GAS SECTOR DEVELOPMENT IN NIGERIA: THE NEXUS BETWEEN GAS SUPPLY, PRICE, UTILIZATION, TAXATION AND ECONOMIC GROWTH

ABSTRACT

This study examines the relationship between natural gas supply, commercial gas pricing, gas utilisation, gas taxation and economic growth in Nigeria. The analysis employs a range of econometric techniques, including descriptive statistics, correlation analysis, unit root tests, cointegration tests, and ARDL-ECM, to explore the impact of these factors on Nigeria's economic growth. The empirical results reveal that natural gas supply has a positive and significant impact on Nigeria's economic growth, highlighting the potential of this resource to drive development in resource-rich economies. Commercial gas pricing is found to have a significant effect on Nigeria's economy, emphasising the importance of a well-functioning and transparent pricing mechanism for ensuring that the benefits of natural gas are adequately distributed across various sectors. The study identifies a significant relationship between gas utilisation and economic growth, suggesting that efficient and sustainable gas consumption practices are crucial for maximising the economic benefits of this valuable resource. Surprisingly, the analysis shows that gas taxation does not have a significant impact on Nigeria's economic growth. To maximise the potential of natural gas supply, it is recommended that the government invests in infrastructure and encourages private sector participation in the gas sector. In terms of commercial gas pricing, policymakers should establish a transparent and market-oriented pricing system that ensures the benefits of natural gas are adequately distributed across various sectors. For gas utilisation, it is advised that policy makers promote greater gas utilisation in various industries, particularly in the power generation, fertiliser, and petrochemical sectors, to create a more diversified and resilient economy.

Key Words: Gas Sector, Supply, Price, Utilization, Utilization, Taxation, and Economic Growth.

1. INTRODUCTION

"The economic theory predicts that a large increase in the relative price of energy will increase the per-unit cost of output which aligns with the assertion of the textbook model, thereby increasing the output (supply) price" [1]. "Thus, increases in Nigerian natural gas prices would be expected to have virtually the same effect in the textbook model as a rise in crude oil prices. Accordingly, one should expect that the effects of an increase or decrease in natural gas prices on economic activity would be conceptually similar as that for crude oil prices. Consequently, the more natural gas is used as clean energy, the greater the likelihood that any country's economy will grow" [2].

Nigeria has a significant potential for increasing its reliance on energy, raising GDP per capita and GDP growth through developing and using alternative energy resources, with a particular emphasis on the natural gas market. This is in line with the assertion claim that approximately 10% of the GDP is attributable to the oil and gas sector's operations [3,4]. Lack of effective rules, laws, policies and political involvement in the past may have made it difficult to develop facilities and make use of the natural gas resources, infrastructures, and markets that Nigeria has plenty of.

"Natural gas is the cleanest-burning fossil fuel known to mankind and it is also becoming the energy source of choice worldwide. Nigeria is endowed with abundant natural gas reserves with current daily gas production of about 8.25 billion cubic feet per day (bcf/day) and less than half of the proven reserves have been committed to define projects" [5]. "Nigeria has consistently been the second worst gas flaring country after Russia. The country must take up the challenge and monetise the gas for the benefit of the country" [6, 7]. "These have contributed to increased interest in the LNG business as a means of utilising valuable natural gas resources and contributing towards sustainable development. The gas sector holds significant potential for Nigeria with a robust reserve base and rapidly evolving demand base too. There is therefore the need to connect these reserves to market which is the key to realising the economic potential of the gas reserves". [5]

There is much research that explores the relationship between energy prices and economic activity, and a reading of this literature suggests that gas prices matter. This should probably not be surprising given that petroleum still accounts for 60 percent of Nigeria's energy usage. The prevailing view is that increases in gas prices reduce real GDP growth for several quarters. The size of the effect varies, but earlier studies seem to suggest larger effects than later studies. This could reflect the fact that the Nigerian economy has become more energy efficient over time. [8-9], has documented a negative and significant relationship between gas price changes and future GDP growth. Conversely, recent research by [10-11] suggests that the causality runs in the other direction. For instance, stronger (weaker) macroeconomic growth increases (decreases) the demand for gas and thus the price of gas. Similarly, [12-13] found that "gas price volatility - a measure of uncertainty-reduced real GDP growth and other measures of macroeconomic activity over the period 1984-2004". Second, it induces costly resource reallocations [14]. Overall, whereas an oil price increase hurts future GDP growth, the effect of an oil price decrease is ambiguous.

Locally, NNPC's subsidiary, Nigerian National Petroleum Company Gas Marketing Limited used to provide gas for power generation as a fuel or feedstock for various industries including cement and fertilizer plants, glass, food and beverage production, manufacturing, and so on. The demand for gas is rising as more local industries realise the benefits of switching to gas. The domestic market is still limited by low levels of industrialisation and inadequacy of the gas transmission and distribution infrastructure. Meanwhile, [8] asserts that Nigeria has an estimated 187 trillion cubic feet of proven natural gas. Hence, there are huge investment opportunities in the gas sector for prospective investors. The objective of this study is to establish the relationship between the gas sector development (proxied by; natural gas supply, commercial gas pricing, gas utilisation and gas taxation) and economic growth (proxied by real GDP). This paper is dived into four major sections. Section 1 introduces the background of the study, section 2 presents the various literature relevant to this study, section 3 enumerates the methodology used in carrying out the study, section 4 presents the results and corresponding discussion that emanates from the study, while section 5 concludes the study with the corresponding recommendations.

1.1 STATEMENT OF THE PROBLEM

"Nigeria is abundantly endowed with energy resources. These include crude oil, hydropower, coal, tar sand, natural gas, solar energy, nuclear and fuel wood" [9]. "However, in recent times, most economies of the world are diversifying away from oil to gas as an energy source" [10]. This is due to several factors of which mainly is the environmental pressures for the use of gas which is a relative "clean" fuel in comparison to oil or coal. Available data from EIA sources [8] reveal that "the recoverable gas reserves in Nigeria is 235 trillion cubic feet, but the proven gas reserve in Nigeria is 182 trillion cubic feet out of which 209 billion cubic feet is produced annually". "About 44% of this figure produced is presently being flamed. Translating this to electricity generation, it can produce 69GW of electricity that is estimated at an economic value of $5billion dollars. However, the Nigerian gas sector has received little attention in terms of development" [11]. Certain things in the industry continue to remain unclear to the public and industry participants. As at the time of this research, the gas industry lacks the necessary infrastructure required to transport the gas to more end users, gas pricing is done on contract basis which points out the need for a general pricing framework [12]. The gas industry does not have a spot market for the purchase and sales of gas, no fiscal regime, there is no legal framework, current policies are poorly implemented and gas flaring. All these problems stem from non-foundational

structure with the absence of single legislation on gas that can address all the issues as well as ensure that all the past policies and plans on gas are fully actualised and enforceable by law. Even though the Petroleum Industry Bill which was passed in 2021 is seen as a saviour of the oil and gas industry because of its fiscal regime and effective regulatory agencies, this bill can be a failure where there is no proper legislation on gas to ensure the full realisation of its aims [13]. However, literature suggests that gas development in Nigeria is a potential revenue increment opportunity for the country owing to the dwindling nature of Nigeria's economy. [14] asserted that when fully harnessed, Nigeria stands to generate more revenue from natural gas than crude oil. It therefore becomes surprising that no literature known to the researcher aimed at studying the impact of gas sector development on economic growth in Nigeria. The researcher assumes that the dearth of research relating the gas sector development to the economic growth of the nation could be a major reason for the undeserved attention the sector has received thus far. This study therefore aims at establishing the connection between Nigeria's gas sector and its economic growth.

2. LITERATURE REVIEW

Most available empirical literature examined the relationship or impact of the oil sector on economic development or growth of Nigeria and only a few studied the impact of the gas sector on economic growth. Also, there were conflicting results as to the nature of the relationship between oil sector or gas sector development on economic growth in Nigeria. These studies were hereafter reviewed. [6] studied "the effects of natural resources such as oil rents and natural gas rents on economic performance in Nigeria for the period 1984–2022. The method of autoregressive distributed lag estimator was used to carry out the study. The findings revealed that the effect of natural resource rents, particularly oil and natural gas on economic performance was different in both cases. Oil rents had a positive and significant effect on GDP growth in the short run but insignificant in the long run. Natural gas rents had a positive and significant effect on GDP growth in the long run, whereas the first lag of natural gas rents was significant in the short run". [2] studied "the effects of natural gas utilised on per capita income measured in term of purchasing power parity (economic wellbeing) in Nigeria from 2010 to 2020 using quarterly data sourced from International Energy Agency and the Central Bank of Nigeria. The Autoregressive and Distributed Lag (ARDL) technique was used to analyse the data after conducting descriptive statistics, trend analysis and unit roots test on the data. The result shows that in the long run, gas demanded for power and transport sectors as well as its cost contributed to a decline in per capita income which ultimately hampered economic wellbeing in Nigeria". [11] investigated "the effects of share prices volatility on economic growth in Nigeria for the period 1980 to 2018. The research utilized secondary data which was sourced from the Nigeria Stock Exchange shares price list and the CBN statistical bulletin published on their website. Data for the study comprised of those on stock market prices in 5 sectors of the NSE and the growth rate of gross domestic product at constant basic prices. The Pooled Mean Group (PMG) of panel Autoregressive Distributed Lag Model (ARDL) method of analysis was adopted and analysis done using Eviews 10.0. Findings of the study showed that in the long run, both share price and share price volatility had positive signs". [13] examined "the impact of natural gas consumption on economic growth of some selected natural producing countries in Africa namely: Algeria, Angola, Egypt, Gabon, Libya and Nigeria over the period 1990 -2021 using Panel ARDL analysis. To achieve the purpose of the study data on growth rate of Gross domestic product (GDP), natural gas consumption, natural gas price and gasoline motor fuel consumption were sourced from the International Energy Agency and the World Bank. Gasoline motor fuel consumption was introduced as a check variable. The result shows that Natural gas consumption had a

negative and insignificant impact on economic growth while Natural gas price and gasoline motor fuel consumption had positive and significant impact on economic growth". [15], examined the effect of natural gas pricing on the Nigerian economy. The authors employed time-series data and used the Autoregressive Distributed Lag (ARDL) model to analyse the short and long-run dynamics of natural gas pricing and economic growth. The main finding is that natural gas pricing has a significant impact on the Nigerian economy. A possible criticism of this study is the lack of consideration for the role of external factors, such as global gas prices and domestic policy issues, that may influence the relationship between gas pricing and economic growth. [16] analyse the impact of natural gas prices on the Nigerian economy. The authors employ time-series data and use the Autoregressive Distributed Lag (ARDL) model to examine the short and long-run dynamics of natural gas prices and economic growth. The main finding is that natural gas prices significantly affect Nigeria's economic growth. A potential criticism of this study is its lack of consideration for the role of external factors, such as global natural gas prices and domestic policy issues, that may influence the relationship between natural gas prices and economic growth. [17] investigated the relationship between natural gas utilisation and economic growth in Nigeria. The authors employed the Autoregressive Distributed Lag (ARDL) model and time-series data to analyse the short and long-run dynamics of natural gas utilisation and economic growth. The main finding was that natural gas utilisation had a positive and significant impact on Nigeria's economic growth. A potential criticism of this study is the lack of consideration for the role of external factors and policy issues that may influence the relationship between natural gas utilisation and economic growth, as well as the potential endogeneity issues in the analysis.

[18] investigated the relationship between natural gas pricing and economic growth in Nigeria using empirical evidence from a bound testing approach. The authors employed time-series data and utilised the Autoregressive Distributed Lag (ARDL) bounds testing approach to examine the short and long-run dynamics of natural gas prices and economic growth. The main finding was that natural gas pricing significantly affected Nigeria's economic growth. A potential criticism of this study is the lack of consideration for other factors, such as global gas prices and domestic policy issues, that may influence the relationship between gas pricing and economic growth. [19] studied the impact of gas exploration taxes on economic growth in Nigeria from 1981 to 2020. The study adopted univariate analysis and bivariate analysis for data analysis with MS Excel 2019 and SPSS Statistics 26. The study found that income tax on gas exploration (ITG) has no significant relationship with per capita income (PCI) but has a significant relationship with employment rate (JOB). From the foregoing, it was observed from literature reviewed that there is a dearth of literature that studies the impact of gas sector development on economic growth. One gap observed was that no study known to the researcher studied the four aspects of gas sector development as identified in this study, gas supply, commercial gas pricing, gas utilisation, and gas taxation and examined their impact on economic growth [11] and [20]. This is the crux of this study.

3. METHODOLOGY

3.1 The Model

In modelling the contribution of Nigeria gas sector development to the economic growth of the nation, the study specifies the following model to capture the impact of natural gas on real GDP in Nigeria. This is adapted from earlier work by [9] with modifications based on variables of consideration for this study. This is specified in a mathematical functional relationship as presented below:

RGDP =f (NGS, CGP, GUZ, GTX) 3.1)

Where, RGDP = Real Gross Domestic Product (GDP), NGS = Natural gas supply, CGP = Commercial gas pricing, GUZ = Gas utilisation, GTX = Gas taxation

This is presented in an econometric equation as follows:

$RGDP = \beta_0 + \beta 1NGS + \beta_2 CGP + \beta_3 GUZ + \beta_4 GTX + \mu$ (3.2)

Where, β_0 = Intercept, β_1, β_2, β_3, β_4 are coefficients of parameters' estimate (with apriori expectations of β_1, β_2, β_3, $\beta_4 > 0$) and μ = Error term.

3.2 Data

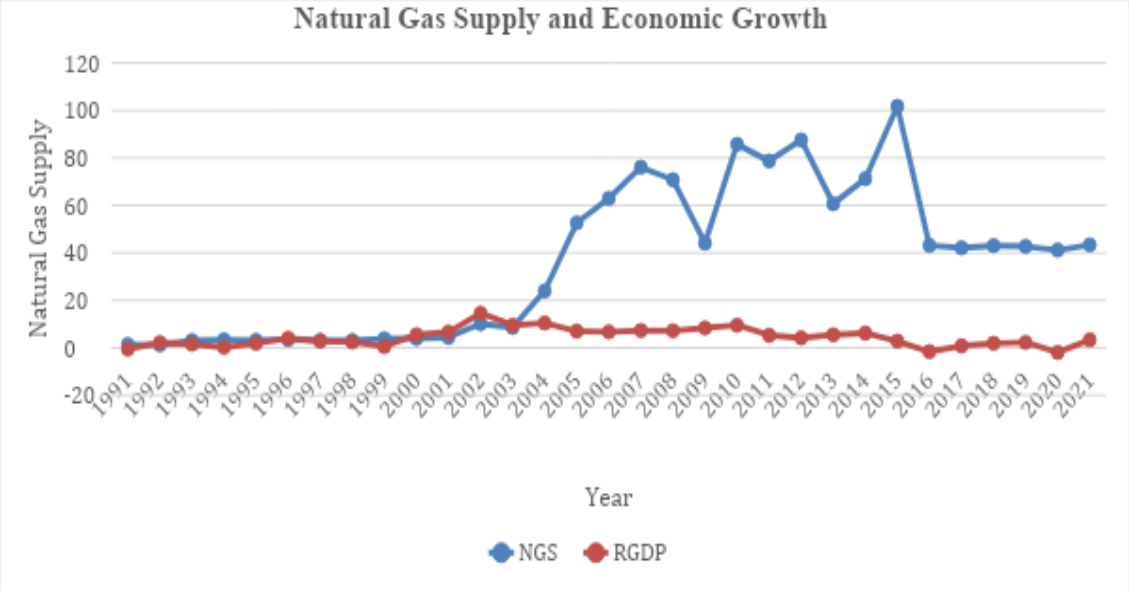
For the purposes of this study, the researcher employed empirical research methods and collected data from secondary sources. The data were obtained from the publications and websites of the Nigerian Bureau of Statistics, Organisation for Economic Cooperation and Development (OECD) as well as the Nigerian Natural gas supply chain statistical bulletins covering the thirty-one (31) year period from 1991 – 2021. To analyze the data collected, an econometric software (EViews-1) was utilized to achieve the objectives of the study. The definition of the data and source are presented in Table 1.

Table 1. Data definition and measurement

Variables	Definition	Measurement	Source
Real gross Domestic Product	A macroeconomic measure defined as the GDP given in constant prices and refers to the volume level of GDP.	Naira	Organisation for Economic Cooperation and Development (OECD)
Natural Gas Supply	The measure of the value of organised delivery and distribution of gas fuel to serve the needs of the national economy	Naira/liter	Nigerian Bureau of Statistics
Commercial Gas pricing	The price benchmarks given to gas to give buyers a way to value the commodity based on quality.	Million cubic feet	Nigerian Bureau of Statistics
Gas Utilization	The measure of the quantity of gas used by the amount of gas supplied. An upward or downward change in the quantity of gas utilisation is one of the variables which suggest gas sector development or underdevelopment, respectively.	Million Cubic Metres	Nigerian Bureau of Statistics
Gas Taxation	The cumulative of all the variety of taxes levied on gasoline at both the federal and state levels, to provide funds for government infrastructure projects and others.	Billion Naira	Nigerian Bureau of Statistics

4. RESULT AND DISCUSSION OF FINDINGS

4.1 Trend Analysis

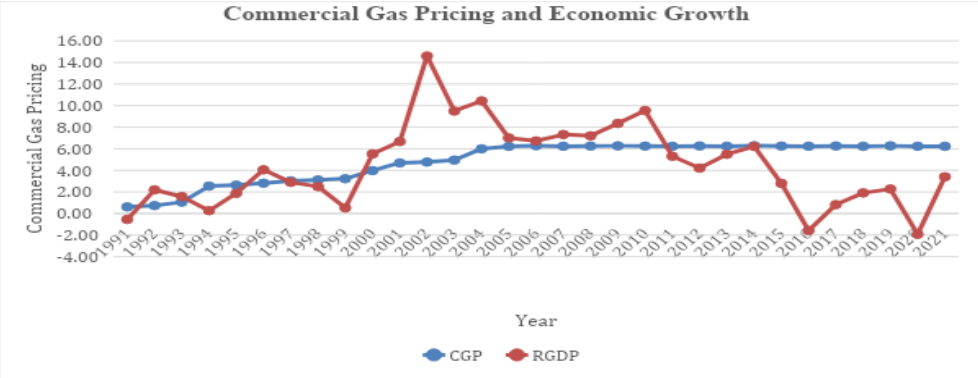


Source: Researcher's Computation (2023)

Figure 1. Trend Analysis between Natural Gas Supply and Economic Growth in Nigeria.

Figure 1 presents the historical trends in natural gas supply (NGS) in Nigeria, measured in million cubic metres, and the Real Gross Domestic Product (RGDP) growth rate in percentage from 1991 to 2021. In the early 1990s, Nigeria's natural gas supply was relatively low, ranging from 14.55 million cubic metres in 1991 to 35.45 million cubic metres in 1996. The RGDP growth rate during this period was erratic, with a negative growth rate in 1991 (-0.55%) and moderate growth rates in the subsequent years. This suggests that Nigeria's economy faced challenges and the natural gas sector's influence on the overall economic growth was not yet significant. Between 1997 and 2002, natural gas supply experienced moderate growth, with supply levels increasing from 31.02 million cubic metres in 1997 to 101.62 million cubic metres in 2002. The RGDP growth rate during this period was highly volatile, with growth rates ranging from 2.5% in 1998 to a peak of 14.6% in 2002. This fluctuation in growth rates can be attributed to various factors such as the evolving gas sector, global energy market changes, and broader economic challenges. From 2003 to 2021, natural gas supply in Nigeria saw a period of substantial growth, with supply levels reaching as high as 1,017.24 million cubic metres in 2015. This period also witnessed a general increase in the RGDP growth rate, with growth rates ranging from 0.82% in 2017 to 10.44% in 2004. The overall growth in natural gas supply and the positive economic growth rates suggest that the gas sector, along with other sectors, contributed positively to Nigeria's economic growth. However, the relationship between natural gas supply and RGDP growth rates during this period was not straightforward. Despite the overall growth in natural gas supply, the RGDP growth rates showed signs of instability, with negative growth rates in 2016 (-1.58%) and 2020 (-1.92%). These negative growth rates might be due to broader economic challenges faced by Nigeria, such as falling oil prices, foreign exchange issues, and structural imbalances in the economy. In conclusion, the trend analysis of natural gas supply and RGDP growth rates in Nigeria from 1991 to 2021 reveals a complex and evolving relationship between the gas sector and the overall economy. While natural gas supply has experienced periods of significant growth, its impact on Nigeria's economic growth has been inconsistent. The trend analysis shows some patterns between natural

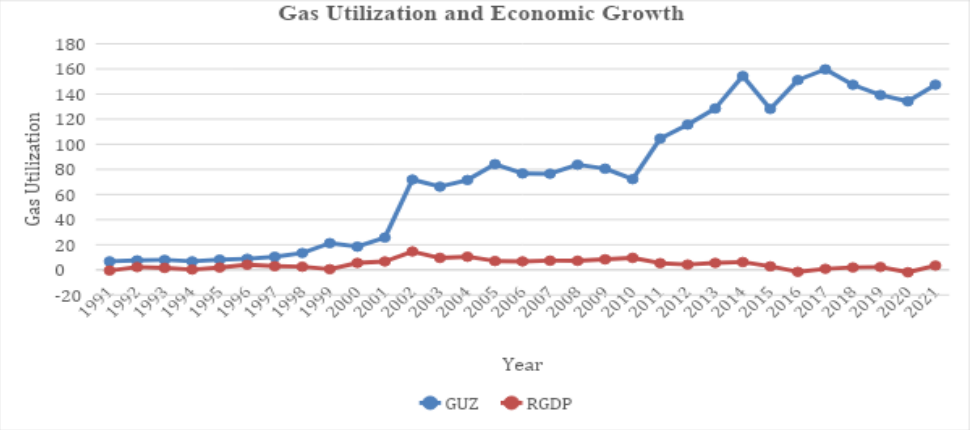
gas supply and Real Gross Domestic Product, as natural gas is a critical input in the production of goods and services. The increase in natural gas supply can boost economic growth by increasing the production of goods and services, which can lead to increased revenue for the government, job creation, and improved living standards.



Source: Researcher's Computation (2023)

Figure 2. Trend Analysis between Commercial Gas Pricing and Economic Growth in Nigeria

Figure 2 illustrates the historical trends in commercial gas pricing (CGP) in Nigerian Naira per litre and Real Gross Domestic Product (RGDP) growth rate in percentage for Nigeria from 1991 to 2021. Commercial gas was quite inexpensive in the early 1990s; it cost 0.61 Naira per litre in 1991 and progressively rose to 1.05 Naira per litre in 1993. The RGDP growth rate fluctuated during this time period, with negative growth in 1991 (-0.55%) and somewhat positive growth in 1992 (2.19%) and 1993 (1.57%). The disparate rates of economic growth indicate that Nigeria's economy was experiencing difficulties, and the gas sector's impact on overall economic development had not yet been firmly established. Between 1994 and 2003, commercial gas prices increased significantly, with prices more than doubling from 2.54 Naira per litre in 1994 to 4.95 Naira per litre in 2003. During this period, the RGDP growth rate displayed significant volatility, with growth rates ranging from 0.26% in 1994 to a peak of 14.6% in 2002. The fluctuating growth rates could be attributed to various factors, including the evolving gas sector, changes in global energy markets, and broader economic challenges. From 2004 to 2021, commercial gas prices exhibited a period of relative stability, hovering between 6.00 Naira per litre in 2004 and 6.28 Naira per litre in 2014. This period also saw a general increase in the RGDP growth rate, with positive growth rates ranging from 2.79% in 2015 to 10.44% in 2004. The overall stability in commercial gas prices and the positive economic growth rates suggest that the gas sector, along with other sectors, was contributing positively to Nigeria's economic growth. Throughout this time, there existed a complicated correlation between commercial petrol prices and RGDP growth rates. The RGDP growth rates exhibited hints of volatility despite the general stability of commercial petrol prices, with negative growth rates in 2016 (-1.58%) and 2020 (-1.92%). Since Nigeria's economy is highly dependent on crude oil income, these negative growth rates may be the result of external factors like rising global oil prices. To sum up, examining the trends in commercial gas prices and RGDP growth rates in Nigeria from 1991 to 2021 exposes a multifaceted and changing relationship between the gas industry and the broader economy. Although commercial gas prices have gone through phases of considerable growth and relative steadiness, their influence on Nigeria's economic expansion has been uneven. As the nation progresses in developing its gas sector and diversifying its economy, it is crucial for policymakers and other stakeholders to comprehend the factors shaping these trends and their consequences for the country's overall economic health.

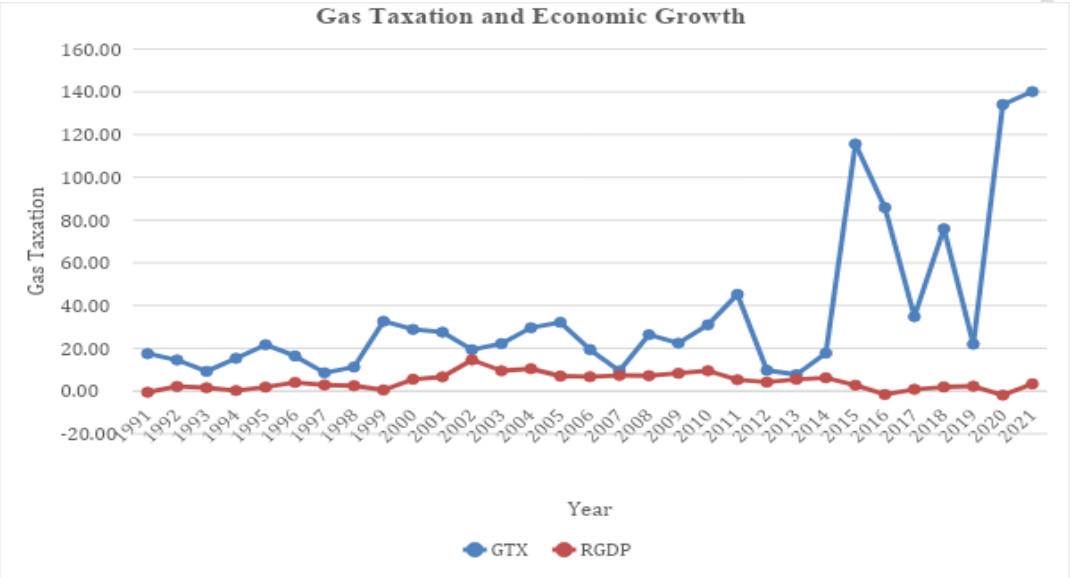


Source: Researcher's Computation (2023)

Figure 3. Trend Analysis Between Gas Utilisation and Economic Growth in Nigeria

Figure 3 outlines the historical trends in Natural Domestic Gas Utilised (GUZ) in million cubic metres and Real Gross Domestic Product (RGDP) growth rate in percentage for Nigeria from 1991 to 2021. Use of domestic natural gas was relatively low in the early 1990s, ranging from 7 million cubic metres in 1991 to 8 million cubic metres in 1995. The RGDP growth rate fluctuated during this time period, with a negative growth rate in 1991 (-0.55%) and somewhat positive growth rates in the years that followed. The inconsistent rates of economic growth imply that Nigeria's economy was having problems and that the gas industry's contribution to overall economic development had not yet been well-established. Between 1996 and 2002, natural domestic gas utilisation experienced a gradual increase, with utilisation growing from 9 million cubic metres in 1996 to 72 million cubic metres in 2002. During this period, the RGDP growth rate displayed significant volatility, with growth rates ranging from 2.89% in 1997 to a peak of 14.6% in 2002. The fluctuating growth rates could be attributed to various factors, including the evolving gas sector, changes in global energy markets, and broader economic challenges. From 2003 to 2021, natural domestic gas utilisation exhibited a period of sustained growth, with utilisation reaching as high as 160 million cubic metres in 2017. This period also saw a general increase in the RGDP growth rate, with positive growth rates ranging from 2.79% in 2015 to 10.44% in 2004. The overall increase in domestic gas utilisation and the positive economic growth rates suggest that the gas sector, along with other sectors, was contributing positively to Nigeria's economic performance. Nonetheless, the connection between natural domestic gas usage and RGDP growth rates during this timeframe was not clear-cut. Even though there was continuous growth in domestic gas consumption, the RGDP growth rates exhibited fluctuations, with negative growth rates occurring in 2016 (-1.58%) and 2020 (-1.92%). These downturns in growth rates could be attributed to wider economic issues Nigeria faced, including declining oil

prices, foreign exchange complications, and imbalances in the country's economic structure. In summary, the link between the gas industry and the entire economy is complicated and dynamic, as shown by the trend analysis of natural domestic gas use and RGDP growth rates in Nigeria from 1991 to 2021. While there have been times when domestic petrol consumption has increased significantly, Nigeria's economic development has not always been affected. To achieve sustainable economic development, the Nigerian government must put in place policies that would encourage economic diversification, enhance non-oil income streams, and lessen the nation's reliance on crude oil revenue.



Source: Researcher's Computation (2023)

Figure 4. Trend Analysis Between Gas Taxation and Economic Growth in Nigeria

Figure 4 provides a historical perspective on the trends in gas taxation (GTX) in billion Naira and Real Gross Domestic Product (RGDP) growth rate in percentage from 1991 to 2021 in Nigeria. From 1991 to the early 2000s, gas taxation revenues exhibited a relatively modest and fluctuating pattern, with no clear upward or downward trend. This period saw gas taxation revenues ranging from 8.56 billion Naira in 1997 to 32.65 billion Naira in 1999. During this timeframe, the RGDP growth rate also demonstrated significant fluctuations, with negative growth in 1991 (-0.55%), followed by positive growth rates that peaked at 14.6% in 2002. The inconsistent growth rates during this period suggest that the Nigerian economy was facing various challenges and that the gas sector had yet to establish a strong and stable influence on overall economic growth. In the mid-2000s, gas taxation revenues began to show a gradual increase, with some fluctuations still present. This period saw gas taxation revenues reaching as high as 45.23 billion Naira in 2011. Meanwhile, the RGDP growth rate experienced a period of relative stability, with positive growth rates ranging from 5.31% to 10.44% between 2004 and 2011. This period of stable economic growth may indicate that the gas sector, alongside other sectors, was contributing positively to Nigeria's overall economic performance. However, the period from 2012 to 2021 witnessed remarkable volatility in gas taxation revenues, with a notable spike in 2015 (115.57 billion Naira), followed by another surge in 2020 (134.06 billion Naira) and 2021 (140.10 billion Naira). This dramatic increase in gas taxation revenues could be attributed to various factors, such as changes in global energy markets, domestic policies, and taxation reforms. On the other hand, the RGDP growth rate during this

period showed considerable instability, with negative growth rates in 2016 (-1.58%) and 2020 (-1.92%), and modest positive growth rates in the other years. The negative growth rates may be a result of broader economic challenges, such as falling oil prices, foreign exchange issues, and structural imbalances. In conclusion, the link between the gas industry and the entire economy is complicated and dynamic, as shown by the trend analysis of gas taxation revenues and RGDP growth rates in Nigeria from 1991 to 2021. Despite the fact that the gas industry has shown it is capable of producing sizable tax revenues, its effects on economic development have been variable, with periods of stability and instability. Understanding the forces driving these changes and their consequences for overall economic performance will be essential for policymakers and stakeholders alike as Nigeria continues to expand its gas industry and diversify its economy.

4.1 Descriptive Statistics

This descriptive statistics result provides an overview of the data from 1991 to 2021, encompassing several economic indicators related to Nigeria's gas sector, including Real Gross Domestic Product (RGDP) growth rate, Natural Gas Supply (NGS), Commercial Gas Pricing (CGP), Natural Domestic Gas Utilised (GUZ), and Gas Taxation (GTX). These observations can help inform further econometric analysis and modelling, ensuring appropriate techniques are applied to account for the data's characteristics. The following interpretation will focus on each statistic and its implications for the data. The summary statistics is presented in Table 2.

The average RGDP growth rate over the period is 4.42%, suggesting that Nigeria experienced steady economic growth during this time. This growth could be attributed to the development of the gas sector, among other factors. The mean natural gas supply, at 3.63E+08 (363 million cubic metres), indicates that Nigeria has consistently provided a considerable amount of natural gas to the domestic and international markets. The average commercial gas pricing stands at 4.85 Nigerian Naira per litre, while the mean natural domestic gas utilised amounts to 75,137,111 million cubic metres. Additionally, the average gas taxation revenue generated during this period is 35.63 billion Naira, contributing to the nation's fiscal capacity.

The standard deviation values show the variability of each variable around its respective mean. The standard deviation of RGDP is 3.802493, which indicates that the growth rate of RGDP has fluctuated over the period. The standard deviation of NGS is 3.20E+08 (320 million cubic metres), which indicates that the natural gas supply has also fluctuated over the period. The standard deviation of CGP is 1.899660, indicating that commercial gas pricing has not varied much over the period indicating that the commercial gas prices have been relatively stable over time. The standard deviation of GUZ is 54,650,454 million cubic metres, indicating significant variation in the natural domestic gas utilised over the period. This could be due to changing domestic demand, infrastructure development, or fluctuations in the global energy market. The standard deviation of GTX is 35.96454 billion Naira, indicating significant variation in gas taxation over the period.

The skewness values reveal the distribution shape of each variable. Skewness measures the degree of asymmetry in the distribution of data. A positive skewness value indicates that the distribution is skewed to the right, while a negative skewness value indicates that the distribution is skewed to the left. A positive skewness, as observed in RGDP (0.51), NGS (0.37), and GUZ (0.07), indicates that the data distribution is right-skewed, with a tail extending towards higher values. Conversely, a negative skewness in CGP (-0.99)

suggests a left-skewed distribution, with a tail extending towards lower values. The skewness of GTX (1.92) is considerably high, pointing towards a substantial positive skewness and possible outliers.

Kurtosis measures the degree of peakedness or flatness of the distribution of data. A higher kurtosis value indicates a more peaked distribution, while a lower kurtosis value indicates a more flat distribution. A kurtosis value close to 3 indicates a normal distribution. In this dataset, RGDP (3.02), NGS (1.81), and CGP (2.61) have kurtosis values relatively close to 3, suggesting that their distributions are close to normal. GUZ (1.58) has a lower kurtosis, indicating a platykurtic distribution with lighter tails and fewer extreme values. The kurtosis of GTX (5.49) is significantly higher than 3, suggesting a leptokurtic distribution with heavy tails and a higher likelihood of extreme values.

The Jarque-Bera test is a test for normality of the distribution of data. A higher Jarque-Bera value indicates a deviation from normality. The probability value associated with the Jarque-Bera test measures the likelihood of the data being normally distributed. The probability value less than 0.05 indicates that the data is not normally distributed, while a probability value greater than 0.05 indicates that the data is normally distributed. The probability values associated with the Jarque-Bera test indicate the likelihood of the data being normally distributed. The probability value for RGDP is 0.510537, indicating that the data is normally distributed. The probability value for NGS is 0.284222, indicating that the data is normally distributed. The probability value for CGP is 0.070471, indicating that the data is also normally distributed. The probability value for GUZ is 0.266517, indicating that the data is normally distributed. Finally, the probability value for GTX is 0.000001, indicating that the data is not normally distributed. Overall, the statistics indicate that, on an average, the data is normally distributed, and there is significant variation in the natural domestic gas utilised and gas taxation over the period. However, the average growth rate of RGDP has been positive, and the commercial gas pricing has not varied much over the period. In summary, the descriptive statistics of the data from 1991 to 2021 indicate that Nigeria experienced economic growth and generated substantial revenue through the gas sector. The variability, distribution shape, and normality of the variables provide insights into the stability and potential challenges faced by the gas sector, and where further be explored through more advanced analyses in this study.

Table 2: Descriptive Statistics Results

	RGDP	NGS	CGP	GUZ	GTX
Mean	4.422581	3.63E+08	4.850645	75137111	35.63476
Median	4.050000	4.21E+08	6.230000	76524011	22.22000
Maximum	14.60000	1.02E+09	6.280000	1.60E+08	140.1000
Minimum	-1.920000	12084127	0.610000	6770247.	7.726900
Std. Dev.	3.802493	3.20E+08	1.899660	54650454	35.96454
Skewness	0.510054	0.367496	-0.993987	0.072605	1.916490
Kurtosis	3.018613	1.813551	2.606121	1.576494	5.491197
Jarque-Bera	1.344585	2.516002	5.305108	2.644631	26.99298
Probability	0.510537	0.284222	0.070471	0.266517	0.000001
Sum	137.1000	1.12E+10	150.3700	2.33E+09	1104.678
Sum Sq. Dev.	433.7686	3.07E+18	108.2612	8.96E+16	38803.44

Observations	31	31	31	31	31

Source: Researcher's Computation Using Eviews-13 (2023)

4.2 Correlation Analysis

The correlation matrix provided offers valuable insights into the relationships between key economic indicators in Nigeria's gas sector, namely Real Gross Domestic Product (RGDP) growth rate, Natural Gas Supply (NGS), Commercial Gas Pricing (CGP), Natural Domestic Gas Utilised (GUZ), and Gas Taxation (GTX). By examining the correlation coefficients and their respective p-values, we can determine the strength, direction, and statistical significance of the linear relationships between these variables. The correlation matrix presented here displays the correlation coefficients between five variables: RGDP, NGS, CGP, GUZ, and GTX. Correlation coefficients quantify the strength and direction of the linear relationship between two variables, ranging from -1 to 1. A positive correlation indicates that the two variables move together in the same direction, while a negative correlation indicates that they move in opposite directions. A correlation coefficient close to 0 suggests no linear relationship between the variables. In addition to the correlation coefficients, the matrix also provides the probability (p-value) associated with each correlation. The p-value is used to test the null hypothesis that there is no correlation between the two variables. If the p-value is less than a predetermined threshold (e.g., 0.05), we can reject the null hypothesis and conclude that there is a statistically significant correlation between the variables.

Table 3: Correlation Matrix

Covariance Analysis: Ordinary
Date: 04/12/23 Time: 11:56
Sample: 1991 2021
Included observations: 31

Correlation Probability	RGDP	NGS	CGP	GUZ	GTX
RGDP	1 -----				
NGS	0.194343 0.2948	1 -----			
CGP	0.346120 0.0565	0.782732 0.0000	1 -----		
GUZ	-0.003104 0.9868	0.712147 0.0000	0.841422 0.0000	1 -----	
GTX	-0.331331 0.0686	0.281578 0.1249	0.383142 0.0334	0.541218 0.0017	1 -----

Source: Researcher's Computation Using Eviews-13 (2023)

Starting with the relationship between RGDP and other variables, we observe a weak positive correlation with NGS (0.194343) and a moderate positive correlation with CGP (0.346120). However, neither of these correlations is statistically significant at the 5% level, as their p-values are above 0.05. This finding suggests that the growth rate of Nigeria's economy may not be directly linked to the natural gas supply or commercial

gas pricing. In contrast, there is almost no correlation between RGDP and GUZ (-0.003104), with no statistical significance. Interestingly, RGDP has a weak to moderate negative correlation with GTX (-0.331331), but this relationship is also not statistically significant at the 5% level. When we turn our attention to the relationships between NGS and the remaining variables, we find a strong and statistically significant positive correlation with CGP (0.782732). This result indicates that an increase in natural gas supply is associated with higher commercial gas prices, suggesting a potential interdependence between these two factors. Furthermore, NGS has a strong positive correlation with GUZ (0.712147), which is also statistically significant. This finding implies that as Nigeria's natural gas supply increases, so does the amount of natural gas utilised domestically. However, the relationship between NGS and GTX is weakly positive (0.281578) and not statistically significant, meaning that there is no strong evidence of a direct link between natural gas supply and gas taxation.

Lastly, the correlations among CGP, GUZ, and GTX reveal important connections within the gas sector. A very strong positive correlation exists between CGP and GUZ (0.841422), with statistical significance. This result suggests that higher commercial gas prices are associated with increased natural gas utilisation within the country. In addition, CGP has a moderate positive correlation with GTX (0.383142), which is statistically significant. This finding indicates that higher commercial gas prices are also linked to increased gas taxation revenue. Finally, GUZ and GTX have a moderately strong positive correlation (0.541218) that is statistically significant, suggesting that higher domestic gas utilisation corresponds to higher gas taxation revenue. In summary, the correlation matrix highlights several key relationships within Nigeria's gas sector, some of which are statistically significant. Among the most notable findings are the strong positive correlations between NGS, CGP, and GUZ, as well as the connections between CGP, GUZ, and GTX. These results underline the importance of understanding the complex relationships among economic indicators in the gas sector and their potential impact on Nigeria's overall economic growth.

4.4 Unit Root Test

Unit root tests are vital in econometric studies, especially when dealing with time series data. These tests assist in determining the stationarity or non-stationarity of the series data utilised in a model, which is crucial for confirming the model's results' validity. In the context of the connection between gas sector development and the Nigerian economy, comprehending the characteristics of the time series data is of particular importance. A unit root in the data suggests non-stationarity, which could lead to false or irrational relationships between variables. This may deceive researchers and policymakers when assessing the impact of gas sector development on Nigeria's economy. As a result, carrying out a unit root test is an essential step in the analysis to establish the correct model specification and guarantee dependable conclusions. The Augmented Dickey-Fuller (ADF) test is a commonly used method for detecting the presence of a unit root in time series data. By applying the ADF test, this research scrutinised the stationarity of both gas sector growth and economic growth series, allowing for the accurate modelling of the relationship and the drawing of valid inferences. This thorough approach guarantees that the analysis results are significant and pertinent for grasping the intricate relationship between gas sector development and Nigeria's economy. The unit root test results presented in Table 4 are essential for understanding the stationarity or non-stationarity of the variables used in the analysis. The Augmented Dickey-Fuller (ADF) test is employed in this study to examine the presence of a unit root in the series data of RGDP, CGP, GTX, GUZ, and NGS. The results of the ADF test are compared to the critical ADF test statistics and the corresponding p-values to determine the order of integration for each variable.

The ADF test statistics for RGDP, CGP, GTX, GUZ, and NGS are -6.472966, -5.257035, -3.497068, -4.898120, and -6.896411, respectively. These test statistics are compared to the critical ADF test statistics, which are -4.309824, -4.323979, -3.248592, -4.416345, and -4.309824, respectively.

The p-values for the ADF test statistics are 0.0001, 0.0011, 0.0759, 0.0036, and 0.0000, respectively. The significance levels of 1%, 5%, and 10% are denoted by *, **, and ***. The order of integration for each variable is determined based on the test statistics, critical values, and p-values. For RGDP, CGP, and NGS, the ADF test statistics are more negative than the critical ADF test statistics, and the p-values are significant at the 1% level, indicating that these variables are integrated of order one or I(1). This means that the first differences of these variables are stationary. On the other hand, the ADF test statistic for GTX is more negative than the critical ADF test statistic at the 10% level (0.0759), indicating that it is also integrated of order one or I(1). However, the ADF test statistic for GUZ is more negative than the critical ADF test statistic, and the p-value is significant at the 1% level, but the variable is integrated of order zero or I(0), indicating that the series is stationary without differencing. In conclusion, the unit root test results in Table 4 provide valuable insights into the stationarity properties of the variables used in this study. This information is crucial for determining the appropriate model estimation and ensuring the validity of the analysis when examining the complex relationship between gas sector development and the Nigerian economy.

Table 4: Summary of Unit Root Test Results

Variable	ADF Test Statistics	Critical ADF Test Statistics	P-value	Order of Integration
RGDP	-6.472966	-4.309824	0.0001*	I(1)
CGP	-5.257035	-4.323979	0.0011*	I(1)
GTX	-3.497068	-3.248592	0.0759***	I(1)
GUZ	-4.898120	-4.416345	0.0036*	I(0)
NGS	-6.896411	-4.309824	0.0000*	I(1)

Note: MacKinnon critical values for the rejection of hypothesis of unit root are in parenthesis in Columns 1 and 2 and the tests include intercept with trend; **,**,*** significant at 1, 5 and 10%; Mackinnon critical*
Source: Researcher's Computation Using Eviews-13 (2023)

4.5 Cointegration Test

Cointegration is a statistical concept that plays a vital role in understanding the long-term relationships between non-stationary time series variables in economics. When two or more time series variables are non-stationary but a linear combination of these variables is stationary, it is said that these variables are cointegrated. In other words, cointegration implies a long-term equilibrium relationship between the variables despite short-term fluctuations. Identifying cointegration between variables is essential in determining the existence of a meaningful long-term relationship and ensuring that the estimations from the model are not spurious. The cointegration results presented in Table 5 are based on the F-Bounds test, which examines the null hypothesis of no levels relationship between the variables. The test statistic (F-statistic) value is 4.020040,

and the number of variables in the model (k) is 4. To interpret the cointegration results, the F-statistic value must be compared to the critical values at different significance levels.

At the 5% level of significance, the lower-bound critical value (I(0)) is 2.56, and the upper-bound critical value (I(1)) is 3.49. In this case, the F-statistic value of 4.020040 is greater than the upper-bound critical value of 3.49 at the 5% significance level as shown in Table 5. This implies that we can reject the null hypothesis of no levels long-run relationship between the variables, suggesting that there is a cointegrating relationship between the variables in the model. By establishing the presence of cointegration, the study thus went ahead to estimate the error correction model.

Table 5: Cointegration Results

F-Bounds Test		Null Hypothesis: No levels relationship		
Test Statistic	Value	Signif.	I(0)	I(1)
F-statistic	4.020040	10%	2.2	3.09
K	4	5%	2.56	3.49
		2.5%	2.88	3.87
		1%	3.29	4.37

Source: Researcher's Computation Using Eviews-13 (2023)

4.6 EFFECT OF GAS SUPPLY, PRICE, UTILIZATION, TAXATION AND ECONOMIC GROWTH IN NIGERIA

The empirical results from the study showed that natural gas supply has a significant impact on the growth of Nigeria's economy. The findings suggest that various sectors, such as power generation, fertilizer and petrochemical production, and cement manufacturing, among other industries, contribute significantly to promoting the economic growth of Nigeria. These sectors rely heavily on natural gas as a primary energy source, which highlights the importance of natural gas supply in driving the country's development. The implication of this result is that vast reserves of natural gas in the country have potentially spurred economic growth through the generation of revenue, job creation, and infrastructural development. This finding is in line with several recent studies that have investigated the relationship between natural gas supply and economic growth in Nigeria. For instance, [22] conducted a sectoral analysis of natural gas consumption and economic growth in Nigeria, revealing that the demand for natural gas by power generation companies, fertiliser/petrochemical companies, and cement industries plays a significant role in promoting economic growth. This finding supports the notion that increased natural gas supply can contribute positively to the Nigerian economy. The results of this study are also consistent with the findings of [23], who found that increases in real per capita GDP had a positive and statistically significant effect on per capita energy consumption and demand. This alignment with previous research reinforces the importance of natural gas supply in Nigeria's economic growth. Matei's findings suggest that as the country's economy expands, the demand for natural gas will continue to rise, further emphasising the need for sustainable development and utilisation of natural gas resources. Similarly, [17] employed a dynamic ARDL approach to examine the relationship between natural gas utilisation and economic growth in Nigeria. Their study revealed that natural

gas utilisation, particularly in the power and industrial sectors, has a significant positive impact on the country's economic growth. This finding further reinforces the importance of natural gas supply in driving Nigeria's economic development. [24] study found that natural gas production positively affects Nigeria's economic growth, suggesting that increased natural gas supply has the potential to enhance the country's economic performance. As Nigeria continues to develop its natural gas sector, it is essential for policymakers and stakeholders to take these findings into account to ensure that the country's economic growth is sustainable and inclusive.

The empirical results from the present study indicate that commercial gas pricing has a significant impact on the Nigerian economy. The outcome of this study suggests that the pricing of natural gas affects the demand and consumption of gas by industrial sectors of the economy. As the price of natural gas influences the cost of production and operations in these sectors, it ultimately impacts Nigeria's overall economic growth. The influence of commercial gas pricing on these sectors may stem from the fact that gas pricing can impact production costs, investment decisions, and overall energy affordability. The implication of the findings shows the need for increased focus on price stability and the diversification of Nigeria's energy sources. By encouraging the development of alternative energy sources, such as solar, wind, and hydro, Nigeria can reduce its dependence on natural gas and mitigate the risks associated with volatile gas prices. Diversifying the energy mix could lead to more stable energy prices and promote sustainable economic growth. The significant impact of commercial gas pricing on the Nigerian economy found in this study is consistent with findings from other recent studies. As these studies suggest, an appropriate pricing mechanism for natural gas is critical to ensuring the optimal utilisation of this resource, contributing to economic growth and development in Nigeria. For instance, [16] discovered that natural gas prices have a substantial influence on the country's economic performance. This finding highlights the need for price stability and balancing the interests of different stakeholders within the sector. Similarly, [18] concluded that there is a strong link between natural gas pricing and economic growth in Nigeria. Their research underlines the importance of proper management of gas resources, as it can have a direct impact on the overall economic development of the country. Considering the findings from this study and the recent literature, it is clear that commercial gas pricing plays a vital role in Nigeria's economic growth. Policymakers should consider the implications of these findings when formulating energy policies and strategies to harness the potential of natural gas resources for the betterment of the Nigerian economy.

Findings from the study showed that gas utilisation has a significant impact on the economic growth of Nigeria. The results suggest that effective gas utilisation in various sectors plays a crucial role in promoting the economic growth of Nigeria. Gas utilisation, particularly in power generation, can lead to increased access to electricity and subsequently contribute to economic growth through improved productivity and the creation of new industries. By expanding the use of natural gas in sectors such as power generation, manufacturing, and transportation, the country can reduce its reliance on imported fuel sources, lower energy costs, and improve its trade balance. This will create a more favourable business environment, attracting both domestic and foreign investment into Nigeria's growing industries. Increased gas utilisation can contribute to environmental sustainability by replacing more polluting energy sources such as coal and oil. The transition to cleaner energy sources, like natural gas, can help Nigeria reduce its greenhouse gas emissions and align with global efforts to combat climate change. This environmental stewardship can enhance Nigeria's international reputation and

attract green investments, leading to sustainable economic growth. The findings from this study are in agreement with [25] indicated that efficient utilisation of natural gas resources in Nigeria's power sector could significantly contribute to the nation's economic growth, particularly by boosting industrial production and providing a more reliable source of energy for domestic consumption. Furthermore, [26] emphasised the potential of natural gas utilisation in Nigeria for enhancing economic growth, as it can provide cleaner and more efficient energy for various sectors, including manufacturing and transportation. By effectively utilising its abundant natural gas resources, Nigeria can capitalise on the opportunities for economic diversification, job creation, and overall growth.

Above all, the results from this study revealed that gas taxation in Nigeria has no significant impact on the country's economic growth. This suggests that the current tax policy regarding natural gas in Nigeria may not be directly influencing the overall economic performance. One possible explanation for the lack of significant impact of gas taxation on economic growth is the complexity and inefficiency of Nigeria's tax system. The current tax framework may not effectively capture the full economic potential of the natural gas sector, and the revenue generated from gas taxation might be insufficient to drive substantial economic growth. Moreover, the presence of tax evasion, regulatory loopholes, and corruption could further undermine the potential benefits of gas taxation in Nigeria. Another important factor to consider is the country's reliance on oil revenue, which might overshadow the impact of gas taxation on the economy. Nigeria's economy has been predominantly dependent on crude oil production, and the fiscal policies have primarily focused on maximising oil revenues. As a result, the natural gas sector might not receive the same level of attention and investment as the oil sector, limiting the potential for gas taxation to contribute significantly to the overall economic growth. Similar findings have been reported by previous studies on the subject. This finding is in line with the study conducted by [27], who observed that the impact of gas taxation on economic growth was not significant across several developing countries, including Nigeria. However, the findings of this study contradict those of [28], who argued that gas taxation has a significant and negative impact on economic growth in Nigeria. They posited that higher gas taxation could lead to increased production costs and reduced competitiveness of domestic industries, thus negatively affecting economic growth.

5. CONCLUSION

The empirical results revealed a significant impact of natural gas supply on Nigeria's economic growth, suggesting that a strategic focus on the efficient management of Nigeria's abundant natural gas resources can serve as a catalyst for economic development. Furthermore, commercial gas pricing was found to have a significant impact on the Nigerian economy. This finding highlights the importance of developing effective pricing mechanisms and regulatory frameworks to ensure the affordability and accessibility of natural gas for various industries and households. The study also discovered that gas utilisation has a significant effect on Nigeria's economic growth, emphasising the need to invest in infrastructure and technology that can harness the full potential of the country's vast gas reserves. This could lead to a more diversified and sustainable economy by reducing overreliance on the oil sector and fostering the development of gas-based industries. Finally, gas taxation was found to have no significant impact on Nigeria's economic growth. This finding suggests that, while taxation can be an essential tool for revenue generation and fiscal policy, it may not be a primary determinant of economic growth in the context of Nigeria's gas sector. This finding indicates that policymakers should carefully consider the implications of altering gas taxation policies, as they may not have

the desired effect on the country's economic performance. Overall, the findings of this study provide valuable insights for policymakers, industry stakeholders, and researchers interested in Nigeria's gas sector and its role in promoting economic growth. By addressing the critical factors identified in this research, Nigeria can leverage its vast gas resources to drive sustainable and inclusive economic development in the years to come.

6. RECOMMENDATION

This study recommends the following:

1 Nigeria should strategically focus on the efficient management of her abundant natural gas resources because it serves as a catalyst for economic development.

2 Nigeria should develop effective pricing mechanisms and regulatory frameworks to ensure the affordability and accessibility of natural gas for various industries and households.

3 Nigeria should emphasise on the need to invest in infrastructure and technology that can harness the full potential of the country's vast gas reserves.

4 Nigerian policymakers should carefully consider the implications of altering gas taxation policies, as they may not have the desired effect on the country's economic performance.

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