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JOINT VENTURE, TECHNOLOGY TRANSFER AND THE PERFORMANCE OF NIGERIAN OIL AND GAS INDUSTRY

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ABSTRACT

Purpose: The objective of this study is to examine joint venture, technology transfer on the performance of Nigeria's oil and gas sector between 1981-2021.

Theoretical Framework: It is indisputable that the Nigerian oil and gas sector is not at peak performance when compared to what is obtainable from its peers in the Organization of Petroleum Exporting Countries (OPEC) (Iheukwumere, 2021; OPEC, ASB 2020). One of the factors responsible for the abysmal performance is ineffective and incoherent technology transfer management through joint venture arrangements (Odusina, 2022). Therefore, there is a need to empirically investigate the impact of joint venture arrangements on Nigeria's oil and gas sector production which lacks sufficient research.

Methodology: The ex-post facto design was used where data were collected through secondary sources on the aggregate output of the joint venture companies and the total yearly output of the upstream sector of Nigeria's oil and gas industry represented the performance of the Nigerian oil and gas sector in the period 1980 to 2021. The collected data were analyzed using the Quantile Autoregressive Distributed Lag (QARDL) approach to test for short and long-run impacts.

Findings: The study revealed that there is a significant impact of joint venture arrangements on oil and gas production in both the short run and long run.

Research, Practical & Social Implication: The study therefore recommends that policymakers and industry stakeholders should carefully evaluate the terms and conditions of joint ventures to ensure their alignment with the goals of maximizing oil and gas production.

Originality/Value: The use of joint venture as a proxy for technology transfer in the production of oil and gas in Nigeria and use of secondary data between 1980-2021 for joint ventures is an eye-opener for further exploration of the study areas in oil and gas production management, particularly in the area of technology transfer, which lacks sufficient research.

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JOINT VENTURE, TRANSFERÊNCIA DE TECNOLOGIA E O DESEMPENHO DA INDÚSTRIA DE PETRÓLEO E GÁS DA NIGÉRIA

RESUMO
Objetivo: O objetivo deste estudo é examinar a joint venture, a transferência de tecnologia sobre o desempenho do setor de petróleo e gás da Nigéria entre 1981 e 2021.
Quadro Teórico: É indiscutível que o setor nigeriano do petróleo e do gás não está no melhor desempenho quando comparado com o que é obtido de seus pares na Organização dos Países Exportadores de Petróleo (OPEP) (Iheukwumere, 2021; OPEP, ASB 2020). Um dos fatores responsáveis pelo desempenho abissal é a ineficácia e a incoerência da gestão da transferência de tecnologia por meio de um acordo de joint venture (Odusina, 2022). Por conseguinte, é necessário investigar empiricamente o impacto do acordo de joint venture sobre a produção do setor do petróleo e gás da Nigéria, que carece de investigação suficiente.
Metodologia: A concepção ex post fato foi utilizada quando os dados foram recolhidos através de fontes secundárias sobre a produção agregada das empresas comuns e a produção anual total do setor a montante da indústria do petróleo e do gás da Nigéria representou o desempenho do setor nigeriano do petróleo e do gás no período de 1980 a 2021. Os dados coletados foram analisados utilizando-se a abordagem Quantile Autoregressive Distributed Lag (QARDL) para testar impactos de curto e longo prazo.
Conclusões: O estudo revelou que há um impacto significativo dos acordos de joint venture na produção de petróleo e gás tanto a curto como a longo prazo.
Investigação, Implicação Prática e Social: O estudo recomenda, por conseguinte, que os decisores políticos e as partes interessadas do setor avaliem cuidadosamente os termos e condições das empresas comuns para garantir o seu alinhamento com os objetivos de maximizar a produção de petróleo e gás.
Originalidade/Valor: O uso de joint venture como uma procuração para a transferência de tecnologia na produção de petróleo e gás na Nigéria e uso de dados secundários entre 1980-2021 para joint ventures é um fator de abertura para a exploração adicional das áreas de estudo na gestão de produção de petróleo e gás, particularmente na área de transferência de tecnologia, que carece de pesquisa suficiente.

Palavras-chave: Joint Venture, Transferência de Tecnologia, Desempenho, Petróleo e Gás.

EMPRESA CONJUNTA, TRANSFERENCIA DE TECNOLOGÍA Y RENDIMIENTO DE LA INDUSTRIA NIGERIANA DEL PETRÓLEO Y EL GAS

RESUMEN
Objetivo: El objetivo de este estudio es examinar la empresa conjunta, la transferencia de tecnología sobre el rendimiento del sector del petróleo y el gas de Nigeria entre 1981 y 2021.
Marco Teórico: Es indiscutible que el sector nigeriano del petróleo y el gas no está en su máximo rendimiento en comparación con lo que se puede obtener de sus pares en la Organización de Países Exportadores de Petróleo (OPEP) (Iheukwumere, 2021; OPEP, ASB 2020). Uno de los factores responsables del pésimo desempeño es la gestión ineficaz e incoherente de la transferencia de tecnología mediante acuerdos de empresas conjuntas (Odusina, 2022). Por lo tanto, es necesario investigar empíricamente el impacto del acuerdo de empresa conjunta en la producción del sector del petróleo y el gas de Nigeria, que carece de investigación suficiente.
Metodología: Se utilizó el diseño ex post facto donde los datos se recopilaron a través de fuentes secundarias sobre la producción agregada de las empresas mixtas y la producción anual total del sector ascendente de la industria del petróleo y el gas de Nigeria representó el rendimiento del sector del petróleo y el gas nigeriano en el período 1980-2021. Los datos recolectados se analizaron mediante el método de la prueba de retardo distribuido autorregresivo cuantil (QARDL) para evaluar los impactos a corto y largo plazo.
Conclusiones: El estudio reveló que los acuerdos de empresas conjuntas tienen un impacto significativo en la producción de petróleo y gas, tanto a corto como a largo plazo.
Investigación, Implicaciones Prácticas y Sociales: Por lo tanto, el estudio recomienda que los responsables de las políticas y las partes interesadas de la industria evalúen cuidadosamente los términos y condiciones de las empresas conjuntas para garantizar su alineación con los objetivos de maximizar la producción de petróleo y gas.
Originalidad/Valor: El uso de la empresa conjunta como sustituto de la transferencia de tecnología en la producción de petróleo y gas en Nigeria y el uso de datos secundarios entre 1980 y 2021 para empresas conjuntas es un factor revelador para la exploración de las áreas de estudio en la gestión de la producción de petróleo y gas, particularmente en el área de transferencia de tecnología, que carece de investigación suficiente.

Palabras clave: Joint Venture, Transferencia de Tecnologia, Rendimiento, Petróleo y Gas.

1 INTRODUCTION

Globally, the oil and gas sector contributes to the economy in significant ways because products from this sector are used in transportation (road, aviation, rail and maritime), petrochemicals (cosmetics, clothing, paints, and building components), and home heating, to mention but a few. All these add up to make the sector important to lives (Dike & Onaiwu, 2022). The sector is equally important to the government as it has boosted its revenue, created millions of jobs in some climes, and contributed significantly to the Gross Domestic Product in different countries, among other growing benefits associated with the performance of the oil and gas sector.

The benefits of the industry are evident in oil and gas-producing nations like Russia, Saudi Arabia, Canada, Iran, Venezuela, Qatar, Kuwait, Iraq etc. However, not all countries of the world are blessed with abundant deposits of oil and gas. In Nigeria, some of the indices for the measurement of the oil and gas sector suggest that some levels of performance are impressive while others are not. For instance, Onakoya and Agunbiade's study in 2020 reported an increase in government revenue while other economic measures such as the unemployment rate, exchange rate, inflation rate and interest rates, among others, remain unimpressive.

It is indisputable that the Nigerian oil and gas sector is not at peak performance when compared to what is obtainable from its peers in the Organization of Petroleum Exporting Countries (OPEC) (Iheukwumere, 2021; OPEC, ASB 2020). According to Iheukwumere, Moore, and Omotayo (2020), the performance of the Nigerian refineries has been dismal, they have failed to close the gap in the supply of refined petroleum products in spite of their total installed capacity of 486 barrels per day (bpd) with the addition of the 10,000bpd Niger Delta Petroleum Refinery at Ogbele, Delta State, and the 5,000bpd capacity Waltersmith Petroman Oil Limited, Imo State in 2020. This performance outlook of the oil and gas sector in Nigeria has resulted in dwindling government revenues as oil production continues to drop, foreign exchange earnings remain unstable, job losses are on the increase, and the environment has become more endangered in the last few years than ever before.

The quest to improve the sector's performance in the sector has been discussed at different levels with insignificant results, as is evident in the hardship consumers of products such as Premium Motor Spirit (PMS), Automotive Gas Oil (AGO), Aviation Turbine Kerosene (ATK), Dual Purpose Kerosene (DPK), other motor oils, Liquified Petroleum Gas (LPG), Natural Gas Liquids (NGL) and Compressed Natural Gas (CNG) are experiencing to get them.

This suggests poor performance in terms of the industry's inability to meet daily production quotas allocated to her by the Organization of Petroleum Exporting Countries (OPEC), coupled with her inability to fulfil local demands for petroleum products such as premium motor spirit (PMS), automotive gas oil (AGO), aviation turbine kerosene (ATK), and various varieties of lubricating oils (Iheukwumere 2020).

Extant reviews by Egwake, et al 2020; Nejati & Bahmani, 2020; Ajibo et al 2019) suggest a wide range of issues responsible for the aforesaid performance in the oil and gas industry viz a viz corruption, sabotage, technology failure, technology transfer and its management, among others. These challenges result from internal and external collaborations to circumvent due process as contained in the agreement knowing fully well that Nigeria, as a developing country, does not have the technology to drive the oil and gas sector. One of the areas of concern is how technology transfer and performance management have been conducted over the years. This scenario made technology transfer management imperative as a vital variable of interest in the study and within the parlance of technology transfer management, the approach has been a joint venture arrangement with investors having percentage allocation to protect the nation's interest.

In a study conducted by Odusina in 2022, it was revealed that the joint venture arrangement between the Nigerian National Petroleum Corporation (NNPC) and International Oil Companies (IOC) is not functioning well. The main problems are the ineffective working relationship, poor organization and governance structure, and lack of synergy among the partners due to the absence of direction and coherent goals. These issues have resulted in a negative atmosphere of mutual distrust, blame culture, pursuit of self-interest, and hidden agendas with a lack of transparency. This situation not only affects the performance of the oil industry but also hinders collaborations among potential investors.

Joint venture arrangement has been identified as a proxy in the context of Jiang (2018) and Howell (2018) as it defines partnership issues in business ownership. This becomes imperative to allocate resources available, expectations and sharing proceeds from such partnership. In the oil and gas industry, such a joint venture arrangement is a contractual relationship between an oil-bearing country like Nigeria and an oil company in acquiring participation interests in crude oil exploitation concessions. In this instance, the joint venture agreement defines an investor's share assets, liabilities, revenues, and expenses. According to Ifesinachi and Aniche (2014), inadequate management experience has challenged the tendency to ensure cordial relationships of partners in the joint venture arrangement between the Nigerian

National Petroleum Company (NNPC) Limited and International Oil Companies (IOCs) in the past. Therefore, insensitivity to the management of the industry concerning joint ventures is a major significant challenge.

Addressing the production challenges in the sector requires understanding various aspects of the industry vis-à-vis how they affect the industry's performance. In the face of the industry’s challenges, some international oil companies have been reported to have divested from the country for diverse reasons including but not limited to insecurity, host community restiveness, pipeline vandalism, oil theft, kidnappings, under-reporting of production figures, etc. There have also been compromises where some Nigerians front for foreigners to acquire stakes beyond the regulated quotas in the joint venture arrangements. This development has, for years, affected the incomes of the government and oil companies in the country.

These call for a joint venture management approach that is proactive and pragmatic enough to address the issues as the practice lingers on in the Nigerian business space. It is anticipated that this study will contribute to the improvement of the industry's performance, arrest its dwindling fortunes over the years in oil and gas production, and proffer suggestions on how to use better management strategies and practices to improve the operations of joint venture arrangements. Therefore, the study aims to investigate the impact of joint venture arrangements as a proxy for technology transfer on the performance of Nigeria's oil and gas production.

2 LITERATURE REVIEW

Technology and technology transfer have become increasingly important in this era. Understanding the concepts and how the different components interact is of utmost importance to managers, entrepreneurs, researchers, and those aspiring to innovate and gain usable knowledge (Bozeman, Rimes, and Youtie, 2014). The concept of ‘technology’ is associated with tools and equipment that are becoming more advanced. Historically, it was in 1829 that the first writing on technology called ‘Bigelow’s Elements of Technology’ was unveiled. The concept was perceived to be from the root words ‘techne’ and ‘logo’ (Carroll, 2017). Techne is a Greek word meaning ‘craft’ or ‘technique’ including know-how, while logo means ‘study’. Therefore, technology is creating a tool or technique to provide some benefits. It is also referred to as a mechanism to produce other things. With this description, technology is know-how (Agar, 2020) which can be acquired or learned. One of the discussions around this is that it can be transferred. Technology transfer was first reported in 1957, as cited by Wahab, Rose, and Osman (2012). In precise terms, it is described as the flow of technology from the source to the benefiting side, whether a firm or society (Aranjo & Teixeira, 2014).

According to Stasiak-Betlejewska (2021), such technology transfer entails conceiving and implementing a unique application for existing technology. Similarly, Prokhorova, Reznik, Bozhanova, and Slastianykov (2019) considered technology transfer as a prerequisite for enterprises' innovative development this also includes sharing skills, technologies, and manufacturing methods and know-how with a wide range of users who can further develop and exploit the them to create new value in the form of processes, applications, materials, products, or services. By this, it is an integrated process where known technologies are applied to new environments, individuals, and applications. However, uneven resources across the world made technology transfer imperative. One means through which technology is transferred is through joint venture arrangements which will form part of our focus here.

2.1 JOINT VENTURE ARRANGEMENTS

Literature points to joint venture arrangement under technology transfer management as coming together of two or more entities to co-own and run a business concern (Sudha 2013), this is done to tactically and strategically gain an edge in the market and can facilitate long-term cooperation between the parties, the motivating them to successfully transfer technology, and to incur lower costs than working independently. In Nigeria, joint venture arrangement among companies accounts for a good portion of Nigeria's oil and gas industry performance. Just like Shell company where almost all of its activities are done through the joint venture arrangement in Nigeria where Nigerian National Petroleum Corporation, NNPC controls investment at about 55% making it a major player in Nigeria's crude oil and gas production. Other multinational companies operate through Joint ventures like TotalFinaElf, Exxon Mobil, ENI/Agip, and Chevron Texaco in which the NNPC has a 60% of investment. Companies initiate a JV arrangement through a contractual agreement between all concerned parties.

In another research on technology transfer management, Rajan et al (2018) revealed that technological alliances, technology transfer, and top management support are substantial for innovation in organizations. Another work by Egwake, Amos, and Nicodemus (2020) reveals that the components of technology transfer significantly positively affect the productivity of selected automobile manufacturing companies in Nigeria. Gupta and Govindarajan (1991) explained that multinational companies are called ‘differentiated networks’ where knowledge is formed and transferred to inter-related units. This is because any organization that is capable of transferring knowledge successfully to another is more productive and has the tendency to grow than organizations that cannot transfer knowledge, especially in the global business environment.

2.2 PERFORMANCE OF THE OIL AND GAS INDUSTRY

Performance as a concept requires description in context. Although not a precise concept both intuitively and in practice, an industry’s performance is related to its capacity to deliver basic goods and services expected of the industry. Such performance can be judged by many different metrics, resulting in many different interpretations of what “Performance” is (Carton, 2004). From a comprehensive perspective, performance refers to an industry’s actual output or results as measured against its intended outputs (or goals and objectives). Specialists in strategic management, operations, finance, and organisational development, among others, are concerned with improving performance.

According to Uwakonye, Osho and Anucha (2006), Bingilar and Kpolode, (2021) found in their study that oil production in Nigeria between 2013 and 2020 based on data made available by the Central Bank of Nigeria dropped significantly. This dropped further due to the COVID-19 experience of 2020, as Nigeria had to cut its oil production benchmark volume twice in 2020. Nigeria cut its production to 1.412 million barrels per day (mb/d), 1.495mb/d and 1.579mb/d for the respective periods of May-June 2020, July-December 2020 and January 2021-April 2022 (KPMG Report, 2022).

In this study, oil and gas production represents the measure of performance. The reason for this is that the production of oil and gas is unified across all the actors in the industry where the data from the industry’s production between 1985-2021 are provided from the NNPC and the Central Bank of Nigeria. This makes the authenticity of data to be validated and trusted.

Figure 1

Researcher's Conceptualization (2024)

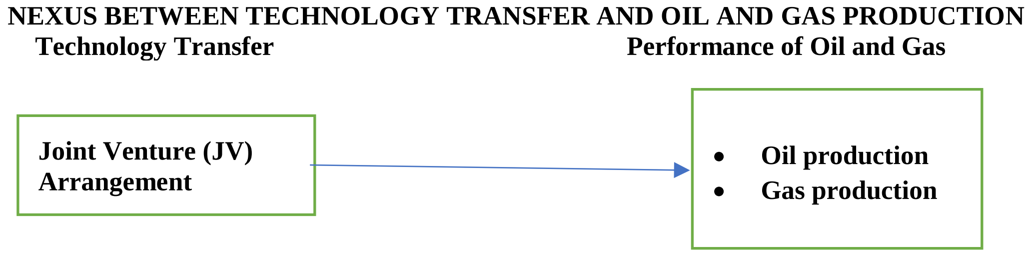

Figure 1 shows the conceptual framework highlighting the nexus between the independent variable (technology transfer) measured by joint venture and the dependent variable which is the performance of the Oil and Gas Industry was proxied by the production of oil and gas.

2.3 THEORETICAL FRAMEWORK

The study anchors on the contingent effectiveness model of technology transfer by Bozeman (2000). The Contingent Effectiveness Model is predicated on the idea that stakeholders in technology transfer have a variety of objectives and standards for effectiveness. Aspects of the transfer agent, aspects of the transfer media, aspects of the transfer object, aspects of the demand environment, and aspects of the transfer recipient are the five main factors in the model to assess effectiveness. Although not exhaustive, these dimensions are broad enough to include most factors examined in university and government technology transfer efforts studies. The technological niche, mission, sector, resources, geographic location, science and technical human capital, organization design, management style, and political constraints are all transfer agents in the contingent effectiveness model (CE model), and they are always present to exert pressure on the transfer. The transfer media, which connects to the technology, comes next. They include freely available academic literature absorption, unofficial connections, staff swaps, in-person demonstrations, and spin-offs. The transfer object for scientific knowledge, physical technology, design, procedure, know-how, and craft comes after the media (Bozeman, 2000).

2.4 EMPIRICAL REVIEW

Odusina (2022) examines the working culture relationship among Joint Ventures partners in Nigeria's Oil and Gas industry. The qualitative research through questionnaires with random sampling was used to get the data from the employees of Nigeria National Petroleum Company and International Oil and Gas Limited. Findings revealed that the poor working culture could not stand a chance of increasing the production of oil and gas in Nigeria. The study suggested that joint venture arrangements should legalized and institutionalized working plans that will be aligned overall goal of the stakeholders. However, it's worth noting that the study failed to adopt a quantitative method, and the sample size is small

Singhai et al. (2021) investigated Technology Transfer Factors using Structural Equation Modeling. The study employed cross-sectional survey research where the structured questionnaire was administered to 321 stakeholders in technology transfer activities. The collected data were analysed using structural equation modelling. The findings show that all five factors viz a viz knowledge, quality of the product, communication, motivation, and innovativeness are significant to technology transfer. On the contrary, the Joint Venture is not a proxy for technology transfer and is not significant to performance of oil and gas industry.

Gilding, et al. (2021) examined variation among transfer mechanisms, science and development-based industries, and barriers across ten different industrial sectors. The study found variations between the use of technology transfer mechanisms as well as certain similarities in barriers. Studies on transfer technology management and performance have been extensive with limited adoption in the Nigerian oil and gas as it relates to the industry's performance.

Studies on transfer technology management and performance have been extensive with limited adoption in the Nigerian oil and gas as it relates to the industry's performance (Iheukwumere 2020, Ogbuigwe 2018).

Among them are how FDI and TT affect economic growth; the extent of differences in TT processes across different industrial sectors; the impact of more substantial intellectual property rights on TT across developing nations; the effect of monetary policy on the performance of the crude petroleum sector; the impact of the Nigerian oil sector on microeconomic variables; FDI, TT, and Angola' energy sector; etc. only few to the best of our knowledge addresses precisely how technology transfer with the use of the joint venture arrangement as variable has been see as a research gap that should be filled, and this research seeks to fill it. Secondly, because of the nature of our data which are characterised by abnormality and extreme values as is familiar with time series data, and the mixed order of variables which tend to be integrated under different quartiles, the application of the quartile auto-regressive distribution lag (QARDL) which can take care of data of that nature needs to be applied to arrive at a more reliable conclusion.

3 METHODOLOGY

Considering that the research philosophy of this study settles for the positivist paradigm because we focused on identifying explanatory associations or causal relationships through a quantitative approach and where empirically based findings from the analyzed data were used to generalize inferences (Park, Y.S., Konge, L., & Artino, A. 2019) and the fact that secondary data was considered appropriate for the study as enunciated by Kenaphoom, (2021). Therefore, the ex-post facto design was used because the study intends to determine the impact of independent variable proxies on the dependent variable proxies and would need to analyze correlations and cause-effect relationships (Sharma. 2019). This study is confined to the issues of technology transfer (joint venture arrangement) and the performance of the Nigerian oil and gas sector in the period 1980 to 2021. This research covers only the upstream sector of the Nigerian oil and gas industry where crude oil and natural gas are the primary products.

Data on the performance of the oil and gas sector is represented by the yearly output of crude oil and natural gas as reported by the Nigerian National Petroleum Company Annual Statistical Bulletin (NNPC ASB). While Joint Ventures (JV) is proxies for technology transfer on annual productions and were obtained from very credible sources like the NNPC ASB, Central Bank of Nigeria (CBN) Annual Statistical Bulletin, OPEC Annual Statistical Bulletin, the United Nations Population, and the Census and Economic Information Centre (CEICdata.com). Data generated come in as yearly aggregates for uniformity and ease of analysis.

This study adapts Bozeman's (2000) contingent effectiveness model of technology transfer as the theoretical underpinnings. Bozeman (2000) also makes some connections between various dimensions and the results of technology transfer in his review.

In a functional form, the relationship between joint venture management tools and the performance of the oil and gas sector is expressed as:

$$pog = f(jva) \quad (1)$$

Mathematically, it is stated as:

$$pog = \varphi_0 + \varphi_1 jva \qquad (2)$$

Where: *pog* represents the performance of the oil and gas sector; *ttm* denotes the vector of technology transfer management variables such as joint venture arrangements (*jva*); and φ_0, φ_1 are parameters.

Equation (2) stands as the theoretical model of the research study and it proposes a direct link between technology transfer management and oil and gas sector performance. It means that the oil and gas sector tends to gain from the high inflow of adequate good joint venture arrangements.

3.1 EMPIRICAL MODEL OF JOINT VENTURE ARRANGEMENTS AND OIL AND GAS PRODUCTION

To investigate the impact of joint venture arrangements on oil and gas production, the study modelled the oil and gas performance as a function of joint venture arrangements including. The baseline model for the time series analysis is specified below as:

$$pog_t = f(jva_t) \qquad (3)$$

To estimate the parameters, the function is transformed into the generalized equation below as:

$$pog_t = \theta_0 + \theta_1 jva_t + \upsilon_t \qquad (4)$$

Where:

pog denotes the performance of the oil and gas sector measured by oil and gas production;
jva represents joint venture arrangements;
θ_0, θ_{1-2} are parameters;
t denotes time; and
υ is disturbance term.

This study used the unit root test to test for the stationarity of the time series data acquired for the research. Since most time series variables in the literature are non-stationary, incorporating non-stationary variables in the model runs the risk of producing an erroneous regression.

3.2 QUANTILE AUTOREGRESSIVE DISTRIBUTED LAG (QARDL) APPROACH

With the aid of the cutting-edge QARDL procedure that Cho, Kim, and Shin (2015) have recently introduced, this research study will examine the nonlinear relationship between technological transfer management and oil and gas performance in the presence of the contingent effectiveness model of technology transfer theory. The QARDL framework makes it possible to quickly evaluate the long-term quantile impact of technology transfer management (which consists of joint venture agreements in a vector form) on Nigeria's oil and gas performance.

When the variables are stationary at I(0) or integrated of order 1 (I(1), the QARDL model is thought to be the optimum estimation strategy. It is a better model than others to capture the short- and long-term effects of explanatory variables on the performance of the oil and gas industry. The consistency of integrating coefficients across the quantiles will be examined using the Wald test. The foundational ARDL method, which uses the ordinary least square (OLS) method to cointegrate variables, is also suitable for simultaneously calculating short-run and long-run elasticities for a small sample size (Duasa, 2007). The order of the variables' integration can be changed with QARDL. The model's explanatory variables, at I(0) and I(1), which are mutually cointegrated, are suitable for QARDL (Frimpong and Oteng, 2006). But if the variable include I(2), it fails. The traditional linear ARDL framework was primarily explained as follows:

$$Y_t = \alpha + \sum_i^p \theta' Y_{t-1} + \sum_i^q \beta' X_{t-1} + \sum_i^q \phi' Z_{t-1} + \varepsilon_t \qquad (5)$$

Where:

Y indicates the natural log of the dependent variable;
X denotes the vector of the independent variable;
Z is the vector of control variables;
ε denotes the white noise residual explained via the bottom ground by (Y_t, X_t, Z_t, Y_{t-1}, X_{t-1}, Z_{t-1},…);
p and q are lag orders selected by the Schwarz Info Criterion (SIC); and
t is time periods.

The context of the quantile ARDL model is then recommended by adjusting equation (3.22) to a framework of quantile, which is stated as:

$$Q_{Y_t} = \alpha(\tau) + \sum_i^p \theta'(\tau) Y_{t-1} + \sum_i^q \beta'(\tau) X_{t-1} + \sum_i^q \phi'(\tau) Z_{t-1} + \varepsilon_t \qquad (6)$$

$$\text{Thus, } \varepsilon_t(\tau) = Y_t - Q_{Y_t}\left({}^{\tau}/_{\varepsilon_{t-1}}\right) \tag{7}$$

According to Kim and White (2003) and $0 < \tau < 1$ is the quantile. This study uses the consecutive couple of quantiles t related to 0.05, 0.25, 0.50, 0.75, and 0.95 to achieve data estimations. In addition, the quantile ARDL model in equation (6) is complete as follows about the probability of a serial correlation in the residual:

$$Q_{Y_t} = \alpha(\tau) + Y_{t-1} + \pi' X_{t-1} + \lambda' Z_{t-1} + \sum_i^p \theta'(\tau) Y_{t-1} + \sum_i^q \beta'(\tau) X_{t-1} + \sum_i^q \phi'(\tau) Z_{t-1} + \varepsilon_t \tag{8}$$

Additionally, a study of equation (9) could provide the following error correction model for the quantile ARDL context (Cho, Kim, and Shin, 2015):

$$Q_{Y_t} = \alpha(\tau) + \rho(\tau)(Y_{t-i} - \pi'(\tau) X_{t-i} - \lambda'(\tau) Z_{t-i}) + \sum_{i=1}^{p-1} \theta'(\tau) Y_{t-1} + \sum_{i=0}^{q-1} \beta'(\tau) X_{t-1} + \sum_{i=0}^{q-1} \phi'(\tau) Z_{t-1} + \varepsilon_t \tag{9}$$

The cumulative short-run influence of earlier oil and gas performance on more recent oil and gas performance is calculated by $\theta'_* = \sum_{i=1}^{p-1} \theta'$. However, the combined short-term influence of the management of technological transfer in the present and in the past on the current stage of oil and gas performance is calculated as $\pi'_* = \sum_{i=1}^{p-1} \pi'$. The same method is used to evaluate the residual aggregate short-run impact of historical and current controlling variables (such as income, trade, interest rate, and inflation) on the current level of oil and gas performance. In equation (9), the speed of adjustment parameter r must be significant and negative (Cho, Kim, and Shin, 2015; Shahbaz *et al*., 2018). As a final point, this study used the Wald-test to determine the particular hypotheses (null and alternate) for the long- and short-run coefficient in order to examine the long- and short-term asymmetric influence of technology transfer management and other control variables.

Following the earlier estimates, some encouraging data appears in Cho, Kim, and Shin (2015). The QARDL process parameter may differ in each quantile, showing that these parameters may have an impact at different eras, according to the first principle of long-short run parameters, which should be based on quantile. The Wald test can also be used to assess the restrictions on the long-short run coefficients between and using the quantiles (Cho, Kim, and Shin, 2015; Zhu, Peng, and You, 2016).

3.3 A PRIORI EXPECTATION

Our a priori expectation in the model specified above is that the independent variable as represented by the proxy joint venture arrangement shall be positively related to the performance of the oil and gas industry (the dependent variable which in our case is oil and gas production). We expect that an increase in the proxies of the independent variables shall lead to an increase in the proxies of the dependent variables.

3.4 DESCRIPTIVE AND TREND ANALYSIS

This sub-section presents the descriptive analysis, trend and pattern of technology transfer management variable and the performance of oil and gas sector in Nigeria. The stylized facts of the trend of oil production (pob1), gas production (pob2), joint venture arrangements (jva) are reviewed under this section using summary statistics in Table 1.

The summary statistic of the variables presented in Table 1 indicated that the mean value of oil and gas performance measured by oil production and gas production stood at 712.43 and 1,722.03, while their highest and (lowest) values are (918.66 and 2,991.44) and (450.97 and 536.51) respectively. It indicates that the Nigerian oil and sector accounts for an average of 712.43 million barrels and 1,722.03 BSCF in the Nigerian economy. The mean values of technology transfer management variable measured by joint venture arrangements (jva) was 574.45 and for trade volume was $27.88 billion, while their maximum and (minimum) values stood at 839.28 and $89.78 billion, and (237.99 and $2.13 billion) respectively.

Table 1

Descriptive Statistics

Signs	Variables Measurement	Mean	Std. Dev.	Max.	Min.	Kurtosis	Skewness	Obs.
Outcome variables								
pob1	Oil production (million barrels)	712.43	131.29	918.66	450.97	-0.762	-0.419	42
pob2	Gas Production (BSCF)	1722.03	842.61	2991.44	536.51	-1.469	0.090	42
Main explanatory variables								
jva	Joint venture arrangements (mbbls)*	574.45	159.83	839.28	237.99	-0.944	-0.263	42
	controlling Variables							
trd	Trade volume - imports ($'billion)	27.877	26.797	89.778	2.130	-0.554	0.866	42
inc	Income (constant 2015 $'billion)	266.40	144.04	518.48	114.54	-1.240	0.643	42
int	Interest rate (%)	13	3.959	26	6	1.911	0.762	41
inf	Inflation rate (%)	18.735	16.513	72.836	5.388	2.938	1.963	42

Note: Std. Dev. – standard deviation; Max. – maximum; Min. – minimum.
Source: Author’s computation (2023).

The average values of other controlling factors determining oil and gas performance stood at $266.4 billion, 13%, and 18.74% for income (*inc*), interest rate (*int*) and inflation rate (*inf*) respectively under the reviewed periods. Their maximum values stood at $518.48 billion, 26%, and 72.84% while the minimum values are $114.54, 6% and 5.39% respectively. Additionally, the standard deviation reports the rate at which these variables deviate from their individual mean values. The variables have low deviation rates in varying magnitude from their mean values, as their standard deviation values are lower than average values. Moreover, oil production and joint venture arrangements skewed negatively with a value of -0.419 and -0.263 respectively, while other indicators skewed rightward. As well, the Kurtosis identified 3.0 suggesting the normal distribution. From Table 1, none of the variables exhibits normal distribution. The variables are platykurtic in distribution that is, all of the variables are not normally distributed.

3.5 CORRELATION ANALYSIS

Table 2 presents the partial correlation of the variables understudied such as oil production, gas production, joint venture arrangements, trade volume, income, interest rate, and inflation rate in Nigeria using an annual dataset within the period of 1980 and 2021. The result of the correlation coefficients shows that oil production has a strong positive correlation with gas production (0.763), indicating a significant positive relationship between the two. The technology transfer management variable positively correlates with oil and gas production. As to the controlling variables, the table revealed that oil and gas production had a direct level of association with trade volumes, income, and interest rate, but they indirectly correlate with inflation rate.

Table 2

Correlation Matrix

	pob2	jva	trd	inc	int	inf
pob1	0.763	0.522	0.586	0.519	0.218	-0.226
pob2	1	-0.057	0.665	0.708	0.033	-0.269
jva		1	-0.226	-0.380	0.304	0.077
trd			1	0.931	-0.261	-0.430
inc				1	-0.156	-0.336
int					1	0.361

Note: pob1 - Oil production (million barrels); pob2 - Gas Production (BSCF); jva - Joint venture arrangements (mbbls); trd - Trade volume - imports ($'billion); inc - Income (constant 2015 $'billion); int - Interest rate (%); and inf - Inflation rate (%).
Source: Author’s computation (2023).

Concerning other controlling factors of oil and gas production variables the result showed that joint venture arrangements negatively correlate with trade volumes and income but positively relate with interest and inflation rates.

3.6 PRE-ESTIMATION TESTS (UNIT ROOT)

Estimating the stationary level of the variables was accomplished through the use of the Augmented Dickey Fuller (ADF) and Phillips Perron (PP) unit root estimation methods in this subsection. These estimators are utilized to uncover the stationary level of technology transfer management indicators as well as oil and gas production in order to provide the appropriate way by which to evaluate the parameters. Table 3 displays the findings of the unit root calculation applied to each of the indicators. The findings of the tau-statistics were employed in intercept and trend form to determine which variables were statistically significant at 1%, 5%, and 10% critical points at levels and first difference. In addition, the lag time for determining whether or not the variables are stationary is chosen automatically and ideally by the Schwarz-Bayesian Information Criterion (SIC), whilst only a handful of the parameters were held constant.

Table 3

Unit root test (ADF, PP and Zivot-Andrews)

Variables	ADF Test		PP Test		Remark	Zivot-Andrew Test		
	Levels	1st Diff.	Levels	1st Diff.		Break	t-statistics	Remark
lnpob1	-0.3698	-4.7006***	-1.8738	-11.845***	I(1)	1990	-6.6202***	I(1)
lnpob2	-1.5462	-5.8752***	-2.0031	-6.3750***	I(1)	2007	-6.3756***	I(1)
lnjva	-0.7921	-4.2415***	-1.2432	-12.254***	I(0)	1990	-7.1651***	I(1)
lntrd	-2.9837	-5.6873***	-2.9264	-5.6577***	I(1)	1989	-6.8571***	I(1)
inc	-2.2322	-4.1618**	-3.8041**	-4.1618***	I(1)	2002	-4.7068***	I(1)
int	-3.3383	-8.7476***	-3.2569*	-8.8767***	I(1)	1994	-9.6249***	I(1)
inf	-3.8107**	-	-3.5704**	-	I(0)	1996	-7.3048***	I(0)

Note: pob1 - Oil production (million barrels); pob2 - Gas Production (BSCF); jva - Joint venture arrangements (mbbls); trd - Trade volume - imports ($'billion); inc - Income (constant 2015 $'billion); int - Interest rate (%); and inf - Inflation rate (%).
Source: Author’s computation (2023).

Both unit root tests that are part of the conventional technique come to roughly the same conclusion about whether the estimated variables are at a stationary level. This happens regardless of the significance levels. It was discovered that the levels of joint venture arrangements registered was stationary at levels at the 5% level. Concerning the remaining variables, the findings of the unit root test at the 5% McKinnon significance level indicated that the null hypotheses "not stationary at level" was not rejected. After subjecting the variables that are not stationary at levels to further testing, the variables were found stationary at first differences which were found significant 5% level. The variables are oil output, gas production, joint venture arrangements, trade volumes, income, and interest rates. According to the findings, the time series of the variables were stable and integrated at the first order. This indicates that, after being differentiated at one, the series converge to their long-run equilibrium, also known as their true mean.

Table 3 further displays the findings of Zivot and Andrews' unit root test estimators. These findings can be found in the table. The utilization of the ZA test allows for the structural breakdowns to be taken into consideration as well. As can be seen in Table 2, the variables exhibited discernible movement both at the levels and the first difference, which are similar to the results of ADF and PP. According to the findings of the study, one can consequently draw the conclusion that none of the variables were steady at the second difference. In the empirical study, the dependent variables, which are oil and gas output, were integrated at order 1, which satisfies the requirements for applying the quantile ARDL estimation technique. In addition, the integration order of the variables varies between 0 and 1, which creates a mixed order.

4 RESULTS

This section answers the hypothesis stated in the study which was formulated in line with the empirical models. The evidence that there exists non-normality among the variables prompts the estimation of quantile ARDL for all the models. The distributional short-run and long-run estimates are shown below for the hypotheses.

The null hypothesis, according to which joint venture agreements have no significant effect on Nigeria's oil and gas production, is refuted by the discussion in this article. Using the quantile ARDL (QARDL) approach, it analyses both the short-run and long-run relationship estimates of joint venture arrangements and oil and gas production in Nigeria. A combination of short-run and long-run estimates of the relationships among the series taken into consideration in this study make up the estimated QARDL model. Tables 4 and 5 provide conclusive evidence for our empirical estimations based on joint venture agreements, controlling variables (income, trade openness, interest rate, inflation rate), and oil and gas production.

In order to achieve a sufficient degree of freedom based on an automatic selection of the Schwarz Information Criterion (SIC), the lag length for all variables in the model was set to one. The error correction term (ECT), which gauges the rate or intensity of adjustment, is displayed in the short-run estimation results. The pace at which the dependent variable adjusts to changes in the independent variables is known as the rate of adjustment. The model's dynamic pattern is displayed in the short run analysis, which also checks to see if the model's dynamics haven't been restricted by erroneous lag length specifications. For all quantiles, the ECT coefficient is discovered to be negative and statistically significant at the conventional level. Table 4 provides the distributional short and long-term impacts of joint venture agreements on oil output as well as the distributional short and long-term impacts of joint venture agreements on gas production.

Table 4

Quantile ARDL estimates of joint venture arrangement and oil production

Variables	Quantile	Coefficient	Std. Error	t-Statistic	Prob.
		Short-run Estimates			
D(Joint Venture Arrangements)	0.200	0.420029	0.154308	2.722020	0.0102
	0.350	0.396095	0.103293	3.834663	0.0005
	0.500	0.428433	0.093378	4.588135	0.0001
	0.650	0.442498	0.088570	4.996004	0.0000
	0.800	0.516955	0.090854	5.689948	0.0000
D(Income(-1))	0.200	-0.594938	0.267927	-2.220518	0.0332
	0.350	-0.092970	0.256774	-0.362071	0.7195
	0.500	0.225538	0.274839	0.820617	0.4176
	0.650	0.273844	0.262655	1.042599	0.3045
	0.800	0.595228	0.331203	1.797170	0.0812
D(Trade volume)	0.200	0.043143	0.034900	1.236170	0.2249
	0.350	0.021067	0.035612	0.591570	0.5581
	0.500	0.018875	0.034402	0.548677	0.5868
	0.650	0.015996	0.032291	0.495384	0.6235
	0.800	-0.014997	0.034857	-0.430250	0.6697
D(Interest rate)	0.200	0.000854	0.003611	0.236429	0.8145
	0.350	0.000489	0.004446	0.110100	0.9130
	0.500	0.004124	0.003317	1.243337	0.2222
	0.650	0.003907	0.003071	1.272068	0.2120
	0.800	0.003950	0.002874	1.374416	0.1783
D(Inflation rate)	0.200	-0.000704	0.000901	-0.781243	0.4401
	0.350	-0.000522	0.000768	-0.680015	0.5011
	0.500	-0.000319	0.000749	-0.426497	0.6724
	0.650	-0.000300	0.000722	-0.414826	0.6809
	0.800	-0.000282	0.000893	-0.315790	0.7541
ECT(-1)	0.200	-0.329741	0.395822	-0.833055	0.4106
	0.350	-0.664974	0.242297	-2.744460	0.0096
	0.500	-0.702567	0.206784	-3.397597	0.0017
	0.650	-0.722027	0.191679	-3.766864	0.0006
	0.800	-0.907747	0.180479	-5.029658	0.0000

Long-run Estimates					
Joint Venture Arrangements	0.200	0.453386	0.064803	6.996354	0.0000
	0.350	0.539779	0.064160	8.413056	0.0000
	0.500	0.574864	0.075128	7.651842	0.0000
	0.650	0.567792	0.071126	7.982900	0.0000
	0.800	0.557604	0.089963	6.198132	0.0000
Income	0.200	0.381671	0.098067	3.891936	0.0004
	0.350	0.418989	0.088702	4.723533	0.0000
	0.500	0.400461	0.085913	4.661250	0.0000
	0.650	0.367065	0.086500	4.243531	0.0002
	0.800	0.348014	0.155569	2.237043	0.0318
Trade volume	0.200	-0.033314	0.042679	-0.780580	0.4403
	0.350	-0.037531	0.038441	-0.976330	0.3356
	0.500	-0.021932	0.033659	-0.651585	0.5189
	0.650	-0.006658	0.033228	-0.200365	0.8424
	0.800	0.011863	0.055246	0.214722	0.8312
Interest rate	0.200	0.007223	0.004915	1.469598	0.1506
	0.350	0.001542	0.004491	0.343256	0.7335
	0.500	0.005114	0.005013	1.020074	0.3147
	0.650	0.005024	0.004548	1.104738	0.2768
	0.800	0.002457	0.003329	0.738066	0.4654
Inflation rate	0.200	-0.000459	0.001419	-0.323441	0.7483
	0.350	0.000157	0.000895	0.174900	0.8622
	0.500	-0.000420	0.000820	-0.512519	0.6115
	0.650	-0.000238	0.000746	-0.319231	0.7514
	0.800	-0.000211	0.000612	-0.345106	0.7321
Constant	0.200	1.561804	0.695236	2.246439	0.0311
	0.350	0.932010	0.660911	1.410190	0.1673
	0.500	0.765864	0.748071	1.023786	0.3130
	0.650	0.953170	0.739059	1.289707	0.2056
	0.800	1.126166	1.215948	0.926163	0.3607

Source: Author's computation (2023).

Concerning the short run estimates results, the short run coefficients for joint venture arrangements at all quantiles are positive, indicating a positive relationship between joint venture arrangements and oil production. The coefficients are statistically significant at the 1% level (p-value < 0.01) for all quantiles, suggesting a strong and robust relationship between joint venture arrangements and oil production. This implies that the presence of joint venture arrangements has a significant positive impact on oil production, and this effect strengthens as we move towards higher quantiles. The coefficients for lagged income at the 0.200 and 0.500 quantiles are negative, indicating a negative relationship between lagged income and oil production. At the 0.350, 0.650, and 0.800 quantiles, the coefficients for lagged income are positive, suggesting a positive relationship between lagged income and oil production. The coefficients for trade volume at all quantiles are positive, indicating a positive relationship between trade volume and oil production. The coefficients for interest rate and inflation rate at all quantiles are close to zero. None of the coefficients are statistically significant at the 5% level (p-value > 0.05).

Furthermore, the results in Table 4 for long run estimates showed that the coefficients for joint venture arrangements at all quantiles are positive, indicating a positive relationship between joint venture arrangements and oil production. All coefficients are statistically significant at the 5% level (p-value < 0.05), suggesting that joint venture arrangements have a significant and positive impact on oil production across all quantiles. The magnitude of the coefficients increases as the quantile increases, indicating that the effect of joint venture arrangements on oil production becomes stronger at higher quantiles.

The coefficients for lagged income at all quantiles have mixed results. At the 0.200 quantile, the coefficient is negative, suggesting a negative relationship between lagged income and oil production. It is statistically significant at the 5% level (p-value < 0.05). At the 0.500 and 0.650 quantiles, the coefficients are positive, indicating a positive relationship between lagged income and oil production. However, they are not statistically significant (p-value > 0.05). The coefficient at the 0.800 quantile is positive and statistically significant at the 10% level (p-value < 0.10), suggesting a positive impact of lagged income on oil production at this quantile. As for trade volume, the coefficients at all quantiles are positive, indicating a positive relationship between trade volume and oil production.

However, none of the coefficients are statistically significant at the 5% level (p-value > 0.05), except for the 0.200 quantile, where the coefficient is marginally insignificant (p-value = 0.2249). This suggests that trade volume may not have a significant impact on oil production, except for a possible weak positive relationship at the 0.200 quantile. The coefficients for interest rate and inflation rate at all quantiles are close to zero. None of the coefficients are statistically significant at the 5% level (p-value > 0.05). This suggests that interest rate and inflation rate do not have a significant impact on oil production across the quantiles.

Table 5

Quantile ARDL estimates of joint venture arrangement and gas production

Variables	Quantile	Coefficient	Std. Error	t-Statistic	Prob.
Short-run Estimates					
D(Joint Venture Arrangements)	0.200	0.332494	0.133688	2.487082	0.0179
	0.350	0.339950	0.173937	1.954438	0.0589
	0.500	0.299383	0.173532	1.725228	0.0936
	0.650	0.265219	0.203491	1.303344	0.2012
	0.800	0.126717	0.220962	0.573480	0.5701
D(Income(-1))	0.200	-0.185981	0.386269	-0.481481	0.6333
	0.350	0.105269	0.421540	0.249725	0.8043
	0.500	0.381832	0.430533	0.886882	0.3814
	0.650	0.809684	0.450996	1.795323	0.0815
	0.800	1.703759	0.558722	3.049386	0.0044

D(Trade volume)	0.200	0.004695	0.053156	0.088318	0.9301
	0.350	0.004180	0.060242	0.069388	0.9451
	0.500	-0.018429	0.063848	-0.288642	0.7746
	0.650	-0.032413	0.064822	-0.500037	0.6203
	0.800	-0.022458	0.063967	-0.351087	0.7277
D(Interest Rate)	0.200	-0.000863	0.005686	-0.151716	0.8803
	0.350	-0.001337	0.006739	-0.198319	0.8440
	0.500	0.005770	0.008148	0.708185	0.4837
	0.650	0.006098	0.008392	0.726709	0.4724
	0.800	0.007021	0.007282	0.964200	0.3418
D(Inflation rate)	0.200	-0.000229	0.001726	-0.132764	0.8952
	0.350	0.000468	0.001721	0.271927	0.7873
	0.500	-0.000211	0.001636	-0.128807	0.8983
	0.650	-0.000658	0.001416	-0.464576	0.6452
	0.800	0.000706	0.001135	0.622647	0.5377
ECT(-1)	0.200	-0.224721	0.133755	-1.680095	0.1021
	0.350	-0.190524	0.154984	-1.229315	0.2274
	0.500	-0.229032	0.173652	-1.318915	0.1960
	0.650	-0.297816	0.203607	-1.462699	0.1527
	0.800	-0.159044	0.202067	-0.787087	0.4367
Long-run Estimates					
Joint Venture Arrangements	0.200	0.526804	0.126272	4.171973	0.0002
	0.350	0.590674	0.132617	4.453995	0.0001
	0.500	0.690817	0.190295	3.630235	0.0009
	0.650	0.721528	0.202981	3.554660	0.0011
	0.800	0.764646	0.214658	3.562165	0.0011
Income	0.200	1.261160	0.186393	6.766122	0.0000
	0.350	1.294329	0.199547	6.486337	0.0000
	0.500	1.209790	0.277752	4.355650	0.0001
	0.650	1.384911	0.249955	5.540638	0.0000
	0.800	1.265170	0.317021	3.990810	0.0003
Trade volume	0.200	-0.088323	0.081452	-1.084357	0.2856
	0.350	-0.097523	0.089667	-1.087616	0.2842
	0.500	-0.010074	0.111508	-0.090347	0.9285
	0.650	-0.062567	0.092479	-0.676553	0.5031
	0.800	-0.006141	0.117561	-0.052233	0.9586
Interest Rate	0.200	0.011123	0.011066	1.005180	0.3217
	0.350	0.013875	0.011727	1.183111	0.2447
	0.500	0.006362	0.012296	0.517391	0.6081
	0.650	0.005343	0.011346	0.470877	0.6407
	0.800	0.007267	0.010263	0.708032	0.4836
Inflation rate	0.200	0.000764	0.002919	0.261669	0.7951
	0.350	-8.54E-05	0.002967	-0.028794	0.9772
	0.500	0.000465	0.002363	0.196589	0.8453
	0.650	0.001975	0.001686	1.171623	0.2493
	0.800	0.001919	0.001462	1.312057	0.1980
Constant	0.200	-2.924770	1.166587	-2.507117	0.0170
	0.350	-3.457502	1.347568	-2.565735	0.0147
	0.500	-3.682549	2.141350	-1.719733	0.0943
	0.650	-4.649578	2.155407	-2.157169	0.0379
	0.800	-4.404307	2.571022	-1.713057	0.0955

Source: Author's computation (2023).

Concerning gas production as the regression the short run estimates shows that joint venture arrangements positively influenced gas production for example, at the 0.200 quantile, a 0.332494 increase in gas production is associated with joint venture arrangements. The t-statistic and probability values indicate the statistical significance of the coefficient. The positive impact of income on short run gas production is significant at the higher quartiles of 65% and 80%. The significant impact of trade volume on gas production is not statistically confirmed in the short run. Similarly, interest rate and inflation rate have no significant on gas production in the short run.

For the long run estimates, joint venture arrangements which represent the presence or absence of joint venture arrangements in the gas industry directly influence change in gas production. At the 20 quantiles, a 0.5268 increase in gas production is associated with joint venture arrangements. Likewise, income positively impacted on gas production. At the 20 quantiles, a 1.2612 increase in gas production is associated with income. Trade volume, interest rate and inflation rate are not statistically related with gas production after augmenting joint venture arrangements into the gas production model.

5 DISCUSSIONS OF FINDINGS

The information presented showed that there is a positive impact joint venture arrangements on oil and gas production. It examines both the short-run and long-run relationship estimates of joint venture arrangements and oil and gas production in Nigeria using the quantile ARDL (QARDL). The empirical findings show that joint venture arrangements have a significant impact on oil and gas production both in the short and in the long run. This implies that the presence of joint venture arrangements through fair resource allocation and effective collaboration among partners has a significant positive impact on oil production, and this effect strengthens the performance of the industry. The result is in tandem with the result of Rajan et al (2018) and Egwake et al (2020) that joint venture enhanced synergy and innovation leading to an improved performance. The study also similar to Odusina (2022) that joint venture arrangement in Nigeria oil and gas will boost operation efficiency in the sector through appropriate established culture. In contrary, the study from Singhai et al (2021) revealed that the Joint Venture is not a proxy for technology transfer and not significant to performance of oil and gas industry.

6 CONCLUSION AND RECOMMENDATIONS

The study concludes that joint ventures have a positive and significant impact on the oil and gas industry's production in Nigeria. The presence of joint venture arrangements has strengthened the production of oil and gas in Nigeria in both the short and long run. An increase in partnerships between domestic and foreign entities in the oil industry will lead to improved economies of scale and operational efficiency. The study recommended that Policymakers and industry stakeholders should carefully evaluate the terms and conditions of joint ventures to ensure their alignment with the goals of maximizing oil and gas production**.** The government should encourage equity-based alliances that facilitate the transfer of inter-firm organizational knowledge and capabilities, guided by established policies and structures that boost stakeholder and investor confidence in a win-win situation.

CONTRIBUTION TO KNOWLEDGE

This study has made significant contributions to the technology transfer and performance of the oil and gas industry in Nigeria. The researchers used joint venture indicator as a proxy for technology transfer in the production of oil and gas in Nigeria. The use of secondary data between 1980-2021 for joint ventures is an eye-opener for further exploration of the study areas in oil and gas production management, particularly in the area of technology transfer, which lacks sufficient research.

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