. One of the main criticisms of Nigeria's SOEs that pushed the country to embrace the privatization and commercialization wave that was then sweeping through countries was that public enterprises (SOEs) are not well managed and consequently are inefficient, especially when efficiency is measured in terms of productivity of capital, use of capital, and unit cost of production (Ugorji, 1995). The Technical Committee on Privatization and Commercialization, which was established by the Nigerian government to oversee the policy of privatizing/commercializing the country's SOEs, remarked that in 1980, there were 70 non-commercial and 110 commercial federal enterprises and parastatals, many of which depended on government support to cover their operational losses.23 This implies that many of the SOEs were running at a loss, and this necessitated the need to reform them by converting them into private enterprises (partially or fully) so as to boost their performance, productivity, and efficiency.

The existing literature mostly provides that SOEs are less efficient than private enterprises both in Nigeria and in other countries. In fact, this, among others, accounts for the popularity of the privatization policy that has swept through countries in recent times, as prescribed by the so-called "Washington Consensus," most especially to the developing countries. On the other hand, countries have used the creation of SOEs to produce some goods and services so as to exert control over the economy and to enforce government policies rather than allow only the market forces to determine the countries' economic direction, which may be detrimental to the said countries' social objectives.

Therefore, the study of SOEs' and private enterprises' efficiency behavior should not be limited to determining which enterprise is "more efficient" but should be directed at examining policies that will be geared towards productivity and efficiency improvements in every aspect, given the importance of both enterprises to the economy of a state. Both GEC & OPEC Countries engaged in ambitious SOE-based industrialization are: Algeria, Bahrain, Indonesia, Iran, Kuwait, Libya, Nigeria, Qatar, Saudi Arabia, United Arab Emirates, and Venezuela.

(Wikipedia, <http://en.wikipedia.org/wiki/Rentier_state>, accessed September 29, 2014).

2.3 Econometric Analysis

Historically, the ordinary least squares (OLS) method was employed for time series regression analysis until the development of longitudinal linear relationship, cointegration, Granger causality, etc. for application in the determination of causality relationships. To explore different ideas from previous papers and to compare the arguments raised by different schools of thought, some literatures were reviewed in this study.

Based on the empirical results obtained in this area of study, some researchers argue that energy consumption is a prerequisite to economic growth (growth hypothesis); others argue that it is the result of economic growth (conservation hypothesis); some others argue that energy consumption and economic growth have no significant relationship (neutrality hypothesis); and there are those who argue that energy consumption and economic growth have a significant feedback effect on each other (feedback hypothesis). In view of the above schools of thought, regressions of one variable on the other should lead to one of the above four scenarios. As a way of determining some underlying factors that might be comparable or relevant to Nigeria's case, the following literatures were classified into two groups: developed and developing countries.

The first study that was conducted in this field was by Kraft and Kraft (1978). Using the standard Granger causality test, they found evidence in favor of causality from gross national product (GNP) to energy consumption in the United States, using data from 1947 to 1974. The main empirical finding of their study was that causality is unidirectional and runs only from GNP to energy consumption. This finding led to the implication that energy conservation measures have no effect on economic growth. Later, after this study was conducted, several studies examining the energy-use-economic-growth relationship were conducted to determine the direction of causality. Supporting this conclusion is the empirical study by Akarca and Long (1980), who also found unidirectional causality from energy consumption to employment in the U.S.

They employed the standard Granger causality test on time series data from 1973 to 1978. Both studies have been challenged by Yu and Choi (1985), Erol and Yu (1987), and Yu and Hwang (1984), however, who found no causal relationship between GNP and energy consumption in the U.S. Consequently, Abosedra and Baghestani (1989) also found unidirectional causality from GNP to energy consumption, supporting the results obtained by Kraft and Kraft (1978).

Using five developed countries; France, Germany, Italy, England, and Canada. Erol and Yu (1987) found unidirectional causality from GDP to energy consumption for Italy and Germany, unidirectional causality from energy consumption to GDP for Canada, and no causality for France and England, from 1952 to 1982. Another study by Yang (2000) investigated the relationship between energy consumption and GDP using time series data from Taiwan for the period 1954-1997. The results of his study showed bidirectional causality between GDP and energy consumption. The results obtained by Yang (2000) were asserted in a study by Masih and Masih (1997), who also found bidirectional causality between energy consumption and economic growth in Taiwan and South Korea. In another study by Glasure and Lee (1997) using data from South Korea and Singapore, bidirectional causality was established between GDP and energy consumption for both countries, using cointegration and the vector error correction model (VECM).

When the standard Granger causality test was employed, however, unidirectional Granger causality was found for Singapore while the results no causality for South Korea. Also, in another study, Yu and Choi (1985), using data from the U.S., South Korea, the Philippines, Poland, and UK, found no causal link between GNP and energy consumption for Poland, UK, and the U.S. but established unidirectional causality from GNP to energy consumption for South Korea and the opposite (ie. unidirectional causality from energy consumption to GNP) for the Philippines. The results for South Korea in this study do not support the results obtained by Glasure and Lee (1997). In a study in Australia by Fatai et al. (2004) using data from 1960 to 1999, unidirectional causality was found from growth towards electricity consumption. This work was supported by Narayan and Smyth (2005), who also found unidirectional causality from economic growth to electricity consumption in Australia from 1966 to 1999.

The results regarding economic growth and energy consumption have also been mixed in developing countries. In the African region, some of the results from the literature have been somewhat consistent while others have been inconsistent.

In a study using 17 African countries, Wolde & Rufael (2006) examined the relationship between electricity consumption and economic growth. Based on data for the period 1971-2001, empirical evidence of Granger causality was obtained for 12 countries. Where unidirectional causality from economic growth to electricity consumption was found for Cameroon, Ghana, Nigeria, Senegal, Zambia, and Zimbabwe. In addition, unidirectional causality from electricity consumption to growth was established for three other countries whereas the neutrality hypothesis was supported for the remaining three countries.

In a similar study, Adom (2011) investigated the relationship between electricity consumption and economic growth for Ghana for the years 1971 to 2008. Using the Toda and Yomamoto Granger causality test, the study obtained results that revealed the existence of a unidirectional causality from economic growth to electricity consumption. Thus, the results obtained by Adom (2011) support the results of the study conducted by Wolde-Rufael (2006).

In a similar study by Twerefo et al. (2008), unidirectional causality was found from economic growth to energy consumption in Ghana for the period 1975-2006, using the VECM model of the Granger causality test. Akinlo (2008) examined the relationship between energy consumption and economic growth for 11 African countries from 1980 to 2003, using the autoregressive distributed lag (ARDL) bounds test. The results of the study, obtained using the Granger causality test based on the VECM framework, revealed that a bidirectional causal relationship exists between energy consumption and economic growth for Ghana, Senegal, and Gambia. In the case of Sudan and Zimbabwe, however, unidirectional causality from economic growth to energy consumption was established. For Cameroon and Cote d'Ivoire, neutrality was established between the variables. Using the VAR framework of Granger causality, the results of the study showed no causality for Nigeria, Kenya, and Togo while establishing unidirectional causality from economic growth to energy consumption for Congo. Thus, the results of the study conducted by Twerefo et al., (2008) on Ghana were not supported by Akinlo, (2008).

In Asia, Asafu-Adjaye, (2000) conducted a study using four Asian developing countries: Thailand, Indonesia, India, and the Philippines. Using income as a proxy for economic growth, his study revealed unidirectional Granger causality from energy consumption to income for Indonesia and India in the short run, while bidirectional Granger causality was established from energy consumption to income for Thailand and the Philippines. The results of his study did not support the neutrality hypothesis, with the exception of Indonesia and India, where neutrality was established in the short run. Gosh (2002) and Gosh (2009), however, found unidirectional causality from economic growth to electricity consumption in India, using time series data from 1950 to 1997 and from 1970 to 2006, respectively. Although the standard Granger causality test was used in the first study and the ARDL test was used in the second study, the results that were obtained were consistent for both studies. Their results, however, are not consistent with that of the study conducted by Asafu-Adjei, (2000).

Gerlagh and Lise (2008) present the partial equilibrium model DEMETER-2E for energy supply and demand with endogenous technological change represented through R&D and learning-by-doing (Lbd). This model allows for two competing technologies (energy sources) and does not assume a prior that these technologies are gross complements. The model produces a transition from fossil fuel to carbon-free energy sources within the next two centuries. The authors also find that induced technological change can accelerate the substitution of carbon energy for fossil fuel and reduces cumulative emissions.

Bretschger (2012) reflects on the question on the extent to which endogeneity of technological change justifies the current, more optimistic view on the compatibility of natural resource use and economic development. He argues that although technological change compensates for natural resource scarcity, diminishing returns to capital, poor input substitution and material balance constraints, fading returns to R&D investments and rising marginal R&D costs may impose a limit to this solution. He is also skeptical about the process of deriving long-run predictions from modeling exercises and argues that only results that survive in different modeling environments would be trustworthy. Jaffe, Newell and Stavins, (2003) propose that both theory and empirical evidence suggest that the rate and direction of technological change are influenced by market and regulatory incentives and can be cost-effectively harnessed by policies based on well-targeted economic incentives.

Requate (2012/2013) challenges the standard evaluation of economic instruments, using new insights from the signaling literature and their implications for the interaction between environmental policy instruments and technological change. He argues in favor of rankings based on incentives to invest in equilibrium rather than on aggregate cost savings. Another interesting insight from this literature is that it also confirms older claims that the abatement incentives of tradable permits that are auctioned or grandfathered are not different at the margin. There is growing number of theoretical papers that succeed in showing how the fundamental mechanisms behind directed technological change may at least postpone “absolute” scarcity issues, with small effects on economic growth under some reasonable assumptions.

Empirical papers demonstrate that these mechanisms are real and do their work in practice. There are two steps in technological change: innovation and diffusion. Innovation involves the scientific or engineering research to establish a new technical idea and to develop that idea into a commercial product or process.

Diffusion is the process by which a new product or process gradually replaces older technology throughout many firms and applications. With government intervention, energy efficiency in relation to technological change in the energy industry can be encouraged through increased efficient natural gas production and utilization, R&D investment and innovation activities of firms. Technological diffusion is promoted as well, when more and more firms within the industry adopt new technologies. This is beneficial in terms of dynamic increasing returns. Technological diffusion can result in cost reduction by increasing learning-by-doing.

Byrne and Polonsky, (2001) and Ewing and Sarigollu, (2000) identified impediments to the growth of AFVS and these remain pertinent and relevant to NGVs. Byrne and Polonsky (2001) noted that the success of AFVs requires stakeholders' financial commitment and depends on the availability of: affordable low carbon AFVs, affordable alternative fuels, convenient fuel delivery outlets, maintenance services, appropriate transport easements, and consumer education.

They observed that speed, acceleration, and driving range before refueling are some of the major concerns for consumers. Ewing and Sarigollu (2000) observed that vehicle cost, performance, safety, socio-cultural considerations, refueling, maintenance and relative emissions can deter consumer adoption. Yeh, (2007) noted that the initial acquisition cost, availability and reliability of vehicle technology and components, and retail NG prices of 40–50% of gasoline equivalent encourage consumers and concluded that none of the countries studied (Argentina, Italy, Pakistan, India and the US) is likely to achieve self-sustaining NGV markets without government support. In the UK, Kirk et al. (2014) examined the light commercial vehicle market for NGVs and concluded that the most important barrier was the lack of refueling infrastructure. They argued that a number of relatively low cost initiatives could help kick-start the market.

Chapter 3.Diamond Model

In this chapter, the following headings shall guide the discussion: Philosophy of the research method of data analysis and modelling approached. It also presents the sampling and ranking procedure methodologies applied in this research analysis.

3.1 Diamond Model Approach

Diamond Model used in this research analyses follows similar method of approach by Adam Smith (2012); his approach on social responsibilities of business to use it resources and engage in activities designed to increase its profits using the ***Porters Diamond Model (1989) and Porter (1990) proposed the diamond model approach, which illustrates the systemic relationship between factors of productivity and four essential diamond factors*** and also used a subsequent methods of approach by Porter and Kramer in (2006) and (2011).

3.2 Diamond Model Analysis

a. Used for Benchmarking the GEC by ranking and sampling procedure.

b. Figure 13 & 14 below illustrates the four essential diamond factors used by this research and Porter (1990)

c. This research used the same four diamond factors to justify the factors used in the study and model the research equations and samples according to similar approach and techniques used by Adam, (2012) and Porter, (1990).

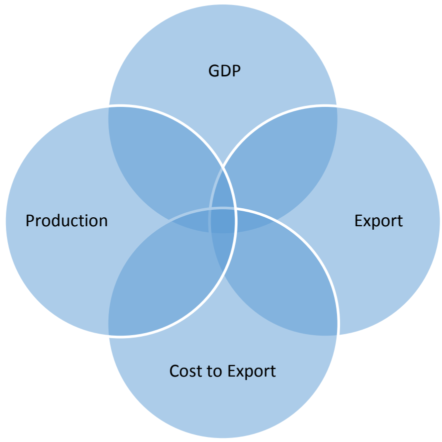


Figure 13: Diamond Model I

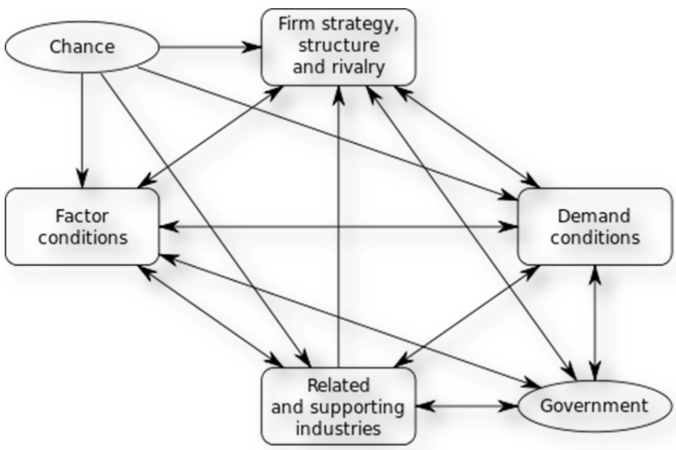


Figure 14: Porter's National Diamond Model (1990-2012)

(Source Michel E. Porter 1989)

3.2.1 Research Relationships

We try to relate change in economic growth in relation to change in production capacity rate *(vice versa)* as dependent variable and change in Export rate, and Cost to export as independent variables for this research analyses; which applies to DEA and Econometric Analyses of this research study.

Terms are define as follows: Economic Growth **(EG)**, Demand Conditions **(DC)**, Factor Conditions **(FC)**, Related Industries **(RI) which represents the quantity of actual production in relation to total production capacity within the Gas Exporting Countries** and Business Context **(BC).**

EG => Economic Growth [GDP]

DC => Consumer Capacity [Export]

FC => Production Capacity [PC]

RI => Actual Production Rate [Apr]

BC => Cost to Export rate [Cexp]

The modification of all the research models, equations and sampling procedures for the models used in this current research, was modified to fit into all the models used in this study in relation to the research concept, questions and hypothesis to be tested accordingly.

3.3 Diamond Model Result Analyses

Diamond Model (I) was implied to categorize, rank and analyze both the dependent and independent variables with respect to all the gas exporting countries [GEC] used in this research analyses. In other to narrow our research scope and focus on the countries that have similar challenges in terms of factors influencing production capacity rate comparable to Nigeria, for a standard model start-up!

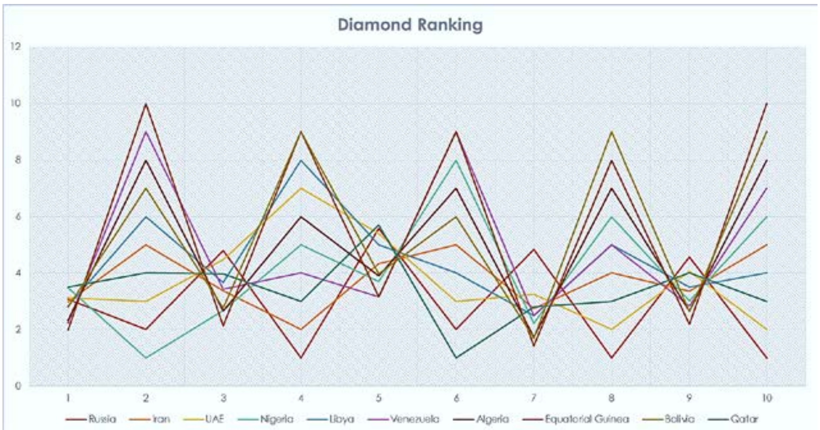


Figure 15: GEC Diamond Ranking Tempo Graph

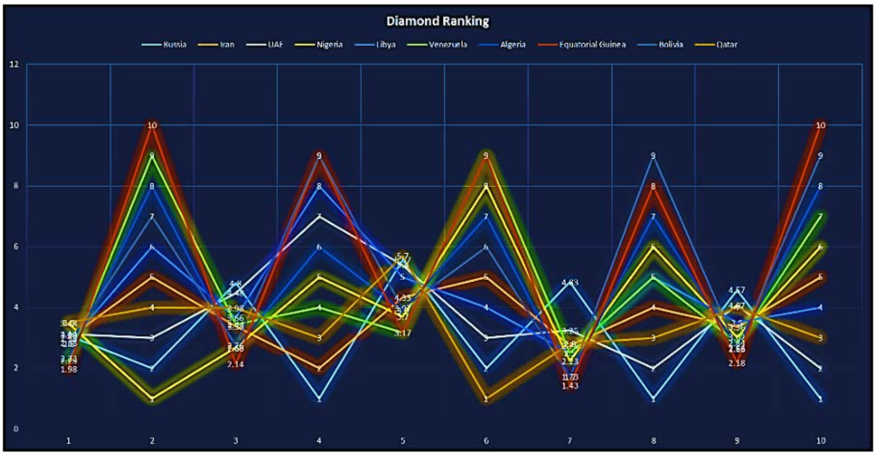


Figure 15.1: GEC Diamond Ranking Saturation Graph

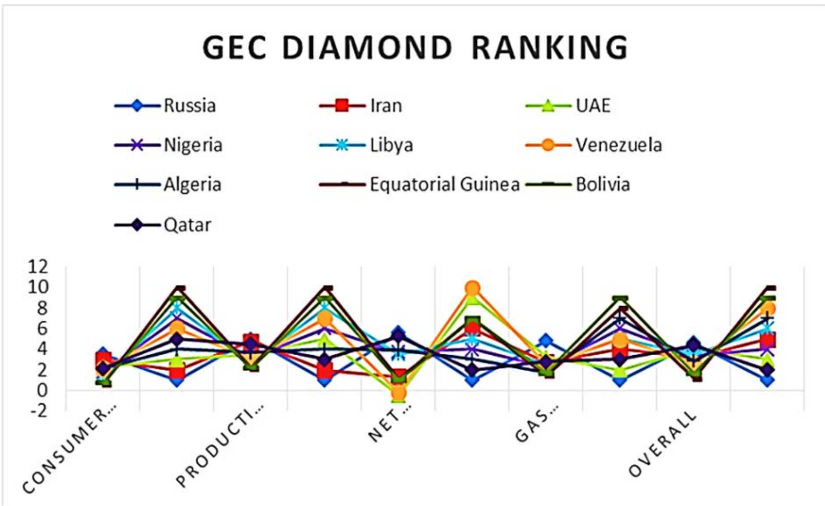


Figure 15.2: GEC Diamond Ranking Graph on Variables

Table 1: Diamond on African Producers

Countries	Factor Conditions	Demand Conditions	Related Industries	Business Context
Nigeria	5.43	26.89	25.82	29.6
Algeria	2.98	28	31.92	28.45
Libya	3.77	22.58	22.72	13.84
Angola	2.86	20.35	30.3	28.69

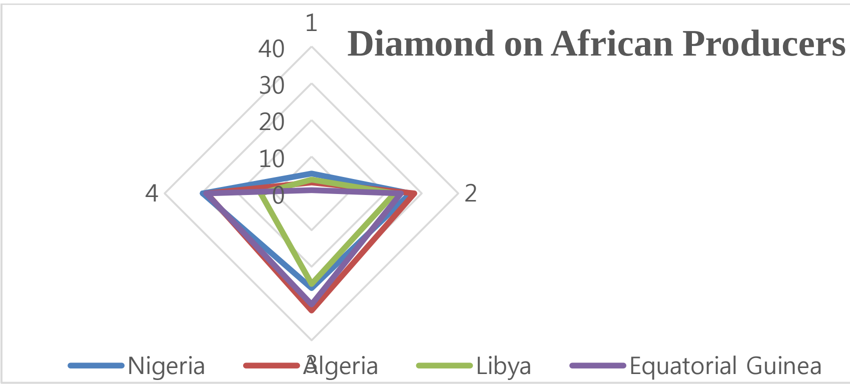


Figure 16: Diamond on African Producers

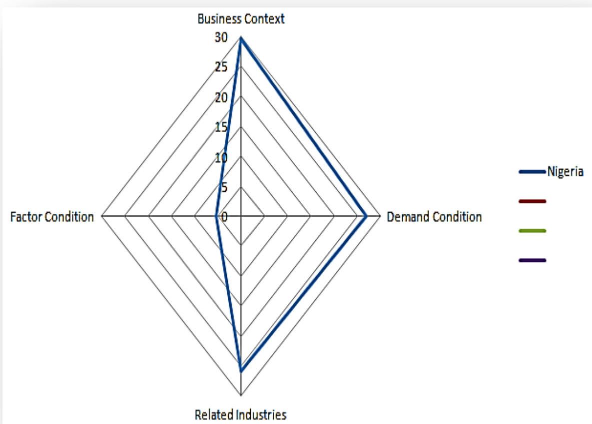


Figure 16.1 Single Diamond on Nigeria

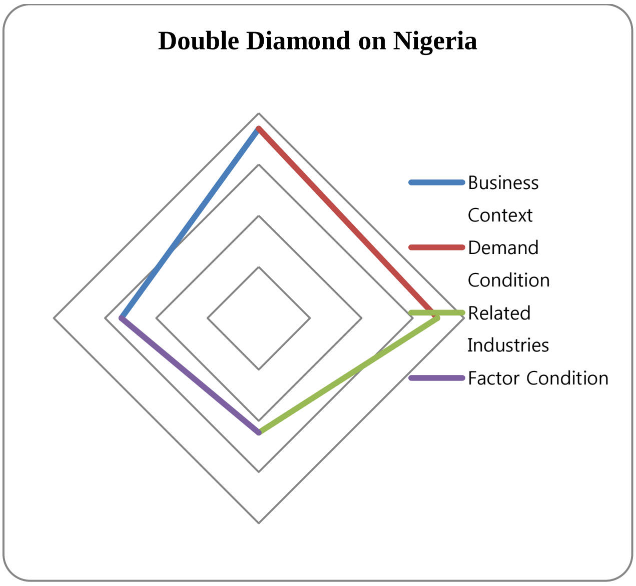


Figure 16.2: Double Diamond on Nigeria

Figure 16.3: SWOT ANALYSIS on Differentiating Values

3.4 Diamond Model Result Summary

This model sampled out all the countries (GEC) scores and ranking in correspondence with the four factors used by Porter's diamond model, which are directly related to the factors used in this research analyses; ***Algeria*** with an ***overall score of 2.66% & ranked 8th*** , ***Angola*** with an ***overall score of 2.18% & ranked 10th*** , ***Nigeria*** with an ***overall score of 3.02% & ranked 6th*** , ***UAE*** with an ***overall score of 4.07% & ranked 2nd*** and ***Qatar*** with an ***overall score of 4.01% & ranked 3rd*** as indicated in the diamond score and ranking analyses which gives us the bases to sampled out these countries for this research analyses; (refer to table 2 below).

Table 2 Summary of Diamond Model Score & Ranking

Country	Overall Score%	Overall Ranking (nth)
Algeria	2.66	8
Angola	2.18	10
Nigeria	3.02	6
UAE	4.07	2
Qatar	4.01	3

Chapter 4 Econometric Analyses

4.1 Regression Analyses using Panel Data Estimation

Time series regression analysis was used as an alternative paradigms for evaluating the economic consequences of production-related decisions with respect to the efficiency/inefficiency of companies. Hoff (2007) claimed that the Tobit and OLS approaches sufficiently represented DEA second-stage analysis in a case study for the Danish fishery. Banker and Natarajan (2008) also argued that OLS yields consistent estimates when the DEA scores are regressed on the variables influences. Simar and Wilson (2011), however, made some observations surrounding the restrictive assumptions underlying the reliance on these proposed methods and the data generating process for DEA second-stage analysis. They argued that care must be taken in carrying out DEA second-stage analysis. Barros and Dieke (2008) measured the economic efficiency of airports and concluded that the truncated bootstrapped second-stage regression proposed by Simar and Wilson (2007) better describes the efficiency scores. These two arguments notwithstanding, using panel data is expected to mitigate the negative concerns and to yield consistent estimates after carrying out the necessary, appropriate statistical tests. [45]As cited in Simar and Wilson (2011)

The steps outlined by Dougherty (2007) were followed in selecting the appropriate panel regression model. First, the observations can be said to be those of a random sample from a given population because the 38 companies were spatially drawn from across the regions of the world and fairly represent the top and major players in the world's oil industry. Therefore, the fixed- and random-effects regression models were used. The Durbin-Wu-Hausman test was carried out to discriminate between the two models, and based on its results, the random-effects model was provisionally selected. The ruling out of the fixed-effects model based on the results of the aforementioned test was expected because some of the variables remained largely unchanged throughout the study period for some of the countries, notably the consumption capacity of Nigeria and Angola respectively estimated as insignificant to the production capacity.

Furthermore, the Breusch and Pagan Lagrangian multiplier test was carried out to determine the presence of random effects; it also discriminates between the selection of a pooled OLS and random-effects regression. The test results led to the selection of time series random-effects regression for the analysis. The robust standard errors of the coefficients were calculated to address the detected heteroskedastic problem with the data. Equation 5.1 above shows the regression equation for estimating the effect of the independent variables on the efficiency of the countries production capacity, using the random-effects model.

4.2 Model Approach [Panel Data]

Regression Model of this research analyses follows the approach of previous literatures; consequently, ***Hoff (2007),*** he claimed that ***Tobit and OLS approaches*** sufficiently represented ***DEA-second-stage analyses*** in a case study of the Danish fishery. Similarly subsequent literatures use related approach; ***Banker and Natarajan, (2008) & Kuosmanen and Johnson, (2008).*** They also argued that OLS yields consistent estimates when the DEA scores are regressed on the variables influences. *(See figure 17 below).*

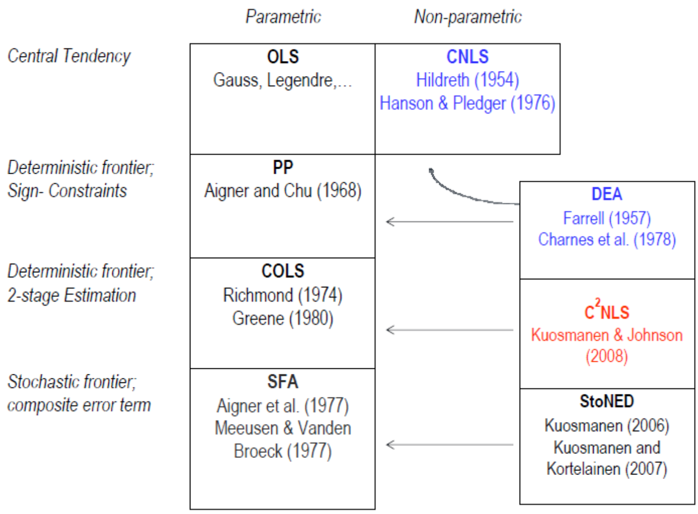


Figure 17: OLS, SFA & DEA Links Established on Statistical Classification of Parametric & Non-parametric Approach of Previous Literatures

(Source HSE, [2009])

Barros and Dieke (2008) measured the economic efficiency of airports and concluded that the approach is linked to previous studies and also simplifies the DEA second-stage regression analyses and also validates the approach proposed by ***Simar and Wilson (2007).*** As such it better describes the efficiency scores; however these two arguments notwithstanding using panel data approach is expected to mitigate the negative concerns and to yield consistent estimates after carrying out the necessary appropriate statistical test. Similarly ***Simar and Wilson, (2011),*** conversely made some observations surrounding restrictive assumptions underlying the reliance on these proposed methods and the data generating process for DEA-second-stage analyses.

Finally this research follows the approach of Rosen, M. A., & Scott, D. S. (1998), Anwar, M.S and Sampath, R.K (1999) and Al-Iriani and Al-Shamsi (2011), to analyze and compare the countries estimated results analyses using regression method for comparative analyses among the GEC countries used in this research study. This thesis sought to analyze the research problem using the following method of approach with regards to regression analyses, (Model III) of this study.

4.3 Model Modification & Specification

The following approach was used in modelling the research concept and equations, also responding to the research questions & hypothesis as well as analyzing the empirical estimation of the data used for this study, with the view to a comparable results analyses of the GEC used in this research analysis

4.3.1 Panel Data Estimation is as follows:

a. Linear Regression Model –OLS

b. Fixed and Random Effect Model (Hausman test)

c. Final Estimation(Random effect and OLS)

4.3.2 Model Equations

The overall panel data model proceeds in subsequent forms:

$(\text{Prod. capacity})_{it} = \alpha + \beta_1\Sigma(\text{IV})it + \varepsilon_{it}$ ……equation 4.0

- Where Production Capacity ***[PC]*** (dependent variable) = f (Independent variables ***[IV]***) => Export ***[Exp]***, Cost to Export ***[Cexp]***, Actual Production Rate ***[Apr]***, economic growth ***[GDP]***)
- Production Capacity = f (economic factors ***[EG]***, demand factor ***[DC]***, business context ***[BC]***, related industries ***[RI]***)
- **EG** => Economic Growth ***[GDP]***
- **DC** => Export ***[Exp]***
- **FC** => Production Capacity ***[PC]***
- **RI** => Actual Production Rate ***[Apr]***
- **BC** => Cost to Export ***[Cexp]***

$$\mathbf{PC_{it} = \alpha + \beta_1\, Exp_{it} + \beta_2\, Cexp_{it} + \beta_3\, GDP_{it} + \varepsilon_{it}} \quad \textbf{equation 4.1}$$

- Where $\mathbf{PC_{it}}$ is the production capacity in each country in year t, $\mathbf{Exp_{it}}$ (expot to consumers) is the vector of independent variables of ith country in year t, $\mathbf{Cexp_{it}}$ represents the vector of cost to export factors of ith country in year t, $\mathbf{Apr_{it}}$ is actual production rate factor in ith country in year t, GDP_{it} represent economic growth (of each gas exporting countries [GEC]) factor in ith country in year t and $\boldsymbol{\varepsilon_{it}}$ is the error term.

DEA Second Stage Approach using Regression Analyses Equation 4.2

$$\mathbf{PC_{it} = \alpha + \beta_1\, Exp_{it} + \beta_2\, Cexp_{it} + \beta_3\, GDP_{it} + \varepsilon_{it}} \quad \textbf{equation 4.2}$$

- Where PC_{it} is the yearly production capacity, Exp_{it} is the consumption capacity, $Cexp_{it}$ is the cost to exports and GDP_{it} is the economic growth of each GEC.

- β_1, β_2 & β_3 are the respective coefficients while εit is the disturbance term, which consists of two components, as follows:

$$\boldsymbol{\varepsilon_{it} = u_i + v_{it}}$$

- Where u_{it} is the unobserved-error effect and ν_{it} is the specific-error term. The usual-error term covariance assumption for the random-effects model is as follows: t=1, 2…15 (years) and i=1, 2…5 (Countries).

- Panel Tobit regression, as used by the previous studies at the DEA second stage, was also calculated and was compared with the random-effects regression. The two models produced similar results and interpretations, thereby increasing the robustness of the results. For simplicity, only the results from the random-effects model are reported herein, (See figure 18, 19, 20 & 21), likewise table 3 & 4 are lessons learned from pervious literatures on related variables that are used in this study.

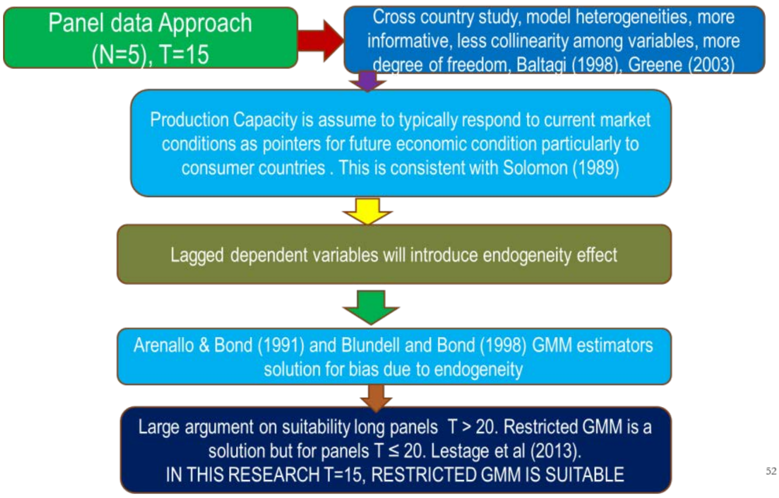


Figure 18: Panel Data Approach

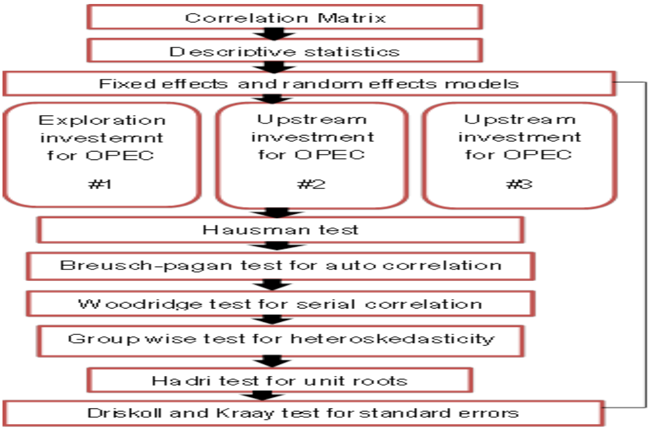


Figure 19: Modelling Procedure from Previous Research

(Heo & Habib, (2014))

Table 3: Regression Independent Variables Selection from Previous Research Literatures

Factors	Variable	Justification for selection
Economic	Net Exports/Imports	Hotelling (1931), Riglund (2004), Iledare (1995), Guerra (2007), Enerbeli et al (2012), Hoff (2011)
	Consumption	Flexible accelerator theory, Pentecost (2000), Cox and Wright (1976), Pesaran (1990),Guerra (2007) and Hvozdyk and Mercer-blackman (2010)
Production	Reserves replacement	Theory of irreversible investment under uncertainty, Iwayemi and Skriner (1986)
	Oil & Gas field depletion	Theory of irreversible under uncertainty, Farzin (2001), Mohn (2007), Managi et la (2005), Iledare (1995) and Kasim and Kemp (2006)
	Oil & Gas Price	Theory of irreversible investment under uncertainty and Broadman (1985)
Technical Gas Facility Types & Capacity	Technological progress	Iledare (2005), Iledare and Pulsipher (1999), Iledare (2001), Mohn (2007),Mohn (2009), Yarzin (2001) and Osmundsen et al (2010)
Petroleum fiscal policy	Oil rent Gas rent	Cate and Mulder (2007), Nakhle (2007), Solomon (1989), Iledare (1995), Cox and Wright (1976) and Hvozdyck and Mercer-blackman (2010),Kasim and Kemp (2005)

Table 4: Lessons & Literature Review of Some Theories on Production Rate in Oil Industry

Theoretical insights on Production Rate in oil industry	Variables selection	Guide on modelling assumptions
Seminal work of Hotellings (1931), Cremer Y Salehi-Istifahani (1991), Guerra (2007).	Exhaustible Resources (Crude oil, reserves & production rate)	Economics of Exhaustible Resources
Chenery (1952), Jorgensen (1971), Pentecost (2000), Parker(2010), Flexible accelerator theory of Investment	Optimal capital stock necessary to yield output	The role of output in driving Investment Behaviour

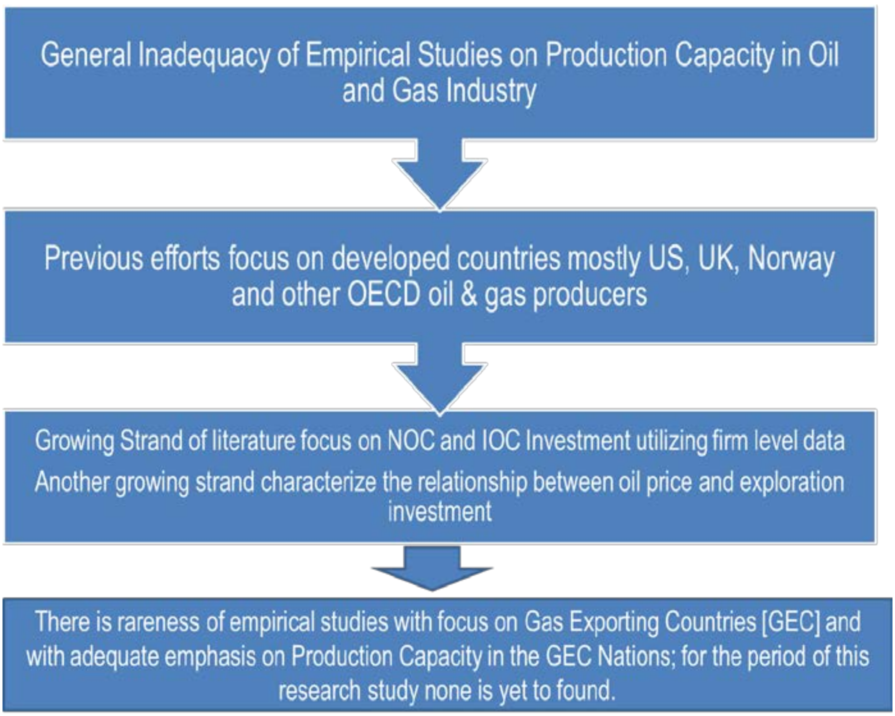


Figure 20: Lessons from Previous Empirical Studies

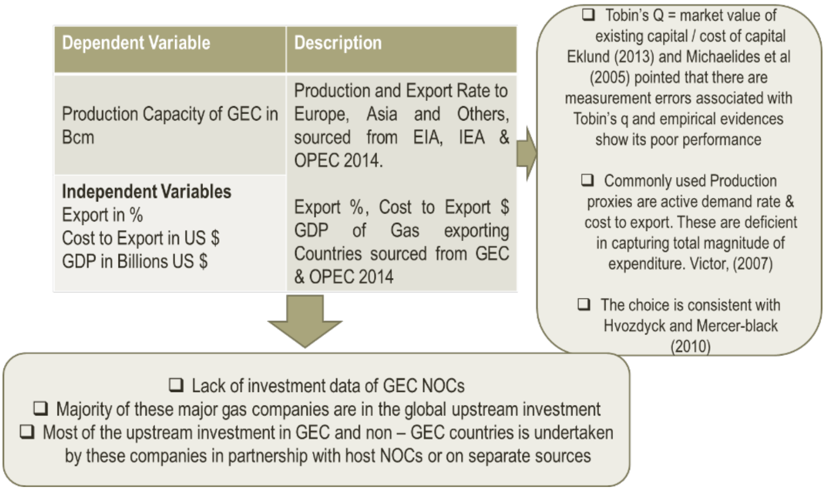


Figure 21: Variables Selection and Data Description

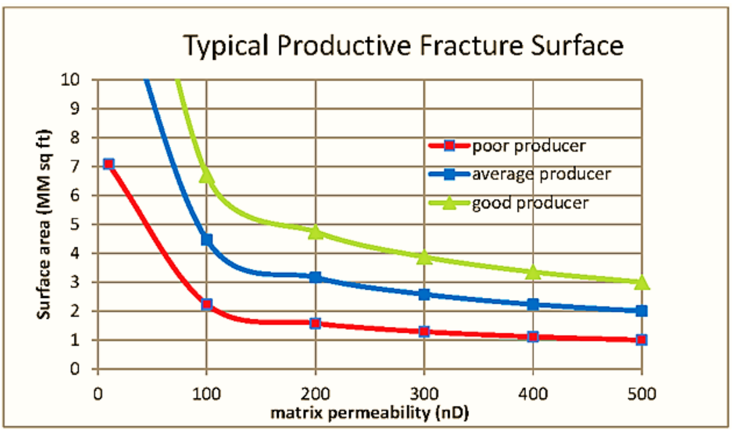


Figure 22: Typical Production Fracture

(Source Economic Watch 2014)

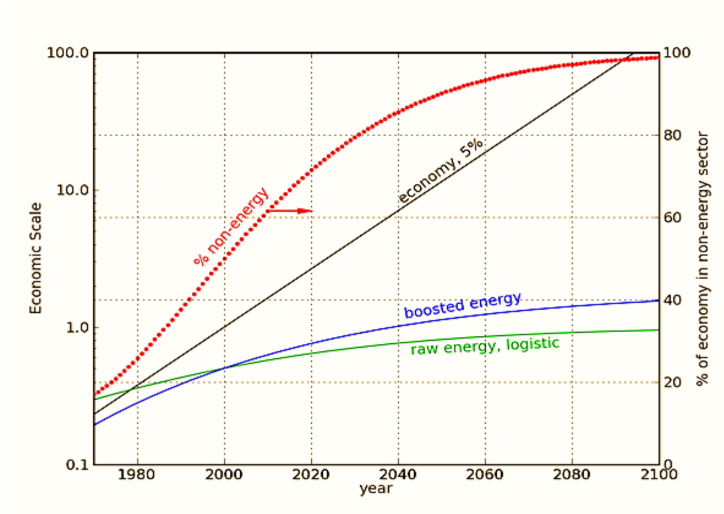
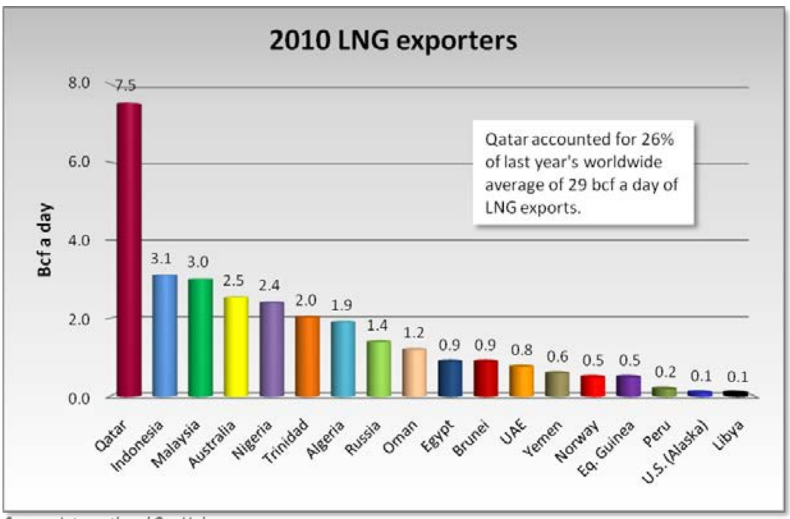


Figure 23: Economics of Scale

(Source Economic Watch 2014)



Source: International Gas Union

Figure 24: World LNG Exporters

(Source International Gas Union)

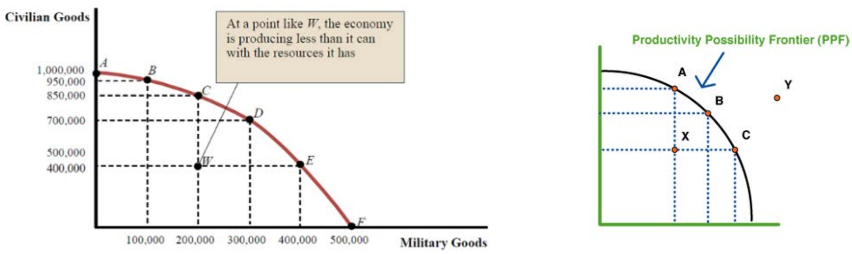


Figure 25: Productivity Possibility Frontier

(Source CCR)

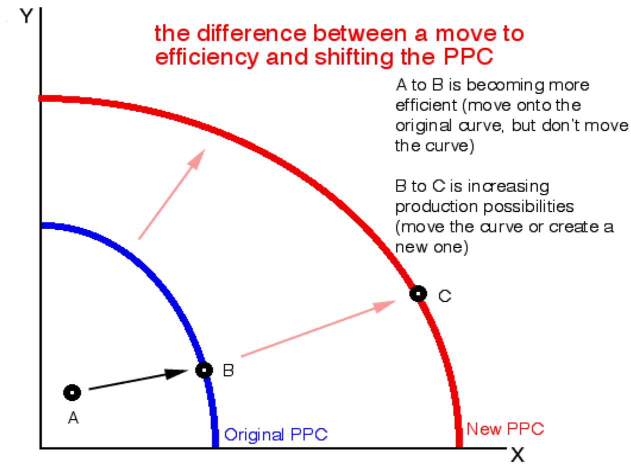


Figure 26: Productivity Possibility Curve/Create

(Source CCR)

Figures 22 to 26 are expressing the perspectives of global productive possibilities, frontiers and typical production fracture in terms of efficient and inefficient producers within a growing economy.

4.4 Three (3) Sub-OLS Models [1, 2 & 3]

Three (3) different Sub-OLS Models were modified to fit into the panel data estimation approach and also to select the best alternative model that will capture all the independent variables and individual country specific. This models are named:

- **Model I** All Gas Exporting Countries [GEC]
- **Model II** Selected GEC's Similar to Nigeria [Major Producers]

➢ **Model III** Selected GEC's including a country outside GEC [Angola] (Minor Producers) (See figure 27-39)

Variable	Production Capacity in GEC		
Production Capacity	All GEC Model I	All GEC Including Angola Model II	Selected GEC's Similar to Nigeria Model III
Export	1.498379 (0.000)	1.510238 (0.000)	1.778034 (0.000)
Cost to Export	-0.0220905 (0.029)	-0.0220907 (0.030)	-0.0428505 (0.039)
GDP	0.0306035 (0.436)	0.0307047 (0.443)	0.2349831 (0.228)
R^2	**0.7803**	**0.7820**	**0.7290**
F-test	F(14, 166) = 42.10 Prob > F = 0.0000	F(15, 180) = 43.05 Prob > F = 0.0000	F(10, 95) = 28.10 Prob > F = 0.0000
No: of Obs	180	195	105

Figure 27: Summary of OLS Model

Fixed Effect Estimation of All Countries

```
Fixed-effects (within) regression               Number of obs      =       195
Group variable: country                         Number of groups   =        13

R-sq:  within  = 0.2110                         Obs per group: min =        15
       between = 0.2985                                        avg =      15.0
       overall = 0.2495                                        max =        15

                                                F(3,179)           =     15.95
corr(u_i, Xb)  = -0.3301                        Prob > F           =    0.0000

------------------------------------------------------------------------------
       prodc |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
      export |   1.460855   .2175569     6.70   0.000     1.030898    1.890612
costtoexport |  -.0245352   .0112211    -2.19   0.030    -.046681   -.0023955
         gdp |   .0306035   .0392055     0.78   0.436    -.0467609    .1079675
     algeria |          0  (omitted)
      angola |          0  (omitted)
     bolivia |          0  (omitted)
       egypt |          0  (omitted)
  equatorial |          0  (omitted)
        iran |          0  (omitted)
       libya |          0  (omitted)
     nigeria |          0  (omitted)
       qatar |          0  (omitted)
      russia |          0  (omitted)
    trinidad |          0  (omitted)
         uae |          0  (omitted)
   venezuela |          0  (omitted)
       _cons |   58.41273   11.43199     5.11   0.000     35.85392    80.97154
-------------+----------------------------------------------------------------
     sigma_u |  98.274756
     sigma_e |  55.924708
         rho |   .5867471   (fraction of variance due to u_i)
------------------------------------------------------------------------------
F test that all u_i=0:     F(12, 179) =    17.08             Prob > F = 0.0000
```

Figure 28: Fixed Effect Estimation

Random Effect Estimation Capturing All GEC Countries Specific Effects

```
Random-effects GLS regression                   Number of obs      =       195
Group variable: country                         Number of groups   =        13

R-sq:  within  = 0.2110                         Obs per group: min =        15
       between = 1.0000                                        avg =      15.0
       overall = 0.6545                                        max =        15

                                                Wald chi2(15)      =    339.07
corr(u_i, X)   = 0 (assumed)                    Prob > chi2        =    0.0000
```

prodc	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
export	1.460655	.2178869	6.70	0.000	1.033604	1.887705
costtoexport	-.0245382	.0112211	-2.19	0.029	-.0465312	-.0025452
gdp	.0306035	.0392055	0.78	0.435	-.0462378	.1074448
algeria	-104.5842	34.59207	-3.02	0.002	-172.3834	-36.78501
angola	-88.15462	31.81702	-2.77	0.006	-150.5148	-25.79441
bolivia	-65.09488	32.23909	-2.02	0.043	-128.2823	-1.907433
egypt	-85.67519	32.62456	-2.63	0.009	-149.6182	-21.73222
equatorial	-89.84352	32.12672	-2.80	0.005	-152.8107	-26.8763
iran	-40.07035	34.58758	-1.16	0.247	-107.8607	27.72006
libya	-110.5539	33.2238	-3.33	0.001	-175.6714	-45.43645
nigeria	-105.1789	32.45602	-3.24	0.001	-168.7915	-41.56625
qatar	-85.69846	49.33959	-1.74	0.082	-182.4031	11.00614
russia	-178.0131	58.01436	-3.07	0.002	-291.7192	-64.3071
trinidad	223.3321	32.73159	6.82	0.000	159.1794	287.4848
uae	32.8101	33.5685	0.98	0.328	-32.98373	98.60394
venezuela	0	(omitted)				
_cons	112.007	25.23558	4.44	0.000	62.54535	161.4686

Figure 29: Random Effect Estimation

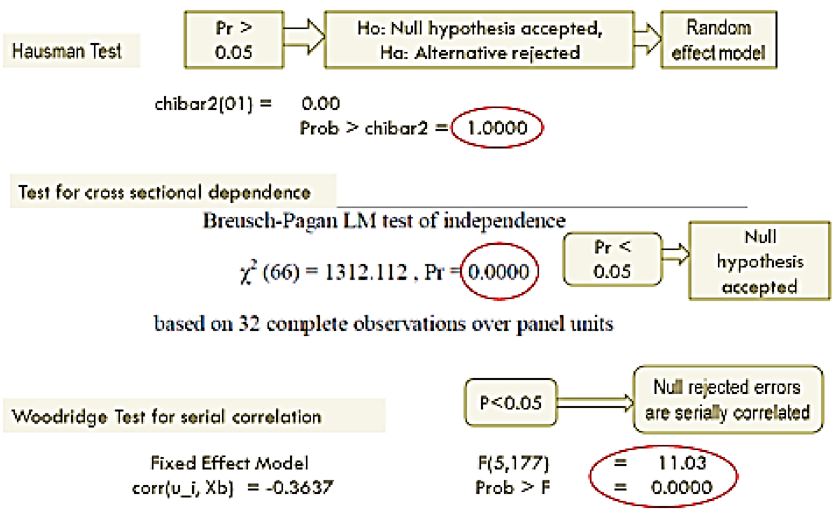


Figure 30 Panel Data Test

```
                  ---- Coefficients ----
             |      (b)          (B)            (b-B)     sqrt(diag(V_b-V_B))
             |     fixed        random       Difference          S.E.
-------------+----------------------------------------------------------------
      export |    1.460655     1.460655        1.11e-14        1.90e-08
costtoexport |   -.0245382    -.0245382       -1.18e-16               .
         gdp |    .0306035     .0306035        3.16e-16        1.32e-09
------------------------------------------------------------------------------
                           b = consistent under Ho and Ha; obtained from xtreg
            B = inconsistent under Ha, efficient under Ho; obtained from xtreg

    Test:  Ho:  difference in coefficients not systematic

                  chi2(3) = (b-B)'[(V_b-V_B)^(-1)](b-B)
                          =        0.00
                Prob>chi2 =      1.0000    Random effect model is recommendable
                (V_b-V_B is not positive definite)
```

Figure 31: Hausman Test for Fixed & Random Effect Estimation

Variable	Production Capacity in GEC			
Production Capacity	Fixed effect model		Random effect model	
Export	1.46065	(0.000)	1.460655	(0.000)
Cost to Export	-0.0245382	(0.030)	-0.0245383	(0.029)
GDP	0.0306035	(0.436)	0.038899	(0.329)
cons	58.41273	(0.010)	87.59017	(0.000)
R^2	**0.2495**		**0.6545**	
F-test	F(3,179) = 15.95, Prob > F = 0.0000		Wald chi2(15) = 339.07 Prob > chi2 = 0.0000	

Figure 32: Summary of Fixed & Random Effect Estimation

Driskol and Kraay Covariance Matrix Estimator Applied on estimated Random Effect Model to adjust for standard errors due to presence of auto and serial correlations

Variable	
Production Capacity	Random Effect Model
Export	1.460655*** (0.000)
Cost to Export	-0.0245383 *** (0.029)
GDP	0.038899 *** (0.329)
Cost to Import	-0.0906318* (0.022)
Net Capital	-2.78e-09 * (0.457)
cons	87.59017 *** (0.000)
R^2	**0.6545**
F-test	Wald chi2(15) = 339.07
	Prob > chi2 = 0.0000

Figure 33: Random Effect Estimation

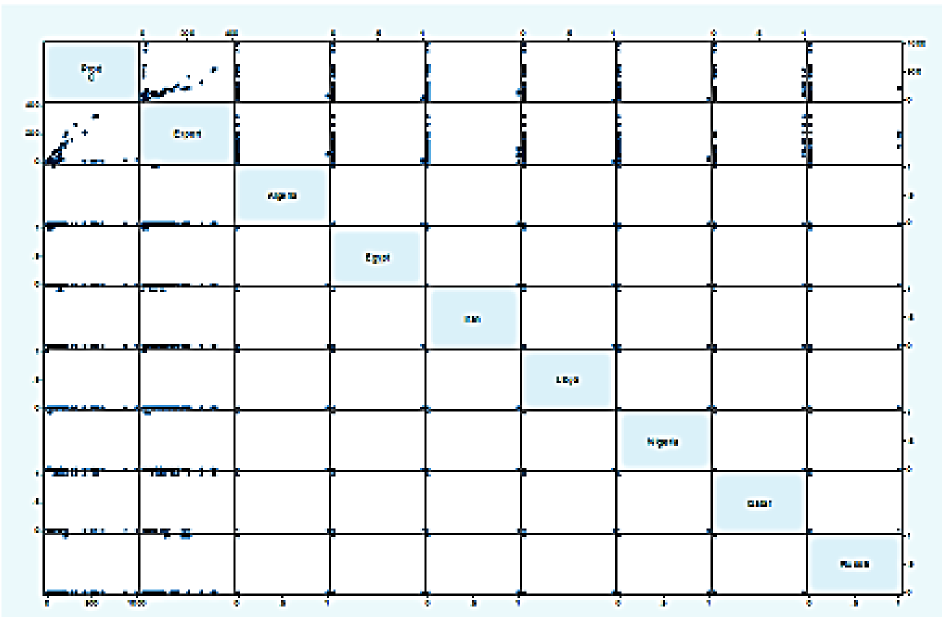


Figure 34: Estimation Graph of Major Exporters of GEC

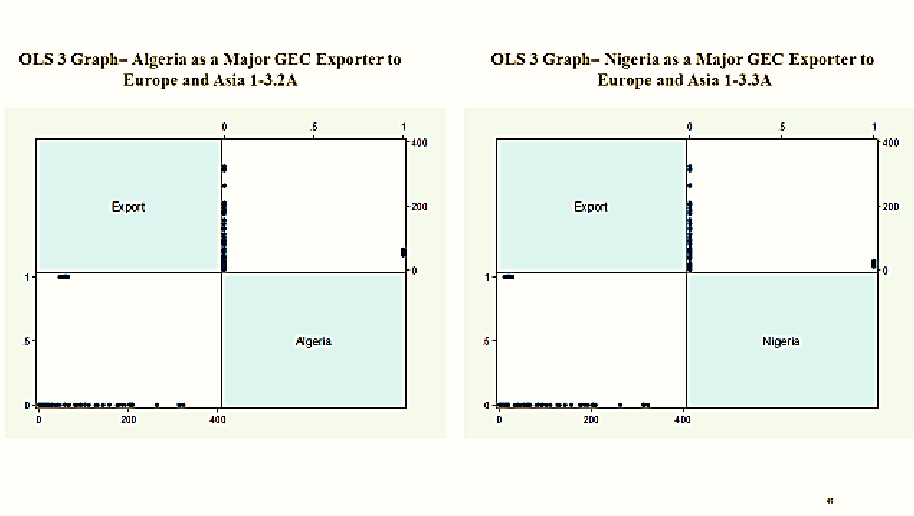


Figure 35: Estimation Graph of Algeria & Nigeria

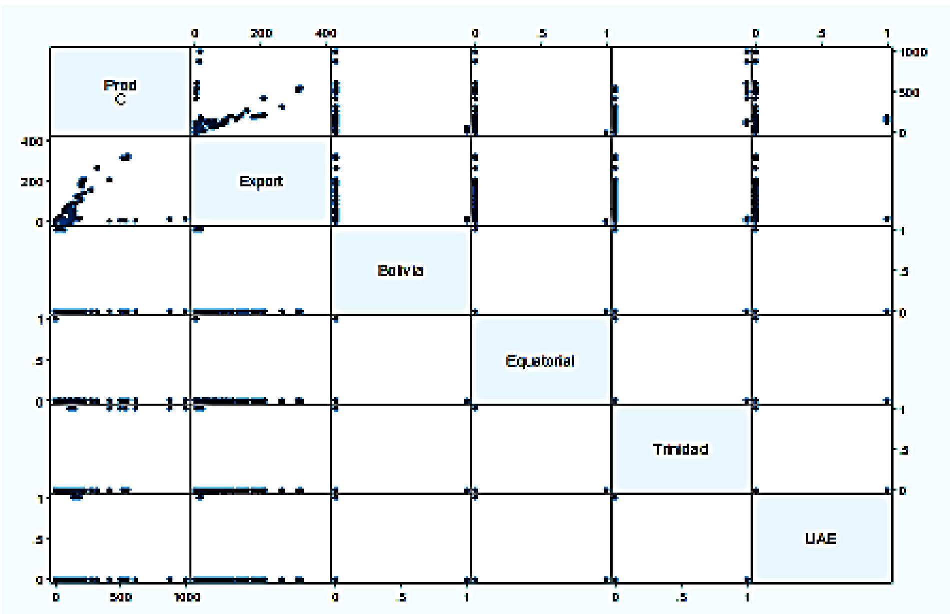


Figure 36: Minor Producers of GEC

Variable	Production Capacity in GEC	
Production Capacity	**Major GEC Producers Model III A**	**Minor GEC Producers Model III B**
Export	1.497226 (0.000)	-13.19571 (0.034)
Cost to Export	-0.0084335 (0.091)	-0.0072503 (0.868)
R^2	**0.9656**	**0.6933**
F-test	F(9, 96) = 298.99 Prob > F = 0.0000	F(6, 54) = 20.35 Prob > F = 0.0000
No: of Obs	105	60

Figure 37: Summary of Major & Minor GEC Producers Estimation

Finally; Diagnostic Checking [Serial Correlation/Cross-Sectional Dependence] Random Effect Estimates

```
Breusch and Pagan Lagrangian multiplier test for random effects

        prodc[country,t] = Xb + u[country] + e[country,t]

        Estimated results:
                         |       Var     sd = sqrt(Var)
                ---------+-----------------------------
                   prodc |   2.86e+07       5352.185
                       e |   17104.73        130.785
                       u |          0              0

        Test:   Var(u) = 0
                             chibar2(01) =     0.00
                          Prob > chibar2 =   1.0000
```

Figure 38 Final Diagnostic Checking on Random Effect I

y = Linear prediction (predict)
= 105.93077

variable	ey/ex	Std. Err.	z	P>|z|	[95% C.I.	]	X
export	.526468	.16051	3.28	0.001	.21187	.841066	40.5761
co~xport	-.1523965	.08413	-1.81	0.070	-.317287	.012494	713.092
gdp	.0368872	.06742	0.55	0.584	-.095259	.169034	187.833

Cost to export is inelastic at -15% & 0.070 significant P-value
While export is elastic at 53% & 0.001 significant P-value

Figure 39: Estimation of Model Elasticity

4.5 Model Result Summary

This model measures and captures the individuality and heterogeneity of both the country's (GEC) specific as independent coefficients and the P-values of all the variables used in this research analyses; finding the overall coefficient of Nigeria to be -66.955% at an insignificant P-value of 0.703 as compared to Algeria with coefficient of 779.869% at a significant P-value of 0.000 and UAE with coefficient of 629.913% at a significant P-value of 0.000 which specifies that these countries are more productive in terms gas production and likewise influencing factors have positive significant impact on production capacity.(refer to result Summary table 5 below).

Table 5 Comparison of GEC Estimated Results

S/No:	Countries Production [Dependent Variable]	Coefficient [Independent Variable] Export, Cost to Export & GDP	P>lzl [Independent Variable] Export, Cost to Export & GDP
1.	**Algeria**	-104.5842	0.002
2.	**Angola**	-88.15462	0.006
3.	**Equatorial G.**	-89.84352	0.005
4.	**Libya**	-110.5539	0.001
5.	**Nigeria**	-105.1789	0.001
6.	**Qatar**	-85.69846	0.082
7.	**Russia**	-178.0131	0.002
8.	**Trinidad T.**	223.3321	0.000
9.	**UAE**	32.8101	0.328

4.6 Auxiliary Discussion of Result Analyses

Porter (1990) defines national competitiveness as the ability of a nation's industry to command high production capabilities in foreign markets (international market share); and the ability of a nation to create jobs that support high wages, employment of citizens at low wages. He maintains that achievement of these objectives depend on the productivity with which a nation's resources (labor and capital) are employed. He concludes that the only meaningful concept of national competitiveness is the value of the output produced by a unit labor and capital.

His theory explains the role played by a nation's economic environment, institutions and policies in the competitive success of its firms. He introduces four broad determinants of a nation competitiveness that promotes or impedes the creation of competitive advantage, individually and as a system including the role of chance and government.

Demand is growing both as a result of strong Asian economic growth and the switch to cleaner energy, particularly in China. This trend is likely to continue, notwithstanding the so-called US shale gas revolution and the coming into operations of the US$ 400 billion Russia-China gas pipeline signed on May 21, 2014. Overall, the future of the LNG market remains bright and is likely to result in high LNG prices for years to come. This will continue to support Qatar's large current account surpluses.

LNG Demand with regards to two basic factors are likely to make global demand continue to outpace global supply. ***First***, energy demand in Asia is expected to remain robust, even after taking into account a slowdown in Chinese growth. Countries like China, India, Indonesia, Malaysia, Pakistan and Thailand have just started to rely on LNG supplies for their energy needs and this trend is likely to grow over the next few years. ***Second***, China's rising pollution will mandate a switch away from coal to cleaner energy sources, particularly LNG and pipeline gas. These two factors are expected to lead to global LNG demand growing steadily by 5-7% a year up to 2020, thus outpacing global supply.

Demand vs. Supply: Overall, robust LNG demand is likely to outpace global supply up to 2020. This is likely to imply higher LNG prices as demand from Asia remains robust. As the largest exporter in the world, Qatar is likely to benefit from higher

LNG prices, resulting in large current account surpluses for years to come. ***Source: QNB Group Published on 23/06/2014***

Related and Supporting Industries refer to the presence or absence in the nation of supplies industries and related industries. A Well-developed financial market in the country which is ranked 86 out of 146 countries in the world economic Forum repot 2011-2012 and ranking second (2nd) in Africa behind South Africa, but specifically the Oil and Gas sector lacks local technical supports needed to support socioeconomic development this is evident from the over 80% of work value is carried out abroad. This has led to a dearth in jobs, skills development, capacity building / utilization, Lack of R&D and lack of sustained national economic development. It is optimistic that the ongoing commitment for free market through the ongoing Petroleum industry reforms and Public private Partnerships might provide the necessary development of a robust supporting and related industries capable of delivering efficient and effective support to sector.

Chapter 5 DEA

5.1 DEA Model Approach

DEA Model II; used in this research follows the approach of ***Victor (2007), Eller et.al. (2009 & 2010)***; they used both DEA and Stochastic frontier estimation (SFA) method of approach to a panel of 78 firms over a period of three (3) years [2002-2004], their empirical evidence for the revenue efficiency of NOC's and IOC's which indicates that NOC's are less efficient than IOC's; they further express that NOC's inefficiency can be explained by the differences in the structural and institutional features of the individual firms, which may arise due to different firms objectives as well as external factors that can lead to inefficiency.

Data Envelopment Analysis (DEA)

a. Measures the performance of Nigerian National Gas Company [NNGC] with comparison to other National Gas Companies [NGC] and International Oil & Gas Companies [IOGC's] by:

b. Following the performance progress with **Malmquist Index**

c. Assess the inefficiency factors using **OLS Model**

5.2 Model Modification, Equations & Data

Measuring efficiency and inefficiency models: DEA (data envelope analysis) is used to calculated the static efficiency score per period, of each categories (1-4) of national and international oil and gas companies (NOGC's & IOGC's) used in this research analyses and Malmquist productivity index of companies over time; benchmarking analysis is carry out subsequently. Victor, (2007), Eller et.al. (2009 & 2010) and Ike & Lee, (2013).

Simple Measuring: Efficiency = $\frac{Output}{input}$ **...........equation 4.1.1**

Measuring the efficiency with weight:

DEA model for efficiency

Nonparametric approach is used in operations research and economics for the estimation of production frontiers.

It is used to empirically measure productive efficiency of decision making units (DMU').

Also used for benchmarking in operations management, where a set of measures is selected to benchmark the performance of e.g. manufacturing and service operations which lead to a ***''best practice frontier''***.

This research focus on the performance efficiency of production capacity

The ratio of weighted sum of the outputs to the inputs equation 4.1.1

$$\frac{u_1y_1 + u_2y_2 + u_3y_3 + \dots\dots u_ny_n}{v_1x_1 + v_2x_2 + v_3x_3 + \dots\dots v_nx_n} = \frac{\text{Total Output}}{\text{Total Input}}, \dots\dots\dots\dots\dots(4.1)$$

where u_n and v_n are the respective weights; y_n and x_n are the outputs and inputs, respectively; and n is the number of variables in each case. The

The first DEA model that was used to demonstrate the aforesaid technique was the CCR model, which is said to have been developed by Charnes, Cooper, and Rhodes in 1978. The CCR model is described following Cooper et al. (2006).

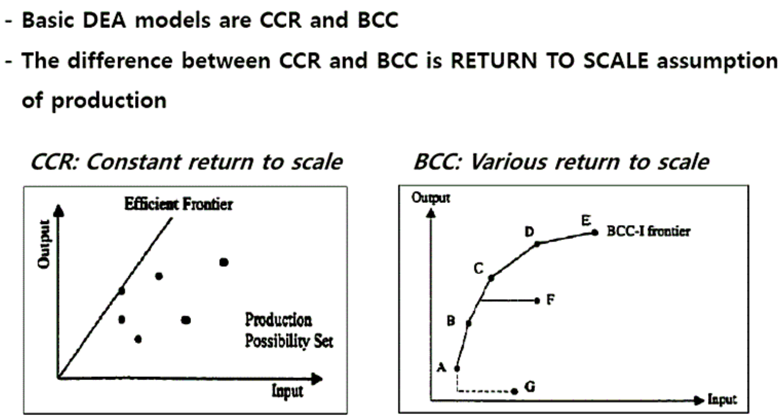


Figure 40: CCR & BBC Models

(Source CCR)

CCR matric model

Let X, an (mxn) matrix, and Y, an (sxn) matrix, denote the input and output matrices for the DMUs, as below.

$$X = \begin{bmatrix} x_{1,1} & x_{1,2} \ldots\ldots & x_{1,n} \\ x_{2,1} & x_{2,2} \ldots\ldots & x_{2,n} \\ \vdots & \vdots & \vdots \\ \vdots & \vdots & \vdots \\ x_{m,1} & x_{m,2} \ldots\ldots & x_{m,n} \end{bmatrix} \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots (4.2)$$

$$Y = \begin{bmatrix} y_{1,1} & y_{1,2} \ldots\ldots & y_{1,n} \\ y_{2,1} & y_{2,2} \ldots\ldots & y_{2,n} \\ \vdots & \vdots & \vdots \\ \vdots & \vdots & \vdots \\ y_{s,1} & y_{s,2} \ldots\ldots & y_{s,n} \end{bmatrix} \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots . (4.3)$$

Consider a set of ***n*** observed companies ***(I= 1… n)*** each producing ***r*** outputs ***(j= 1… r)*** using ***s*** inputs ***(k= 1… s)***. The output efficiency score for observation ***(x', y')*** $\in \mathfrak{R}_+ \times \mathfrak{R}_+$ is given by: equation 4.4 below.

$$E(x', y') = \max \left\{ E \,\middle|\, x' \geq \sum_{i=1}^{n} \lambda^i x^i ,\ Ey' \leq \sum_{i=1}^{n} \lambda^i y^i ,\ \sum_{i=1}^{n} \lambda^i = 1, \lambda^i \geq 0 \right\}. \quad \ldots 4.4$$

DEA Model II Equation (4.4)

- If the input/output data of ***n*** DMUs with ***m*** and ***s*** inputs and outputs, respectively, are arranged as in equation 4.4 below, then the efficiency of each DMU can be evaluated using ***n*** optimizations for each of them.
- Let the trial be designated as DMUs, where ranges over ***1*** through ***n***.

- Equations (4.4, 4.5, 4.6 & 4.7) below outline the fractional programming problem to obtain values for the input weights ***(Vi; i=1,…,m)*** and the output weights ***(ur; r=1,…,s).***

- Where ***m*** and ***s*** are the number of inputs and outputs, respectively; representing the number of DMUs in the sample (oil & gas companies). For example, $\boldsymbol{x_{1,\,1}}$ is the ***DMU***$_1$; $\boldsymbol{x_{1,\,2}}$ is the input $\boldsymbol{x_1}$ used by ***DMU*** $_2$; and $\boldsymbol{x_{m,\,n}}$ is the ***DMU n***. This is similar for the case of the output matrix. Victor, (2007).

$$\max_{v,u} \theta = \frac{u_1y_{1\hat{j}} + u_2y_{2\hat{j}} + u_3y_{3\hat{j}} + \ldots\ldots u_sy_{s\hat{j}}}{v_1x_{1\hat{j}} + v_2x_{2\hat{j}} + v_3x_{3\hat{j}} + \ldots\ldots v_mx_{m\hat{j}}} \ldots\ldots\ldots\ldots\ldots\ldots\ldots(4.4)$$

$$\text{Subject to } \frac{u_1y_{1j} + u_2y_{2j} + u_3y_{3j} + \ldots\ldots u_sy_{sj}}{v_1x_{1j} + v_2x_{2j} + v_3x_{3j} + \ldots\ldots v_mx_{mj}} \leq 1 \ (j=1,\ldots,n)\ldots.(4.5)$$

$$v_1, v_2, \ldots v_m \geq 0 \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots(4.6)$$

$$u_1, u_2, \ldots u_s \geq 0 \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots(4.7)$$

- The constraints are added to ensure that the ratio of the output to the input does not exceed **1** for every DMU.

- The objective is to obtain weights that maximize ratio of DMU. The optimal value of DMUs, is at most **1**.

- The fractional programming of equations (4.4) to (4.7) above can be converted into the equivalent linear programming, as in equations (4.8) to (4.12) below.

$$\max_{v,u} \theta = u_1 y_{1ĵ} + u_2 y_{2ĵ} + u_3 y_{3ĵ} + \ldots \ldots u_s y_{sĵ} \ldots\ldots\ldots\ldots\ldots\ldots (4.8)$$

$$\text{Subject to } v_1 x_{1ĵ} + v_2 x_{2ĵ} + v_3 x_{3ĵ} + \ldots \ldots v_m x_{mĵ} = 1 \ldots\ldots\ldots\ldots\ldots (4.9)$$

$$u_1 y_{1j} + u_2 y_{2j} \ldots u_s y_{sj} \leq v_1 x_{1j} + v_2 x_{2j} + \ldots v_m x_{mj} \; (j=1,\ldots,n) \ldots (4.10)$$

$$v_1, v_2, \ldots v_m \geq 0 \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (4.11)$$

$$u_1, u_2, \ldots u_s \geq 0 \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (4.12)$$

- ***(u*, v*)*** was obtained as an optimal solution for the linear programming
- Results in a set of optimal weights for ***DMUĵ***. The ratio scale is evaluated using equation (4.13).

$$\theta^* = \frac{\sum_{r=1}^{s} u_r^* y_{rĵ}}{\sum_{i=1}^{m} v_i^* x_{iĵ}} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (4.13)$$

- ***(u*, v*)*** is the set of most favorable weights for DMUĵ as it maximizes ***Ө****.
- An evaluated DMU is CCR-efficient if ***Ө*=1*** and if there exists at least one optimal ***(u*, v*)*** with ***u*> O*** and ***v*> O***. Otherwise, the DMU is CCR-inefficient, and the value of ***Ө****which is less than **1**, reflects the level of relativity to the efficient ***DMUs***. (See figure 15 below)

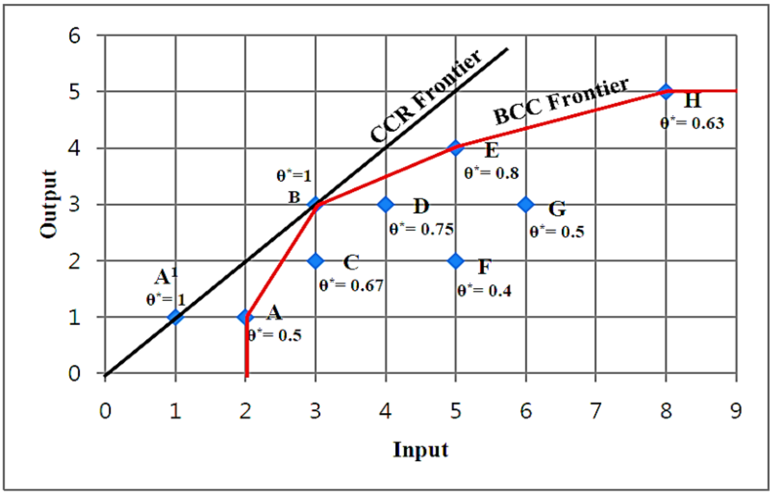


Figure 41 Output-Input Ratio for Eight DMU's (A, B...H)

(Source CCR)

- ***DEA Malmquist Index [MI]*** (measuring the catch-up and shift effect).
- ***DEA MI*** is the combination of DEA model and Malmquist index that allow the dynamic efficiency and productivity of ***DMUs*** over certain period of time, see equation 4.14 below and figure 16 below.

$$MI_{catch\text{-}up} = \frac{\text{Efficiency of } X_2 \text{ with respect to period 2 frontier}}{\text{Efficiency of } X_1 \text{ with respect to period 1 frontier}} = \frac{ZB}{ZX_2} \bigg/ \frac{YD}{YX_1} \ldots\ldots \quad \ldots.4.14$$

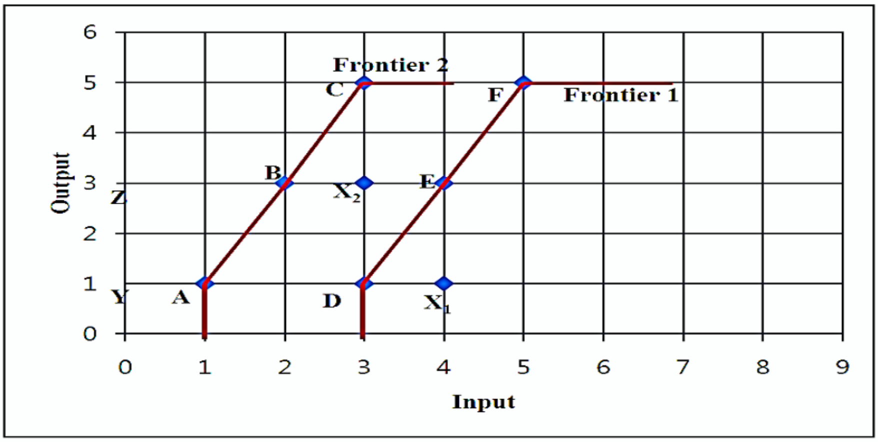


Figure 42: DEA Malmquist Index (Catch-up & Frontier Shift Effect)

(Source CCR)

5.3Model Data Modification & Description

- 23 oil and Gas companies (national & international oil & gas companies, NGC's, NOC's, IOGC's & Vast IOGC's)
- NLNG, NNPC, EIA & IEA (23 oil and gas companies operational data (1999-2014)
- Operational data (oil & gas reserves ratio & production capacity -000bb/d, product sales-000bb/d, oil & gas production rate bcm/y extraction capacity-000bb/d, revenue US$m, net income US$m, total assets US$m, (%))

5.3.1 Selection of Input and Out variables

- Variables input (oil production capacity, gas production capacity & consumption capacity bscf/y) two output variable (oil and gas production rate bscf/y)
- Category of companies [1-4] (DMU's)
- GEC NGC's & NOC's (Companies in Category 1)
- Non GEC NGC's & NOC's (Companies in Category 2)
- IOGC's (Companies in Category 3)
- Vast IOGC's (BP, Chevron, CoP, Shell, ExxonMobil and Total) (Companies in Category 4)
- Despite better understanding of statistical foundation of DEA, major conceptual and operational barriers remain, Andrew Johnson, (2009).

5.4 Model Result Analysis

DEA was used to analyze the performance of NOCs and that of IOC's empirically; using macro-level data and various performance indicators, 25 oil and gas companies introduced by Victor 2007- IOC tended to have higher production to reserves ratio. Eller et al. (2009). He applied both DEA and stochastic frontier estimation (SFA) to a panel of 78 firms over three years (2002-2004) to present empirical evidence for the revenue efficiency of NOCs and IOCs. NOCs are less efficient than IOCs, and in addition, that much of the inefficiency can be explained by the differences in the structural and institutional features of the firms, which may arise due to different firms' objectives (Eller et al., 2010).

From the DEA scores obtained in the study, the IOGCs were found to be clustered near the frontier, with an average DEA efficiency score of 0.73, while the NOGCs, although dispersed throughout the study, tended to be clustered farther away from the frontier and with a score of 0.28 and the Nigerian National Gas Company (NGC) with a score of 0.25 [in the 4th Quadrant of the Malmquist Index Analyses]. Which indicates inefficiency compared to other gas producers in the globe.

However, Malmquist productivity index is incomplete since it accounts for the scores of TFP (total factor productivity) growth that arise only from the technical change and efficiency change. A study conducted by J.D.Lee, Kim and Heo, (1998) to estimate the Malmquist index and its two components for South Korean manufacturing sectors during the period of 1967-1993, found that productivity was achieved through technical progress and efficiency change negatively contributed to the productivity growth. The same results were found for the Taiwanese manufacturing industry, regarding the negative effects of technical efficiency on the TFP growth (Fare, Grosskopf, & Lee, 1995, 2001). While other studies based on cross-countries comparison found that efficiency improvement has higher effect than technical progress in the developing countries including South Korea (Chang & Luh, 1999; Cook & Uchida, 2002; T.Kim & Park, 2006; Kruger, Canter, & Hanusch, 2000; Taskin & Zaim 1997).

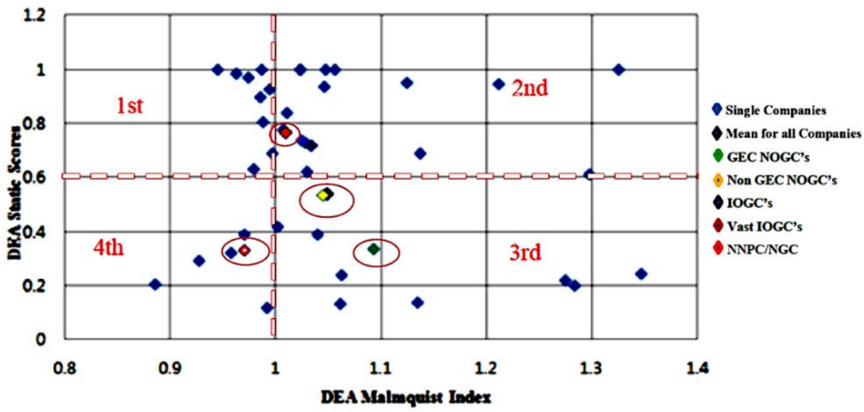


Figure 43: DEA Malmquist Index

Table 6: DEA Sample (23 National & International Oil & Gas Companies)

S/No:	Company	Country HQs	Cat 1 GEC NOGC's	Cat 2 NonGEC NOGC's	Cat 3 IOGC's	Cat 4 Vast IOGC's
1	Adnoc	UAE	O	-	-	-
2	Apache	USA	-	-		-
3	BG	UK	-	-	O	-
4	BP	UK	-	-	-	O
5	Chevron	USA	-	-	-	O
6	ConocoPhillips	USA	-	-	-	O
7	EGPC	Egypt	O	-	-	-
8	Eni	Italy	-	O	-	
9	ExxonMobil	USA	-	-	-	O
10	Gazprom	Russia	O	-	-	-
11	Libya	Libya	O	-	-	-
12	Lukoil	Russia	O	-	-	-
13	NIGC	Iran	O	-	-	-
14	NIOC	Iran	-	O	-	-
15	NNPC	Nigeria	O	-	-	-
16	NLNG/NGC	Nigeria	-	-	O	-
17	PDO	Oman	O	-	-	-
18	PDV	Venezuela	O	-	-	-
19	QG	Qatar	O	-	-	-
20	Royal Dutch Shell	Netherlands	-	-	-	O
21	Sonatrach	Algeria	O	-	-	-
22	Surgutneftegas	Russia	O	-	O	-
23	Total	France	-	-	-	O
	O=Yes & -=No		12	2	3	6

Table 7: All Categories Mean Static vs. Malmquist DEA Score

Category		Input		Output	
	Gas Prod (Bcf)	Oil Prod (Mil Bb/d)	Consumption rate	Gas (Mscf/d)	Oil ('000b/d)
All Companies					
Min	2.345	704	3,143	396	128
Max	1,146,387	263,329	350,249	35,096	8,456
Average	104,141	29,017	53,683	3,947	1,304
Std Dev	211632	53567	62947	6841	1687
GEC NOGC's					
Min	16,891	1,368	5,900	398	179
Max	1,146,387	263,329	103,000	11,987	8,456
Average	259,396	78,952	39,872	3,899	1,973
Std Dev	298385	141114	33810	2962	2927
Non GEC NOGC's					
Min	5,891	1,094	3,143	396	128
Max	499,750	13,811	350,249	35,096	1,773
Average	58,941	3,976	89,651	3,985	1,291
Std Dev	169841	3590	108103	597	11836
IOGC's					
Min	2.345	704	3,800	478	143
Max	19,803	10,901	83,915	1,991	1,677
Average	7,652	2,846	28,000	1,563	445
Std Dev	5957	3971	35,112	657	489
Vast IOGC's					
Min	19,965	2,874	23,467	3,746	984
Max	63,540	9,701	71,637	10,789	1,890
Average	29,873	5,899	57,073	4,962	1,692
Std Dev	17980	1683	18099	2411	289

Table 8: Mean % of each Category of the Indicators Frontier (1999 - 2014)

Category		Input		Output	
	Gas Prod (Bcf)	Oil Prod (Mil Bb/d)	Consumption Rate (Bcf)	Gas Out (Mscf/d)	Oil Out ('000b/d)
Category 1: GEC NOGC's	-4.97	-21.09	-3.06	208.95	34.71
Category 2: Non GEC NOGC's	-1.37	-13.73	-23.68	78.57	69.28
Category 3: IOGC's	-1.92	-8.05	-17.02	53.83	13.98
Category 4: Vast IOGC's	0.97	-09.42	-11.83	23.06	9.05
All Companies	-3.65	-33.07	-3.58	119.87	17.85
NNGC	-03.82	-2.88	0.001	96.85	0.27

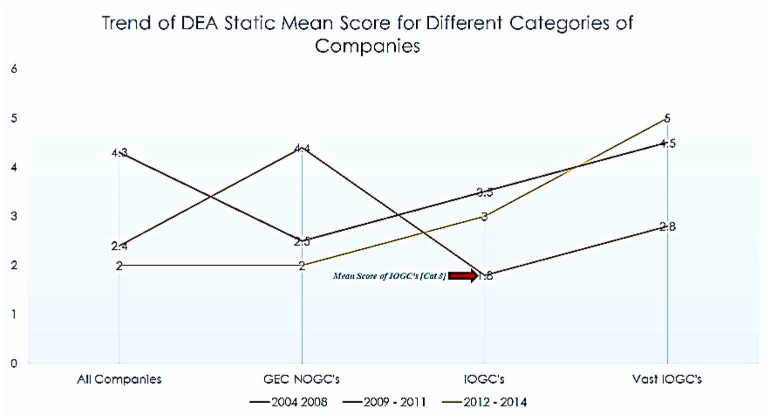


Figure 43.1: DEA Static Mean Score Chart

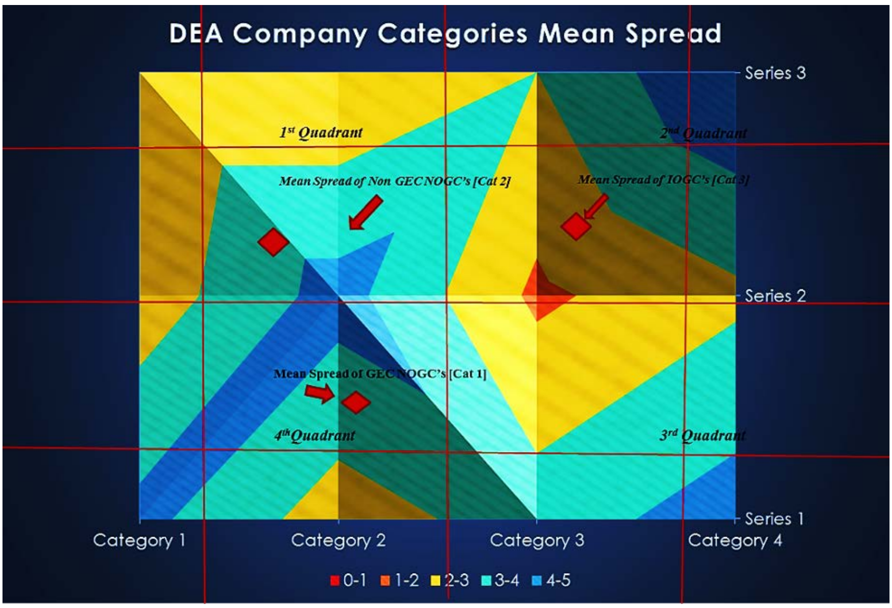


Figure 43.2: DEA Static Mean Spread Chart

5.5 DEA Model Result Summary

DEA captures the performance of the oil & gas producing companies in most of the gas exporting countries (GEC) with a specific keen interest on the Nigerian National Gas Company (NGC) which is found to be highly inefficient; obtaining a score of 0.25 of the Malmquist Index indicating the index of the NGC in the 4^{th} Quadrant of the DEA research analyses compared to other Non- GEC’s and IOGC’s showed in this research analyses.

Chapter 6 Comparative Analyses of Countries

6.1 Global Analyses of the Energy Industry

Global energy demand continues to grow but that growth is slowing and mainly driven by emerging economies led by China and India; according to the *BP Energy Outlook 2035*, The *Outlook* reveals that global energy consumption is expected to rise by 41 per cent from 2012 to 2035 compared to 55 per cent over the last 23 years (52 per cent over the last twenty) and 30% over the last ten. Ninety five per cent of that growth in demand is expected to come from the emerging economies, while energy use in the advanced economies of North America, Europe and Asia as a group is expected to grow only very slowly – and begin to decline in the later years of the forecast period. Shares of the major fossil fuels are converging with oil, natural gas and coal each expected to make up around 27% of the total mix by 2035 and the remaining share coming from nuclear, hydroelectricity and renewables. Among fossil fuels, gas is growing fastest, increasingly being used as a cleaner alternative to coal for power generation as well as in other sectors.

''The Outlook leads us to three big questions: (i) Is there enough energy to meet growing demand? (ii) Can we meet demand reliably? (iii) And what are the consequences of meeting demand? In other words, is the supply sufficient, secure and sustainable?"

"On the first question, the answer is 'yes'. The growth rate for global demand is slower than what we have seen in previous decades, largely as a result of increasing energy efficiency. Trends in global technology, investment and policy leave us confident that production will be able to keep pace. New energy forms such as shale gas, tight oil, and renewables will account for a significant share of the growth in global supply."

On the question of security, the *Outlook* offers a mixed, though broadly positive, view. Among today's energy importers, the United States is on a path to achieve energy self-sufficiency, while import dependence in Europe, China and India will increase. Asia is expected to become the dominant energy importing region. Dudley noted: "This need not be a cause for concern if the market is allowed to do its work, with new supply chains opening up to these big consuming regions."

On the question of sustainability, global carbon dioxide emissions are projected to rise by 29%, with all of the growth coming from the emerging economies. The *Outlook* notes some positive signs: emissions growth is expected to slow as natural gas and renewables gain market share from coal and oil; and emissions are expected to decline in Europe and the US. Indeed towards the end of the period covered by the *Outlook* we expect many advanced countries will be seeing their economies grow while their energy use falls.

The *Outlook* shows global energy demand continuing to increase at an average of 1.5% a year to 2035. Growth is expected to moderate over this period, climbing at an average of 2% a year to 2020 and then by only 1.2% a year to 2035. 95% of this growth is expected to come from non-OECD economies, with China and India accounting for more than half of the increase. By 2035, energy use in the non-OECD economies is expected to be 69% higher than in 2012. In comparison use in the OECD will have grown by only 5%, and actually to have fallen after 2030, even with continued economic growth.

While the fuel mix is evolving, fossil fuels will continue to be dominant. Oil, gas and coal are expected to converge on market shares of around 26-27% each by 2035, and non-fossil fuels – nuclear, hydro and renewables – on a share of around 5-7% each.

Natural gas is expected to be the fastest growing of the fossil fuels – with demand rising at an average of 1.9% a year. Non-OECD countries are expected to generate 78% of demand growth. Industry and power generation account for the largest increments to demand by sector. LNG exports are expected to grow more than twice as fast as gas consumption, at an average of 3.9% per year, and accounting for 26% of the growth in global gas supply to 2035.

Shale gas supplies are expected to meet 46% of the growth in gas demand and account for 21% of world gas and 68% of US gas production by 2035. North American shale gas production growth is expected to slow after 2020 and production from other regions to increase, but in 2035 North America is still expected to account for 71% of world shale gas production.

6.1.1 International LNG Export Demand Trend [Europe and Asia]

Europe and Asia's natural gas import demand trends has substantially grew over the past decades; pipeline shipments grew by 2.3%, driven by a 12% increase in net Russian exports, which offset declines in Algeria (-17.9%); Algeria is facing pressure to boost natural gas output with new projects to meet growing domestic demand and to fulfill long-term contractual obligations to export natural gas to Europe, among importers, growth in Germany (+14%) and China (+32.4%) more than offset a continued decline in the US (-10.9%). Global LNG trade rebounded by 0.6% in 2013. Increased imports in South Korea (+10.7%), China (+22.9%), and South and Central American importers (+44.7%) were partially offset by lower imports in Spain (-35.6%), the UK (-31.9%) and France (-19.4%). LNG's share of global gas trade declined slightly to 31.4%. [Global LNG BP statistics 2014].

This research analysis also compare the trends in LNG exports [Producers/Exporters] and import demand from Europe and Asian consumers of LNG, the result analysis further indicates that Asian LNG importers demand is growing rapidly above average at about 67% significant level, than the European LNG importers demand of about 58% from the regression analysis obtained in this study.

World natural gas consumption grew by 1.4%, below the historical average of 2.6%. Consumption growth was above average in the OECD countries (+1.8%) and below average outside the OECD (+1.1%) [BP statistics 2014].

Growth was below average in every region except North America. China (+10.8%) and the US (+2.4%) recorded the largest growth increments in the world, together accounting for 81% of global growth. India (-12.2%) recorded the largest volumetric decline in the world, while EU gas consumption fell to the lowest level since 1999. [BP statistics 2014].

6.1.2 Actual Production Rate amongst the GEC [Utilization Ratio]

Utilization ratio is actually very low, about 10% in most GEC countries like Libya (28.2%), Nigeria (39.9%), Venezuela (17.03%) and Equatorial Guinea (-24%) compared to other major GEC's utilization ratio of about 89% to 95% actual production ratio in countries like Russia (69%), Qatar(67%), UAE (63%) Algeria (61%) and Iran (58%).

This research study also estimate Country Specific Elasticity (CSE) that determines production capacity in relation to export flexibility with regards to how elastic or inelastic production capacity is to export rate to Europe and Asia [consumers] for a specific country. (See table 9 below)

Table 9 GEC Elasticity

Major GEC Exporters to Europe & Asia

Country	Europe %	Asia %	Domestic %
Algeria	89	3	8
Angola	95	-	5
Egypt	31	-	69
Nigeria	43	48	9
Qatar	1.5	97	1.5
UAE	-	95	5
Russia	91	8	1

Total Export to Europe %	Total Export to Asia %
58	50

Specific Export Elasticity amongst GEC To Europe & Asia

Country	Elasticity %	Export to Europe %	Export to Asia %
Algeria	-0.72	89	3
Angola	-0.44	95	-
Bolivia	-0.46	-	-
Egypt	-0.53	31	-
E. Guinean	-0.60	-	-
Iran	-0.03	-	-
Libya	-0.61	-	-
Nigeria	-0.62	43	48
Qatar	-0.57	1.5	97
Russia	-12.1	91	8
Trinidad & T	+0.18	-	-
UAE	+0.31	-	95

6.2 Global Gas Market Analyses

World natural gas production increased by 1.1% in 2013, slightly below the growth rate of global consumption (+1.4%) Growth was below average in all regions except Europe and Eurasia. The US (+1.3%) remained the world's leading producer, but both Russia (+2.4%) and China (+9.5%) recorded larger growth increments in 2013. Nigeria (-16.4%), India (-16.3%), and Norway (-5%) recorded the largest volumetric declines.

Figure 44: Transmission Gas Pipeline Network Connection

Gas production comprises marketed production and excludes gas flared or recycled gas. It also includes natural gas produced for Gas-to-Liquids transformation. Natural gas production is provided in three different units of measurement to accommodate regional customary usage, billion cubic metres (bcm), and billion cubic feet per day (Bcf/d) .and million tonnes oil equivalent (mtoe).

Global natural gas trade grew by 1.8% in 2013, well below the historical average of 5.2% in terms of natural gas trade movements. Pipeline shipments grew by 2.3%, driven by a 12% increase in net Russian exports, which offset declines in Algeria (-17.9%), Norway (-4.5%) and Canada (-5.5%). Among importers, growth in Germany (+14%) and China (+32.4%) more than offset a continued decline in the US (-10.9%). Global LNG trade rebounded by 0.6% in 2013. Increased imports in South Korea (+10.7%), China (+22.9%), and South and Central American importers (+44.7%) were partially offset by lower imports in Spain (-35.6%), the UK (-31.9%) and France (-19.4%). LNG's share of global gas trade declined slightly to 31.4%.

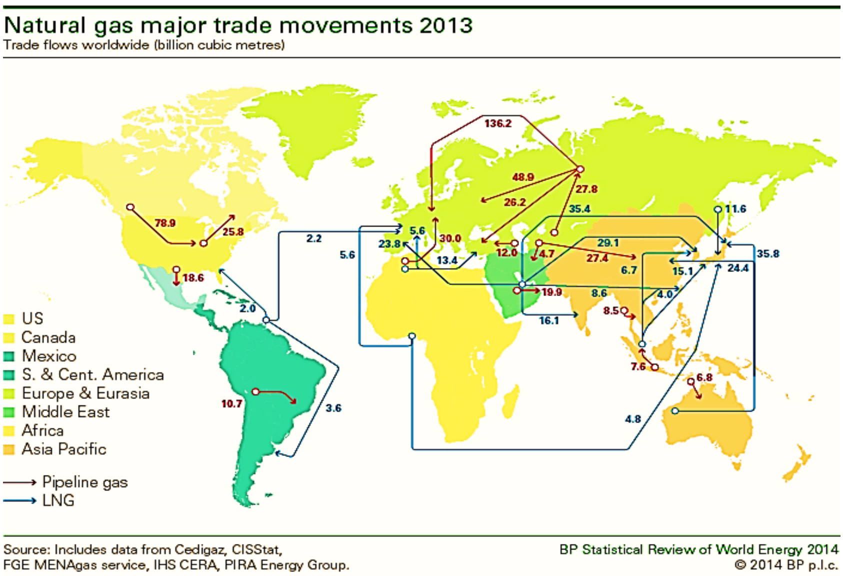


Figure 45: Global Natural Gas Trade Movement

Trade flows are on a contractual basis and may not correspond to physical gas flows in all cases. The Chart (fig 36) illustrates the flow of pipeline natural gas and LNG between sources of production and the regions of consumption. Natural gas trade is shown in billion cubic metres (bcm).

6.3 Analysis of Oil & Gas Industry Value Chain in Nigeria

Nigeria is the 10th largest oil producer and the 7th largest gas producer in the world, and the largest in Africa. The Nigerian economy is largely dependent on its oil sector which supplies the bulk of its foreign exchange earnings and income. The upstream oil industry is Nigeria's lifeblood and the single most important sector in the economy. According to the 2008 BP Statistical Energy Survey, Nigeria oil reserves stands at 37.20 billion barrels at the end of 2007 or 2.92 % of the world's reserves[5].

Nigeria's downstream oil industry has four refineries with a nameplate capacity of 445,000 bbl/d. Problems such as fire, sabotage, poor management, lack of turn-around maintenance and corruption have meant that the refineries often operate at 40% of full capacity, if at all. This has resulted in shortages of refined products and the need to increase imports to meet domestic demand.

Nigeria is a major importer and exporter of petroleum among nations of the world. While she exports crude oil to a number of countries in the world, she imports refined petroleum products such as petrol, kerosene, diesel etc in order to meet her domestic needs.

Nigeria imports petroleum products despite being a major producer of crude. Though this scenario happens in some countries such as United States, the reason and

[5] 2014 BP Statistical Energy Survey

motives no doubt is different. The major reason for Nigeria's high importation of petroleum products is as a result of the country's inability to meet her domestic consumption.

Even if the four refineries are producing up to their optimum capacity, Nigeria will still not meet her domestic demand of petroleum products, hence the need for importation to augment domestic production.

The rapid development of an indigenous technical workforce has become more compelling than ever before against the background of the expected imminent injection of massive investment in the sector. With a current production capacity of about 2.5 million barrels per day (bpd), Nigeria plans to increase her production capacity to about 4 million bpd. Already, Nigeria is the leading oil and gas producer in Africa, currently ranked the seventh highest in the world (NNPC 2004; The Guardian 2006). In addition to the above, Nigeria which is widely referred to as a gas province, has natural gas reserves that triple crude oil reserves, being estimated in excess of 187.5 trillion standard cubic feet(scf) (Africa Oil and Gas 2004).

This study is intended to expand the body of knowledge in respect of the application of Creating Shared Value (CSV) to the oil and gas sector especially in a developing economy like Nigeria that earns over 80% of her foreign exchange from oil and particularly, as the Federal Government is putting in place policies and strategies to improve the oil sector's contributions to the Nigeria economy. The sensitivity of petroleum resource is clearly reflected in the fact that it has remained or continued to be the goose that lay a golden eggs for the Nigerian economy as well as the supreme foreign exchange earner contributing over 80% of government revenues and helps the development of Nigeria's infrastructures and other industries (Anya 2002; Chukwu 2002; Gary and Karl 2003; Amnesty International, 2004).

However, due largely to the highly technical nature of exploration and production, the sector depends substantially on imported technologies and facilities for most of its operations. In view of the critical importance of the sector to the nation's economy and its capacity to generate far-reaching multiplier effect, the grooming of highly skilled indigenous manpower to participate keenly in the activities of the sector to redress the foreign dominance becomes imperative (Baker 2006). See table 10 below.

Table 10: The Key Stakeholders in Nigerian Oil and Gas Sector

Policy Makers	**Regulators**	**Operators**	**Trade Unions**	**Host Communities**	**Service Providers**
President	Department of Petroleum Resources (Technical Regulator)	International Oil and Gas Companies	Petroleum and Natural gas senior staff association (PENGASSAN)	Traditional Rules	Geosciences and Petroleum Engineering Consultants
Federal Ministry of Petroleum Resources	National Petroleum Investment Management Services (Cost and Investment regulators)	National Oil & Gas Company(NNPGC)	Nigeria Union of Petroleum and Natural gas workers (NUPENG)	Youth Leaders	Drilling Contractors
National Assembly	Nigeria Content Development and Monitoring Board (local content regulator)	Indigenous Oil & Gas Companies	Petroleum Technology Association of Nigeria (PETAN)	Women groups	Logistic Providers

	Petroleum Products Pricing Regulatory Agency (retail price regulator)	Marginal Fields Operators	Depots and Petroleum Marketers Association of Nigeria (DAPMAN)	Politicians	Engineering Procurement and Construction Vendors
			Independent Petroleum Marketers Association of Nigeria (IPMAN)		Inspection Consultants
			Petroleum Tanker Drivers(PTD)		Safety and Environmental Consultants

Source: Compiled by Naif Abdussalam 2013

6.3.1 International Oil & Gas Companies in Nigeria

There are eighteen international oil & Gas companies operating in Nigeria. Some of them are new entrants who have an interest in the deep offshore blocks in partnership with other operators. The oil & gas sector account for about 95% of crude oil production in Nigeria.

All petroleum production and exploration is taken under the auspices of joint ventures between foreign multi-national corporations and the Nigerian federal government. This joint venture manifests itself as the Nigerian National Petroleum Corporation, a nationalized state corporation. All companies operating in Nigeria obey government operational rules and naming conventions (companies operating in Nigeria must legally be sub-entities of the main corporation, often incorporating "Nigeria" into its name). Joint ventures account for approximately 95% of all crude oil output, while local independent companies operating in marginal fields account for the remaining 5%.

Additionally, the Nigerian constitution states that all minerals, oil, and gas legally belong to the federal government. Six companies are operating in Nigeria and are listed with their countries of origin (most of the following is extracted from a Human Rights Watch report).

- **Royal Dutch Shell (British/Dutch)**

Shell Petroleum Development Company of Nigeria Limited (SPDC), usually known simply as Shell Nigeria: A joint venture operated by Shell accounts for 50% of Nigerian's total oil production (899,000 bbl/d (142,900 m^3/d) in 1997) from more than eighty oil fields. The joint venture is composed of NNPC (55%), Shell (30%), Elf (10%) and Agip (5%) and operates largely onshore on dry land or in the mangrove swamp in the Niger Delta. "The company has more than 100 producing oil fields, and a network of more than 6,000 kilometers of pipelines, flowing through 87 flow stations. SPDC operates 2 coastal oil export terminals".

The Shell joint venture produces about 50% of Nigeria's total crude. Shell Nigeria owns concessions on four companies, they are: Shell Petroleum Development Company (SPDC), Shell Nigeria Exploration and Production Company (SNEPCO), Shell Nigeria Gas (SNG), Shell Nigeria Oil Products (SNOP), as well as holding a major stake in Nigerian Liquefied Natural Gas (NLNG). Shell formerly operated alongside British Petroleum as Shell-BP, but BP has since sold all of its Nigerian concessions. Most of Shell's operations in Nigeria are conducted through the Shell Petroleum Development Company (SPDC).

- **Chevron (American)**

Chevron Nigeria Limited (CNL): A joint venture between NNPC (60%) and Chevron (40%) has in the past been the second largest producer (approximately 400,000 bbl/d (64,000m^3/d)), with fields located in the Warri region west of the Niger River and offshore in shallow water. It is reported to aim to increase production to 600,000 bbl/d (95,000 m^3/d) in 2015.

- **Exxon-Mobil (American)**

Mobil Producing Nigeria Unlimited (MPNU): A joint venture between the NNPC (60%) and Exxon-Mobil (40%) operates in shallow water off Akwa Ibom state in the southeastern delta and averaged production of 632,000 bbl/d (100,500 m^3/d), making it the second largest producer, as against 543,000 pbd in 1996. Mobil also holds a 50% interest in a Production Sharing Contract for a deep water block further offshore, and is reported to plan to increase output to 900,000 bbl/d (140,000 m^3/d).

Industry sources indicate that Mobil is likely to overtake Shell as the largest producer in Nigeria within the next five years, if current trends continue, mainly due to its offshore base allowing it refuge from the strife Shell has experienced on onshore activities. It is headquartered in Eket and operates in Nigeria under the subsidiary of Mobil Producing Nigeria (MPN).

- **Agip (Italian)**

Nigerian Agip Oil Company Limited (NAOC): A joint venture operated by Agip and owned by the NNPC (60%), Agip (20%) and ConocoPhillips (20%) produces 150,000 bbl/d (24,000 m^3/d) mostly from small onshore fields.

- **Total (French)**

Total Petroleum Nigeria Limited (TPNL): A joint venture between NNPC (60%) and Elf (now Total) produced approximately 125,000 bbl/d (19,900 m^3/d), both on and offshore. Elf and Mobil are in dispute over operational control of an offshore field with a production capacity of 90,000 bbl/d (14,000 m^3/d).

- **Texaco (now merged with Chevron)**

NNPC Texaco-Chevron Joint Venture (formerly Texaco Overseas Petroleum Company of Nigeria Unlimited): A joint venture operated by Texaco and owned by NNPC (60%), Texaco (20%) and Chevron (20%) currently produces about 60,000 bbl/d (9,500 m^3/d) from five offshore fields.

6.3.2 Indigenous Oil and Gas Companies in Nigeria

In ways like never before from 2000-to date Nigerian companies are on the rise, taking on prodigious challenges and overcoming them. They are increasing participation in areas that for long, have been the exclusive preserve of foreign companies. Increasingly, Nigerian companies have become more assertive, more ambitious and more resilient.

Recently, the power sector which has seen local indigenous companies in partnerships with foreign companies bid big and win big. It is essentially a sign of the growing assertiveness of the young entrepreneurial Nigerians that are clearly unafraid to take risk. Likewise the opportunities brought about by the local content law initiation has opened Nigerian companies to be unparalleled.

- **Conoil Nigeria:** is one of the most formidable names in Nigeria's downstream petroleum industry. They are engaged in the marketing of refined petroleum products and also in the manufacturing and marketing of Liquefied Petroleum Gas (LPG) for domestic and industrial use. The company is reputed for its unwavering commitment to excellent products and service providers Conoil is the first and largest indigenous oil marketing company in Nigeria, over the years they gained a unique understanding of research and quality control, which was continuously applied in all their businesses in order to offer the best propositions to customers.

  They also developed innovative means of manufacturing and distributing processes. Good financial and technical resources in the development of high-performance products and in the provision of services that match or even surpass international standards, paying strict attention to the finest details of health, safety and environmental best practices.

- **Forte Oil PLC:** is an indigenous energy group, headquartered in Lagos, Nigeria, with extended operations in Ghana. It operates majorly in the downstream sector of the Nigeria's Oil and Gas industry, but has diversified its businesses into other sectors of the energy value chain. The downstream division specializes in the distribution of a wide range of petroleum products; Premium Motor Spirit (PMS), diesel, aviation fuel, kerosene, as well as a range of lubricants for various automobiles and machines; distributed mostly to the automobile, industrial, aviation and marine markets.

- **MRS:** MRS Oil & Gas Nig. Plc is a fully integrated and efficient downstream player with leading positions in the Nigeria Oil Industry. M.R.S. Oil and Gas Company Limited distributes and supplies petroleum products. It offers kerosene and gas oils. The company was founded in 1998 and is based in Lagos, Nigeria. M.R.S. Oil and Gas Company Limited operates as a subsidiary of MRS Group.
- **Oando:** Oando Exploration and Production (OEPL) is the exploration and production subsidiary of Oando PLC. Since its incorporation in 2003, OEPL has built a portfolio of oil and gas assets in the Niger Delta basin and acts as both operator and partner to Nigerian and Multinational companies. Oando Energy Resources is a leading African exploration and production company, listed on the Toronto Stock Exchange (TSX) in Canada. An independent oil and gas company with world-class operations, they are at the cutting edge of Africa's upstream sector, with significant investments in a robust portfolio of oil and gas fields, as well as participating interests in onshore and offshore producing assets.
- **Sahara Oil & Gas:** Nigeria-based energy-oriented conglomerate. Involved in refining and sale of petroleum products, exploration and development, and various oil industry Sahara Group is a leading privately owned Power, Energy, Gas and Infrastructure Conglomerate established in 1996 with operating companies active in the downstream, midstream, upstream, infrastructure and power sectors. Sahara has presence in different locations including Africa, The

Caribbean, Asia and Europe. Sahara Energy Exploration and Production among others. Their core businesses create shareholder value by oil and gas reserves and production growth but they also contribute to socio-economic development where they operate. Through partnerships with employees, local communities, contractors and other stakeholders Sahara's affiliates help create and develop sustainable interventions.

6.3.3 Value Chain Analyses

Value chain analysis, as popularized by Porter (1985 & 2012), investigates the sequence of activities required to bring a product or service from conception and procurement through production and distribution to the final customer. Such analysis can be done for individual firms, for clusters of firms whose value chains are interlinked – referred to as value systems by Porter and usually involving suppliers, distributors/sellers, and customers – or for selected industries (within or across national borders). In line with the research focus on social value creation, it will consider the industry value chain for the petroleum sector, which includes development, production, processing, transportation and marketing of hydrocarbon

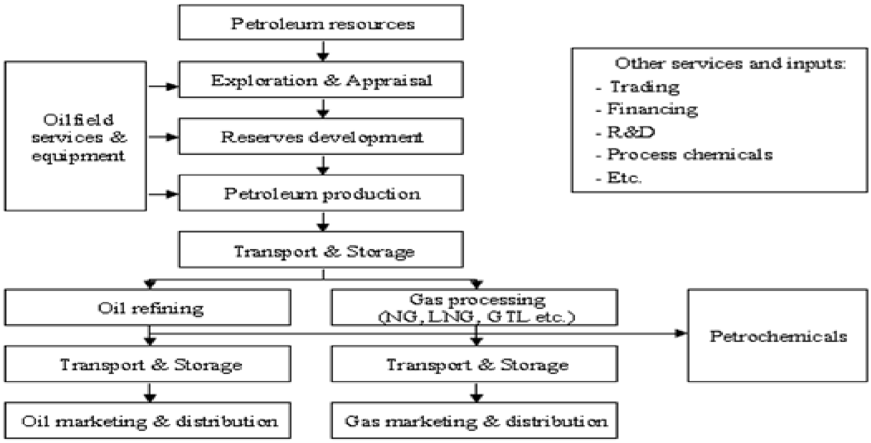


Figure 46. Petroleum Value Chain

(Source: Wolf, 2014)

The value chain starts with the identification of suitable areas to conduct exploration for oil and/or gas. After initial exploration, petroleum fields are appraised, developed, and produced. These activities are generally called exploration and production (E&P) or referred to as upstream oil and gas.

Oilfield services include a number of auxiliary services in the E&P process, such as geological and geophysical surveys and analysis, drilling, equipment supply, and engineering projects. They form an important part of the overall oil and gas industry, but will not be the focus of our overview. Infrastructure, including transport (such as pipelines and access to roads, rail, and ports) and storage, is critical at various stages in the value chain, including the links between production and processing facilities and between processing and final customer.

These parts of the value chain are usually referred to as Midstream. Oil refining and gas processing turn the extracted hydrocarbons into usable products. The processed products are then distributed to wholesale, retail, or direct industrial clients. Refining and marketing (R&M) is also referred to as Downstream. Certain oil and gas products are the principal input for the petrochemicals industry.

This explains the close historical and geographical links between the two. Individual companies can perform one or more activities along the value chain, implying a degree of vertical integration (integrated firms are engaged in successive activities, typically E&P and R&M). They can also seek to expand within a given activity, leading to horizontal consolidation (business scale). At the country level, horizontal integration in the upstream is limited by natural resource endowments and downstream by the size of the domestic market and the country's ability to export goods and services.

Companies' vertical and horizontal integration choices are affected by country-level industrial policies and the related legal and regulatory frameworks. For example, in some countries, such as South Africa, vertical integration in the petroleum sector is prohibited. Other countries, such as Brazil, limit the market share of industry participants. To create value along the chain, the value of aggregate outputs must exceed the value of aggregate inputs on a sustainable basis. By aggregate inputs it means all economic costs such as production cost, cost of funding, cost of resource depletion, and opportunity cost (Heal 2007). At the most general level, the potential sources of petroleum sector value creation are:

1) ***External Situation and Circumstances***. Many variables are exogenous to the actor's decision making, but can materially affect value creation. These factors include, amongst others: the quality and quantity of the resource endowment

(including geological properties), which determines the availability, technical complexity, and cost structure of upstream production; the geographic position of the country, and of the resources within the country, and the availability of natural infrastructure (sea ports, rivers etc), which determines the ease of access to domestic and export markets; the structure of the domestic economy, including its dependence on and interactions with the petroleum sector.

2) ***The companies participating in the sector***. These include NOCs, NGC sand IOGCs. Key factors for value creation include:
   - cost efficiency of operations (including exploration, production, refining, and marketing), overhead spending, and investments;
   - technical excellence, which may support higher reserve replacement and field recovery rates, fewer fuel line losses, and higher-value product yield (refining);
   - benefits of horizontal concentration (economies of scale) and vertical integration (transaction costs, economies of scope); and
   - Strategic choices, such as asset selection, and targeting of domestic versus export markets.
3) ***The sector's organization and institutional properties***. A company's ability and willingness to perform well are affected by sector organization and governance, which to a large extent are the result of specific policy decisions, including:
   - The mechanism/regime for capital allocation decisions between different stages of the value chain and within individual stages. Possible choices

include free and competitive licensing policy, depletion policy, pricing policies, and subsidies;

- the tax system, which the government can use to encourage desired behavior, and to capture a share of the value;
- the independence, responsibility, and competence of regulatory authorities;
- legal and regulatory frameworks, including market and trade regulation; and
- National petroleum and industrial policy, including local content and economic development policies.

Policy Decisions Affecting Value Creation

Policy decisions largely determine sector organization and governance, which in turn affect a company's ability and willingness to perform well. A thorough discussion of each policy alternative is beyond the scope of this research. In this section, the research is limited to four important policy decisions—industry participation, licensing and petroleum contracts, taxation, and depletion policy and discuss their relationship to value creation.

Industry Participation

Each policy choice influences the participants' ability and willingness to create social value. At one end of the continuum is a pure monopoly held by a state-owned entity without any outside participation; at the other end is a perfectly competitive market without any entry regulation or direct state intervention; in between are many possible combinations.

In reality, no country has implemented either of the extreme options. Saudi Arabia and Mexico, for example, have a state monopoly on upstream equity ownership, but private oil service contractors' face few restrictions, and Saudi Arabia now provides limited opportunities for equity participation in natural gas projects. At the other end of the spectrum, even the most market-oriented countries usually set pre-qualification criteria for participation in auctions, which in some cases may reduce competition and market contestability. Countries often adopt different policies for the different stages of the value chain. Resource holding nations are often categorized into those that are fully open, partially open, or closed to outside participation with respect to access to petroleum reserves. Besides the different degree of openness across countries, a country's policy on access to reserves may differ depending on whether oil or gas is considered. In general terms, countries are more likely to allow access to gas reserves in order to attract the technology and capital needed to develop them.

Licensing and Petroleum Contracts

The terms and conditions of petroleum agreements provide the basis for many technical and commercial decisions by petroleum firms (such as where to invest, how much to invest, and whether or not there are incentives for cost-efficiency). The state can also use its licensing system to shape industry structure. For example, it can decide on the frequency and area coverage of any licensing (whether by auction or negotiated deal), set up economic incentives for participation, or impose conditions such as mandatory involvement of the state. In essentially all countries outside the United States, the subsoil is either state-owned (irrespective of the ownership of the surface land), or the state retains a veto on its use (Mommer, 2002).

In Nigeria Exploration rights are usually auctioned or awarded pursuant to solicited or unsolicited offers from interested companies. Bidding often takes the form of commitments to the country, such as developing infrastructure, spending a minimum amount of money on exploration, training and capacity building, using local contractors, or drilling a minimum number of wells.

Taxation

Taxation is a critical consideration. The petroleum sector is among the most heavily taxed sectors, and taxation impacts on contractual relationships, asset selection, behavioral incentives, the dynamics of supply as well as demand, and most obviously on the financial position of the various parties involved. Ideally taxation should not alter allocating decision-making (and possibly even correct for market failures such as unduly low private costs of environmental pollution).

This would support efficient behavior and maximize total welfare. If the fiscal regime is distortive (for example, it creates a disincentive to cost savings or encourages excess investment) net welfare losses will result. In upstream oil and gas, total government share (the government share of available cash flow from a petroleum project) varies around the world from about 40 percent to well over 90 percent (Johnston 2007).

In the years 2002 to 2008, with commodity prices raising significantly, many states have increased the government share from upstream oil and gas. The fiscal terms applicable in a given country can change in a number of different ways: (I) contractually;

(ii) when new concessions are awarded on different terms than previously awarded ones; (iii) through competition as oil companies bid the terms or bid the signature bonuses they are willing to pay up front; or (iv) by law. An important consideration when determining appropriate levels of government take is the potential trade-off between short-term state rent capture and longer-term value creation. Given the uncertainty of petroleum exploration and production, maximizing the net present value of rent capture might discourage longer-term investment, which in turn forms the basis for future rents (Tordo, 2007). In downstream oil, most industrialized countries levy significant consumption taxes (value added taxes, or VAT) on top of the taxes on crude oil. Looking at a consumption-weighted average of the main refined product in the EU in 2003, only 28 percent of the final sales price was accounted for by the cost of crude oil, whereas 62 percent of the final price was due to taxes (including VAT) and the remaining 10 percent was refining cost and company profit (OPEC 2005).

The following are some taxes and payment being made by International oil Companies operating in Nigeria; (1) Signature Bonus, (2) Royalty, (3) Niger Delta Development Corporation (NDDC) fund, (4) Education Tax Fund, (5) Licenses, (6) Permits and (7) Petroleum Profit Tax.

Depletion Policy

Governments must decide whether or not to explore for petroleum, at what pace to explore, and who should undertake such exploration. If the reserve base is assumed to be known, then maximization of social welfare will be achieved by the appropriate pattern of production (that is, drawing down the inventory) over time (Tordo, 2009).

Establishing an appropriate depletion policy involves the following factors:good oilfield practice, politics, State budget, public pressure on spending, domestic economy, institutional framework / national governance, resource curse, price expectations, cost expectations, and time value of money

Local Content Policies and Value Creation

Local content policies affect both IOCs and NOCs, although not necessarily to the same extent. They were first introduced in the North Sea in the early 1970s and ranged from restrictions on imports to the creation of NOCs. The aim of local content policies has evolved from creating backward linkages (that is, supplying input to the local economy through transfer of technology, the creation of local employment opportunities, and increasing local ownership and control) to creating forward linkages (that is, processing the sector's output prior to export through, for example, the establishment of refineries, petrochemical industry, and the production of fertilizers). More recently, local content has come to include wider economic diversification, thus going beyond the oil and gas sector value chain.

Governments use various instruments to implement their local content policies, including: (1) simple contractual requirements that favor the use of local goods and services or impose training obligations; (2) regulation and taxation that discriminate in favor of local industries, and other protectionist measures (3) regulation or contractual obligations that foster the transfer of technology from international to domestic companies; (4) bidding parameters that include local content among the criteria for winning oil and gas exploration and production licenses and contracts; (5) incentives to foreign investors to reinvest their profits domestically; (6) investment in infrastructure and education; (7) the mandatory incorporation of foreign companies; (8) local ownership requirements; and (9) direct government intervention through state owned enterprises (SOEs). It has been argued that local content policies create distortions, inefficiency, and, in some cases, even corruption. However, this cannot be generalized.

Nigerian Local Content is the quantum of composite value added or created in the Nigerian economy through the utilization of Nigerian human and material resources for the provision of goods and services to the petroleum industry within acceptable quality, health, safety and environment standards in order to stimulate the development of indigenous capabilities.

Despite huge investments made by the Federal Government of Nigeria in the oil and gas sector of the economy, an average of $10 billion USD per annum, its contribution to GDP growth has been minimal. This is largely due to low Nigerian Content in the industry, evident from the over 80% of work value carried out abroad. This has led to a dearth in jobs, skills development, capacity building / utilization and lack of sustained national economic development.

To address the situation, the Federal government has set Nigerian Content targets for the oil and gas industry of 45% by 2006 and 70% by 2010 respectively. In addition, presidential directives have been issued with the aim of domesticating a significant portion of economic derivatives from the oil and gas industry. To deliver on these directives and targets, the Nigerian National Petroleum Corporation (NNPC) has put in place a comprehensive Nigerian Content development strategy currently being rolled out in the industry.

NNPC's "Nigerian Content" vision is to transform the oil and gas industry into the economic engine for job creation and national growth by developing in-country capacity and indigenous capabilities. In this way a greater proportion of the work will be done in Nigeria with active participation of all sectors of the economy and ultimately Nigeria will be positioned as the hub for service delivery within the West African sub-region and beyond.

The Nigerian Content Policy seeks to promote a framework that guarantees active participation of Nigerians in oil and gas activities. The policy also focuses on the promotion of value addition in Nigeria through the utilization of local raw materials, products and services in order to stimulate growth of indigenous capacity. The Federal Government is optimistic that its policy will result in steady measurable and sustainable growth of Nigerian Content throughout the oil and gas industry.

Key Levels for Successful Nigerian Content Implementation

Short term directives have been issued by the NNPC to all stakeholders in the industry indicating the scope of work on all E&P projects that must be executed in Nigeria.

These are as follows:

1) FEED and detailed engineering design for all projects is to be domiciled in Nigeria.
2) Project Management Teams and Procurement centers for all projects in the Nigerian Oil and Gas industry must be located in Nigeria.

3) All operators and project promoters must forecast procurement items required for projects and operational activities and forward the Materials List on or before 31st January of every year. Also, a Master Procurement Plan (MPP) for ongoing and approved projects should be submitted to the Nigerian Content Division of NNPC on or before 31st January of every year.
4) Fabrication and integration of all fixed (offshore and onshore) platforms weighing up to 10,000 Tons are to be carried out in Nigeria. For the fixed platforms (offshore and onshore) greater than 10,000 Tons, all items in directive 5, pressure vessels and integration of the topside modules are to be carried out in Nigeria.
5) Fabrication of all piles, decks, anchors, buoys, jackets, pipe racks, bridges, flare booms and storage tanks including all galvanizing works for LNG and process plants are to be done in Nigeria.
6) All flow-lines and risers must be fixed and must be fabricated in Nigeria except for special cases to be demonstrated and approved by NCD.
7) Assembling, testing and commissioning of all Subsea valves, Christmas trees, wellheads and system integration tests are to be carried out in Nigeria.
8) All FPSO contract packages are to be bid on the basis of carrying out topside integration in Nigeria. A minimum of 50% of the total tonnage of FPSO topside modules must be fabricated in Nigeria.
9) All third party services relating to fabrication and construction including but not limited to NDT, mechanical tests, PWHT as well as certification of welding

procedures and welders must be carried out in Nigeria. Nigerian Institute of Welding must certify all such tests in collaboration with international accreditation bodies.

10) All operators and project promoters must ensure that recommendations for contract awards in respect of all major projects being forwarded to NNPC/constituted boards of such oil and gas companies for approval must include evidence of binding agreement by the main contractor with Nigerian Content Subcontractor(s). Such agreements shall indicate the cost and detailed scope including total man-hours for engineering, tonnage and man-hours of fabrication and relevant defining parameters for materials to be procured locally as well as other services.

11) All low voltage Earthling cables of 450/750 V grade and Control, Power, Lighting Cables of 600/1000 V grade must be purchased from Nigerian cable manufacturers.

12) All Line-pipes, sacrificial anodes, Electrical switchgear paints, ropes, pigs, and heat exchangers and any other locally manufactured material and equipment must be sourced from in-country manufacturers.

13) All carbon steel pressure vessels shall be fabricated in Nigeria.

14) All seismic data acquisition projects, all seismic data processing projects, all reservoir management studies and all data management and storage services are to be carried out in Nigeria.

15) All waste management, onshore and swamp integrated completions, onshore and swamp well simulations, onshore fluid and mud solids control, onshore measurement while drilling (MWD), logging while drilling (LWD) and directional drilling (DD) activities are to be performed by indigenous or indigenous companies having genuine alliances with multinational companies.

16) Coating of all Line-pipes and threading of all oil country tubular goods (OCTG) are to be carried out in Nigeria.

17) All concrete barges and concrete floating platforms are to be fabricated in-country.

18) Operation and maintenance of offshore production units, FPSO and FSO in particular, are to be performed by Nigerian companies.

19) All international codes and standards used in the industry are to be harmonized to support utilization of locally manufactured products such as paints, cables, steel pipes, rods, sections, ropes etc and to improve capacity utilization in local industries. Clauses that create impediments for/exclude participation of local companies should not be included in any ITT

20) Operators and project promoters must ensure that recommendations for contract award for all drilling contracts shall include a binding agreement at Technical Evaluation stage for the sourcing of Barite and Bentonite form local manufacturers.

21) All projects and operations in the Oil and Gas industry must demonstrate strict compliance with provisions in the insurance Act 2003 and submit a certificate of

compliance issued by NAICOM to NCD as part of technical evaluation requirements for insurance or reinsurance Contracts.

22) In this respect, NAICOM verified Gross underwriting capacity of Nigerian Registered Insurance companies must be fully utilized to maximize Nigerian Content before ceding risk offshore.

23) All projects and operations in the Oil and Gas industry must demonstrate strict compliance with provisions of the Sabotage Act.

24) All operators and service providers must make provisions for targeted training and understudy programs to maximize utilization of Nigerian personnel in all areas of their operations. All operators must therefore submit detailed training plans for each project and their operations

(Source: http://www.nigcontent.com)

Inefficiency introduced by local content policies is strongly influenced by the degree of technological strangeness. An economy that is very limited or primitive can hardly be expected to quickly be able to supply services (let alone to build forward linkages). Furthermore, the ability of the rest of the economy to develop a service sector often depends upon the speed at which the oil or gas resources are developed, which is determined by the government's depletion policy. For example, Norway decided to develop its hydrocarbons more slowly than the United Kingdom, with the explicit objective of allowing a Norwegian service sector to develop. By contrast, the United Kingdom's speedy development of its North Sea resources attracted American service companies and expertise (Hallwood, 1990).

Economic histories of a number of developed and developing countries show that linkages between the primary resource sector and other sectors influenced economic growth. These linkages are defined by the technologies of resource extraction. In some cases, the development of the resource sector stimulates the rise of industries that supply its inputs and that process the staple products prior to export. Thus, an economy gradually becomes diversified. However, the diversification does not take place if the linkages are weak, such as when inputs are supplied from abroad. In this case, production concentrates in the resource sector that has little contact with the rest of the economy, and the country falls into a staple trap (Polterovich and Popov, 2005).

In economies like Nigeria, where a number of economic sectors are weak, crowding out by the oil sector may hinder economic recovery. If this is the case, the use of local content policies to encourage economic diversification and the development of strong backward linkages may be appropriate. Local content policies are in essence a tradeoff between short-term efficiency and long-term economic development. While a comprehensive legal and fiscal framework may be required to execute the government's local content policies, it is essential that this framework be transparent, reliable, and predictable. Studies of many resource abundant countries show that the staple trap theory, while useful, has limited explanatory power since it does not take into account the role of macroeconomic and political economy variables (Findlay and Lundahl 2001; Abidin, 2001; Gylfason, 2001). In his study of resource based industry in eight oil exporting countries, Auty (1989) identifies three critical determinants of performance: (i) the sectoral mix of projects; (ii) the type of enterprise; and (iii) the country's macroeconomic policies. Auty argues that the risk of underperforming is minimized when optimum sized, joint-venture projects feed dynamic markets. Hence, a risk-reducing resource-based industry should be small enough that is does not dominate the domestic economy, and large enough to capture the flexibility of several diversified projects of optimum size. This would also require the careful pacing of infrastructure investments and projects to avoid crowding. The author further found that joint ventures between the government and well-established multinational resource corporations spread investment risk and improve implementation by providing access to technical, managerial, and marketing skills.

Finally, a risk-reducing strategy should aim to link the resource to the market. Full capacity utilization and access to market is required for these large investments to be economically feasible. At the same time, macroeconomic policies that sustain domestic GDP growth and/or a competitive exchange rate are required for these local content policies to succeed (Auty, 1989).Local content often involves multiplier effects and it might be argued that the higher the multiplier, the greater the backward linkages.

However, as discussed earlier in this section, not all linkages are good for the national economy. The procurement of goods and services can act as a multiplier for local economic development by contributing to employment, strengthening skills, and developing local suppliers and enterprises.

Developing local content in the petroleum sector should be based on existing capabilities within manufacturing, fabrication, and services. In other words, successful strategies identify which existing products and services the country can produce profitably. However, many countries have a weak and narrow industrial base. For this reason, local content policies commonly contain some measures that allow for the preferential treatment of domestic companies. To ensure sustainable industrial growth, however, such preferences should be temporary.

Market-based inputs cannot replace public inputs in all cases. There are functions that markets cannot perform, such as establishing company registries, setting norms, enforcing contracts and laws, and providing infrastructure. An inadequate supply of these public inputs affects the productivity of market-based activities. Determining the right level of government intervention is complicated: different activities require different kind of intervention, and there are no clear price signals to guide government choices. Nonetheless, the idea that governments can limit their intervention to the provision of an enabling environment for market-based activities to develop is a simplistic one, since it ignores the role and complexity of public inputs and capabilities. As stated in Hausmann and Rodrik (2006), “industrial policy is hard, but there is no argument against its use”.

6.4 Financial and Production Linkages between the Oil & Gas Sector and Other Sectors of the Economy

Financial Linkages

Financial linkages concern consumption linkages and fiscal linkages. Consumption linkages relate to the way in which the factor incomes generated by the sector are spent by consumers, since this can influence the pattern of domestic output and imports. But these patterns are unlikely to be influenced by the behavior of the IOGC and therefore it is the size and nature of the fiscal linkage that is of concern since this is directly influenced by IOGC behavior.

The fiscal linkage refers to the ability of the IOGC to create economic rent by producing oil and gas and then to maximize the capture of the rent for deployment on the promotion of development. This ability to capture rent depends very much upon how the oil sector is structured, the capacity of the players in the oil sector, how the IOGC reacts to other players in the sector, and how the fiscal system is configured (ESMAP, 2007). Obviously how the revenue is deployed in terms of promoting development will be a key factor in the success of the oil & Gas sector's contribution, but normally this is the responsibility of the government rather than the IOGC.

Production linkages

There are two kinds of production linkages: (1) *forward linkages*, whereby the sector supplies inputs to the rest of the economy, and (2) *backward linkages*, whereby the sector draws on inputs from the rest of the economy. When considering these production linkages, it is important to remember what Hirschman called "technological strangeness." This refers to the extent to which the oil industry presents an "alien" technology to the host environment. If the gap is too wide, then it is unlikely that production linkages will develop or at least will take a long time to do so.

One forward linkage concerns energy inputs to the rest of the economy. Energy is a key factor input into any economy and also a major influence on peoples' standard of living. The role of the NNPC (NOC) and NGC relates to its ability to ensure the physical availability of oil and gas to the domestic market, either for energy or feedstock purposes at "acceptable" prices.

Another forward linkage concerns manpower inputs from the IOGC to the rest of the economy. Often, the IOGC is the most competent organization in Nigeria. If trained IOGC staff leave to enter another part of the economy, this can represent a major contribution. The classic example was Operation Bultiste, undertaken by Aramco in the 1950s, whereby a number of the brightest young Saudis working for the company were encouraged to leave, with contracts and access to capital, to set up activities to supply Aramco's operational needs (Coon, 1955). In a similar vein, the IOGC can provide an example of good business practice to be copied by other entities in the rest of the economy. Again, Saudi Aramco has been instrumental in encouraging better business practices among its suppliers.

But not all forward inputs to the rest of the economy are positive. An undesirable linkage from the IOGC to the rest of the economy is environmental damage. One of the arguments used for the creation of an NOC and NGC is that it would look after the national environment in a way that would be superior to that of private companies (Stevens, 2008). Unfortunately, casual empiricism suggests the reverse has been the case, and many NOCs and NGCs have developed a very poor reputation for environmental management.

Backward employment linkages relate to the use of nationals in the IOGC labor force, their development and training, and the local content. Developing the local content of the oil and gas sector can be a major contribution to increasing the size of the non-hydrocarbon sector and creating some form of sustainable future when oil or gas revenues dry up.

6.4.1 Porter's Value Chain Analysis

Rather than looking at departments or accounting cost types, Porter's Value Chain focuses on systems, and how inputs are changed into the outputs purchased by consumers. Using this viewpoint, Porter described a chain of activities common to all businesses, and he divided them into primary and support activities, as shown below.

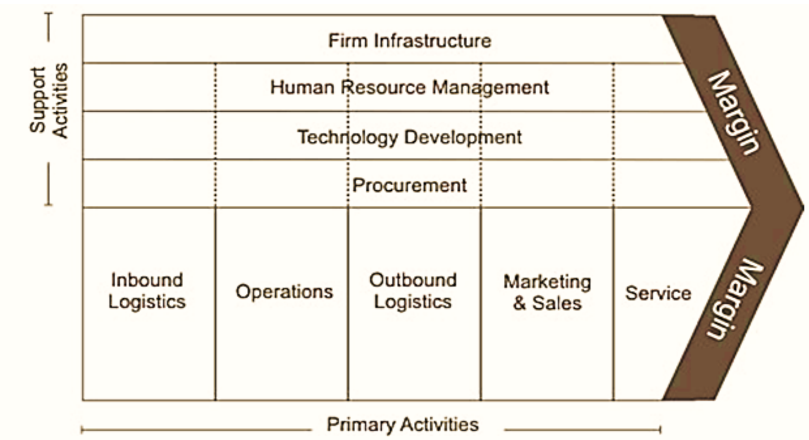


Figure 47: Porters Value Chain Analyses

Primary activities relate directly to the physical creation, sale, maintenance and support of a product or service. They consist of the following:

- **Inbound logistics (Exploration)** – These are all the processes related to receiving, storing, and distributing inputs internally. Supplier relationships are a key factor in creating value here.
- **Operations (Production)** – These are the transformation activities that change inputs into outputs that are sold to customers. Here, operational systems create value.
- **Outbound logistics (Transportation)** – These activities deliver your product or service to customer. These are things like collection, storage, and distribution systems, and they may be internal or external to organization.
- **Marketing and sales (Refining)** – These are the processes use to persuade clients to purchase from instead from competitors. The benefits offer, and how well they are communicating, are sources of value here.
- **Service (Retail)** – These are the activities related to maintaining the value of product or service to customers, once it's been purchased.

Support Activities

These activities support the primary functions above. In the diagram, the dotted lines show that each support, or secondary, activity can play a role in each primary activity. For example, procurement supports operations with certain activities, but it also supports marketing and sales with other activities.

- **Procurement (purchasing)** – This is what the organization does to get the resources it needs to operate. This includes finding vendors and negotiating best prices.

- **Human resource management** – This is how well a company recruits, hires, trains, motivates, rewards, and retains its workers. People are a significant source of value, so businesses can create a clear advantage with good HR practices.
- **Technological development** – These activities relate to managing and processing information, as well as protecting a company's knowledge base. Minimizing information technology costs, staying current with technological advances, and maintaining technical excellence are sources of value creation.
- **Infrastructure** – These are a company's support systems, and the functions that allow it to maintain daily operations. Accounting, legal, administrative, and general management are examples of necessary infrastructure that businesses can use to their advantage.

Companies use these primary and support activities as "building blocks" to create a valuable product or service.

Using Porter's Value Chain

To identify and understand company's value chain, the following steps will be followed.

Step 1 – Identifying the sub-activities for each primary activity.

For each primary activity, specific sub-activities create value. There are three different types of sub-activities:

- **Direct activities** create value by themselves. For example, in a book publisher's marketing and sales activity, direct sub-activities include making sales calls to bookstores, advertising, and selling online.

- **Indirect activities** allow direct activities to run smoothly. For the book publisher's sales and marketing activity, indirect sub-activities include managing the sales force and keeping customer records.
- **Quality assurance** activities ensure that direct and indirect activities meet the necessary standards. For the book publisher's sales and marketing activity, this might include proofreading and editing advertisements.

Step 2 – Identifying sub-activities for each support activity.

For each of the Human Resource Management, Technology Development and Procurement support activities, the sub-activities that create value within each primary activity will be determine. For example, considering how human resource management adds value to inbound logistics, operations, outbound logistics, and so on.

Step 3 – Identifying links.

Finding the connections between all of the value activities identified. The links serves as key in increasing competitive advantage from the value chain framework.

Step 4 – Looking for Opportunities to Increase Value.

Reviewing each of the sub-activities and links that were identified, and looking on how to change or enhance it to maximize the value offer to customers and the society.

Step 5 - Value Chain of Oil and Gas

The standard value chain for oil and gas sector runs through about five areas. It begins from exploration activities which involves the search for oil resources to production activities which entails exploitation of oil and gas. Further activities include transportation of oil to refineries and finally to consumer through various modes such as pipelines and vessels as well as road networks.

Refining involves the transformation of crude oil into finished products such as fuel, kerosene and diesel. The final stage is the distribution of finished products to consumers. In the case of natural gas, the activities also start with exploration just like in the case of oil; the next stage is drilling to bring gas to surface.

Then the natural gas has to be processed before been taking to the markets through various modes of transportation the final stage is the distribution of the natural gas to the various consumers. The oil and gas value chain consists of upstream, midstream, and downstream activities as can be seen in the Diagram below.

The areas of focus of this study run through the entire value chain particularly the fabrication activity which is very important to both upstream and downstream activities. The well construction and completion activity is an important part of the upstream activity, while the Control system and ICT is critical to both upstream and downstream activities.

Strategic Steps for Creating Shared Value (Moon etal. 2014)

1. **Re-conceiving products and markets (Demand Conditions):** The societal benefits of providing appropriate products to lower-income and disadvantaged consumers can be profound, while the profits for companies can be substantial. For a company, the starting point for creating this kind of shared value is to

identify all the societal needs, benefits, and harms that are or could be embodied in the firm’s products. The opportunities are not static; they change constantly as technology evolves, economies develop, and societal priorities shift. An ongoing exploration of societal needs will lead companies to discover new opportunities for differentiation and repositioning in traditional markets, and to recognize the potential of new markets they previously overlooked.

2. **Redefining productivity in the value chain (Factor Conditions):** A company’s value chain inevitably affects—and is affected by—numerous societal issues, such as natural resource and water use, health and safety, working conditions, and equal treatment in the workplace. Opportunities to create shared value arise because societal problems can create economic costs in the firm’s value chain. Many so-called externalities actually inflict internal costs on the firm, even in the absence of regulation or resource taxes.
3. **Enabling local or Global cluster development (Supporting Conditions):** No company is self-contained. The success of every company is affected by the supporting companies and infrastructure around it. Productivity and innovation are strongly influenced by “clusters,” or geographic concentrations of firms, related businesses, suppliers, service providers, and logistical infrastructure in a particular field.
4. **Defining core competence (Rivalry Conditions):** Carrying out CSV activities in the field of company’s core competence allows it to produce an equivalent value at a lower cost or a greater value for a comparable cost than its rivals.

Once a company decides on what to do, it can take other steps: redefining productivity in the value chain; re-conceiving comprehensive targets; and enabling local or global cluster the company can define its core competencies and look for unmet social needs that could be addressed, and find ways to create wealth.

6.5 Algeria's Analyses on Natural Gas Industry

Algeria is the leading natural gas producer in Africa, the second-largest natural gas supplier to Europe outside of the region, and is among the top three oil producers in Africa. Algeria became a member of the Organization of the Petroleum Exporting Countries (OPEC) in 1969, shortly after it began oil production in 1958. Algeria's economy is heavily reliant on revenues generated from its hydrocarbon sector, which account for about 30% of the country's gross domestic product (GDP), more than 95% of export earnings, and 60% of budget revenues, according to the International Monetary Fund (IMF).

Figure 48: Drilling Rig in the Desert in Rnourde EL Baguel Algeria

Oil and natural gas export revenues amounted to almost $63.8 billion in 2013, down from $69.8 billion in the previous year, mainly because of lower export volumes, according to the Middle East Economic Survey (MEES). Algeria's oil and gas export revenue has allowed the country to maintain a comfortable level of foreign exchange reserves, which reached $194 billion by the end of December 2013, according to the country's central bank.

Algeria is estimated to hold the third-largest amount of shale gas resources in the world, according to [EIA 2014]. The EIA study estimates that Algeria contains 707 trillion cubic feet (Tcf) and 5.7 billion barrels of technically recoverable shale gas and oil resources, respectively. Some industry analysts are cautious about the prospects of Algeria becoming a notable shale producer. An analysis by MEES points out the obstacles Algeria will face, which include: the remote location of the shale acreage, the lack of infrastructure and accessibility to sites, water availability, the lack of roads and pipelines to move materials, and the need for more rigs because shale wells deplete quicker.

The 2013 militant attack on the In Amenas gas facility prompted security concerns about operating in Algeria's remote areas, particularly in the south. Any major disruption to Algeria's hydrocarbon production would not only be detrimental to the local economy but, depending on the scale of lost production, could affect world oil prices. Also, because Algeria is the second-largest natural gas supplier to Europe outside of the region, unplanned cuts to natural gas output could affect some European countries. Algeria also relies on its own oil and natural gas production for domestic consumption, which is heavily subsidized. Natural gas and oil account for almost all of Algeria's total primary energy consumption. Domestic prices for oil products (diesel, gasoline, and liquefied petroleum gas) and natural gas are very low in Algeria by regional and global standards, according to the IMF. The IMF estimates that Algeria has the second-cheapest domestic price for natural gas in Africa, after Libya, as retail prices have not changed since 2005 and are now below operational costs. The IMF estimates that the cost of the implicit subsidies on oil products and natural gas (both in the intermediary and final-use stages) amounted to $22.2 billion in 2012, or 10.7% of GDP.

Natural gas accounts for 98% of power generation in Algeria, according to the IMF. Like natural gas, electricity prices have also been unchanged since 2005. However, the cost of gaining an electricity connection to obtain access can be time-consuming and costly. Nonetheless, more than 99% of Algeria's population has access to electricity. Algeria's government is attempting to reduce the country's dependence on natural gas in the power sector by initiating more renewable energy projects. Soneglaz, Algeria's state electricity and gas utility, has signed contracts to bring online solar projects, and they recently initiated a wind farm pilot program.

According to OGJ, as of January 2014, Algeria had 159 Tcf of proved natural gas reserves, the tenth-largest natural gas reserves in the world and the second largest in Africa, behind Nigeria. Algeria's largest natural gas field, Hassi R'Mel, was discovered in 1956. Located in the center of the country to the northwest of Hassi Messaoud, it holds proved reserves of about 85 Tcf, more than half of Algeria's total proved natural gas reserves. According to the *Arab Oil & Gas Journal*, Hassi R'Mel accounted for three-fifths of Algeria's gross natural gas production in 2012. The remainder of Algeria's natural gas reserves is located in associated and non-associated fields in the southern and southeastern regions of the country.

Algeria also holds vast untapped shale gas resources. According to EIA June 2013, Algeria contains 707 Tcf of technically recoverable shale gas resources, the third-largest amount in the world after China and Argentina. The Ghadames Basin, encompassing eastern Algeria, southern Tunisia, and western Libya, was identified as a major shale gas basin in the assessment. In May 2014, Algeria's Council of Ministers gave formal approval to allow shale oil and gas development. The Council of Ministers estimated that it would take 7 to 13 years to confirm Algeria's potential shale resources.

Algeria's gross natural gas production was 6.4 Tcf in 2012, a 4% decline from the previous year. Algeria's gross production has been falling since its peak of 7.1 Tcf in 2008. The decline in 2012 mainly reflects fewer volumes of natural gas used to improve oil recovery by re-injecting it into wells.

In 2012, 56% (3.6 Tcf) of gross production was marketed, 42% (2.7 Tcf) was reinjected into wells to enhance oil recovery, and 2% (0.1 Tcf) was vented or flared. Despite the decrease in gross production, the marketed volume increased in 2012 by 4% over the previous year. Dry natural gas (a sub-category of marketed gas that occurs when associated liquid hydrocarbons are removed) was 3.05 Tcf in 2012, of which 1.3 Tcf was consumed locally and 1.7 Tcf was exported.

Algeria has been planning to bring on-stream several new natural gas fields to compensate for the loss of production from mature fields, but many of these projects have been delayed by several years, mostly because of delayed government approval, difficulties attracting investment partners, infrastructure gaps, and technical problems.

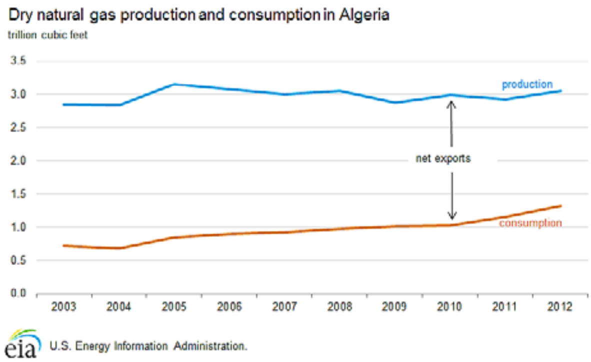


Figure 49: Dry Natural Gas Production & Consumption in Algeria

Algeria is in the process of developing its Southwest Gas Project, which includes the Reggane Nord, Timimoun, and Touat projects, all of which are expected to start production at the earliest in 2017, at least three years behind the initial schedule. The Repsol-led Reggane Nord project consists of developing six fields and is expected to reach a peak production rate of 100 Bcf/y. The Timimoun project, led by Total in partnership with Sonatrach and Cepsa, is expected to reach a peak production of 60 Bcf/y, and the Touat project, led by the France-based GDF Suez in association with Sonatrach, is projected to reach a peak production of 160 Bcf/y. The Southwest Gas Project entails the construction of gas-gathering facilities, a gas treatment plant, and a pipeline to the Hassi R'Mel gas hub, called the GR5 pipeline. The planned infrastructure will connect the remote Southwest gas fields to the Hassi R'Mel region and allow for the commercialization of other fields in the south as well. The development and commercialization of the Ahnet natural gas project in the south will also depend on the new infrastructure.

The Southwest Gas Project is very important for Algeria's ability to meet contracted exports and its expected growth in domestic demand. Gross natural gas production in the country will most likely continue to steadily decline in the short term, but it may recover in the medium term if planned projects come online and offset natural declines. Output from the Southwest Gas Project and other proposed projects (some of which are not included in the table) have the potential to increase Algeria's output by 1 Tcf/y or more after 2018. However, these projects are contingent on attracting investors and building new infrastructure or upgrading older infrastructure.

Algeria exported more than 1.7 Tcf of natural gas in 2012, of which approximately 1.2 Tcf was transported via pipelines and 0.5 Tcf by LNG tankers. Algeria is Europe's second-largest natural gas supplier outside of the region, after Russia. In 2012, more than 90% of Algeria's pipeline exports were sent to Italy, Spain, and other European countries, and the remainder was sent to Morocco and Tunisia as payment in lieu of transit fees. Also, more than 90% of Algeria's LNG exports were sent to Europe, primarily to France, Turkey, and Spain, and the remainder was sent to markets in Asia and Oceania.

Recent estimates from the 2014 BP Statistical Review show that Algeria's natural gas exports declined to 1.5 Tcf in 2013 (1.0 Tcf pipeline and 0.5 Tcf LNG), more than 10% lower than the previous year. The decline mainly reflects a substantial decrease of pipeline exports to Italy. Nonetheless, BP's data still show that Algeria was Europe's second-largest natural gas supplier in 2013.

Overall, Algeria's natural gas exports have gradually declined over the past decade, as gross production decreases and domestic consumption increases. Despite new export LNG infrastructure and increased capacity, Algeria's LNG exports have declined over the past few years.

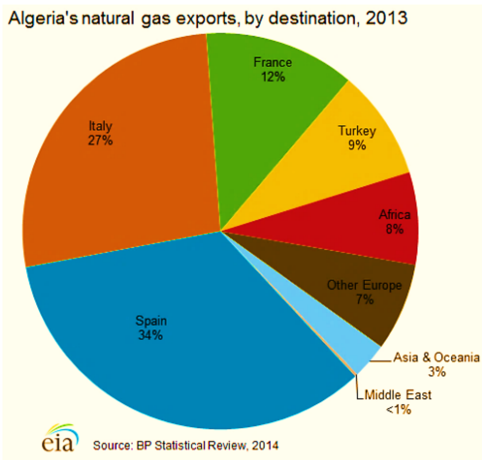


Figure 50: Algeria’s Natural Gas Exports by Destination

6.6 Angola’s Analyses on Natural Gas Industry

Angola is the second-largest oil producer in Sub-Saharan Africa, behind Nigeria. The country experienced an oil production boom between 2002 and 2008 as production started at several deepwater fields. In 2007, Angola became a member of the Organization of the Petroleum Exporting Countries (OPEC).

Angola is a small natural gas producer, ranking eighth in the region in dry natural gas production in 2012. The vast majority of Angola's natural gas production is associated gas at oil fields, and it is vented, flared (burned off), or re-injected into oil wells. Angola's first liquefied natural gas (LNG) plant started operations in 2013 to commercialize the country's natural gas resources. However, the LNG plant is currently producing well below its capacity of 5.2 million tons per year because of technical problems.

Despite being the third-largest economy in Sub-Saharan Africa, in terms of GDP, around 36% of Angolans live below the poverty line, according to the United Nations Development Program. The latest 2010 estimate from the World Bank indicates that only 40% of Angolans have access to electricity, leaving about 8 million people without access. As a result, the majority of people typically use traditional solid biomass and waste (typically consisting of wood, charcoal, manure, and crop residues) to meet off-grid heating and cooking needs, mainly in rural areas. In 2011, about 55% of the Angola's primary energy consumption consisted of traditional solid biomass and waste.

Sonangol, Angola's national oil company, is a shareholder in almost all oil and natural gas exploration and production blocks. International oil companies (IOCs) from the United States and Europe lead oil and natural gas exploration and production in Angola. Companies from China also participate in the industries, but mostly as shareholders in exploration blocks.

Angola currently produces small quantities of marketed natural gas as the vast majority of the country's gross production is flared (burned off) or re-injected into oil wells. However, in mid-2013, Angola began exporting liquefied natural gas (LNG), following the recent start-up of the LNG plant at Soyo. Angola hopes to commercialize more of its natural gas resources for export and for domestic consumption.

Angola holds an estimated 9.7 trillion cubic feet (Tcf) of proved natural gas reserves, according to the latest OGJ estimates released January 2014. Angola only produces small quantities of commercially marketed natural gas because the vast majority of its production is flared or re-injected into oil fields to aid recovery. Until recently, Angola lacked much of the infrastructure needed to commercialize more of its natural gas resources. The construction of Angola's first LNG facility at Soyo was recently completed, and it shipped out its first cargo in June 2013 to Brazil.

Gross natural gas production in Angola has almost quadrupled over the past two decades, growing from 97 billion cubic feet (Bcf) in 1990 to 383 Bcf in 2012. The vast majority of Angolan natural gas is re-injected into oil fields to help recovery or it is vented or flared as a by-product of oil operations. In 2012, 91% of gross natural gas production was re-injected or it was vented or flared. Angola's natural gas production comes entirely from associated fields, although Angola LNG, the operator of the facility, plans to develop some previously-discovered non-associated natural gas fields.

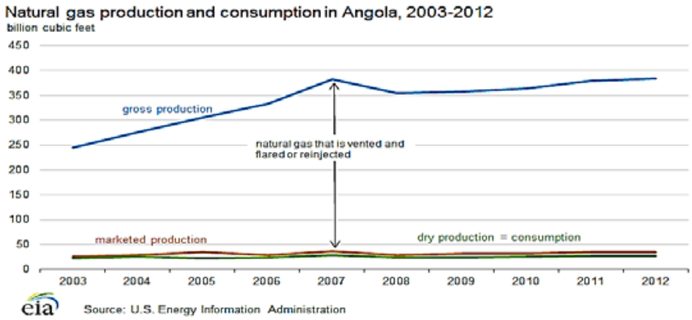


Figure 51: Angola's Natural Gas Production & Consumption

Chevron's $1.9 billion Sanha project (located offshore near Soyo) began operations in 2005, and is capable of processing 100,000 bbl/d of oil, condensate, and liquefied petroleum gas (LPG). The project significantly reduced the need for gas flaring in block 0 because dry natural gas (which is what remains after the raw product is stripped of condensate and LPG) is re-injected into the Sanha reservoir to help with oil recovery operations. This process is estimated to both reduce flaring in Block 0 by at least 50% and to reduce carbon dioxide emissions by more than 2.0 million tons per year, according to Offshore Magazine. The Takula gas processing platform began operating in late-2008 and also reduced gas flaring in block 0. Takula processes gas for re-injection and for the Cabinda gas plant. The Cabinda gas plant processes gas for a nearby power plant, according to IHS CERA. Sonangol also plans to further reduce gas flaring by bringing online a gas condensate facility to produce liquefied petroleum gas (LPG). It is scheduled to come online in 2015. With offshore oil exploration continuing apace,

Angola will need to address its capacity for processing the large volumes of associated gas its oil operations will continue to produce. Enhancing LNG capabilities, developing the domestic market for commercial natural gas, and enhanced oil recovery techniques will be important components to Angola's natural gas strategy moving forward. Central to Angola's plan to commercialize more of its natural gas reserves is the LNG facility at Soyo, which began exporting LNG in 2013. Operations were set to begin in the first quarter of 2012, but many delays pushed the start date further into the future.

Angola LNG is the operator of the new facility. The consortium includes: Sonangol (22.8%), Chevron (36.4%), Total (13.6%), BP (13.6%), and Eni (13.6%). According to Angola LNG, the project represents the largest single investment in Angola's history.

The LNG plant is currently operating below capacity because of technical problems, and exports have been infrequent. When the LNG plant reaches full capacity, it will receive 1 Bcf/day of associated gas from offshore oil fields and produce 5.2 million tons per year of LNG, natural gas liquids, and up to 125,000 cubic feet per day of natural gas for domestic consumption. Associated natural gas will be sourced from various offshore and deepwater oil fields within blocks 0, 14, 15, 17, and 18. Angola LNG also plans to develop non-associated gas fields in blocks 1 and 2 to feed the LNG plant.

Initial plans called for Angola's LNG cargoes to be shipped to a re-gasification facility in Pascagoula, Mississippi in the United States. However, U.S. natural gas imports have declined drastically because of the recent boom in domestic natural gas production. Angola LNG is now targeting consumers in Asia and Europe, although its first cargo was shipped to Brazil.

6.7 Nigeria's Analyses on Natural Gas Industry

Nigeria is the largest oil producer in Africa, holds the largest natural gas reserves on the continent and was the world's fourth leading exporter of LNG in 2012. Despite the relatively large volumes it produces, Nigeria's oil production is hampered by instability and supply disruptions, while the natural gas sector is restricted by the lack of infrastructure to monetize gas that is currently flared (burned off).

Nigeria became a member of the Organization of the Petroleum Exporting Countries (OPEC) in 1971, more than a decade after oil production began in the oil-rich Bayelsa State in the 1950s. Although Nigeria is the leading oil producer in Africa, production suffers from supply disruptions, which have resulted in unplanned outages as high as 500,000 barrels per day (bbl/d). The oil and natural gas industries are primarily located in the Niger Delta region, where it has been a source of conflict. Local groups seeking a share of the wealth often attack the oil infrastructure, forcing companies to declare force majeure (a legal clause that allows a party to not satisfy contractual agreements because of circumstances that are beyond their control that prevent them from fulfilling contractual obligations) on oil shipments. At the same time, oil theft, commonly referred to as "bunkering," leads to pipeline damage that is often severe, causing loss of production, pollution, and forcing companies to shut in production.

Aging infrastructure and poor maintenance have also resulted in oil spills. Also, natural gas flaring, the burning of associated natural gas that is produced with oil, has contributed to environmental pollution. Protest from local groups over environmental damages from oil spills and gas flaring have exacerbated tensions between some local communities and international oil companies (IOCs). The industry has been blamed for pollution that has damaged air, soil, and water, leading to losses in arable land and decreases in fish stocks.

Nigeria's oil and natural gas resources are the mainstay of the country's economy. The International Monetary Fund (IMF) estimates that oil and natural gas export revenue accounted for 96% of total export revenue in 2012. For 2013, Nigeria's budget is framed on a reference oil price of $79 per barrel, providing a wide safety margin in case of price volatility. Savings generated when oil revenues exceed budgeted revenues are placed into the Excess Crude Account (ECA), which can then be drawn down in years when oil revenues are below budget, according to the IMF.

EIA estimates that in 2011 total primary energy consumption was about 4.3 quadrillion British thermal unit (Btu). Of this, traditional biomass and waste (typically consisting of wood, charcoal, manure, and crop residues) accounted for 83%. This high share represents the use of biomass to meet off-grid heating and cooking needs, mainly in rural areas. World Bank data for 2010 indicate that electrification rates for Nigeria were 50% for the country as a whole - leaving approximately 80 million people in Nigeria without access to electricity.

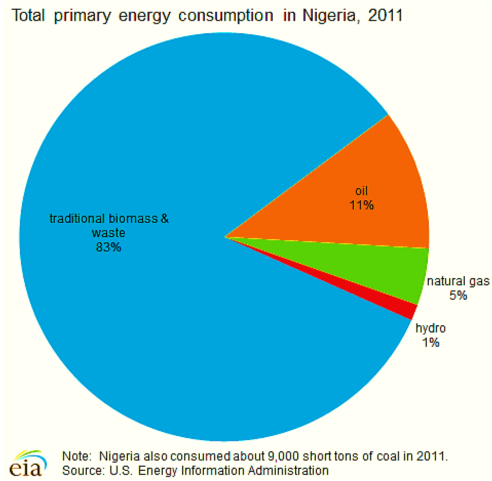


Figure 52: Total Primary Energy Consumption

The Petroleum Industry Bill (PIB), which was initially proposed in 2008, is expected to change the organizational structure and fiscal terms governing the oil and natural gas sectors, if it becomes law. IOCs are concerned that proposed changes to fiscal terms may make some projects commercially unviable, particularly deepwater projects that involve greater capital spending.

Some of the most contentious areas of the PIB are the potential renegotiation of contracts with IOCs, changes in tax and royalty structures, deregulation of the downstream sector, restructuring of NNPC, a concentration of oversight authority in the Minister of Petroleum Resources, and a mandatory contribution by IOCs of 10% of monthly net profits to the Petroleum Host Communities Fund.

The latest draft of the PIB was submitted to the National Assembly by the Ministry of Petroleum Resources in July 2012. The delay in passing the PIB has resulted in less investment in new projects as there has not been a licensing round since 2007, mainly because of regulatory uncertainty. The regulatory uncertainty has also slowed the development of natural gas projects as the PIB is expected to introduce new fiscal terms to govern the natural gas sector.

Nigeria had an estimated 182 trillion cubic feet (Tcf) of proven natural gas reserves as of January 2013, according to OGJ, making Nigeria the ninth largest natural gas reserve holder in the world and the largest in Africa. Despite holding a global top-10 position for proven natural gas reserves, Nigeria produced about 1.2 Tcf of dry natural gas in 2012, ranking it as the world's 25th largest dry natural gas producer. The majority of the natural gas reserves are located in the Niger Delta. The natural gas industry is also affected by the same security and regulatory issues that affect the oil industry.

Nigeria established a Gas Master Plan in 2008 that aimed to reduce gas flaring and monetize gas resources for greater domestic use and to export regionally and internationally. Draft proposals of the PIB also include these goals. There are a number of recently developed and upcoming natural gas projects that are focused on monetizing natural gas that is flared. These projects are discussed in the Gas Flaring section below.

Dry natural gas production grew for most of the past decade until Shell declared a force majeure on gas supplies to the Soku gas-gathering and condensate plant in November 2008. Shell shut down the plant to repair damages to a pipeline connected to the Soku plant that was sabotaged by local groups siphoning condensate. The plant reopened nearly five months later, but was shut down again for most of 2009 for operational reasons. The Soku plant provides a substantial amount of feed gas to Nigeria's sole LNG facility. As a result, its closure led to a reduction in Nigeria's natural gas production, particularly from Shell's fields in the Niger Delta, and a decline in LNG exports in 2008 and 2009.

Natural gas production gradually grew after 2009, and it reached its highest level of 1.2 Tcf in 2012. Typically, most of Nigeria's dry natural gas production is exported in the form of LNG, with smaller volumes exported regionally via the West African Gas Pipeline. Nigeria consumed 224 Bcf of dry natural gas in 2012, less than 20% of its total production.

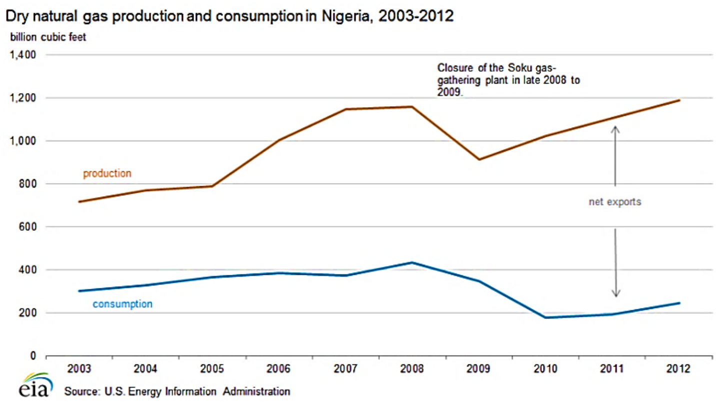


Figure 53: Natural Gas Production & Consumption

Nigeria flares the second largest amount of natural gas in the world, following Russia. Natural gas flared in Nigeria accounts for 10% of the total amount flared globally. Gas flaring in Nigeria has decreased in recent years, from 575 Bcf in 2007 to 515 Bcf in 2011. There are a number of recently developed and upcoming natural gas projects that are focused on monetizing natural gas that is flared.

Because some of Nigeria's oil fields lack the infrastructure to capture the natural gas produced with oil, known as associated gas, much of it is flared (burned off).

According to the National Oceanic and Atmospheric Administration (NOAA), Nigeria flared slightly more than 515 Bcf of natural gas in 2011 - or more than 21% of gross natural gas production in 2011. Natural gas flared in Nigeria accounts for 10% of the total amount flared globally. Shell recently reported that it was able to reduce the amount of gas it flared in 2012 because of improved security in some Niger Delta areas and stable co-funding from partners that allowed Shell to install new gas-gathering facilities and repair existing facilities damaged during the militant crisis of 2006 to 2009. Shell also plans to develop the Forcado Yokri Integrated Project and the Southern Swamp Associated Gas Gathering Project to reduce gas flaring.

Other recently developed or upcoming gas projects include: the Escravos Gas-to-Liquids plant, Brass LNG, Escravos gas plant development, Sonam field development, Onshore Asset Gas Management project, Assa-North/Ohaji South development, Gbaran-Ubie, the Idu project, and the Tuomo gas field.

The Nigerian government has been working to end gas flaring for several years, but the deadline to implement the policies and fine oil companies has been repeatedly postponed, with the most recent deadline being December 2012. In 2008, the Nigerian government developed a Gas Master Plan that promoted investment in pipeline infrastructure and new gas-fired power plants to help reduce gas flaring and provide much-needed electricity generation. However, progress is still limited as security risks in the Niger Delta have made it difficult for IOCs to construct infrastructure that would support gas monetization.

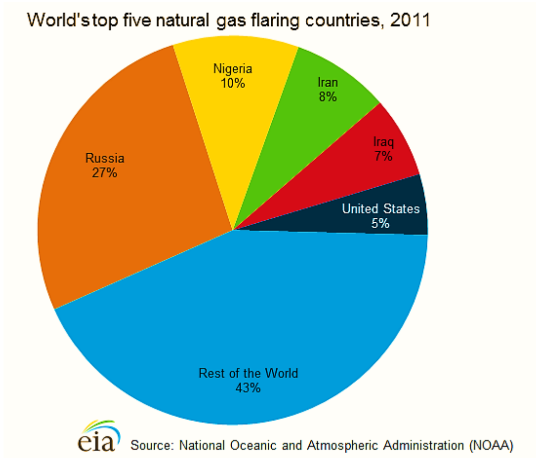


Figure 54: World’s Top Five Natural Gas Flaring Countries

A Chevron-operated Escravos GTL project is currently underway. Chevron (75%) and NNPC (25%) are jointly developing the $9.5 billion facility. Sasol Chevron, a joint venture between South Africa's Sasol and Chevron, provided technical expertise to design and develop the GTL plant. The project is expected to be operational within a year. The project will convert 325 MMcf/d of natural gas into 33,000 bbl/d of liquids, principally synthetic diesel, to supply clean-burning, low-sulfur diesel fuel for cars and trucks, according to Chevron.

Nigeria exports the vast majority of its natural gas in the form of LNG, and a small amount is exported via the West African Gas Pipeline (WAGP) to nearby countries. The pipeline was shut down from August 2012 to July 2013 for repairs. The pipeline had been severed by a ship's anchor in the Togolese waters, according to the pipeline's operator. As a result, natural gas exports via WAGP fell from 29 Bcf in 2011 to 14 Bcf in 2012.

Nigeria exported 19.8 MMtpa (950 Bcf) of LNG in 2012, according to FACTS Global Energy, making Nigeria the fourth largest LNG exporter in the world. Nigeria's LNG exports accounted for more than 8% of globally traded LNG. Japan is the largest importer of Nigerian LNG and imported 24% of the total in 2012, followed by Spain (19%), France (12%), South Korea (9%), and India (7%).

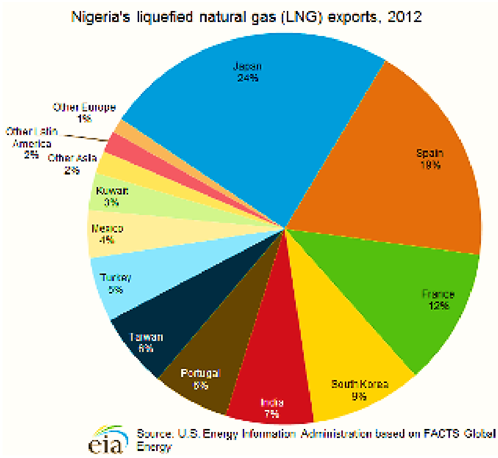


Figure 55: Nigeria’s LNG Exports

Trade patterns for Nigerian LNG have changed over the past few years. Most notably, Nigeria's LNG exports to Europe have decreased significantly. In 2010, Europe imported around 67% of total Nigerian LNG exports, but in 2012, that share dropped to 43%. Nigeria has increased its LNG exports to Asia, namely Japan, following the Fukushima nuclear incident in March 2011. In 2012, Japan imported 4.8 MMtpa (229 Bcf) of LNG, seven times that of the 0.63 MMtpa (30 Bcf) imported in 2010, according to FACTS Global Energy. For the first time since 1999, the United States did not import LNG from Nigeria in 2012, mostly as a result of growing U.S. domestic production.

The Nigeria NLNG facility on Bonny Island is Nigeria's only operating LNG plant. NLNG partners include NNPC (49%), Shell (25.6%), Total (15%), and Eni (10.4%). NLNG currently has six liquefaction trains and a production capacity of 22 MMtpa (1,056 Bcf/y) of LNG and 4 MMtpa (80,000 bbl/d) of liquefied petroleum gas. A seventh train is under construction to increase the facility's LNG capacity to more than 30 MMtpa (1,440 Bcf/y).

Brass LNG Limited, a consortium made up of NNPC (49%), Total (17%), ConocoPhillips (17%), and Eni (17%), is developing the Brass LNG Liquefaction Complex. The LNG facility is expected to have two liquefaction trains with a total capacity of 10 MMtpa (480 Bcf/y) and a loading terminal. The project is in its engineering phase.

Nigeria exports a small amount of its natural gas via the West African Gas Pipeline (WAGP). The pipeline is operated by the West African Gas Pipeline Company Limited (WAPCo), which is owned by Chevron West African Gas Pipeline Limited (36.7%), NNPC (25%), Shell Overseas Holdings Limited (18%), Takoradi Power Company Limited (16.3%), Societe Togolaise de Gaz (2%), and Societe BenGaz S.A. (2%).

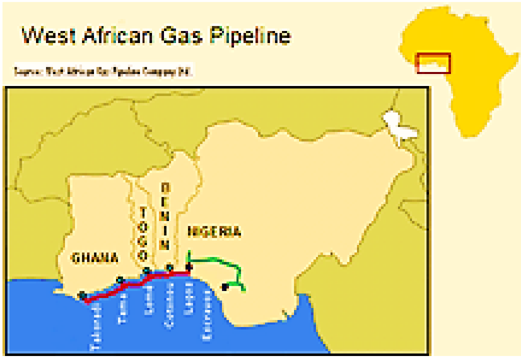


Figure 56: West African Gas Pipeline

The 420-mile pipeline carries natural gas from Nigeria's Escravos region to Togo, Benin, and Ghana, a regional transmission pipeline network in which it's mostly used for power generation. WAGP links into the existing Escravos-Lagos pipeline and moves offshore at an average water depth of 35 meters. According to Chevron, the pipeline has the nameplate capacity to export 170 MMcf/d of natural gas, although its actual throughput is lower.

Proposed: Trans-Saharan Gas Pipeline [TSGP]: Nigeria and Algeria have proposed plans to construct the Trans-Saharan Gas Pipeline (TSGP). The 2,500-mile pipeline would carry natural gas from oil fields in Nigeria's Delta region to Algeria's Beni Saf export terminal on the Mediterranean Sea and is designed to supply gas to Europe. In 2009, NNPC signed a memorandum of understanding (MoU) with Sonatrach, the Algerian national oil company, to proceed with plans to develop the pipeline. Several national and international companies have shown interest in the project, including Total and Gazprom. Security concerns along the entire pipeline route, increasing costs, and ongoing regulatory and political uncertainty in Nigeria have continued to delay this project.

(Sources of Data: APEX Tanker Data, Afroil: Africa Oil and Gas Monitor (Newsbase) BBC News, BP Statistical Review of World Energy, 2011, Brass LNG Limited, Business Monitor International, CIA World Factbook, Chevron, Economist, Energy Intelligence Group, Eni, Eurasia Group, EuroStat, ExxonMobil, FACTS Global Energy, Financial Times, Global Trade Atlas, Harvard- Nigeria: The Next Generation, IHS Cera, IHS Global Insight, International Energy Agency 2014).

6.8 Qatar’s Analyses on Natural Gas Industry

Qatar is the largest exporter of liquefied natural gas (LNG) in the world, and the country's exports of LNG, crude oil, and petroleum products provide a significant portion of government revenues.

Qatar was the world's fourth largest dry natural gas producer in 2012 (behind the United States, Russia, and Iran), and has been the world's leading liquefied natural gas (LNG) exporter since 2006. Qatar is also at the forefront of gas-to-liquids (GTL) production, and the country is home to the world's largest GTL facility. The growth in Qatar's natural gas production, particularly since 2000, has also increased Qatar's total liquids production, as lease condensates, natural gas plant liquids, and other petroleum liquids are a significant (and valuable) byproduct of natural gas production.

Qatar produced nearly 1.6 million barrels per day (bbl/d) of liquid fuels (crude oil, condensates, natural gas plant liquids, gas-to-liquids, and other liquids) in 2013, of which 730,000 bbl/d was crude oil and the remainder was non-crude liquids. While Qatar is a member of the Organization of the Petroleum Exporting Countries (OPEC), the country is the second-smallest crude oil producer among the 12-member group. Natural gas meets the vast majority of Qatar's domestic energy demand, so the country is able to export most of its liquid fuels production. Given its small population, Qatar's energy needs are met almost entirely by domestic sources. Qatar's fiscal year 2012-13 budget assumed an oil export price of $65 per barrel, and with the average export price of the country's Qatar Land export stream averaging nearly $110 per barrel over that period, the government earned significantly higher revenues than expected.

Natural gas is at the center of Qatar's energy sector. Already the world's largest exporter of liquefied natural gas (LNG), several recent developments in the country's natural gas sector could boost production in the short term. As of January 2014, Qatar had the third-largest proved reserves of natural gas in the world at 885 trillion cubic feet (Tcf), according to the *Oil & Gas Journal*. Nearly all of Qatar's reserves are in the country's North Field, which is part of the world's largest natural gas deposit. Iran's South Pars and Qatar's North Field together comprise the entire deposit.

There is currently a moratorium on new projects in Qatar's massive North Field while operators continue to examine ways of sustaining high levels of output over the longer term. The moratorium, initially scheduled to end in 2008, will run through at least 2015 after several extensions. Nevertheless, growth from other fields and new projects could result in overall output growth, although likely at low levels.

Qatar spent many years developing its natural gas resources particularly in the North Field—and in 2012, Qatar was the second-largest dry natural gas producer in the Middle East and the fourth-largest producer in the world. With its relatively low domestic energy demand, Qatar is able to export nearly all of its natural gas production. As such, Qatar has been the world's leading exporter of LNG since 2006, and is a member of the Gas Exporting Countries Forum (GECF).

Qatar's growing natural gas production has increased its output of condensates and natural gas plant liquids, which are valuable byproducts of natural gas production. Qatar is also at the forefront of gas-to-liquids (GTL) technology, which processes natural gas into heavier hydrocarbons, such as distillates and naphtha.

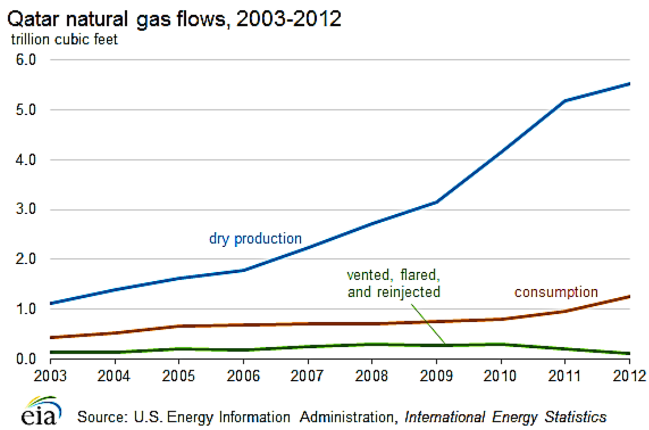


Figure 57: Qatar Natural Gas Flows

Qatar's dry natural gas production reached 5.5 Tcf in 2012, up from just 1.1 Tcf ten years earlier. The vast majority of Qatar's production comes from the North Field, although some smaller fields contribute production volumes as well.

The $10.4 billion Barzan Gas Project should boost Qatar's natural gas production from the North Field in the near term. The project consists of both onshore and offshore developments, including offshore platforms, pipelines, and a gas processing unit. Announcements by government officials and ExxonMobil indicate that the project which began in 2011 will begin operations in 2014 and be capable of processing 1.4 Bcf/d of natural gas.

While nobody expects another discovery like that of the North Field in 1971, exploration in Qatar may still uncover commercially viable natural gas resources. In May 2013, QP and Wintershall announced the discovery of natural gas in Block 4 (North) off the coast of Qatar. The discovery may contain more than 2.5 Tcf in recoverable reserves, and Wintershall expects production of between 200 and 400 million cubic feet per day (MMcf/d).

Qatar is a global leader in gas-to-liquids (GTL) technologies, and the country has two operational facilities. GTL technology uses a refining process to turn dry natural gas into liquid fuels such as low-sulfur diesel and naphtha, among other products. Qatar is one of only three countries with South Africa and Malaysia being the others—to have operational GTL facilities, although pilot projects in a number of other countries are underway.

Qatar's Oryx GTL plant (QP 51%, Sasol-Chevron GTL 49%) came online in 2007, but due to initial problems, it was not fully operational until early 2009. At full capacity, the Oryx project uses about 330 MMcf/d of natural gas feedstock from the Al Khaleej field to produce 30,000 bbl/d of GTL products. Officials have discussed a 100,000 bbl/d expansion of the Oryx facility in the event Qatar lifts the moratorium on North Field developments.

The Pearl GTL project (QP 51%, Shell 49%) uses 1.6 Bcf/d of natural gas feedstock to produce 140,000 bbl/d of GTL products as well as 120,000 bbl/d of natural gas liquids and liquefied petroleum gases (LPG). The plant's initial phase commenced in early 2011, and the first shipments of gasoil were sent out in June 2011. After initiating the second phase of development, Pearl GTL achieved full capacity in October 2012. In addition to being the largest GTL plant in the world, the Pearl GTL project is also the first integrated GTL operation, meaning it will have upstream natural gas production integrated with the onshore conversion plant.

Qatar consumption capacity meets all of its internal natural gas demand from domestic sources. Natural gas consumption has grown quickly over the past several years, nearly tripling between 2003 and 2012. This tracks closely with overall natural gas production, which more than quadrupled over the same period. In 2012, consumption reached 1.3 Bcf/d, growing 30% from the 2011 level. The electricity and water (desalinization) sectors account for most of the natural gas consumption in Qatar.

Qatar is the world's second-largest exporter of natural gas, exporting nearly 4.3 Tcf in 2012, and the country was again the world's largest LNG exporter, as it has been since 2006. Most of Qatar's exports go to markets in Asia in the form of LNG, while the country sends a small amount of natural gas via the Dolphin Pipeline to the United Arab Emirates (UAE) and Oman.

Qatar's LNG export capacity is the highest in the world at 77 million tons per year (MMt/y), approximately 3.7 Tcf, split between Qatargas (42 MMt/y) and RasGas (35 MMt/y). The companies added 5 of the country's 14 trains in 2009 and 2010. The latest, the 14th train (Qatargas IV Train 7), came online in January 2011 with a capacity of 380 Bcf/y (7.8 MMt).

Historically, most of Qatar's LNG exports were part of long-term, oil-indexed contracts, but over the past few years the country began to shift to more short-term contracts and spot-market sales. In 2012, Qatar exported over one quarter of its LNG as short-term or spot-market sales (19.9 MMt according to QNB), accounting for more than a third of short-term and spot-market sales in the world.

Several recent agreements between Qatargas and international LNG importers are of the short-term variety, including a deal based on continental European prices rather than oil-indexation for the first time in the company's history.

Qatar has over 90% of its LNG production volumes committed as part of supply purchase arrangements (SPAs) between 2014 and 2020. LNG production growth elsewhere in the world over the next few years may challenge some of Qatar's remaining spot volumes, although with the majority of its LNG already sold, the impact on Qatar's natural gas exports should be limited in the near term.

The Dolphin Pipeline—which currently has a capacity of approximately 2 Bcf/d—transported 1.9 Bcf/d in 2012 according to Dolphin Energy Limited (DEL), which operates the pipeline. UAE received approximately 1.7 Bcf/d in 2012, while the remainder (approximately 200 MMcf/d) went to Oman. DEL plans to expand capacity of the pipeline to 3.2 Bcf/d, full design capacity, in 2015.

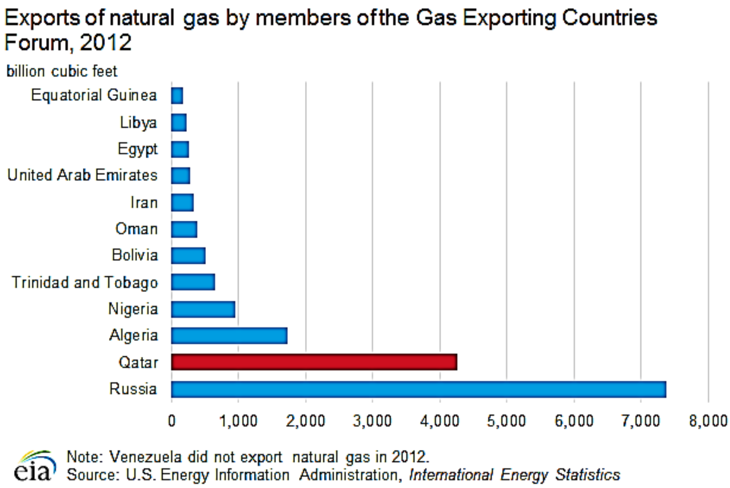


Figure 58: Gas Exporting Countries Natural Gas Exports

6.9 UAE's Country Analyses on Natural Gas

The United Arab Emirates is one of the 10 largest oil and natural gas producers in the world, and is a member of the Organization of the Petroleum Exporting Countries (OPEC) since 1967 when Abu Dhabi joined the UAE is one of the most significant oil producers in the world. The likelihood of further major oil discoveries is low, but the UAE uses enhanced oil recovery (EOR) techniques to increase the extraction rates of the country's mature oil fields. Continued higher oil prices will help increase the commercial viability of EOR.

Natural gas use in the UAE is rising. While the country is a member of the Gas Exporting Countries Forum (GECF), domestic demand is likely to draw heavily on the

UAE's potentially-exportable natural gas resources. Presently, the country both imports and exports liquefied natural gas (LNG) and shares international natural gas pipelines with Qatar and Oman. The UAE is also one of the world's leaders in the use of natural gas in EOR techniques, but with natural gas demand rising, the government plans to expand into other EOR techniques to divert the gas volumes for domestic consumption.

The UAE is making notable progress in diversifying its economy through tourism, trade, and manufacturing. However, in the near term, oil, natural gas, and associated industries will continue to account for the majority of economic activity in the seven emirates.

The UAE holds the seventh-largest proved reserves of natural gas in the world, at just over 215 trillion cubic feet (Tcf). Despite its large endowment, the UAE became a net importer of natural gas in 2008. This phenomenon is a product of two things: (i) the UAE re-injected approximately 26% of gross natural gas production from 2003 to 2012 into its oil fields as part of EOR techniques, and (ii) the country's inefficient and rapidly-expanding electricity grid already taxed by the swift economic and demographic growth of recent decades relies on electricity from natural gas-fired facilities.

To help meet the growing demand for natural gas, the UAE boosted imports from neighboring Qatar via the Dolphin Gas Project's pipeline over the past several years. The pipeline runs from Qatar to Oman via the UAE and is one of the principal points of entry for the UAE's natural gas imports. In addition to the imports from Qatar, Dubai and Abu Dhabi both engage in LNG trading; the former as an importer and the latter as an exporter. The UAE is a member of the Gas Exporting Countries Forum (GECF).

The UAE's natural gas has a relatively high sulfur content that makes it highly corrosive and difficult to process. For decades, the country simply flared the gas from its oil fields rather than undertake the extensive and expensive processes associated with separating the sulfur from the gas. The technical difficulties of producing the country's sulfur-rich (sour) gas once posed a great impediment to the development of the UAE's reserves, but advances in technology and the growing domestic demand for natural gas make the country's vast reserves an enticing alternative to Qatari imports.

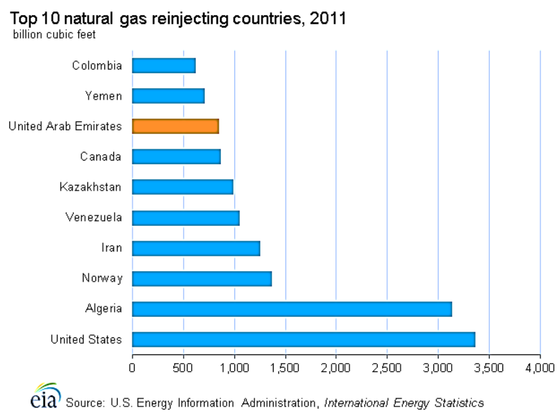


Figure 59: Top 10 Natural Gas Reinjecting Countries

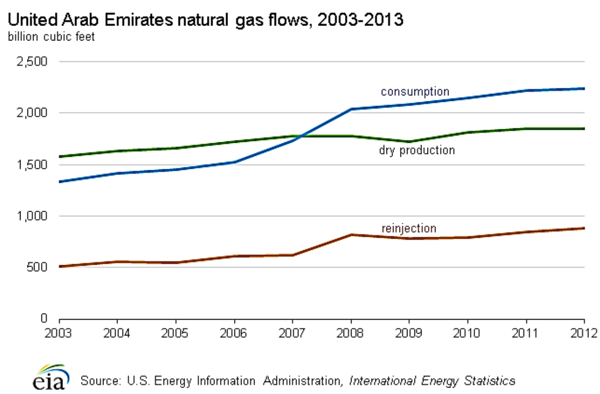


Figure 60: UAE Natural Gas Flows

Dry natural gas production in the UAE rose to nearly 1.9 Tcf in 2012, continuing the upward trend that began in the 1980s. Dry production grew steadily by an annual average rate of 1.6% between 2003 and 2012. The UAE's dry natural gas production ranks the country in the top-20 globally for 2012, based on EIA estimates. Despite the challenges of producing natural gas domestically, the UAE hopes to further boost production to help meet the country's growing demand, which increased at an annual average rate of nearly 5.3% between 2003 and 2012.

Several recent and ongoing projects—the Onshore Gas Development (OGD), Integrated Gas Development (IGD), and Offshore Associated Gas (OAG) projects—may increase production of the country's reserves, and could help meet the rapidly growing demand for natural gas in the country. OGD phases one and two expanded associated gas production at the Asab and Sahil fields to help increase reservoir pressure in the oil fields, with the Asab field dry production reaching 800 million cubic feet per day (MMcf/d), and 6.4 MMcf/d of natural gas liquids (NGL). Phase three of the project—completed in 2008—brought production of the Bab field gas to 1.2 billion cubic feet per day (Bcf/d). Abu Dhabi reportedly plans to boost production from the Bab field to more than 2 Bcf/d by 2015 and to nearly 2.5 Bcf/d by 2018. In April 2013, ADNOC selected Shell to develop Bab's natural gas resources under a 30-year joint venture agreement. The Bab field is an important part of the UAE's carbon dioxide (CO_2) EOR plans. ADCO aims to receive 800,000 tons of CO_2 per year from a nearby steel plant for reinjection to aid in oil recovery.

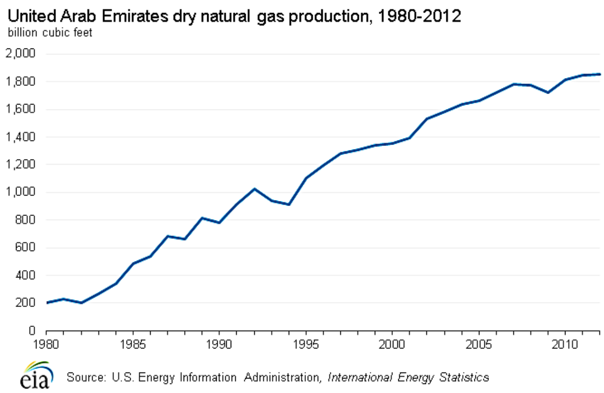


Figure 61: UAE Natural Gas Production

Despite steadily increasing production, the UAE became a net importer of natural gas in 2008. Consumption in the UAE grew by an average of more than 5% per year between 2003 and 2012, which was only partially met by domestic production. Natural gas imports grew from just 7 Bcf in 2003 to 662 Bcf in 2012, while exports remained relatively flat through the entire period, rising by just 30 Bcf over the same period.

In 2012, approximately 95% of UAE's natural gas exports of 281 Bcf were LNG cargoes. All of UAE's exported LNG cargoes went to Japan, totaling more than 260 Bcf. With planned expansion at the terminal at Das Island and the country's new focus on developing its vast natural gas reserves, the UAE could experience export growth in the short to medium term. There is a proposal to expand the Das Island facility with a fourth LNG train that would add roughly 150 Bcf per year capacity. However, the fourth train may end up replacing one of UAE's older trains so the net gain would be minimal.

The UAE uses much of its imported and domestically produced natural gas in its extensive EOR operations and to operate its many power plants and desalinization plants. Meeting domestic demand will require large import volumes for the foreseeable future. Advances in EOR techniques and carbon capture and storage (CCS) could free up additional volumes for domestic consumption, and improvements to the domestic electricity grid will further alleviate supply problems.

While the global macroeconomic crises of the last several years dampened energy demand in the UAE it even declined slightly in 2009 solid economic growth and resulting energy demand over the past few years is again straining the country's natural gas supplies. Natural gas consumption in UAE reached a record high of more than 2.2 Tcf in 2012.

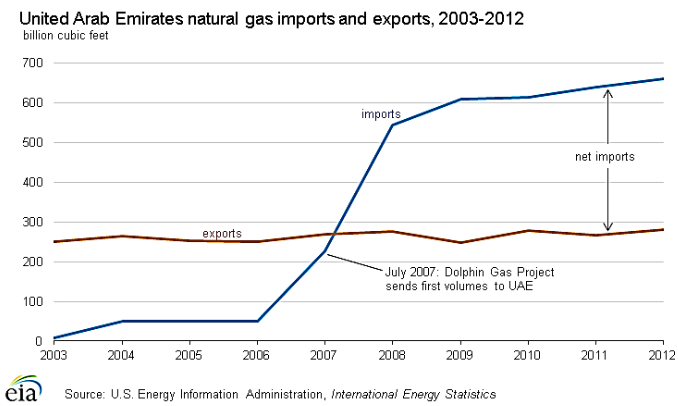


Figure 62: UAE Natural Gas Imports & Exports

6.10 Comparative Analyses of the Countries Results

This research follows the approach of Rosen, M. A., & Scott, D. S. (1998), Anwar, M.S and Sampath, R.K (1999) and Al-Iriani and Al-Shamsi (2011), to compare the countries result analyses using regression method for comparative analyses among countries.

The regression results analyzed on gas exporting countries [GEC] in relation to factors influencing production capacity, with the overall view of all the countries natural gas industry analyses used for this research study, represents alternative paradigms for evaluating the economic significances of production-related choices.

The research findings are reported of Comparism based on Nigeria with negative coefficient -105.179, Angola -88.155, and Qatar -85.698 indicates negative relationship with production capacity compared to Trinidad and UAE with positive coefficient of 223.332 & 32.810 and significant P-values (0.000) for Trinidad respectively. Their coefficients and P-values specifies an efficient production capacity. The influence of all the independent variables with-regards to countries specific effects varies with time entity as it relates to production capacity either in a positive or negative relationship amongst the GEC.

From the countries natural gas industry analyses, ***Algeria's*** gross production capacity of natural gas amounts to 64Tcf in 2012, but experience 4% decline which has been falling since it peak of 7.1Tcf in 2008. Algeria exports 98% of its LNG to Europe (France, Turkey, Spain etc.), approximately 1.7Tcf of natural gas is produce in 2012 and 1.2Tcf is transported via pipeline and 0.5Tcf by LNG Tankers. Production of natural gas amounted to 3.05Tcf in 2012 and expected to increase by 1.5Tcf from 2013 to 2014, [BP statistical review 2014]. Consumption rate is about 0.8Tcf in 2013.

Angola's first LNG plant started operations in 2013. However the country currently is producing well below its capacity of 5.2 MTP/y because of technical problems. Small quantity of marketed natural gas as of January 2014 is produced. As the vast majority of the country's gross production is flared (burned off) or re-injected into oil wells. The country is expected to produce 1Bcf/d of associated gas. Angola will need to address its capacity for processing the large volumes of associated gas its oil operations will continue to produce.

Nigeria has similar case with Angola, with regards to flaring associated gas (burned off). But the government has since 2008 introduce initiatives on how to encourage operators to monetize the associated gas.

Aging infrastructure and poor maintenance culture have also resulted in oil spills and natural gas flaring (burning of associated natural gas) that contributes to environmental pollution (Shell Nigeria recently paid $84 million as a result of oil spillage in the Niger Delta Region). IMF estimates that oil and natural gas exports revenue accounted for 96% of total export revenue in 2012.

Nigeria produce natural gas up to a level of 1.2Tcf in 2012, which is mostly exported in the form of LNG with smaller volumes of about 29Bcf exported via regional West African Gas Pipeline to Benin, Ghana and Togo. 224Bcf of dry natural gas is consumed in 2012, which is less than 20% of its total production rate.

Nigeria exported 19.8MMTP/a, approximately 950Bcf of LNG in 2012, [EIA 2014]. This amount accounted for more than 8% of globally traded LNG. Japan is one of Nigeria largest importer of LNG, 24% of the total in 2012. Since US and other countries in Europe drop imports from Nigeria with about 43%. Other importers of LNG from Nigeria are Spain 19%, France 12%, South Korea 9% and India 7%.

Qatar produce dry natural gas of about 5.5Tcf in 2012; up from 1.1Tcf ten years earlier. Qatar is global leader in gas-to-liquids (GTL) technology. Consumption reached about 1.3Bcf/d in 2012 growing 30% from 2011 level.

Qatar exports nearly 4.3Tcf of natural gas in 2012 as the largest exporter. Qatar supplies small amount of natural gas via Dolphin pipeline to United Arab Emirates and Oman. They have an LNG capacity of 77MMt/y approximately 3.7Tcf split between Qatargas (42MMt/y) and RasGas (35MMt/y). Growth prospects of about 90% of it LNG production volume in 2014-2020.

United Arab Emirates presently both imports and exports natural gas. UAE is one of the world's leaders in the use of natural gas in Enhance Oil Recovery [EOR] techniques. The government recently plans to expand into other EOR techniques to direct the gas volumes for domestic consumption, mainly electricity generation heavily relies on natural gas fired plants. Approximately 28% of gross natural gas production is re-injected into the oil fields as part of EOR techniques.

UAE currently received approximately 1.7Bcf/d of dry natural gas from Qatar for domestic demand. These three countries shares an international pipeline that suppliers UAE (1.7Bcf/d) and Oman (200MMcf/d); where Qatar and it consumers are regionally expanding the supply capacity of the natural gas transmission pipeline to 3.2Bcf/d in 2015. This indicates that the rise in domestic demand in UAE can potentially affects its exportable natural gas resources.

Gas production capacity is driven by higher export rates; likewise besides intrinsic demand factors such as economic growth, relative fuel prices and transport, as well as import infrastructure both supply and trade play a paramount role in determining natural gas demand processes in relation to analyzed independent variables that are observed with respect to country specific individuality as overall coefficients for the bases of our comparison in this research analyses. They are determined empirically using panel regression model analyses; and the sum of errors are found not to have any serial correlation in the model [Random effect Model I].

Consequently comparative analyses of Nigeria, Algeria Angola, Qatar and UAE used in this research analyses can be applied to other GEC's in relation to production-related activities towards enhancement of existing structure and design of future production processes for proper implementation process of continuous redesigning in acquiring innovative technological capabilities [gas processing plant & operational processes].

However, due to some production related limitations in the short run can lead to contradictory production-related decisions. Likewise integrating production capacity and its activities among the GEC will require more innovative, transparent and accountable approach towards overcoming factors influencing production-capacity especially in Nigeria and Angola.

An overall view of the results analyses illustrate a significant empirical evidence on factors influencing production capacity of GEC's accordingly.

Chapter 7 Summary & Policy Implications

7.1 Summary

Categorically, this recent research findings also validates the findings of the previous literatures in which Eller's, (2009 & 2010), findings also justifies Victors, (2007), findings; that NOCs are less efficient than IOCs, and in addition, that much of the inefficiency can be explained by the differences in the structural and institutional features of the firms, which may arise due to different firms' objectives, (Eller, et. Al 2009-2010).

This research analyses focus not just on oil companies as previous literatures, but relatively advance a step ahead with more emphasis on gas production capacity and with the view on both gas exporting countries and national gas companies. As such from the DEA scores obtained in this study, the IOGCs were found to be clustered near the frontier, with an average DEA efficiency score of 0.95 to 1.1, while the NOGCs, although dispersed throughout the study, tended to be clustered farther away from the frontier and with a score of 0.28, and the Nigerian National Gas Company (NGC) with a score of 0.25 [in the 4^{th} Quadrant of the Malmquist Index analyses, see figure 29].

DEA evaluated a score of 0.25 for Nigerian National Gas Company and is categorized in the fourth Quadrant of the Malmquist index; which specifies Nigerian National Gas Company is highly inefficient compared to other GEC NOGC's. Non-GEC NOGC's, IOGC's and Vast IOGC's respectively; justifying the result findings of the regression analyses [Random Effect Model I Estimation Result table 15 page 168]. This also respond to the research question that measures how efficient is Nigerian National Gas Company to other Gas Companies in the GEC

To find obtainable model between fixed effect model and random effect estimation, through the application of ‘’***Hausman Test’’*** was conducted. Statistically insignificant P-value of 0.45 is obtained, which is greater than 5% implying that null hypothesis shall not be rejected, which also indicates that Random effect estimation is better to use for the regression analyses than fixed effect model. Independent variables [net exports/imports, facility and GDP] are statistically significant to explain or have influence on production capacity at 10% significance level.

We finally apply the diagnostic checking; to check whether there is serial correlation in the residual, in other words [cross-sectional dependence test] if the residuals are correlated across entities; it indicates **Probability = 1.0000;** which is very high, more than 5% meaning that we can accept null hypothesis & there is no any serial correlation in the Model [Random effect model].

Positive independent coefficient also indicates a positives relationship btw production, consumption, net & facility, but positive association ship btw GDP and production, indicates that if the production goes up, GDP goes up & if the production goes down, GDP comes down. The coefficient 43% for GDP as positive, which is normal and significant.

Elasticity has shown **0.7% cost to export P-value at significance export rate 0.000;** which indicates a positive relationship btw production capacity and GDP. Both

Random effect & OLS model estimations are positive; which means if country has good GDP the production rate/capacity will increase and if the production rate increases the GDP will increase vice-versa.

Most recent studies that use panel data models use robust standard error estimators which entail the application of covariance matrix estimators to adjust the standard errors of the estimated coefficients for possible dependence in the residuals. Antione et al (2010, 2013 & 2014) pointed that standard error estimate of commonly applied covariance matrix estimation techniques are biased due to inadequacy in accounting for auto correlation. Driscoll and Kraay (1998) modified the standard nonparametric covariance estimator in such a way that it is robust to general forms of cross-sectional and temporal dependence relying on large T- asymptotics Hoechle (2007). He applies the Newey-West type adjustment to the sequence of cross sectional averages of the moment conditions Hoechle (2007).

Changing the standard error estimates in this form ensures that the covariance matrix estimator is consistent, and independently of the cross-sectional dimension N. The test assumes that the error structure is heteroskedastic or (homoscedastic as in this case), and auto correlated up to some lag and possibly correlated between the panels. Three years lag was assumed for running the test considering the fact that investment shock in one year could continue into several years. This is consistent with Hvozdyk and Mercer-Blackman (2010) who finds 2-3 years lag between price signal and investment of major IOCs. The results of the test confirmed the correction of the error structure in the fixed effect model. Stat command *xtscc dependent variable, independent variables, fe* is used to perform the test.

Unit root test for stationarity of variables have widely been applied in time series analysis, but recently there is a growing interest in its application in panel data models. Hadri (2000) developed Lagrange Multiplier (LM) procedures to test the null hypothesis that all the individual series in the panel According to OPEC, outlook; upstream production that needs future capacity expansion; will amount to about $4.2 trillion from 2011 - 2035 (OPEC outlook 2014) also according to the developments in fiscal terms are of vital concern in the valuation of the feasibility of an oil exploration and production investments, due to the associated risk of the oil sector and the characteristic uncertainty of the international oil market conditions; Adenikinju and Oderinde, (2009).

The prospects for growth in Nigeria are very bright going by the achievements recorded during the last ten to fifteen years and the current reforms in the various sectors. However, for Nigeria to consolidate these economic gains and move higher in the frontlines of growth and development, it must deepen reforms that will advance on transforming the influencing factors affecting performance measures with regards to production capacity; consequential to this research findings and pragmatic results. Also responding to the research hypothesis that postulates if the NNGC are efficient, vast revenue could be generated from the sector.

Nigeria should also outspread her production capacity towards reaching out to other external factors that were not used in this research analyses as observable variables;

but were studied in most of the related literatures as dependent & independent variables used in their empirical research findings and analyses, Anwar,M.S and Sampath, R.K (1999), Hoff (2007), Al-Iriani and Shamsi (2011), respectively; towards impacting on human capital, promote high-quality public infrastructure, and encourage competition, reserves depletion measure, fiscal framework etc.

The pillars to sustain this consolidation must include a firm fiscal policy, transparent fiscal operations, development-oriented monetary and exchange rate policies, strengthening of the financial sector and strict adherence to the rule-of-law and respect for the sanctity of contract as well as commitment to fighting corruption and corrupt practices. In all of these, Nigeria has opportunity for progress. It must break away from the past to deliver a new Nigeria that the future generations of Nigerians would be proud of. The electoral process must not only be credible, but must be seen to be credible, since robust economic performance necessarily requires a robust political environment to transpire.

7.2 Recommendation

Qatar, Angola & Nigeria should imitate UAE and Algeria in terms of new technology in gas processing facility plants, regional transmission networks, related industries and policy review to attract more industry players by creating a favorable environment for the stakeholders.

These research analyses provides useful alternative towards analyzing factors influencing the production rate in the GEC and can be applied to numerous other related factors and variables, depending upon the intension of the research idea. It can also be used to evaluate the cost and benefit of using each paradigm and its relative advantage for making different types of production-related decisions.

Either the GEC Government, firms/related gas industries or production influencing factors has complete control or has no control over the level of production and consumption capacity; this can be the future focus of this research analyses; towards understanding how management [GEC Government, Firms & Production Influencing Factors] degree of control over production & consumption capacity affects the selection of an optimal alternative in relation to economic growth and development.

7.3 Policy Implications

- The positive effect of increases in gas production capacity in the GEC indicate that production control policies could checkmate risky/uncertainty in exploration processes by enhancing operators cash flow.

- Policies to encourage transmission, distribution and development of acute advantage technologies in the oil and gas regional and sectorial assessment and utilization of resources accordingly

- Policy Review through R&D and involvement of all stakeholders, industry players, and research institutes, members of the national assembly, professional skilled expatriates and the Ministry of Petroleum Resources Professional Executives officers should all harmonize together when enacting a new policy in the energy sector and all other sectors of the economy.

Since the Business environment is found to be a major driver of National Competitiveness and Value Chain in the Oil and Gas sector in Nigeria, therefore effort should be made to address the problems associated with this driver.

For Government

The on-going privatization and industrial policies in Nigeria should be fine-tuned to encourage more local ownership and joint venture in the oil and gas sector than before. The bank of industry, the small and medium scale industry equity investment scheme (SMIEIS) and the micro-finance banks should be strengthened to cater for the small and medium scale enterprises. In general, the cost of capital (interest rate) should be reduced to encourage indigenous investment in the oil sector. Indigenous entrepreneurs should be encouraged by government to partner with foreign firms in the delivery of services to the oil sector operators.

Given the poor state of infrastructure in Nigeria particularly power, there is the need to expedite action on the deregulation of the power sector to promote adequate service delivery. The foundation for industrialization and enhancing linkages is the availability of good infrastructure especially electricity and transportation.

There is the need to set up a committee for effective implementation of the recently passed National Content Bill. This is because the bill will go a long way to promote local sourcing of inputs and upgrading of local skills. All these will also promote employment and increased value added.

The NSI in Nigeria needs to be properly integrated with the rest of the economy particularly the oil sector. There is the need to increase the share of government expenditure on education so that the NSI in Nigeria can function effectively.

Governments should work together bilaterally and multilaterally with Stakeholders to provide efficient, affordable, clean energy and reliable gas supplies to ensure the stability of domestic gas utilization and World Gas Market accordingly. [Collaborative Public & Private approach for energy efficiency can be one alternative out of numerous ones]

For the Corporate sector

Local firms should be ready to upgrade their technology in order to be able to service the oil sector. This may be easy through partnership with foreign firms as in the case of some existing domestic firms such as Niger-Dock and Delta-Afrik which partner with Worley-Parson based in the US. While the IOC's should engage in CSV as against the conventional CSR this will go a long way in proving the necessary and needed value for the society and the companies

Policy Frame work on Local Content

Although country-specific factors influence the optimal design of local content policies, we can identify general principles that can be applied broadly: Set transparent and measurable targets. What constitutes local content needs to be clearly defined, and targets should be established for each component of the desired local content policy. Targets should be objectively measurable and reasonable (i.e. within the reach and capability of the country) to avoid creating unrealistic expectations and companies – IOGCs and NOGCs – should be held accountable for missing targets.

- Accountable for technological strangeness
- Gradually maximize local value-added
- Create and enhance local capabilities
- Report on the local content performance of operators
- Create an enabling environment

7.4 Suggestions for Future Research Focus

The perception of this study is expected to examine the current and future oil & gas activities within and outside the scope of gas exporting/producing countries, based on an assessment of global developments and regional developments that will affect demand and supply of oil and gas from consumer perspectives for sustainable economic activities, growth and developments.

7.5 Research Limitation

This research study is not able to provide somewhat linkage between innovative technical production capacity efficiency and domestic natural gas production capacity and utilization due to lack of sufficient data availability (hypothesis three (3) of this research analyses); which can be an area of further research study.

Bibliography

Aad, G., Abbott, B., Abdallah, J., Abdel Khalek, S., Abdelalim, A. A., Abdesselam, A., & Alison, J. (2012). Combined search for the standard model higgs boson using up to 4.9 fb− 1 of pp collision data at with the atlas detector at the lhc. *Physics Letters B, 710*(1), 49-66.

Aad, G., Abajyan, T., Abbott, B., Abdallah, J., Abdel Khalek, S., Abdelalim, A. A., & Allbrooke, B. M. M. (2012). Observation of a new particle in the search for the Standard Model Higgs boson with the ATLAS detector at the LHC. *Physics Letters B, 716*(1), 1-29.

Aad, G., Abbott, B., Abdallah, J., Abdelalim, A. A., Abdesselam, A., Abdinov, O. & Allport, P. P. (2013). Jet energy measurement with the ATLAS detector in proton-proton collisions at\ sqrt {\ mathrm {s}} = 7\\ mathrm {TeV}. The European Physical Journal C, 73(3), 1-118.

Abazov, V. M., Abbott, B., Acharya, B. S., Adams, M., Adams, T., Alexeev, G. D., & Boos, E. E. (2011). Model-independent measurement of t-channel single top quark production in collisions at. *Physics Letters B, 705*(4), 313-319.

Al-kasim (2006a): Managing Petroleum Resources: The ‘Norwegian Model ‘in a Broad Perspective; Oxford Institute for Energy Studies, Oxford, UK

Ali G. A. (2009). Environmental Impact Analyses of Natural Gas Production, Utilization, Transmission and Distribution in the Natural Gas Sector. Salford University, Manchester United Kingdom.

Al-Shibami, A. H. (2011). Location related determinants of Foreign Direct Investment in Yemen: Dunning’s Eclectic Paradigm perspective. *Australian Journal of Basic and Applied Sciences*, *5*(8), 394-404.

Alkhasawneh, M. F. (2013). The Granger Causality Relationship between Foreign Direct Investment (FDI) and Economic Development in the State of Qatar. *Appl. Math*, *7*(5), 1767-1771.

Al-Qahtani, A., Edward B., Carol D. (2008): Literature Review on Oil Market Modeling and OPEC's Behaviour. Colorado School of Mines, Golden Co. 80401

Al-Sultan, A. M. (1995): "Alternative Models for OPEC Behaviour." *Journal of Energy and Development*, 18(2): pp. 263-281

Al-Sultan and Yucel, M. (1990): Dynamic Modellling and Testing of OPEC Behaviour. *The Journal of Energy and Development* 18 (2): pp. 263-280

Alvarez and Fiorito (2005): Venezuelan Oil Unifying Latin America; Stanford University; June, 2005

Al-Yousef, N. A. (1998): "Modeling Saudi Arabia Behaviour in the World Oil Market 1976- 1996." Department of Economics, University of Surrey. SEEDS 93.

Amirahmadi, Hooshang (1996): Oil at the turn of the twenty first century: *Futures*, Vol.28, No.5 pp. 433-452.

Amponsah, W., Colyer, D., & Jolly, C. (1999). Global trade integration and economic convergence of developing countries. *American journal of agricultural economics*, 1142-1148.

Andersson, M. (2007): Fixed Effects Estimation of Marginal Railway Infrastructure Costs in Sweden," Working Papers 2007:11, Swedish National Road & Transport Research Institute (VTI)

Antonie, M.D, Cristescu, A & Cataniciu, N (2010): A Panel Data Analysis of the Connection between Employee Remuneration, Productivity and Minimum Wage in Romania. World Scientific and Engineering Academy and Society (WSEAS) Stevens Point, Wisconsin, ISBN: 978-960-474-194-6 pp. 134-139.

Ang, B. W., & Zhang, F. Q. (2000). A survey of index decomposition analysis in energy and environmental studies. *Energy*, *25*(12), 1149-1176.

Ang, B. W., & Liu, F. L. (2001). A new energy decomposition method: perfect in decomposition and consistent in aggregation. *Energy*, *26*(6), 537-548.

Ang, B. W. (2004). Decomposition analysis for policymaking in energy: which is the preferred method? *Energy policy*, *32*(9), 1131-1139.

Ang, B. W. (2005). The LMDI approach to decomposition analysis: a practical guide. *Energy policy*, *33*(7), 867-871.

Ang, B. W., Liu, F. L., & Chung, H. S. (2002). Index numbers and the Fisher ideal index approach in energy decomposition analysis. *Department of Industrial and Systems Engineering, National University of Singapore, Singapore*.

Ang, B. W. (1995). Decomposition methodology in industrial energy demand analysis. *Energy*, *20*(11), 1081-1095.

Ang, B. W., & Lee, S. Y. (1994). Decomposition of industrial energy consumption: some methodological and application issues. *Energy Economics*, *16*(2), 83-92.

Ang, B. W., & Liu, F. L. (2001). A new energy decomposition method: perfect in decomposition and consistent in aggregation. *Energy*, *26*(6), 537-548.

Ang, 1995 B.W. Ang Decomposition methodology in industrial energy demand analysis, Energy, 20 (1995), pp. 1081–1095

Alcántara and Roca, 1995 V. Alcántara, J. Roca Energy and CO_2 emissions in Spain, Energy Economics, 17 (1995), pp. 221–230

Arya, PB 2012, 'Impact of M&A on Indian Companies', International Journal of

Knowledge and Research in Management and E-Commerce, vol. 2, no. 2.

A. Torvanger, 1995 manufacturing sector carbon dioxide emissions in nine OECD

Assessing Measures Of Energy Efficiency Performance And Their Application In Industry ''Kanako Tanaka'' International Energy Agency Oecd/Iea, February 2008.

AORAN, M. (2012).*Index Decomposition Analysis: Some Methodological Issues*

(Doctoral dissertation).

Ang, B. W., & Liu, N. (2007). Energy decomposition analysis: IEA model versus other methods. *Energy Policy, 35*(3), 1426-1432.

Ajakaiye, D.O., 1990 Inter-Industry Linkages in the Nigerian Economy 1973-1977, NISER Monongraph Series No 2 NISER, Ibadan.

Baltagi, B. H. & Chang, Y. J. (1994): Incomplete panels: A comparative study of alternative estimators for the unbalanced one-way error component regression model. *Journal of Econometrics* 62(2), pp. 67-89.

Baltagi, B. H. (2001): Econometric analysis of panel data. 2d ed. Chi Chester, UK: Wiley.

Baltagi, B.H. (2005) Econometric Analysis of Panel Data. 3rd ed., John Wiley & Sons, Chi Chester, UK.

Baltagi and Li (1991): A transformation that will circumvent the problem of autocorrelation in an error component model. *Journal of Econometrics* 48, pp 385 – 393.

Baltagi and Wu (1999): Unequally Spaced Panel data regressions with AR (1) Disturbances. *Econometric Theory* 15 pp 814 - 323

Barnosky, A. D., Hadly, E. A., Bascompte, J., Berlow, E. L., Brown, J. H., Fortelius, M., & Smith, A. B. (2012). Approaching a state shift in Earth/'s biosphere. *Nature*, *486*(7401), 52-58.

Barros, C. P., & Dieke, P. U. (2008). Measuring the economic efficiency of airports: a Simar–Wilson methodology analysis. *Transportation Research Part E: Logistics and Transportation Review*, *44*(6), 1039-1051.

Basil, Ajith (2011): OPEC & its influence on Price of Oil, accessed via www.greatlakes.edu.in/.../OPEC&its_Influence_on_the_Price_of_Oil_Ajith_Basil dated 06/07/2013

Bhattacharyya.S.C. (2010): Energy Economics: Concepts, Issues, Markets and Governance. Springer Publishers, London, 2011

Bandyopadhyay, K.R (2009): Does OPEC act as a Residual Producer? Asian Institute of Transport Development. Munich Personal RePEc Archive Paper No. 25841, via http://mpra.ub.uni-muenchen.de/25841/

Baum, C.F (2001): Residual diagnostics for cross-section time series regression models. *The Stata Journal* (2001) 1, Number 1, pp. 101–104

Bently, R.W (2002): Global Oil & Gas depletion: An overview. *Energy Policy* 30 pp189–205

Beredjick and Walde (1988): Petroleum Investment Policies in developing Countries; Graham and Trotman Limited, London, 1988. 400

Berg E. et al. (1996). "Gains from Cartelization in the Oil Market." Discussion Paper 181, Statistics Norway Research Department.

Bernanake, B (1983): Irreversibility, Uncertainty and Cyclical Investment. *Quarterly Journal of Economics*, 98(1), pp. 85-106

Bertola, G. (1990): 'Irreversible investment', mimeo, Princeton University.

Biscoff, C.W (1969): Hypothesis Testing and the Demand for Capital Goods, *Review of Economics and Statistics*, Cambridge, Mass., Harvard University Press, pp. 354 368

Blundell, R., Bond, S. (1998): Initial conditions and moment restrictions in dynamic panel data Models. *Journal of Econometrics* 87 (1), pp. 115–143

Bockem, S. (2004) "Cartel Formation and Oligopoly Structure: a New Assessment of the Crude Oil Market." *Applied Economics*, Vol. 36: pp. 1355-1369.

Boscheck (2007): The governance of oil Supply: An institutional perspective on NOC control and the questions it poses. *International Journal of Energy Sector Management* 1 (4) pp. 366-389.

Bravo-Ureta, B. E., Solís, D., López, V. H. M., Maripani, J. F., Thiam, A., & Rivas, T. (2007). Technical efficiency in farming: a meta-regression analysis. *Journal of Productivity Analysis*, *27*(1), 57-72.

Byzalov, D. (2002).“A Dynamic Model of OPEC: Collusive Behaviour and Demand-ReducingInvestment.” Foerder Institute for Economic Research and Sackler Institute for Economic Studies, EitanBerglas School of Economics, Tel-Aviv University, working paper no. 11.

Broadman H (1985): Incentives and Constraints on exploratory drilling for petroleum in Developing countries; *Annual Review of Energy*.10 (1985) pp. 217-49.

Campbell, N. C., Murray, E., Darbyshire, J., Emery, J., Farmer, A., Griffiths, F., & Kinmonth, A. L. (2007). Designing and evaluating complex interventions to improve health care. *Bmj*, *334*(7591), 455-459.

Carruth, A. et al (1997): Econometric Modelling of UK Aggregate Investment: The Role of Profits and Uncertainty. University of Manchester, ISSN 1463-6786.

Casassus, J., P. Collin-Dufresne and B. Routledge (2005): “Equilibrium Central Bank of Nigeria Annual Report and Statement of Accounts, CBN, Abuja.Countries, 1973–1987 Energy Economics, 13 (1991), pp. 168–186 Commodity Prices with Irreversible Investment and Nonlinear Technology”, NBER Working Paper 11864.

Cate and Mulder (2007): The Impact of the oil price and fiscal facilities on offshore mining at the Dutch Continental Shelf. *Energy Policy* Vol. 35, Issue 11, November 2007, pp. 5601–5613

Chenry (1952): Over Capacity and the Acceleration principle. *Econometrica*, 20.

Cherif, R and Hasanov, F (2012): Oil Exporters' Dilemma: How Much to Save and How Much To Invest. IMF Working Paper WP/12/4, 2012

Colgan, Jeff (2013): The Emperor Has No Clothes: The Limits of OPEC in the Global Oil Market. American University.

Connor (2009): Warning: Oil supplies are running out fast. The Independent, August 3, 2009 via http://www.regione.vda.it/energia/notiziario_ultime/allegati/allegato1676ita.pdf on 19/11/2014

Corts, K (2000): 'Turnkey Contracts as a Response to Incentive Problems: Evidence from the Offshore Drilling Industry', working paper, Harvard University.

Cremer J. and Salehi-Isfahani D. (1989): The Rise and Fall of Oil prices: A Comparative Review. *Annales d Economie de la statistique et, de etudes economique*, Paris: pp. 427-54

Cremer, J., and Weitzman, M.L. (1976) "OPEC and the Monopoly Price of World Oil." *European Economic Review*, Vol. 8: 155-164.

Cox, J.C and Wright, A.W (1976): The determinants of investment in petroleum reserves and their implications for public policy. *The American Economic Review*, 66 (1976), pp. 153–165

Dada, W., (2000): "Modeling Investment Decisions for Oil Exploration Companies: Do International Oil Companies Differ from National Oil Companies?" mimeo, Research department, International Monetary Fund, Washington, DC.

Dahl, C.A. and Celta, D. J. (2000): "OPEC as a Social Welfare Maximizer." Division of Economics, Colorado School of Mines, Working Paper.

Dakurah, A. H., Davies, S. P., & Sampath, R. K. (2001). Defense spending and economic growth in developing countries: A causality analysis. *Journal of Policy Modeling*, *23*(6), 651-658.

Darrah, P. A., Patel, D. T., De Luca, P. M., Lindsay, R. W., Davey, D. F., Flynn, B. J. & Seder, R. A. (2007). Multifunctional TH1 cells define a correlate of vaccine-mediated protection against Leishmania major. *Nature medicine*, *13*(7), 843-850.

Dahl, C and Mine, Y. (1990): Dynamic Modelling and Testing of OPEC Behaviour, Oxford Institute for Energy Studies

Dahl, Carol and Mine Yucel (1991): “Testing Alternative Hypotheses of Oil producer Bahviour”, *The Energy Journal* 12 (4): pp. 117-137

Danielsen, A.L. and Kim S. (1988) “OPEC Stability: An Empirical Assessment.” *Energy Ecoonomics,* 10(3):174-184.

Davidson, P (1972): Money and the Real World. London: Macmillan, 1972

De Santis, R.A (2003): Crude oil price fluctuation and Saudi Arabia’s behaviour. *Energy Economics*, 25(2), pp. 155-173

Deacon, R.T., S. DeCanio, H.E. French, Iii and M.B. Johnson (1990): Taxing energy: oil severance taxation and the economy, (Holmes and Meier, New York,NY).

DeCanio, S. J., & Watkins, W. E. (1998). Investment in energy efficiency: do the characteristics of firms matter? *Review of economics and statistics, 80*(1), 95-107.

Dunning, J., 2000, The Eclectic Paradigm as an Envelope for Economic and Business Theories of MNE Activity. *International Business Review*, 9: 163–190.

Dixit, A. (1992): ‘Investment and hysteresis’, *Journal of Economic Perspectives*, 6, pp. 107-32.

Dixit, A. and R. S. Pindyck (1994): Investment under uncertainty. New Jersey: Princeton University Press.

Driscoll, J.and Kraay. A.C. (1998): Consistent covariance matrix estimation with spatially dependent data. *Review of Economics and Statistics* 80: pp. 549-560.

Drukker, D.M (2003): Testing for serial correlation in linear panel-data models, *The Stata Journal*, Vol. 3, No. 2, pp. 168–177.

Ekern, S. (1988): 'An option pricing approach to evaluating petroleum projects',*Energy Economics* 91-9.

Eklund, JE (2013): Theories of Investment: A Theoretical Review with Empirical Applications. Working Paper series; Swedish Entrepreneurship Forum.

Enebeli E.E., Cheng,J. and Wang, X.L. (2012): Petroleum Exploration and the oil price dynamics; A case study of Nigerian Petroleum Industry, *African Journal of Business Management* Vol.6 (9), pp. 3342-3348, March 7th, 2012

Energy Information Administration (EIA 2014) Gas Production Country Analyses

Energy Use in India, CO_2 emission, by Shyamal Paul and Rbindra Nath Bhattacharya 2004.

Efficient energy utilization as a tool for sustainable development in Nigeria, Sunday Olayinka Oyedepo 2012.

Eigen, P. (2006). Fighting corruption in a global economy: Transparency initiatives in the oil and gas industry. *Hous. J. Int'l L.*, *29*, 327.

Ernest and Young (2012): Ernest &Young global oil and gas tax guide 2012

Falls and Natke (2007): An Empirical Analysis of a Keynesian Investment Theory using Brazilian Firm-Level Panel Data. *Journal of Post Keynesian Economics*, 29 (3) 2007, pp. 501-519

Farnejad (2013): How competitive is the Iranian buy-back contract in comparison to contractual production sharing fiscal systems? University of Dundee, 2013

Farzin, Y.H (2001): “The impact of oil price on additions to US proven reserves", *Resource and Energy Economic*s, 23(3), 2001, pp. 271-291

Fattouh, B. (2004): The Investment Challenge for Oil Producing Countries: Vol.XLVII, No.38, *Middle East Economic Survey*, September, 2004

Fattouh, B. (2007): OPEC Pricing Power: The Need for a New Perspective .Oxford Institute for Energy Studies WPM 31

Fattouh, B. (2008): The North African Oil and Foreign Investment in Changing Market Conditions: Oxford Institute for Energy Studies, WPM 37, July, 2008.

Fattouh and Mahadeva (2013): OPEC: What difference has it Made? Oxford Institute for Energy Studies MEP3

Favero, C. A. and M. H. Pesaran (1994): Oil investment in the North Sea. *Economic Modelling* 11 (3), pp. 308-329.

Favero, C. A. et al. (1994): A duration model of irreversible oil investment: Theory and empirical evidence. *Journal of Applied Econometrics*, Vol. 9, pp. S95- S112

Favero.C.A (1992): Taxation and the optimization of oil exploration and production: the UK Continental Shelf .*Oxford Economic Papers*, 44 (1992), pp. 187–208

Fee, D (1988): Petroleum Exploitation Strategy. Belhaven Press, London.

Fesharaki (1990): Oil Prices in the short, medium and long term: *Energy policy*, January/February, 1990, pp. 66-71.

Fisher, F.M. (1964): Supply and costs in the United States petroleum industry. John Hopkins University Press, Baltimore

Freshfields Bruchhaus Deringer (2013): Insights. Freshfields Bruckhaus Deringer LLP Via www.freshfields.com/uploadedFiles/SiteWide/News_Room/Insight

Frees, E. W. (2004). *Longitudinal and panel data: analysis and applications in the social sciences*. Cambridge University Press.

Garba, A. A. (2014). Efficiency in Domestic Gas Production & Utilization in Sub-Saharan Africa & Other Gas Exporting Countries. Technical Paper Venezuela & IAEE

Garba Ali, A. (2005). Quantitative Analyses of Hazardous Effects from Sharada Phase II Industrial Area Kano; to the Contiguous Community. Kano State Nigeria.

Garba, A. A. (1999). Analytical Determination of Molybdenum in Soil and Plant Sample from Sharada Phase II Industrial Area Kano. Kano State Nigeria.

Gately, D. (1984): "A Ten Year Retrospective: OPEC and the World Oil Market." *Journal of Economic Literature,* 22(3): pp. 1110-1114.

Geroski, P.A., Ulph, A.M. and Ulph, D.T. (1987): 'A model of the Crude Oil Market in which Market Conduct Varies', *the Economics Journal*, 97, pp 77-86

Greene D. L. (1991); "A Note on OPEC Market Power and Oil Prices." *Energy Economics*: pp. 123-129.

Greene, W. (2000): Econometric Analysis. Upper Saddle River, NJ: Prentice Hall.

Greene, W.H. (2003) Econometric Analysis. 5th ed. Prentice Hall, Upper Saddle River, NJ

Greene D. L. (1991): "A Note on OPEC Market Power and Oil Prices." *Energy Economics*: pp.123-129

Giménez-García, V. M., Martínez-Parra, J. L., & Buffa, F. P. (2007). Improving resource utilization in multi-unit networked organizations: The case of a Spanish restaurant chain. *Tourism Management*, *28*(1), 262-270.

Global Energy Efficiency Action Initiative OECD/International Energy Agency (IEA

2014)

Griffin, J. (1992) “OPEC and World Oil Prices: Is the Genie Back in the Bottle?” *Energy Studies Review*, 4(1): 27-39.

Griffin, J.M. and J.R.Moroney (1985): The economic impact of severance taxes: results from an econometric model of the Texas oil and gas industry. Report to the Texas mid Continent Oil and Gas Association.

Griffin, J. and Steele H. (1986): Energy Economics and Policy. New York: Academic Press.

Griffin G. M. and Teece D. J. (1982): OPEC Behaviour and World Oil Prices. George Allen & Unwin (Publishers) Ltd, UK

Guerra, S (2007): Long run relationship between oil prices and aggregate oil investment: Empirical Evidence via www.usaee.org/usaee2007/.../Sergio%20Guerra%20WP%2017-05-07.pdf dated 29/12/2014

Gugler, K et al (2003): Marginal q, Tobin’s q, cash flow and Investment. *Southern Economic Journal*, 70, pp. 512 – 531

Ghorban (2009): Potential and challenges in the Iranian oil and gas industry: Middle East Institute via http://www.mei.edu/content/potentials-and-challenges iranian-oil-and-gas-industry visited on 13/08/2012

Gujarati, N.D. (1988): Basic Econometrics, Second Edition, McGraw-Hill Company, New York

Gullen, S.G (1996): Is OPEC a cartel? Evidence from co-integration and Causality tests: The *Energy Journal*, 17 (20) pp. 43-57

Gurney, J. (1996): Libya: The Political Economy of Oil, Oxford Institute for Energy

Studies, Oxford

Hadri, K (2000): Testing for stationarity in heterogeneous panel data. Econometrics Journal, (3) pp.148-161.

Hamad, R.S (2011): Modelling the impact of oil price volatility on investment decision-making. PhD Thesis. University of Hull, UK, December, 2011.

Hammoudeh S. and Madan V. (1995): "Expectation, Target Zones, and Oil Price Dynamics." *Journal of Policy Modeling*, 17(6): pp. 597-613

Hartley, P. and Medlock, K. B. (2008): "A model of the Operation and Development of a National Oil Company", *Energy Economics,* (30), pp. 2459-2585.

Hausman, J.A (1978): Specification Tests in Econometrics. *Econometrica,* 46 (6), pp. 1251-1271

Heo,Eunnyeong (2013): Global Energy Environmental Change and Issues in Korea's Future Energy Mix. Korean Economic Review, 10 (2) 2011, pp 187-205

Heo, E., Kim, J., & Boo, K. J. (2010). Analysis of the assessment factors for renewable energy dissemination program evaluation using fuzzy AHP. *Renewable and Sustainable Energy Reviews*, *14*(8), 2214-2220.

Hoechle, D (2007): Robust standard errors for panel regressions with cross- sectional dependence. *The Stata Journal* (2007) Vol.7, No. 3, pp. 281-312

Hook, M (2009): Depletion and Decline Curve Analysis in Crude Oil Production. PhD Thesis, Global Energy Systems Department for Physics and Astronomy, Uppsala University

Hotelling, H (1931): The economics of exhaustible resources; *Journal of Political Economy*, vol. 39 (1931), pp. 137–175

Hopkins, M. 2007, *Corporate Social Responsibility and International Development: Is*

Business the Solution? Sterling, VA: Earthscan.

Hsiao, C. (1986): Analysis of panel data. Cambridge, UK: Cambridge University Press.

Hurn, A.S and Wright, R.E (1994): Geology or Economics? Testing Models of Irreversible Investment Using North Sea Oil Data. *The Economic Journal*, 104, No. 423 pp. 363-371

Hnyilicza, E. and Pindyck, R. S. (1976) "Pricing Policies for a Two-part Exhaustible Resource Cartel, the Case of OPEC." *European Economic Review*, 8: 139-154.

Hvozdyk, L. and Mercer-Blackman,V.(2010): What Determines Investment in the Oil Sector ? A New Era for National and International Oil Companies Inter-America Development Bank Working Paper Series No.IDB-WP-209

Idemudia, U., & Ite, U. E. (2006). Corporate–community relations in Nigeria's oil industry: challenges and imperatives. *Corporate Social Responsibility and Environmental Management*, *13*(4), 194-206.

Ike, C. B., & Lee, H. (2014). Measurement of the efficiency and productivity of national oil companies and its determinants. *Geosystem Engineering*, *17*(1), 1-10.

Iledare (2009): Econometric modeling of deep water petroleum exploration and development operations in the US Gulf of Mexico. Presented at IAEE Conference, San Francisco, CA, June 21-24, 2009.

Iledare, O. O. (1995): Simulating the effect and policy incentives on natural gas drilling and gross reserve additions. *Resource and Energy Economics* 17, pp. 261-279

Iledare, O. O. and Pulsipher, (1999) Sources of change in petroleum drilling productivity in onshore Louisiana in the US, 1977-1994. *Energy Economics* 21 pp. 261-271

Iledare, O. O.; Pulsipher, A.G.; and Olatubi, W. O. (1999) "Modeling Petroleum Productivity in the U.S. Gulf of Mexico Outer Continental Shelf (OCS) Region, "*Energy Studies Review*: Vol. 9: 2, Article 4.

IEA (International Energy Agency). 2014, *World Energy Outlook 2014*

Johnston, D. 1992, *Oil Company Financial Analysis in Non-Technical Lan*guage. Tulsa: Pennwell Corporation.

Jaramillo, P., Griffin, W. M., & Matthews, H. S. (2008). Comparative analysis of the production costs and life-cycle GHG emissions of FT liquid fuels from coal and natural gas. *Environmental science & technology*, *42*(20), 7559-7565.

Jorquera, O., Kiperstok, A., Sales, E. A., Embiruçu, M., & Ghirardi, M. L. (2010). Comparative energy life-cycle analyses of microalgal biomass production in open ponds and photobioreactors. *Bioresource technology, 101*(4), 1406-1413.

Karagiannis, R. (2013). A system-of-equations two-stage DEA approach for explaining capacity utilization and technical efficiency. *Annals of Operations Research*, 1-19.

Khazzoom, J.D. (1971). The FPC staff's econometric model of natural gas supply in the United States. *The Bell Journal of Economics and Management Science.* Vol. 2. Quoted from Kimmel (1977).

Kim, K., & Kim, Y. (2012). International comparison of industrial CO_2 emission trends and the energy efficiency paradox utilizing production-based decomposition. Energy Economics, 34(5), 1724-1741.

Kohler U and Kreuter, F (2009): Data Analysis Using Stata, 2nd ed., Stata Press, 2009.

Koyck, L.M (1954): Distributed lags and Investment Analysis. Amsterdam: North Holland publishing company

Kornelis Blok, (2006). Introduction to Energy Analysis

Kuminoff, Nicolai V., V. Kerry Smith, and Christopher Timmins. 2013. "The New Economics of Equilibrium Sorting and Policy Evaluation Using Housing Markets."

Journal of Economic Literature, 51(4): 1007-62.

Laser, M., Larson, E., Dale, B., Wang, M., Greene, N., & Lynd, L. R. (2009). Comparative analysis of efficiency, environmental impact, and process economics for mature biomass refining scenarios. *Biofuels, Bioproducts and Biorefining*, *3*(2), 247-270.

Lee, C. C., & Chang, C. P. (2008). Energy consumption and economic growth in Asian economies: a more comprehensive analysis using panel data. *Resource and Energy Economics*, *30*(1), 50-65.

Lestage, R.,Flasher,D., Kim,Y., Kim,J. and Kim,Y (2013): Competition and Investment in Telecommunications: Does Competition have the same Impact on Investment by Private and state-owned Firms?. *Information Economics and Policy* 25 (2013) pp. 41-50.

Liu, C. H. L., & Hsu, C. E. (2008). The Association between Government Expenditure and Economic Growth: Granger Causality Test of US Data, 1947~ 2002. *Journal of Public Budgeting, Accounting, and Financial Management*, *20*(4), 439-452.

Mangir, F., Ay, A., & Saraç, T. B. (2012). Determinants of foreign direct investment: A comparative analysis of Turkey and Poland. *Economic and Environmental Studies*, *12*(1), 65-86.

May, S., & DeGruttola, V. (2007). Nonparametric Tests for Two-Group Comparisons of Dependent Observations Obtained at Varying Time Points. *Biometrics*, *63*(1), 194-200.

McDonald, J. (2009). Using least squares and Tobit in second stage DEA efficiency analyses. *European Journal of Operational Research*, *197*(2), 792-798.

Mehrara, M., & Falahati, Z. (2013). The examination of FDI and ICT effects on economic growth. *International Journal of Applied*, *1*(1).

Ministry of Resources and Energy and Korea Energy Economics Institute, 1994 Yearbook of energy statistics (Seoul) 1994.

Moon, H.C.,Rugman, A.M., and Verbeke, A., 1998, A Generalized Double Diamond Approach to the Global Competitiveness of Korea and Singapore,*International Business Review*, 7: 135–150.

Moon, H.C., Parc, J., Yim, S.H., and Park, N., 2011, An Extension of Porter and Kramer's Creating Shared Value (CSV): Reorienting Strategies and Seeking International Cooperation *Journal of International and Area Studies*, 18(2):49-64

National Planning Commission-NPC, 2009, Nigeria Vision 20:2020: Economic Transformation Blue Print, NPC, Abuja.

National Planning Commission-NPC, 2009, The first National Implementation Plan for NV20:2020: The vision and Development Priorities. Nigeria Vision 20:2020: Economic Transformation Blue Print, NPC, Abuja. Volume I.

National Planning Commission-NPC, 2009, The first National Implementation Plan for NV20:2020: Sectoral plans and Programmes. Nigeria Vision 20:2020: Economic Transformation Blue Print, NPC, Abuja. Volume II.

Nigeria National Petroleum Corporation-NNPC, 2009, National Content Guideline, Presentation to Investors on the Gas Master Plan, NNPC, Abuja.

Obi, C., 2007. "The Struggle for Resource Control in a Petro-state: A Perspective from Nigeria", in P. Bowles, et al; National Perspectives on Globalisation, Hampshire and New York: Palgrave Macmillan.

Ogunlowo, O. O., Bristow, A. L., & Sohail, M. (2014). Developing compressed natural gas as an automotive fuel in Nigeria: Lessons from international markets. *Energy Policy*.

Oyedepo, S. O. (2014). Towards achieving energy for sustainable development in

Nigeria. *Renewable and Sustainable Energy Reviews*, *34*, 255-272.

Oyedepo, S. O. (2012). On energy for sustainable development in Nigeria. *Renewable and Sustainable Energy Reviews*, *16*(5), 2583-2598.

OPEC (Organization of Petroleum Exporting Countries), 2007. *World Oil Outlook.* Vienna.

Pestana Barros, C., & Dieke, P. U. (2008). Technical efficiency of African hotels. *International Journal of Hospitality Management*, *27*(3), 438-447.

Perfect decomposition techniques in energy and environmental analysis B.W. Ang, F.L. Liu, E.P. Chew Nov. 2003.

Podinovski, V. V., & Thanassoulis, E. (2007). Improving discrimination in data envelopment analysis: Some practical suggestions. *Journal of Productivity Analysis*, *28*(1-2), 117-126.

Podinovski, V. V., Førsund, F. R., & Krivonozhko, V. E. (2009). A simple derivation of scale elasticity in data envelopment analysis. *European Journal of Operational Research*, *197*(1), 149-153.

Porter, M., 1990, the Competitive Advantage of Nations, New York, NY: The Free Press.

Porter, M., 1998a, "Cluster and the New Economics of Competition," *Harvard Business Review,* 76(6): 77-90.

Porter, M., 1998b, *On Competition*, Boston: Harvard Business School Press.

Porter, M., 2000, "Location, Competition, and Economic Development: Local Clusters in a Global Economy," *Economic Development Quarterly,* 14(1): 15-34.

Porter, M., and Kramer, M., 1999, "Philanthropy's New Agenda: Creating Value," *Harvard Business Review,* 77(6): 121-130.

Porter, M., and Kramer, M., 2002, “The Competitive Advantage of Corporate Philanthropy,” *Harvard Business Review,* 80(12): 56-69.

Porter, M., and Kramer, M., 2006, “The Link between Competitive Advantage and Corporate Social Responsibility,” *Harvard Business Review,* 84(12): 78-92.

Porter, M., and Kramer, M., 2011, “Creating Shared Value,” *Harvard Business Review,* 89(1/2): 62-77.

Raskind, M. A., Peskind, E. R., Hoff, D. J., Hart, K. L., Holmes, H. A., Warren, D. & McFall, M. E. (2007). A parallel group placebo controlled study of prazosin for trauma nightmares and sleep disturbance in combat veterans with post-traumatic stress disorder. *Biological psychiatry*, *61*(8), 928-934.

Ren, T., Daniëls, B., Patel, M. K., & Blok, K. (2009). Petrochemicals from oil, natural gas, coal and biomass: Production costs in 2030–2050. Resources, Conservation and Recycling, 53(12), 653-663.

Rifkin, J. (2012). The Third Industrial Revolution: how the internet, green electricity, and 3-D printing are ushering in a sustainable era of distributed capitalism. *World Financial Review*, *1*.

Rosen, M. A., & Scott, D. S. (1998). Comparative efficiency assessments for a range of hydrogen production processes. *International Journal of Hydrogen Energy*, *23*(8), 653-659.

Rubin, E. S., Rao, A. B., & Chen, C. (2004). Comparative assessments of fossil fuel power plants with CO2 capture and storage.

Saltz, L. B., Lenz, H. J., Kindler, H. L., Hochster, H. S., Wadler, S., Hoff, P. M., & Chen, H. X. (2007). Randomized phase II trial of cetuximab, bevacizumab, and irinotecan compared with cetuximab and bevacizumab alone in irinotecan-refractory colorectal cancer: the BOND-2 study. *Journal of Clinical Oncology*, *25*(29), 4557-4561.

Simar, L., & Wilson, P. W. (2011). Two-stage DEA: caveat emptor. *Journal of Productivity Analysis*, *36*(2), 205-218.

Simar, L., & Wilson, P. W. (2011). Performance of the bootstrap for DEA estimators and iterating the principle. In *Handbook on data envelopment analysis* (pp. 241-271). Springer US.

Simar, L., & Zelenyuk, V. (2011). Stochastic FDH/DEA estimators for frontier analysis. *Journal of Productivity Analysis*, *36*(1), 1-20.

Simar, L., Wilson, P. W., & Kiviet, J. F. (2013). *Estimation and inference in nonparametric frontier models: Recent developments and perspectives*. Now.

Simar, L., Vanhems, A., & Wilson, P. W. (2012). Statistical inference for DEA estimators of directional distances. *European Journal of Operational Research*, *220*(3), 853-864.

Śmiech, S., & Zysk, W. (2014). The Influence of Foreign Direct Investment on Foreign Trade in the Visegrad Countries from 2001 to 2011. *Entrepreneurial Business and Economics Review*, (Vol. 2 No. 3), 7-18.

Srinivasan, P., Kalaivani, M., & Ibrahim, P. (2011). An empirical investigation of foreign direct investment and economic growth in SAARC nations. *Journal of Asia Business Studies*, *5*(2), 232-248.

Spalding-Fecher, R., Winkler, H., & Mwakasonda, S. (2005). Energy and the World Summit on Sustainable Development: what next? *Energy policy*, *33*(1), 99-112.

Stevens, P. J., 2003. "Economists and the Oil Industry: Facts versus Analysis, the Case of Vertical Integration." In *Energy in a Competitive Market: Essays in Honor of Colin Robinson*, ed. L. C. Hunt. Cheltenham: Edward Elgar.

Sterne, J. A., Sutton, A. J., Ioannidis, J., Terrin, N., Jones, D. R., Lau, J & Higgins, J. (2011). Recommendations for examining and interpreting funnel plot asymmetry in meta-analyses of randomised controlled trials. *Bmj*, *343*.

Stevens, P., 2008. "National Oil Companies and International Oil Companies in the Middle East: Under the Shadow of Government and the Resource Nationalism Cycle." *Journal of World Energy Law and Business,* 1(1): 5-30.

Subhes C. Bhattacharyya, Energy Economics, DOI: 10.1007/978-0-85729-268-1_15, Springer-Verlag London Limited 2011.

South African Oil & Gas Alliance 2000 – 2014.

Sustainable Energy Regulation and Policy Making Training Manual, The Energy Sector in Africa, updated version 2014.

The Third Industrial Revolution, Jeremy Rifkin 2010.

UNCTAD/CALAG (2006) "Creating Local Linkages by Empowering Indigenous Entrepreneurs. African Oil and Gas Services Sector Survey. Vol.1-Nigeria. United Nations Conference on Trade and Development.

Usman, M., Ashfaq, S., & Mushtaq, N. (2012). Relationship of export and economic growth; an empirical study of Pakistan. *Far East Journal of Psychology and Business*, *6*(3), 1-10.

Van der Linde, C. 2000. *The State and the International Oil Market: Competition and the Changing Ownership of Crude Oil Assets*. Boston: Kluwer Academic Publishers.

Weiss, M., Junginger, M., Patel, M. K., & Blok, K. (2010). A review of experience curve analyses for energy demand technologies. *Technological forecasting and social change*, *77*(3), 411-428.

Wlazlowski (2008) "Crude oil-end Product Linkages in the European Petroleum Markets" *OPEN Review,* 31(2): 73-90.

Wolf, C. (2009). Does ownership matter? The performance and efficiency of State Oil vs.

Private Oil (1987–2006). *Energy Policy*, *37*(7), 2642-2652.

Wooldridge, J. M. (2010). *Econometric analysis of cross section and panel data*. MIT press.

Xiangyang, D., & Guiqiu, Y. (2011). China's Greenhouse Gas emissions' dynamic effects in the process of its urbanization: A perspective from shocks decomposition under long-term constraints. *Energy Procedia 5*, 1660-1665.

Zhao, X., Ma, C., & Hong, D. (2010). Why did China's energy intensity increase during 1998–2006: decomposition and policy analysis? *Energy Policy*, *38*(3).

Appendix A-1 Panel Data Correlation on Variables

	country	year	prodc	export	europec	asiac	worldc	actual~d
country	1.0000							
year	0.0000	1.0000						
prodc	0.4443	0.0060	1.0000					
export	0.1776	0.1479	0.4871	1.0000				
europec	0.0000	-0.2957	-0.0301	-0.0496	1.0000			
asiac	0.0000	0.3548	-0.0219	0.0617	0.7502	1.0000		
worldc	0.0000	-0.0531	-0.0253	-0.0071	0.9556	0.9060	1.0000	
actualprd	0.0460	0.0813	0.0068	0.3067	-0.0020	0.0335	0.0074	1.0000
gdp	0.2627	0.3281	0.1881	0.5528	-0.1104	0.1177	-0.0229	0.2259
price	-0.0000	0.0367	-0.0256	0.0094	0.2883	0.0797	0.1804	0.1118
interestrate	-0.0669	0.0378	0.0295	-0.0547	-0.0180	0.0062	-0.0103	-0.0729
costtoexport	-0.0064	0.7140	-0.0657	0.1566	-0.1488	0.3085	0.0185	0.0157
costtoimport	-0.0435	0.7338	-0.0863	0.1189	-0.1617	0.3095	0.0108	-0.0072
costofbusi~s	-0.2331	0.0191	-0.1794	-0.1478	0.0632	0.0177	0.0396	-0.1303
netcapital	-0.1071	-0.1045	-0.2350	-0.4077	0.0316	-0.0557	-0.0064	0.0128
forinv	0.2285	0.1518	0.1665	0.4731	0.1506	0.2291	0.1873	0.2691

	gdp	price	intere~e	co~xport	co~mport	costof~s	netcap~l	forinv
gdp	1.0000							
price	-0.0285	1.0000						
interestrate	-0.0703	-0.0222	1.0000					
costtoexport	0.5019	0.0856	-0.0181	1.0000				
costtoimport	0.4296	0.0784	-0.0112	0.9760	1.0000			
costofbusi~s	-0.1085	0.2146	0.0283	0.1200	0.1323	1.0000		
netcapital	-0.3623	0.0758	-0.0034	-0.1555	-0.1178	0.0449	1.0000	
forinv	0.7967	0.1100	-0.0522	0.3101	0.2331	-0.0750	-0.3543	1.0000

Appendix A 1.1 Algeria's Panel Correlation

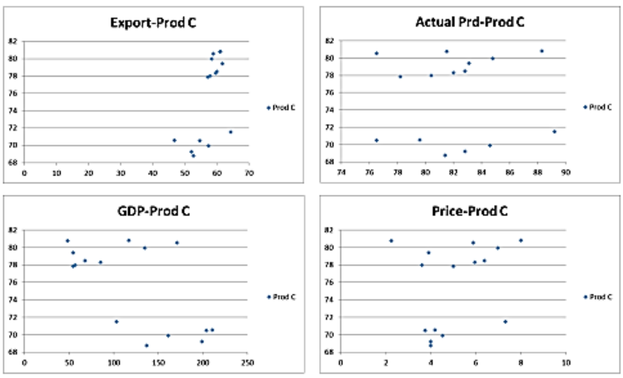
	country	year	prodc	export	europec	asiac	worldc	actual~d
country	.							
year	.	1.0000						
prodc	.	-0.7175	1.0000					
export	.	-0.7096	0.6134	1.0000				
europec	.	-0.2957	0.2327	0.6532	1.0000			
asiac	.	0.3548	-0.2907	0.0878	0.7502	1.0000		
worldc	.	-0.0531	0.0332	0.4530	0.9556	0.9060	1.0000	
actualprd	.	-0.1409	0.0167	0.4862	0.2572	0.0394	0.1453	1.0000
gdp	.	0.9749	-0.6392	-0.6820	-0.3003	0.3600	-0.0479	-0.2065
price	.	0.0367	0.2761	0.4225	0.2883	0.0797	0.1804	0.5583
interestrate	.	0.0595	-0.1951	-0.4492	-0.2093	-0.1477	-0.2027	-0.3456
costtoexport	.	0.7836	-0.5141	-0.2672	-0.0320	0.4066	0.1198	0.2916
costtoimport	.	0.7657	-0.5015	-0.2416	-0.0204	0.4021	0.1249	0.3151
costofbusi~s	.	0.6455	-0.3585	-0.1911	0.0363	0.3335	0.1327	0.2758
netcapital	.	-0.2266	0.0827	-0.0440	-0.1124	-0.2947	-0.2309	0.0429
forinv	.	0.5075	-0.3472	-0.1698	0.5283	0.8172	0.6580	0.0053

	gdp	price	intere~e	co~xport	co~mport	costof~s	netcap~l	forinv
gdp	1.0000							
price	-0.0126	1.0000						
interestrate	-0.0583	-0.2197	1.0000					
costtoexport	0.7794	0.3493	-0.0756	1.0000				
costtoimport	0.7606	0.3884	-0.0835	0.9994	1.0000			
costofbusi~s	0.5877	0.5702	-0.1159	0.6019	0.5992	1.0000		
netcapital	-0.2614	-0.1751	0.0014	-0.3406	-0.3588	-0.1743	1.0000	
forinv	0.4882	0.1554	0.1103	0.5876	0.5796	0.3797	-0.0446	1.0000

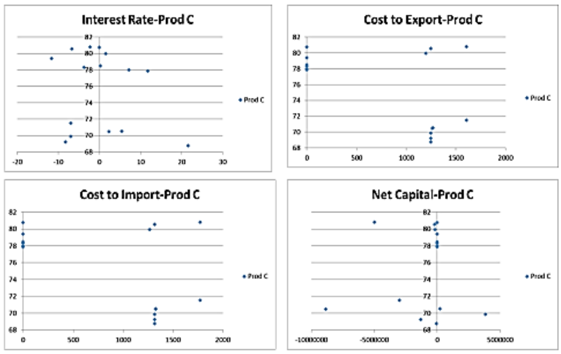
1.2 Algeria’s Variance Inflation Factor

Variable	VIF	1/VIF
costtoexport	78252.90	0.000013
costtoimport	66669.95	0.000015
worldc	15302.92	0.000065
europec	9930.24	0.000101
asiac	2594.94	0.000385
gdp	1248.26	0.000801
export	819.30	0.001221
forinv	246.38	0.004059
interestrate	160.63	0.006225
actualprd	87.55	0.011422
netcapital	71.57	0.013972
costofbusi~s	26.90	0.037179
price	22.07	0.045305
Mean VIF	13494.89	

Appendix 1.3 Algeria (Trends)



Appendix 1.4 Algeria (Trends)



Appendix 1.5 Nigeria's Panel Correlation

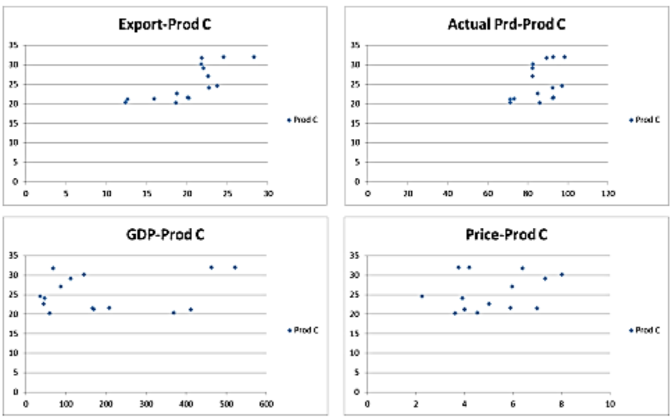
	country	year	prodc	export	europec	asiac	worldc	actual~d
country	.							
year	.	1.0000						
prodc	.	0.1459	1.0000					
export	.	-0.1528	0.7518	1.0000				
europec	.	-0.2957	-0.3925	-0.3255	1.0000			
asiac	.	0.3568	-0.3313	-0.4034	0.7502	1.0000		
worldc	.	-0.0531	-0.3778	-0.3439	0.9554	0.9060	1.0000	
actualprd	.	-0.2427	0.4160	0.8074	-0.4685	-0.5749	-0.5125	1.0000
gdp	.	0.9248	0.2048	-0.0506	-0.4601	0.2166	-0.2011	-0.0897
price	.	0.0367	0.2935	0.0494	0.2883	0.0797	0.1804	-0.1000
interestrate	.	0.1164	0.2237	0.3326	-0.1534	-0.0940	-0.1266	0.2303
costtoexport	.	0.9292	0.0415	-0.1879	-0.1624	0.4350	0.0577	-0.2405
costtoimport	.	0.9026	0.0398	-0.1599	-0.1889	0.3741	0.0128	-0.2487
costofbusi~s	.	0.6431	0.2505	-0.1289	0.1181	0.3980	0.2127	-0.3328
netcapital	.	-0.0365	0.3845	0.1367	0.1810	0.0155	0.0964	-0.1557
forinv	.	0.6028	-0.3150	-0.4348	0.4948	0.8690	0.6701	-0.5218

	gdp	price	intere~e	co~xport	co~mport	costof~s	netcap~l	forinv
gdp	1.0000							
price	-0.1983	1.0000						
interestrate	-0.0362	0.0241	1.0000					
costtoexport	0.8188	0.1086	0.0318	1.0000				
costtoimport	0.7942	0.1396	0.0135	0.9760	1.0000			
costofbusi~s	0.4251	0.4662	0.2436	0.5527	0.5641	1.0000		
netcapital	-0.1497	0.6556	-0.0759	0.1477	0.2157	0.0893	1.0000	
forinv	0.3880	0.1561	0.0950	0.7248	0.6849	0.5538	0.0849	1.0000

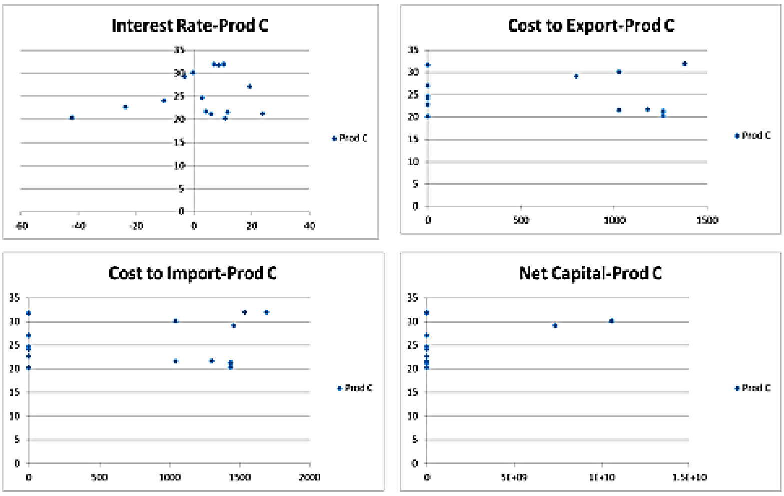
Appendix 1.6 Nigeria's Variance Inflation Factor

Variable	VIF	1/VIF
worldc	25275.79	0.000040
asiac	7345.17	0.000136
europec	7055.27	0.000142
costtoexport	868.53	0.001151
forinv	332.88	0.003004
gdp	133.66	0.007482
export	55.34	0.018069
costtoimport	54.43	0.018371
costofbusi~s	35.80	0.027931
actualprd	20.82	0.048032
netcapital	11.52	0.086834
price	6.48	0.154246
interestrate	5.82	0.171740
Mean VIF	3169.35	

Appendix 1.7 Nigeria (Trends)



Appendix 1.8 Nigeria (Trends)



Appendix 1.9: Correlation Matrix of Coefficients III

	iran	libya	nigeria	qatar	russia	trinidad	uae
iran	1.0000						
libya	-0.0833	1.0000					
nigeria	-0.0833	-0.0833	1.0000				
qatar	-0.0833	-0.0833	-0.0833	1.0000			
russia	-0.0833	-0.0833	-0.0833	-0.0833	1.0000		
trinidad	-0.0833	-0.0833	-0.0833	-0.0833	-0.0833	1.0000	
uae	-0.0833	-0.0833	-0.0833	-0.0833	-0.0833	-0.0833	1.0000
venezuela	-0.0833	-0.0833	-0.0833	-0.0833	-0.0833	-0.0833	-0.0833
prodc	0.0539	-0.1337	-0.1079	-0.0160	0.9694	-0.0952	-0.0641
export	-0.1305	-0.1287	-0.0735	0.1114	0.9205	-0.0867	-0.0760
actualprd	0.0739	-0.1355	-0.1086	-0.0162	0.9638	-0.0967	-0.0664
gdp	0.0681	-0.1202	0.0053	-0.0942	0.7493	-0.1502	0.0289
price	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

	venezu~a	prodc	export	actual~d	gdp	price
venezuela	1.0000					
prodc	-0.1071	1.0000				
export	-0.1544	0.9540	1.0000			
actualprd	-0.1122	0.9990	0.9494	1.0000		
gdp	0.0319	0.7943	0.7426	0.7985	1.0000	
price	0.0000	-0.0053	-0.0037	-0.0102	-0.0503	1.0000

Appendix 1.10 Covariance Matrix of Coefficients

e(V)	export	actualprd	gdp	price	algeria	bolivia	egypt	equatorial	iran	libya	nigeria	qatar
export	1.2312743											
actualprd	-.52759179	.4419235										
gdp	-.00267991	-.01060119	.00284794									
price	-.14246232	.10796666	.00813598	6.4946752								
algeria	-29.419111	-2.8898606	.78517672	.6104247	4124.9261							
bolivia	-8.4472224	2.3492909	.19095274	1.2442654	1443.4908	2266.0124						
egypt	10.505406	-11.37459	.15791455	-3.4854241	1397.5797	1101.7104	2606.8594					
equatorial	-3.9576921	1.5652432	.10494574	1.0859394	1205.9445	1171.4543	1088.2385	2253.2686				
iran	55.606045	-46.080802	.69478422	-13.313386	1436.1632	869.57284	2368.4484	910.72283	7177.3014			
libya	-3.9525213	.59130918	.07770159	.3781283	1296.603	1172.5325	1139.7746	1151.4321	1078.5987	2255.6007		
nigeria	-5.3707545	1.5513546	-.15053015	-.53558374	1544.5356	1205.8816	1168.5074	1151.6638	1035.0018	1174.9405	2412.1841	
qatar	-27.546801	-1.5527514	.78526125	1.0714658	2841.8595	1427.1488	1353.795	1211.4088	1327.2194	1285.5083	1505.005	3845.8934
russia	52.657051	-135.88455	3.9482721	-38.352696	8254.7049	1406.3407	5400.8621	724.59089	15681.093	1451.6494	2275.1098	7421.851
trinidad	-2.3454853	-4.4754538	.41313238	-.20134428	1624.8881	1202.3594	1290.6395	1147.456	1575.6353	1175.5751	1212.1281	1583.7674
uae	3.4602875	-5.2615898	.00743406	-3.2370827	1972.5279	1144.0811	1418.0796	1103.0578	2065.9641	1158.7789	1238.8309	1514.0056
venezuela	3.5375818	-5.6550565	-.23505847	-3.1771481	1047.3503	1067.0352	1304.7569	1085.2502	1511.2274	1117.1381	1138.8755	1083.1207
_cons	4.5554585	-3.0757935	-.144353	-45.144723	-1159.3527	-1174.2613	-1048.6549	-1168.2471	-778.48376	-1150.0718	-1135.8605	-1169.409

e(V)	russia	trinidad	uae	venezuela	_cons
russia	66504.875				
trinidad	3564.8063	2446.0159			
uae	5218.5518	1255.0903	2582.5016		
venezuela	2737.0254	1144.3117	1276.0471	2428.9784	
_cons	-174.49149	-1130.1172	-1081.2143	-1064.2256	1474.5579

Appendix 1.11 Elasticity of GEC & Variables Coefficients

y = Linear prediction (predict)
= 2844.4821

variable	ey/ex	Std. Err.	z	P>|z|	[95% C.I.	]	X
export	.0978102	.01179	8.30	0.000	.074704	.120917	30.3319
actual~d	.7328933	.01946	37.66	0.000	.694753	.771034	82.6328
gdp	.0026467	.00352	0.75	0.453	-.00426	.009554	187.833
price	.0087763	.00606	1.45	0.148	-.00311	.020662	6.76867
algeria	.0014094	.00181	0.78	0.436	-.002133	.004952	.076923
angola	-.0113893	.00133	-8.55	0.000	-.014001	-.008777	.076923
bolivia	-.0062722	.00139	-4.51	0.000	-.009	-.003544	.076923
egypt	.0016832	.00133	1.26	0.206	-.000927	.004293	.076923
equato~l	-.0065974	.00137	-4.83	0.000	-.009273	-.003922	.076923
iran	.0124615	.00209	5.96	0.000	.008361	.016562	.076923
libya	-.005984	.00135	-4.44	0.000	-.008628	-.00334	.076923
nigeria	-.0055977	.00137	-4.09	0.000	-.008283	-.002913	.076923
qatar	-.0017025	.00175	-0.97	0.332	-.00514	.001735	.076923
russia	.0986791	.00682	14.47	0.000	.085312	.112046	.076923
trinidad	-.0026907	.00137	-1.96	0.050	-.005385	3.8e-06	.076923
uae	.0012186	.00134	0.91	0.361	-.001398	.003835	.076923

Appendix 1.12A Major GEC Producers

Source	SS	df	MS
Model	2374813.36	9	263868.151
Residual	84724.0525	96	882.542214
Total	2459537.41	105	23424.1659

Number of obs =	105
F(9, 96) =	298.99
Prob > F =	0.0000
R-squared =	0.9656
Adj R-squared =	0.9623
Root MSE =	29.708

prodc	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
export	1.497226	.0774129	19.34	0.000	1.343562	1.650889
costtoexport	-.0084335	.004941	-1.71	0.091	-.0182414	.0013744
_Icountry_1	-3.805833	9.051509	-0.42	0.675	-21.77294	14.16127
_Icountry_4	23.36258	7.945524	2.94	0.004	7.590839	39.13432
_Icountry_6	67.49723	8.729486	7.73	0.000	50.16934	84.82512
_Icountry_7	.4205777	7.70285	0.05	0.957	-14.86946	15.71061
_Icountry_8	.659838	8.344905	0.08	0.937	-15.90467	17.22434
_Icountry_9	16.90631	14.19985	1.19	0.237	-11.28016	45.09279
_Icountry_10	-61.4379	15.6312	-3.93	0.000	-92.46558	-30.41022

Appendix 1.12B Minor GEC Producers

Source	SS	df	MS
Model	2384505.18	6	397417.53
Residual	1054626.32	54	19530.117
Total	3439131.5	60	57318.8584

Number of obs =	60
F(6, 54) =	20.35
Prob > F =	0.0000
R-squared =	0.6933
Adj R-squared =	0.6593
Root MSE =	139.75

prodc	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
export	-13.19571	6.069576	-2.17	0.034	-25.36448	-1.026941
costtoexport	-.0072503	.043524	-0.17	0.868	-.0945106	.08001
_Icountry_3	165.8353	55.28335	3.00	0.004	54.99881	276.6717
_Icountry_5	20.59502	49.20791	0.42	0.677	-78.06091	119.2509
_Icountry_11	522.6466	77.92325	6.71	0.000	366.4199	678.8733
_Icountry_12	371.3833	92.0125	4.04	0.000	186.9094	555.8573

Appendix 1.13 All Countries

Source	SS	df	MS
Model	4691516.87	16	293219.804
Residual	1321566.93	179	7383.05545
Total	6013083.79	195	30836.3272

Number of obs =	195
F(16, 179) =	39.72
Prob > F =	0.0000
R-squared =	0.7802
Adj R-squared =	0.7606
Root MSE =	85.925

prodc	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
export	1.460655	.2178869	6.70	0.000	1.030698	1.890612
gdp	.0306035	.0392055	0.78	0.436	-.0467609	.1079678
costtoexport	-.0245382	.0112211	-2.19	0.030	-.046681	-.0023955
_Icountry_1	7.422745	25.66706	0.29	0.773	-43.2262	58.07169
_Icountry_2	23.85234	24.4961	0.97	0.332	-24.48594	72.19062
_Icountry_3	46.91208	24.02566	1.95	0.052	-.4978864	94.32205
_Icountry_4	26.33177	22.68957	1.16	0.247	-18.44168	71.10522
_Icountry_5	22.16344	24.03386	0.92	0.358	-25.26271	69.5896
_Icountry_6	71.93661	25.26718	2.85	0.005	22.07675	121.7965
_Icountry_7	1.453054	22.2494	0.07	0.948	-42.4518	45.35791
_Icountry_8	6.828087	23.32711	0.29	0.770	-39.20343	52.8596
_Icountry_9	26.3085	40.86817	0.64	0.521	-54.33689	106.9539
_Icountry_10	-66.00619	52.58745	-1.26	0.211	-169.7773	37.7649
_Icountry_11	335.3391	22.82802	14.69	0.000	290.2924	380.3857
_Icountry_12	144.8171	23.31573	6.21	0.000	98.808	190.8261
_Icountry_13	112.007	25.23598	4.44	0.000	62.20867	161.8052

Appendix B DEA

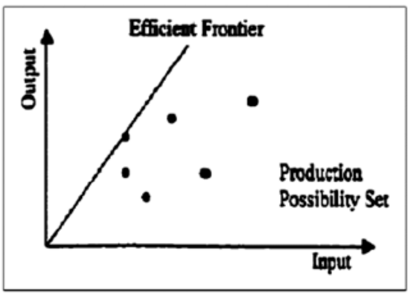
Table 1

Data for DEA Static Mean for Different Categories

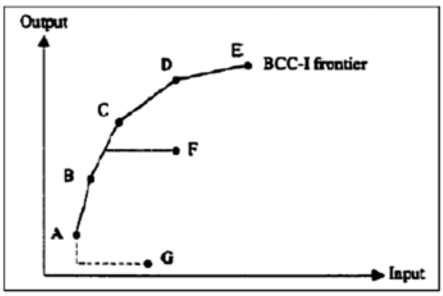
		2004	2005	2006	2007	2008	2009	2010	2011
General - All Companies									
	Min	0.07684588	0.07551569	0.077795484	0.097516339	0.110899267	0.131855778	0.119526744	0.098553951
	Max	1	1	1	1	1	1	1	1
	Mean	0.522011885	0.520607733	0.516961715	0.53942334	0.53234048	0.561449154	0.548007668	0.557145647
	Std Dev	0.329266153	0.332496412	0.341438538	0.324618807	0.324567415	0.328752717	0.330587898	0.335248869
Cat1-GEC NOGC's									
	Min	0.07684588	0.07551569	0.077795484	0.110083837	0.138366124	0.131855778	0.119526744	0.098553951
	Max	1	1	1	1	1	1	1	1
	Mean	0.311799896	0.327730858	0.289220485	0.329049583	0.335562327	0.383054538	0.352090521	0.370545448
	Std Dev	0.30445038	0.312738929	0.340274213	0.324900235	0.324632261	0.366101172	0.375046831	0.365181076
Cat2-NGENOGC's									
	Min	0.13080946	0.102496696	0.097145226	0.097516339	0.110899267	0.143743717	0.13027204	0.12342936
	Max	1	1	1	1	1	1	1	1
	Mean	0.542901384	0.51785515	0.547643093	0.545723403	0.519685079	0.52848095	0.535819022	0.545209006
	Std Dev	0.34186285	0.35976293	0.347390044	0.336579872	0.322937425	0.340834634	0.338919081	0.36172929
Cat3-IOGC's									
	Min	0.099374709	0.115619644	0.132188429	0.248343642	0.23097426	0.26503687	0.30274593	0.346340479
	Max	1	1	1	1	1	1	1	1
	Mean	0.697982887	0.68508404	0.698784325	0.721653956	0.71805626	0.748271368	0.758352341	0.713066886
	Std Dev	0.324432507	0.316782786	0.312081982	0.291285637	0.31472467	0.297293752	0.283015559	0.298062861
Cat4-Vast IOGC's									
	Min	0.631588659	0.610226555	0.581468414	0.63977142	0.655199587	0.656282252	0.600806246	0.635148533
	Max	0.838441968	1	1	1	1	1	1	1
	Mean	0.732014997	0.754462938	0.76429632	0.774792353	0.772508395	0.786827374	0.738831907	0.795825063
	Std Dev	0.08297514	0.133005855	0.150806096	0.13410361	0.134491478	0.129756819	0.151400266	0.157814145

- **Basic DEA models are CCR and BCC**
- **The difference between CCR and BCC is RETURN TO SCALE assumption of production**

CCR: Constant return to scale



BCC: Various return to scale



Dedication:

I dedicate this research work to all my Teachers/Professors, Past, Present and Future, as well as my entire Family for their sustenance, encouragement and positive understanding.

초 록

본 연구는 나이지리아 국영 가스 회사의 생산성을 다이아몬드 (Diamond), 자료포락분석 (DEA), 회귀분석 (Regression) 방법을 이용하여 여타 가스 수출국과 비교하였다. 분석대상 국가로 선정한 알제리, 앙골라, 나이지리아, 아랍에미리트, 카타르의 생산능력에 영향을 주는 요인들을 국가간 비교분석하고, 생산량, 소비량, 순 수출/수입, 가스 설비 종류, 국내 총 생산측면에서의 효율성 증대를 다이아몬드 모형의 공유가치창출 4 가지 요인의 강점, 약점, 기회, 위협으로 분류하여 분석하고자 하였다.

본 연구는 크게 3 가지 분석 방법을 사용하였다. **(i) 다이아몬드 모형은** Porter 의 다이아몬드 모형 (2001), Porter and Kramer (2006; 2011), 에 따라 설정하였으며, 요인 별 분석 (종속 변수[생산 능력]와 독립 변수[소비량, 순 수출/수입, 가스 처리 설비 종류, 국내 총 생산])을 통해 국가 간 순위를 메겼다 (표 6, 그림 22 참고)

(ii) 지표포락분석 (DEA) 은 Victor (2007)의 방법을 활용하였으며, Malmquist index analysis 를 이용하여 가스 수출국 간 효율성을 포착하고자 하였다. DEA 는 거시적 데이터 및 다양한 성과 지표를 활용하여 NOC 와 IOC 의 생산능력을 경험적으로 측정하는데 사용되었다. 특히 Victor (2007) 은 25 개 석유 및 가스회사를 대상으로 분석을 진행하였고, IOC 가 매장량 대비 생산량이 더 큰 것으로 나타났다. 또한 Eller et al. (2009) 은 78 개 회사의 3 년간 (2002−2004) 패널 데이터를 지표포락분석 (DEA)과 확률적 프론티어 분석(SFA)을 활용하여 NOC 와 IOC 의 수익 효율성을 경험적으로 보이고자 하였다. Eller et al. (2009) 에 따르면, NOC 는 IOC 에 비해 덜 효율적이며, 이는 개별 가스 회사의 설립목적 차이와 같은 기관적·구조적 특징의 차이에 기인한다고 보았다. DEA 분석 결과, IOGC 는 0.95−1.1 평균 DEA 수익 효율성으로 프론티어 부근에서 분포하고, NOGC 는 0.28 평균 DEA 수익 효율성으로 널리 흩어져 분포하는 것으로 나타났다.

특히 나이지리아 국영 가스 회사의 평균 DEA 수익 효율성은 0.25 로 나타났으며, Malmquist Index 분석상에서 4 분면에 위치하는 것으로 나타났다 (그림 29).

(iii) 패널 회귀 모형을 사용하여 석유 및 가스 산업의 상호의존관계를 생산량과 가치사슬에 영향을 주는 요인 (소비량, 순 수출/수입, 가스 설비 종류, 경제성장)관계를 통해 검토하고자 하였다. Hoff (2007) 에 따르면, 패널 회귀분석은 효율적/비효율적 회사의 생산 관련 의사결정에 따른 경제적 결과 평가 대안의 전형적인 예가 된다고 보았다. Hoff (2007) 는 덴마크 어업에 대한 사례 연구에서 Tobit 과 OLS 방법이 DEA 2 단계 분석 방법으로 충분하다고 보았다. 또한 Banker and Natarajan (2008) 역시, DEA 결과가 변수의 영향에 회귀하는 경우 OLS 일관된 추정치를 산출한다고 보았다. 그러나, Simar and Wilson (2011). Barris and Dieke (2008) 는 공항의 경제적 효율성을 측정하였고, Simar and Wilson (2007)이 제안한 truncated second-stage 회귀분석이 효율성을 더 잘 설명한다고 결론지었다. 위의 주장에도 불구하고, 패널 데이터의 사용은 Simar and Wilson (2011) 가 언급한 것과 같이, 부정적 견해를 약화시키고, 필수적이고, 적절한 통계적 검정[45]을 통해 일관된 추정치를 제공할 것으로 예상된다.

Dougherty (2007)이 제시한 단계별 절차를 참고하여 적절한 패널 회귀 모델을 선정하였다. 본 연구 분석에서는 적절한 패널 회구 모델을 선정하기 위해 Hausman 검정을 사용하였다. 본 연구에서 제시한 부분은 다이아몬드 모델 I 에 사용된 전체 가스 수출 공사의 다이아몬드 샘플링 및 순위 부여 절차에 속한 것으로, DEA 모델 II 를 통한 효율성 측정의 근본이 되었다. DEA 분석에 투입된 23 개의 업체는 유사한 생산 성향을 보이나 운영 절차, 생산량 및 능력에 있어서 서로 차이를 보이는 가스 수출 공사 중에서 선발하였으며, 이를 통해 세계 가스 업계의 최상위 업체로부터 최 하위 업체에 이르기까지 참여 업체에 이르기까지 고르게 대변할 수 있도록 하였다모. 그러므로 고정 및 무작위적 효과 회귀 델이 사용되었다. Durbin Wu-Hausman 검정을 통해 두 모델 간의 차이점 분석을 실시하고자 하였으며, 그 결과에 따라 무작위 효과 모델 3 을 본 연구 분석을 위해 잠정적으로 설정하였다 (그림 32 &33).

본 연구에 사용 된 데이터는 분석에서 사용된 세 가지 모델에 모두 적합하도록 수정되었다. 또한 데이터는 주로 전자 매체와 같은 보조 소스를 통해 수집 되었으며, 진정성 확보를 위해 국제 석유 및 가스 회사 연례 보고서를 포함한 다양한 기사, 저널 및 간행물을 포함한다.

수집된 데이터는 계수 분석, 확률, 카이 제곱 값, 통계적 유의성, 평균 값, 비율 및 퍼센트 등 통계적 분석법을 통하여 분석되었다. 분석 기간은 15 년 [1999 –2014] 으로, 나이지리아의 경우 나이지리아 국영 석유 공사 자료를 사용하였으며, IEA, EIA, 세계 은행의 자료 중 타 국가의 자료 역시 마찬가지로 사용하였다. 또한 모든 데이터는 분석에서 사용된 3 가지 모형에 모두 적합하도록 수정이 가해졌다(그림 10)

분석 결과, 국가 별로 상이하게 나타났다. 즉, 나이지리아 국영 가스 회사 및 여타 가스 생산국의 경제성장과 가스 부문의 성장에 영향을 주는 생산 효율성 요인 간 관계는 다르게 나타났다 (그림 35, 36,37, 39). 본 연구의 결과는 에너지 효율성, 지속 가능한 경제성장, 가스 산업의 발전의 측면에서 적절한 정책의 설정과 안전한 비즈니스 환경 및 규제 체제 마련을 위한 정부의 노력에 유용한 시사점을 제공할 것으로 예상된다.

산업의 가치 사슬은 세무, 라이선스, 석유 및 가스 계약, 고갈 정책, 산업 참여 등의 정책 결정에 큰 영향을 받는다. 또한 회사의 수직 및 수평적 합병은 국가 단위의 산업 정책과 관련 법률 및 규제 체제의 영향을 받는다. 공유 가치를 창출함으로써 평화롭고 조화로운 비즈니스 환경이 달성 될 수 있으며, 생산성이 증가하게 된다. 공유 가치 창출을 위한 첫 번째 단계는 회사의 핵심 역량을 정의하는 것으로, 이렇게 함으로써 사회와 가치 공유를 함께 할 수 있다.

나이지리아 국영가스회사의 매력도는 GEC 의 다른 멤버 국가와 비교했을 때, 평균 이하로 떨어지며, 이는 주로 뒤쳐지는 사업 환경, 안전 문제, 관련 산업의 부재를 그 원인으로 들 수 있다. 외국인 직접 투자가 이루어지지 못하고 있는 또 다른 원인으로는 정부 측에서 새로운 석유 산업법 (Petroleum Industry Bill, PIB)을 들 수 있다. 이는 가스 산업의 재무적 체계를 규정하는 법안이나, 이로 인해 나이지리아 국영 가스 회사의 비효율적인 업무 수행의 원인이 되고 있는 것으로 본 연구 모델

분석 결과 나타나고 있다. 비록 나이지리아가 관련 국가들 중 가장 큰 시장 규모를 가지고 있으나, 이와 같은 이점이 가치 창출로 전환되고 있지 않으며, 이는 주로 가스 산업 중류 및 하류 부문의 IOGC 참여 부재 때문으로 볼 수 있다.

인프라 개발 및 건전한 지배 구조의 확립은 개발 도상국 경제성장의 주요 요인으로 작용한다. 또한 가스 수출 및 소비국의 양자−다자간 협력 및 공동 작업 역시 핵심 요소로 작용할 것이다.

키워드: 경제성장, 생산량, 공유가치창출, 양자 및 다자간 협력 시스템, 가스 수출국.

Student Number: 2012 – 30753