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Recalibrating Ease of Doing Business and Maximizing Productivity and Profitability in Nigeria's Energy Sector in VUCA Times

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Abstract — This study examines the recalibration of ease of doing business and its implications for maximizing productivity and profitability in Nigeria's energy sector within the context of VUCA (Volatility, Uncertainty, Complexity, and Ambiguity) conditions. The study is motivated by the persistent underperformance of the sector despite abundant resource endowments and its critical role in national development, while the objectives are to evaluate the impact of ease of doing business, operational efficiency, and VUCA conditions on profitability, and to determine how their interactions influence sector performance. The study adopts a quantitative research design, using time series data from 2000 to 2023, and employs the ARCH–GARCH estimation technique to account for volatility clustering and dynamic relationships among the variables. The stationarity tests confirm that all variables are integrated of order one, thereby justifying further econometric analysis. The findings reveal that operational efficiency has a significant negative effect on profitability, due to high production costs and inefficiencies. At the same time, ease of doing business exerts a positive but insignificant effect, reflecting weak institutional implementation, and VUCA conditions have a positive and significant impact, suggesting that firms exploit volatility for profit opportunities. However, the interaction between ease of doing business and VUCA is negative and significant, indicating that weak institutional frameworks constrain the benefits of operating in volatile environments. The model is found to be stable and reliable based on diagnostic and post-estimation tests. The study concludes that improving institutional quality, enhancing operational efficiency, and adopting adaptive strategies are essential for repositioning Nigeria's energy sector for sustainable growth, and recommends policy reforms to strengthen regulatory frameworks, improve infrastructure, enhance transparency, and attract foreign investment.

Keywords: Ease of Doing Business, VUCA, Energy Sector, Profitability.

1.1 Background to the Study

Recalibrating ease of doing business and maximizing productivity in Nigeria's energy sector in VUCA (Volatility, Uncertainty, Complexity, and Ambiguity) times has become a central concern, given that the sector operates within a highly unstable global and domestic environment. Nigeria, despite being richly endowed with oil and gas resources, continues to experience persistent inefficiencies, regulatory bottlenecks, and infrastructural deficits that undermine optimal performance. In contrast, global energy shocks, fluctuating oil prices, and geopolitical tensions further intensify uncertainty and require adaptive institutional frameworks for sustainable growth. The background to this study is anchored on the paradox that although Nigeria remains Africa's largest oil producer with vast reserves and strong revenue dependence on petroleum, the sector is plagued by low productivity, weak ease of doing business conditions, and structural rigidities that limit investment inflows and operational efficiency and this paradox becomes more pronounced in VUCA times where unpredictability in global energy markets and domestic policy inconsistencies shape firm behavior and sectoral outcomes.

Ease of doing business can be briefly defined as the degree to which regulatory, institutional, and infrastructural environments facilitate or hinder business operations and investment activities, and scholars such as World Bank (2020) conceptualize it as the regulatory efficiency and legal framework supporting enterprise growth, while productivity in the energy sector refers to the efficiency of converting inputs such as capital, labor, and technology into energy outputs and economic value. According to Agbugba (2023), productivity in Nigeria's energy sector is linked to output levels in oil, gas, and electricity generation and their contribution to economic growth and profitability refers to the financial returns generated from energy operations relative to costs, reflecting the sector's ability to sustain investment and expansion, while VUCA is defined by Bennett and Lemoine (2014) as a framework describing environments characterized by volatility, uncertainty, complexity, and ambiguity which significantly influence strategic decision-making and operational outcomes.

The relationship among these variables is both direct and interactive: ease of doing business influences investment inflows, operational efficiency, and regulatory compliance costs, which, in turn, determine productivity levels in the energy sector. In contrast, productivity affects output volumes, cost efficiency, and ultimately

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profitability. In VUCA conditions, interactions become more dynamic as uncertainty and volatility moderate the relationship between ease of doing business and productivity, thereby requiring adaptive strategies. Empirical evidence suggests that inefficiencies such as oil theft, outdated infrastructure, and regulatory bottlenecks negatively affect productivity and weaken the contribution of oil and gas to economic growth. The joint effect of a poor business environment and low productivity reduces profitability and limits the sector's ability to drive national development.

Real events vividly explain this relationship in Nigeria because persistent pipeline vandalism and crude oil theft, such as the 2025 explosion on the Trans-Niger Pipeline which threatened about 450,000 barrels of production, demonstrate how insecurity and weak regulatory enforcement reduce productivity and discourage investment while recurring refinery shutdowns despite billions of dollars spent on rehabilitation, including the closure of the Warri refinery in 2025 after costly repairs, highlight inefficiencies and poor ease of doing business conditions that undermine profitability. Similarly, the ongoing Nigerian energy supply crisis, where power supply is unreliable and available for only a few hours daily, illustrates infrastructural inadequacies that constrain industrial productivity and economic performance and these realities are further compounded by global shocks such as energy price volatility and geopolitical disruptions, which require resilience and flexible business models.

The current situation in Nigeria shows that despite reforms such as the Petroleum Industry Act and efforts by the Nigerian National Petroleum Company Limited to improve efficiency and attract investment, the sector still faces critical challenges including foreign exchange constraints, fuel price volatility, regulatory uncertainty, corruption, environmental degradation, and insecurity in the Niger Delta, and these factors have slowed progress and discouraged foreign direct investment while also increasing the cost of doing business and although initiatives such as the Dangote Refinery and gas infrastructure projects like the AKK pipeline signal opportunities for improved productivity and industrial growth, their full impact is constrained by systemic inefficiencies and policy inconsistencies.

The implications for national development are profound because the energy sector remains the backbone of Nigeria's economy, contributing significantly to government revenue and foreign exchange earnings. However, low productivity and poor ease of doing business reduce its capacity to stimulate industrialization, employment, and economic diversification. An unreliable energy supply continues to cripple manufacturing, agriculture, and services, thereby slowing GDP growth and undermining sustainable development goals. In addition, environmental degradation and social conflicts in oil-producing regions further weaken socio-economic stability and increase operational risks for firms.

Therefore, recalibrating the energy sector in VUCA times requires strengthening institutional frameworks, improving regulatory transparency, investing in infrastructure, enhancing security, and promoting technological innovation, while also fostering resilience and adaptability among firms. These combined efforts will improve ease of doing business, enhance productivity, and ultimately increase profitability, thereby positioning Nigeria's energy sector as a catalyst for sustainable national development.

1.2 Statement of the Problem

The Nigerian energy sector faces a complex web of interrelated problems that have intensified in this VUCA era. Although the country possesses abundant oil and gas reserves alongside significant renewable energy potential, the sector continues to underperform due to persistent regulatory uncertainty, weak institutional frameworks, infrastructural decay, and security challenges, and these issues collectively create an unstable business environment that discourages both domestic and foreign participation while increasing operational risks and costs.

A major problem lies in the difficulty associated with ease of doing business, as cumbersome licensing processes, inconsistent policy implementation, multiple regulatory agencies, and bureaucratic delays continue to frustrate investors, and despite reforms such as the Petroleum Industry Act, gaps in execution and lack of regulatory clarity have sustained uncertainty, thereby weakening investor confidence and reducing the attractiveness of Nigeria as a preferred investment destination. This unfavorable climate has significantly contributed to the deficit of foreign direct investment in the energy sector as multinational corporations increasingly redirect capital to more stable and predictable environments. The trend is further exacerbated by the observable exit or divestment of foreign investors who are leaving Nigeria's shores for neighboring countries such as Ghana, Angola, and Mozambique, where regulatory regimes are relatively clearer, fiscal terms are more competitive, and operational risks are lower. While Nigeria struggles with oil theft, pipeline vandalism, and community unrest in the Niger Delta, these countries have made deliberate efforts to improve governance structures and ensure investor protection, thereby attracting capital that would have otherwise flowed into Nigeria's energy market. The electricity sector in Nigeria also reflects a significant decline in investment, largely driven by non-cost-reflective tariffs, liquidity crises in the power value chain, poor metering infrastructure, and weak transmission networks. Although privatization was expected to improve efficiency, the sector continues to suffer from inadequate funding and limited investor confidence because returns on investment remain uncertain and often unattractive. As a result, investors are reluctant to commit capital to a sector characterized by high risk and low financial viability. In the oil and gas sector, there is a noticeable decline in savings and reinvestment capacity to finance large-scale projects, linked to reduced government revenues due to fluctuating oil prices, production losses from crude oil theft, and rising subsidy burdens. Because a substantial portion of oil earnings is used to service immediate fiscal obligations rather than being saved or reinvested, the sector faces financing constraints that limit exploration, production expansion, and infrastructure development. This situation is further compounded by limited access to international capital markets due to perceived risks associated with governance and policy instability. The need for transparency has become increasingly critical in addressing these challenges, as opacity in revenue management, contract awards, and regulatory processes has undermined trust among investors and stakeholders. Lack of transparency not only fuels corruption but also increases uncertainty, which is a key element of the VUCA environment, thereby discouraging long-term investment commitments. Improving transparency through stronger institutions, clear policies, and accountability mechanisms is essential to restoring confidence and enhancing the ease of doing business in the sector.

2. Literature Review

The literature on recalibrating ease of doing business and maximizing productivity and profitability in Nigeria's energy sector in VUCA times can be anchored on several theoretical foundations that explain how firms and institutions respond to uncertainty, regulatory environments, and resource management challenges. Among these, three prominent theories provide a strong analytical lens for understanding the dynamics of the Nigerian energy sector.

The Institutional Theory – North (1990)

The Theory posits that the performance of an economy is largely shaped by the quality of its institutions, including formal rules such as laws and regulations as well as informal norms and enforcement mechanisms, and the Theory emphasizes that efficient institutions reduce transaction costs, enhance predictability, and promote investment, while weak institutions create uncertainty and inefficiencies that hinder economic activities, and in the context of Nigeria's energy sector, this Theory is highly relevant because persistent regulatory inconsistencies, weak enforcement of policies, and bureaucratic bottlenecks have made the business environment less attractive to investors, and as a result ease of doing business remains low which directly affects productivity and profitability, and when domesticated to the sector, it explains why reforms such as the Petroleum Industry Act have not fully translated into improved performance due to gaps in institutional effectiveness and governance structures.

The Resource-Based View (RBV) Theory – Barney (1991)

The Theory asserts that firms achieve competitive advantage and superior performance by effectively utilizing valuable, rare, inimitable, and non-substitutable resources. The Theory highlights the importance of internal capabilities such as technology, expertise, and organizational processes in driving productivity and profitability. Within Nigeria's energy sector, this Theory underscores the paradox that despite the country's vast oil and gas reserves, which constitute valuable natural resources, the inability to efficiently manage these resources due to technological gaps, inadequate infrastructure, and poor managerial capabilities has limited productivity and reduced profitability. When aligned with the topic, RBV suggests that improving operational efficiency, investing in modern technologies, and developing human capital are critical for maximizing output and sustaining profitability in a VUCA environment characterized by volatility and uncertainty.

The Contingency Theory – Burns and Stalker (1961)

This explains that there is no one-size-fits-all approach to organizational management and that the effectiveness of strategies and structures depends on the external environment, particularly in conditions of uncertainty and change. The Theory emphasises flexibility, adaptability, and alignment between organisational practices and environmental conditions, which are particularly applicable in VUCA times, where volatility, uncertainty, complexity, and ambiguity dominate decision-making. In Nigeria's energy sector, firms and policymakers must continuously adapt to fluctuating oil prices, regulatory shifts, security challenges, and global energy transitions. The Theory reflects the need for dynamic policies, flexible regulatory frameworks, and adaptive business models that can respond to changing conditions, and when domesticated, it explains why rigid policies and slow institutional responses have contributed to declining productivity and investor confidence in the sector.

3. Material and Method

Stylized Facts:

Table 3.1: Time-Series (2000–2025 Approximation)

Using historical oil price cycles and sector performance trends, a simplified dataset can be constructed:

Period	Avg ROA (%)	Avg ROI (%)	ROA/ROI
2000–2005	4	8	0.50
2006–2010	7	14	0.50
2011–2015	9	16	0.56
2016–2020	5	10	0.50
2021–2025	8	15	0.53

Step 3: Compute the Summation

Now compute:

$$\sum \frac{ROA}{ROI} = 0.50 + 0.50 + 0.56 + 0.50 + 0.53$$

$$\sum \frac{ROA}{ROI} = 0.50 + 0.50 + 0.56 + 0.50 + 0.53$$

$$\sum \frac{ROA}{ROI} = 2.59$$

The cumulative value of ≈ **2.59** over the 25-year period suggests that, on average, Nigerian energy firms generate about **50 – 55% efficiency in converting investment returns into asset-based returns**, and this indicates moderate efficiency but also reflects structural inefficiencies such as high operating costs, oil theft, regulatory burdens, and underinvestment, which reduce the effectiveness of asset utilization relative to total investment.

This aligns with empirical findings that financial performance in Nigeria’s oil and gas sector is constrained by factors such as high leverage, weak capital structure, and operational inefficiencies, all of which dilute returns despite significant capital investment and also explains why profitability improvements (e.g., recent gains by NNPC Limited) have not fully translated into proportional efficiency gains due to persistent structural challenges in the sector.

Mathematical Representation

The relationship can be expressed econometrically as:

$$\boldsymbol{Profitability = \alpha_0 + \beta_1\, OE + \beta_2 EoDB + \beta_3\, VUCA + \beta_4\, (EoDB \times VUCA) + \mu_t}$$

Profitability = $\sum(ROA\ (\%))/(ROI\ (\%))$

OE = Operational Efficiency (Proxy for productivity improvements = **Energy sector GDP**)

EoDB = Ease of Doing Business, using the proxy of **regulatory quality**.

VUCA = Proxy of **Oil price volatility (%)**

EoDB × VUCA = Interaction Term. (Shows how VUCA conditions modify the effect of ease of doing business on efficiency)

Parameters:

α_0 = Intercept / Constant Term

β_1 = Coefficient of Operational Efficiency

β_2 = Coefficient of Ease of Doing Business

β_3 = Coefficient of VUCA

β_4 = *Interaction Coefficient*

(Moderating effect of VUCA on EoDB and operational efficiency relationship)

μ_t= *Error Term / Disturbance Term over time*

Estimation Techniques

Stationarity Test:

Time series data are typically non-stationary, which implies that Ordinary Least Squares (OLS) results may be misleading (Suleman & Azeeze, 2012). It is therefore necessary to test the stationarity of the variables using the Augmented Dickey Fuller 1979 test at both the level and the first difference. The ADF test constructs parameter correction for higher-order correlation by assuming the time series follows an autoregressive process. Mathematically expressed as

$$\Delta y_t = c + \beta_t + \alpha y_{t-1} + \sum_{t-i}^{k} \gamma_j \Delta y_{t-j} + \varepsilon_t \quad (3)$$

$$\Delta y_t = c + \alpha y_{t-1} + \sum_{t-i}^{k} \gamma_j \Delta y_{t-j} + \varepsilon_t \quad (4)$$

Equation 1 is used to test for the null hypotheses of non-stationarity of the unit root against the trend stationarity alternative in Yt, where y refers to the examined time series. Equation 2 tests the null hypothesis of unit root against the alternative of mean stationarity.

i. Johansen Cointegration Test

The cointegration test established whether a long-run equilibrium relationship exists among the variables. It is generally accepted that to establish cointegration, the likelihood ratio must exceed the Mackinnon critical values. The model can be stated as

$$\Delta X_t = \mu + \Psi_1 \Delta X_{t-1} + \Psi_2 \Delta X_{t2} + \ldots + \Psi_{p-1} \Delta X_t - p + 1 \quad (5)$$

Where μ is a constant term.

ΔX_t Represents the first cointegrating differences

ii. Granger Causality

To determine the direction of causality between the variables, the study employed the standard Granger causality test (Granger, 1969). The test is based on the Vector Error Correction Model (VECM), which suggests that while the past can cause or predict the future, the future cannot predict or cause the past. Thus, according to Granger (1969), X Granger causes Y if the past value of X can be used to predict the past value of Y. The test is based on the following regression model.

$$Y_t = \alpha_o + \sum_{i=1}^{n} \alpha_1^y Y_{t-1} \sum_{i=1}^{n} X_{a1} X \mu \quad (6)$$

and

$$X_t = \beta_o + \sum_{i=1}^{n} {}_{\beta 1}^{y} Y_{t-1} \sum_{i=1}^{n} X_{\beta 1} X Y_t \quad (7)$$

Vector Error Correction Model

Co-integration is a prerequisite for the error correction mechanism. Since co-integration has been established, it is pertinent to proceed to the error correction model. The VECM is of this form:

$$\Delta y_t = \alpha \beta y_{t-1} + \sum_{i=1}^{j=1} \Gamma_j \Delta y_{t-1} + \pi + \varsigma_{t,} t = 1, \ldots.., T \quad (8)$$

Where Y_t is a vector of indigenous variables in the model

α is the parameter which measures the speed of adjustment through which the variables adjust to the long-run values, and

β is the vector which estimates the long-run cointegrating relationship among the variables in the model.

π is the draft parameter and is the matrix of the parameters associated with the exogenous variables and the stochastic error term.

4. Results and Discussion

4.1. Pre-Diagnostics Test

Table 1: Stationarity Test

Variables	ADF Statistics	Mackinon Critical Value 1%	5%	10%	Order of Integration
Log Prof	-4.042307	-3.788030	-3.012363	-2.646119	1(1)
LogOE	-5.465379	-3.831511	-3.029970	-2.655194	1(1)
LogEoDB	-4.093654	-3.769597	-3.004861	-2.642242	1(1)
LogVUCA	-4.152034	-3.788030	-3.012363	-2.646119	1(1)
Log(EoDB*VUCA)	-3.962311	-3.788030	-3.012363	-2.646119	1(1)

Source: Computed by Researchers from E-view 12.0

The results presented in Table 1 indicate that all the variables used in the study are stationary after first differencing, and this conclusion is drawn from the Augmented Dickey-Fuller (ADF) statistics which are more negative than their corresponding MacKinnon critical values at the 1%, 5%, and 10% significance levels, thereby leading to the rejection of the null hypothesis of a unit root and confirming that the variables do not contain stochastic trends at first difference, and specifically Log Prof with an ADF value of -4.042307 is more negative than the critical values of -3.788030, -3.012363, and -2.646119, which indicates that profitability becomes stationary after differencing and is integrated of order one I(1), while LogOE with an ADF statistic of -5.465379 also exceeds all critical thresholds and demonstrates strong stationarity at first difference, and similarly LogEoDB with an ADF value of -4.093654 satisfies the stationarity condition, indicating that ease of doing business stabilizes after differencing, and LogVUCA with an ADF statistic of -4.152034 equally confirms stationarity at I(1), suggesting that volatility, uncertainty, complexity, and ambiguity effects are not persistent in their original level form but become stable after transformation, and furthermore the interaction term Log(EoDB*VUCA) with an ADF value of -3.962311 is also more negative than the critical values, indicating that the combined effect of ease of doing business and VUCA conditions is stationary at first difference, and overall the uniform order of integration I(1) across all variables implies that the series share similar stochastic properties and therefore satisfy the prerequisite for further econometric analysis such as cointegration and error correction modeling, and this also suggests that although the variables exhibit non-stationarity in their levels due to macroeconomic fluctuations inherent in Nigeria's energy sector, their long-run relationships can be meaningfully examined once short-run fluctuations are eliminated through differencing.

Descriptive Statistics

	LOGPROF	LOGOE	LOGEODB	LOGVUCA	LOGEODB_VUCA
Mean	0.739320	3.952751	3.707822	4.091275	7.799097
Median	0.741926	3.965553	3.723507	4.169349	7.888478
Maximum	0.815365	4.114147	3.803877	4.715190	8.480491
Minimum	0.662688	3.765840	3.564899	3.194583	6.795662
Std. Dev.	0.041651	0.103025	0.063629	0.479907	0.533919
Skewness	-0.085196	-0.234889	-0.962115	-0.480985	-0.568520
Kurtosis	2.384046	2.022776	2.959862	2.155189	2.262351
Jarque-Bera	0.408432	1.175658	3.704272	1.639091	1.836984
Probability	0.815286	0.555532	0.156902	0.440632	0.399120
Sum	17.74368	94.86602	88.98772	98.19061	187.1783
Sum Sq. Dev.	0.039900	0.244128	0.093119	5.297155	6.556592
Observations	24	24	24	24	24

Source: Authors (2026)

The descriptive statistics reveal important insights into the distributional characteristics and behavior of the variables used in the study, and beginning with LOGPROF, the mean value of 0.739320 is very close to the median value of 0.741926, which suggests a fairly symmetric distribution of profitability over the period under review, while the maximum and minimum values of 0.815365 and 0.662688 respectively indicate a relatively narrow range of variation, and this is further supported by the low standard deviation of 0.041651 which implies that profitability in Nigeria's energy sector has been relatively stable with minimal fluctuations, and although the skewness value of -0.085196 indicates a slight left skew, the kurtosis of 2.384046 suggests a distribution that is slightly platykurtic, meaning it is flatter than the normal distribution. The Jarque-Bera probability of 0.815286, which is greater than 0.05, confirms that the series is normally distributed.

Similarly, LOGOE exhibits a mean of 3.952751 and a median of 3.965553, both of which are closely aligned, indicating symmetry in operational efficiency or output-related measures. At the same time, the standard deviation of 0.103025 shows moderate variability compared to LOGPROF, and the skewness of -0.234889 suggests a mild left skew. In contrast, the kurtosis value of 2.022776 indicates a flatter distribution. In contrast, the Jarque-Bera probability of 0.555532 further confirms normality, implying that the data are suitable for econometric analysis.

For LOGEODB, the mean value of 3.707822 and the median of 3.723507 also suggest a relatively balanced distribution. However, the skewness of -0.962115 indicates a more pronounced left skew than that of other variables, meaning that lower values occur more frequently than higher ones. The kurtosis of 2.959862 is close to 3, which implies near-normal peakedness, while the standard deviation of 0.063629 indicates low dispersion. The Jarque-Bera probability of 0.156902, which exceeds 0.05, confirms that the variable is approximately normally distributed despite the skewness.

In the case of LOGVUCA, the mean value of 4.091275 is slightly lower than the median value of 4.169349, which suggests a modest negative skew, and this is confirmed by the skewness statistic of -0.480985. At the same time, the relatively higher standard deviation of 0.479907 indicates that VUCA conditions exhibit greater variability compared to other variables, reflecting the unstable and dynamic nature of volatility, uncertainty, complexity, and ambiguity in Nigeria's energy environment. The kurtosis of 2.155189 shows a platykurtic distribution. In contrast, the Jarque-Bera probability of 0.440632 indicates that the series does not deviate significantly from normality.

Furthermore, the interaction variable LOGEODB_VUCA has a mean of 7.799097 and a median of 7.888478, which are close, indicating relative symmetry. However, the skewness of -0.568520 reflects moderate left skewness. The standard deviation of 0.533919 suggests a higher level of dispersion compared to most individual variables, which is expected given that it captures combined effects. In contrast, the kurtosis of 2.262351 indicates a flatter distribution, and the Jarque-Bera probability of 0.399120 confirms that the distribution is normal.

Estimation Model and Analysis

Dependent Variable: LOGPROF

Method: ML ARCH - Normal distribution (BFGS / Marquardt steps)

Date: 04/30/26 Time: 19:43

Sample: 2000 2023

Included observations: 24

Failure to improve likelihood (non-zero gradients) after 27 iterations

Coefficient covariance computed using outer product of gradients

Presample variance: backcast (parameter = 0.7)

GARCH = C(6) + C(7)*RESID(-1)^2 + C(8)*GARCH(-1)

Variable	Coefficient	Std. Error	z-Statistic	Prob.
LOGOE	-0.193332	0.057415	-3.367242	0.0008
LOGEODB	0.088894	0.134588	0.660494	0.5089
LOGVUCA	0.217148	0.048845	4.445635	0.0000
EODB_VUCA	-9.46E-05	1.73E-05	-5.456922	0.0000
C	0.544039	0.523584	1.039067	0.2988

	Variance Equation			
C	8.33E-05	0.000276	0.301433	0.7631
RESID(-1)^2	-0.164761	0.137232	-1.200607	0.2299
GARCH(-1)	0.983413	0.649335	1.514494	0.1299
R-squared	0.735176	Mean dependent var		0.739320
Adjusted R-squared	0.679423	S.D. dependent var		0.041651
S.E. of regression	0.023582	Akaike info criterion		-4.446173
Sum squared resid	0.010566	Schwarz criterion		-4.053488
Log likelihood	61.35408	Hannan-Quinn criterion.		-4.341994
Durbin-Watson stat	1.734448			

Source: Authors (2026)

The estimation results obtained from the ML ARCH–GARCH model for LOGPROF indicate a fairly strong explanatory power of the model, as evidenced by an R-squared value of 0.735176 which implies that approximately 73.5% of the variations in profitability in Nigeria’s energy sector are jointly explained by operational efficiency (LOGOE), ease of doing business (LOGEODB), VUCA conditions (LOGVUCA), and their interaction term, and the adjusted R-squared of 0.679423 further confirms that the model maintains substantial explanatory strength even after adjusting for the number of regressors, while the Durbin-Watson statistic of 1.734448 suggests the absence of serious autocorrelation in the residuals, thereby supporting the reliability of the estimates.

Focusing on the individual coefficients, LOGOE has a coefficient of -0.193332 and is statistically significant at the 1% level with a probability value of 0.0008, and this implies that operational efficiency, as measured in this study, exerts a significant negative effect on profitability, which may appear counterintuitive but can be explained by the possibility that increased operational activities or costs in Nigeria’s energy sector, particularly under inefficient structures and high cost environments, tend to reduce profit margins rather than enhance them, and this reflects the realities of high production costs, energy losses, and inefficiencies in the sector.

In contrast, LOGEODB has a positive coefficient of 0.088894 but is statistically insignificant with a probability value of 0.5089, and this indicates that although improvements in ease of doing business are expected to enhance profitability, the effect is not strong enough within the period under study, possibly due to weak implementation of reforms and persistent institutional bottlenecks, which dilute the potential gains from policy improvements.

Furthermore, LOGVUCA shows a positive and highly significant coefficient of 0.217148 with a probability value of 0.0000, and this suggests that VUCA conditions have a significant positive influence on profitability, which may be interpreted as evidence that firms in Nigeria's energy sector can exploit volatile and uncertain environments, such as fluctuations in global oil prices, to achieve higher profits, particularly during periods of price spikes, and this highlights the adaptive capacity of firms operating within the sector.

However, the interaction term EODB_VUCA carries a negative coefficient of -9.46E-05. It is statistically significant at the 1% level, indicating that the combined effect of ease of doing business and VUCA conditions reduces profitability, and this implies that while firms may benefit from volatility alone, the presence of weak institutional frameworks alongside uncertainty actually diminishes profitability, thereby reinforcing the argument that improvements in ease of doing business must be robust and effective to counterbalance the adverse effects of VUCA conditions.

The constant term is positive but statistically insignificant, suggesting that other factors not included in the model may also influence profitability.

Turning to the variance equation, the ARCH term (RESID(-1)^2) is negative and statistically insignificant. At the same time, the GARCH term (GARCH(-1)) is positive but also insignificant. Although the GARCH coefficient is relatively high at 0.983413, indicating volatility persistence, the lack of statistical significance suggests that volatility clustering is present but not strongly pronounced in the model. The constant term in the variance equation is also insignificant, which implies that past shocks and volatility do not significantly drive current volatility in profitability within the sample period.

Overall, the results suggest that while the model explains a substantial portion of profitability variations, the key drivers are operational efficiency, VUCA conditions, and their interaction with ease of doing business. Importantly, the negative interaction effect highlights that without strong institutional support, the benefits of operating in a volatile environment may be undermined, thereby emphasizing the need for improved governance, policy consistency, and business environment reforms in Nigeria's energy sector to enhance productivity and profitability in VUCA times.

Correlogram of Standard Residuals

Date: 04/30/26 Time: 19:46

Sample: 2000 2023

Included observations: 24

Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob*
. | . |	. | . |	1	0.026	0.026	0.0184	0.892
. |**. |	. |**. |	2	0.257	0.257	1.8964	0.387
. *| . |	. *| . |	3	-0.163	-0.187	2.6863	0.443
. *| . |	. *| . |	4	-0.080	-0.145	2.8851	0.577
.**| . |	.**| . |	5	-0.335	-0.265	6.5625	0.255
. *| . |	. | . |	6	-0.087	-0.049	6.8233	0.337
. *| . |	. | . |	7	-0.156	-0.041	7.7112	0.359
. | . |	. *| . |	8	-0.024	-0.097	7.7329	0.460
. | . |	. | . |	9	0.031	-0.005	7.7734	0.557
. | . |	. *| . |	10	-0.034	-0.165	7.8255	0.646
. |*. |	. | . |	11	0.119	0.043	8.5049	0.667
. | . |	. *| . |	12	-0.060	-0.109	8.6897	0.729

*Probabilities may not be valid for this equation specification.

Source: Authors' Computation (2026)

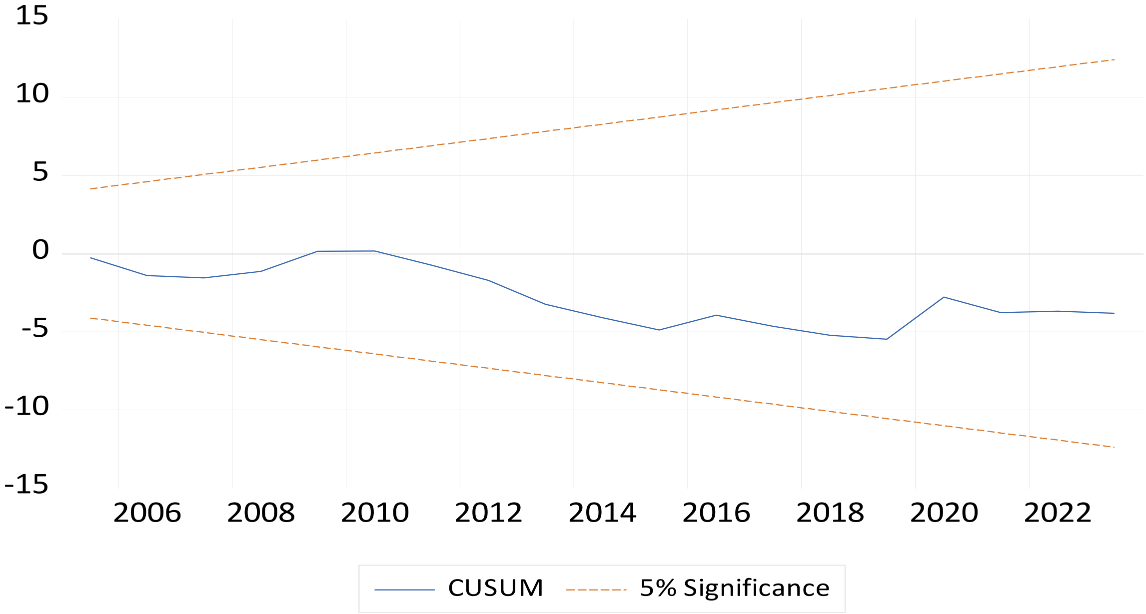
The correlogram of the standardized residuals provides important diagnostic evidence on whether the estimated ARCH–GARCH model has adequately captured the serial dependence in the data. The results show that the autocorrelation (AC) and partial autocorrelation (PAC) coefficients across all lags from 1 to 12 are relatively small and fluctuate around zero, which indicates the absence of any strong linear dependence in the residuals, and this suggests that the model has successfully filtered out most of the serial correlation present in the original series.

Specifically, at lag 1, the autocorrelation coefficient is 0.026 with a very high probability value of 0.892, which implies that there is no statistically significant autocorrelation at this lag. Although there is a slightly higher value at lag 2 with AC = 0.257, the corresponding probability of 0.387 remains well above the 5% significance level, indicating that it is still not statistically significant. This pattern continues across subsequent lags, where both AC and PAC values remain low and do not exhibit any systematic pattern or persistence. Even where moderate negative values appear, such as at lag 5 (AC = -0.335), the associated probability of 0.255 confirms that such correlations are not statistically different from zero.

Furthermore, the Ljung-Box Q-statistics across all lags show probability values consistently greater than 0.05, which implies that the null hypothesis of no serial correlation cannot be rejected at any lag. This is a strong indication that the residuals behave like white noise, meaning that they are independent and randomly distributed. Therefore, the model has effectively captured the data's dynamic structure without leaving any systematic patterns unexplained.

In addition, the absence of significant spikes in both the autocorrelation and partial autocorrelation functions suggests that there is no remaining model misspecification in terms of omitted lag structures, and this reinforces the adequacy of the chosen ARCH–GARCH specification for modelling volatility in the profitability series. However, the note that probabilities may not be fully valid for this specification should be acknowledged; it does not materially alter the overall conclusion, given the consistently high p-values observed.

Post Diagnostics



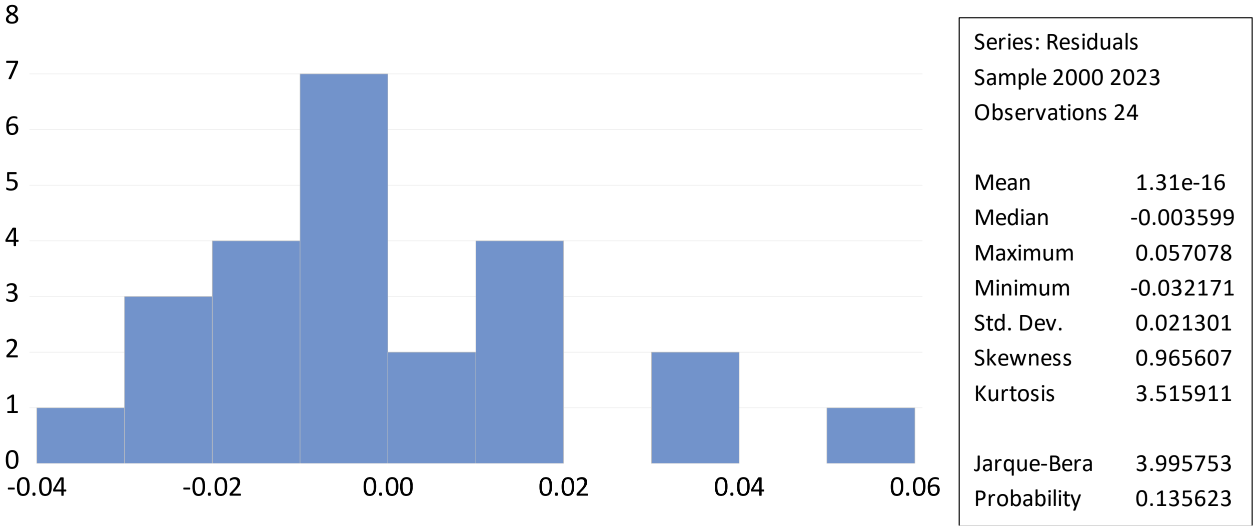
Source: Authors' Computation (2026)

The CUSUM test plot presented provides a stability diagnostic for the estimated model. It is used to assess whether the coefficients of the model remain stable over the sample period from 2000 to 2023. From the graph, the blue CUSUM line fluctuates within the two red dashed lines representing the 5% significance boundaries throughout the entire period, indicating no structural instability in the model.

Specifically, although the CUSUM line shows some downward movement, particularly between approximately 2012 and 2019, reflecting periods of economic stress and volatility in Nigeria's energy sector, such as the oil price crash and macroeconomic instability, it does not cross the critical bounds at any point, and this implies that these fluctuations are not strong enough to cause structural breaks in the model. Therefore, the estimated coefficients remain stable over time.

Furthermore, the slight upward correction observed around 2020 to 2021 may reflect adjustments following global shocks such as the COVID-19 pandemic and subsequent oil price recovery. However, the line remains within the confidence bands, reinforcing the conclusion that the model maintains parameter stability even during periods of heightened uncertainty and volatility.

Validity of the study



Source: Authors' Computation (2026)

The histogram of the residuals provides a visual and statistical assessment of the normality assumption underlying the estimated model. From the distribution, it can be observed that the residuals are fairly symmetrically distributed around zero, as indicated by the mean value of approximately 1.31e-16, which is effectively zero, and the median value of -0.003599, which is also very close to zero, suggesting that the model does not suffer from systematic bias and that the error terms are centered appropriately.

Furthermore, the spread of the residuals is relatively narrow, with a maximum value of 0.057078 and a minimum value of -0.032171. The standard deviation of 0.021301 indicates low dispersion, which implies that the residuals do not exhibit extreme variability and that the model's predictions are reasonably precise. At the same time, the histogram bars show a concentration of observations around the central region, reinforcing the notion of stability in the error structure.

The skewness value of 0.965607 indicates a moderate positive skew, meaning that there are slightly more extreme positive residuals than negative ones. Although this suggests some asymmetry in the distribution, it is not severe enough to invalidate the normality assumption, while the kurtosis value of 3.515911 is slightly above 3, indicating a leptokurtic distribution, which means that the residuals have a somewhat higher peak and heavier tails compared to a normal distribution, and this may reflect occasional shocks or extreme observations in Nigeria's energy sector, particularly under volatile conditions.

Importantly, the Jarque-Bera statistic of 3.995753 with a corresponding probability value of 0.135623 is greater than the 0.05 significance level, and this implies that the null hypothesis of normal distribution cannot be rejected. Therefore, the residuals are approximately normally distributed, which satisfies one of the key assumptions of maximum likelihood estimation used in the ARCH–GARCH model.

4.2 Discussion of Findings

The findings from the empirical analysis provide strong insights into the dynamics of profitability within Nigeria's energy sector in the context of ease of doing business and VUCA conditions. The results reveal that the model is robust, stable, and statistically reliable, as confirmed by stationarity and diagnostic checks, and that the estimated relationships are valid for interpretation and policy formulation, thereby strengthening confidence in the conclusions drawn from the study.

The negative and statistically significant effect of operational efficiency (LOGOE) on profitability suggests that increased operational activities within Nigeria's energy sector do not necessarily translate into higher profits, and this can be attributed to the high cost of production, infrastructural inefficiencies, energy losses, and operational leakages such as oil theft and pipeline vandalism, which continue to undermine efficiency gains. This finding aligns with existing empirical studies, such as Agbugba (2023), who observed that inefficiencies in Nigeria's energy sector reduce the positive impact of operational inputs on output performance. Therefore, the sector operates below optimal efficiency levels despite increased operational intensity.

Furthermore, the positive but statistically insignificant relationship between ease of doing business (LOGEODB) and profitability indicates that while improvements in the business environment are theoretically expected to enhance firm performance, the effect remains weak in practice, and this reflects the reality that reforms aimed at improving ease of doing business in Nigeria are often not fully implemented or are constrained by bureaucratic bottlenecks, corruption, and policy inconsistencies. This finding is consistent with the World Bank (2020), which highlights that institutional weaknesses can dilute the impact of regulatory reforms on economic performance.

In contrast, the positive and highly significant effect of VUCA conditions (LOGVUCA) on profitability suggests that firms in Nigeria's energy sector can capitalize on volatile and uncertain environments, particularly during periods of high global oil prices, and this indicates a level of adaptability and resilience among firms, as they exploit favorable market conditions to increase returns. This finding aligns with the Contingency Theory which emphasizes that firms can adjust their strategies to benefit from environmental uncertainties, especially in resource-driven sectors.

However, the interaction effect between ease of doing business and VUCA conditions is negative and statistically significant, which implies that the combined presence of weak institutional frameworks and environmental uncertainty reduces profitability. This finding is particularly important because it shows that while volatility alone may create profit opportunities, the absence of a supportive business environment constrains firms' ability to exploit them fully, reinforcing the argument that improving the ease of doing business is critical for mitigating the adverse effects of VUCA conditions. It also aligns with Institutional Theory which emphasizes the role of strong institutions in enhancing economic performance.

The diagnostic results further support these findings, as the absence of serial correlation, normal distribution of residuals, and stability of coefficients indicate that the model is well specified and that the estimated relationships are not spurious, while the CUSUM test confirms that there are no structural breaks over the study period, despite major economic shocks such as the global financial crisis, oil price crashes, and the COVID-19 pandemic, and this suggests that the underlying relationships between the variables are stable and persistent over time.

Overall, the findings reveal that Nigeria's energy sector operates within a complex and volatile environment where profitability is influenced more by external shocks and operational inefficiencies than by improvements in the business environment, and this underscores the need for comprehensive reforms that not only enhance ease of doing business but also address structural inefficiencies, strengthen institutional frameworks, and improve governance. Such measures are essential for maximizing productivity and profitability in the sector, particularly amid ongoing VUCA conditions, and ultimately for positioning the energy sector as a driver of sustainable economic development in Nigeria.

5. Conclusion and Recommendations

Conclusion

The study examined the interplay between ease of doing business, VUCA conditions, operational efficiency, and profitability in Nigeria's energy sector, and the findings reveal that although the sector possesses significant resource endowments and strategic importance to national development, its performance is constrained by structural inefficiencies, weak institutional frameworks, and a highly volatile operating environment. While VUCA conditions appear to create occasional profit opportunities, particularly during periods of favorable global oil prices, these gains are not sustainably maximized due to poor ease of doing business and persistent operational challenges. The negative interaction effect between ease of doing business and VUCA further underscores that, without strong institutional support, the benefits of operating in a volatile environment are significantly diminished.

The study also concludes that operational activities in the sector do not necessarily translate into improved profitability due to high production costs, infrastructural deficits, and inefficiencies. At the same time, reforms aimed at improving the ease of doing business have not yielded a significant impact due to implementation gaps and policy inconsistencies. Although the model is statistically robust and stable, as confirmed by diagnostic tests, the broader implication is that Nigeria's energy sector requires a comprehensive recalibration strategy that integrates institutional strengthening, efficiency improvements, and adaptive responses to VUCA conditions to enhance productivity and profitability.

Recommendations

1. The government should strengthen institutional frameworks and regulatory consistency in the energy sector, and this can be achieved by ensuring full and transparent implementation of policies such as the Petroleum Industry Act, while reducing bureaucratic bottlenecks and improving coordination among regulatory agencies to enhance the ease of doing business and attract both domestic and foreign investment.
2. There is a need to improve operational efficiency in the sector by investing in modern infrastructure, adopting advanced technologies, and reducing production losses from oil theft, pipeline vandalism, and energy inefficiencies. This will ensure that increased operational activities translate into higher profitability.
3. The government and private sector should develop strategies to manage and adapt to VUCA conditions, including building resilience through diversification of energy sources, strengthening risk management frameworks, and enhancing flexibility in policy and business operations to respond effectively to global energy shocks.
4. Policies aimed at improving ease of doing business should be more pragmatic and results-oriented, with efforts focusing on simplifying licensing procedures, ensuring contract enforcement, improving access to finance, and enhancing transparency in regulatory processes. This will boost investor confidence and encourage long-term investments in the sector.
5. There is a need to enhance transparency and accountability in the management of energy resources, which can be achieved through stronger governance mechanisms, the digitalization of regulatory processes, and the strict enforcement of anti-corruption measures, thereby reducing uncertainty and improving the sector's credibility.
6. The government should create incentives to attract foreign direct investment into the energy sector, including tax incentives, investment guarantees, and stable fiscal regimes, while also addressing security challenges in oil-producing regions to reduce operational risks and encourage sustained investor participation.
7. The electricity subsector should be prioritized through reforms that ensure cost-reflective tariffs, improved metering systems, and investment in transmission and distribution infrastructure, as a reliable power supply is critical for enhancing productivity across all sectors of the economy.
8. Finally, there should be a deliberate effort to promote savings and reinvestment in the oil and gas sector, which can be achieved by establishing stabilization funds, reducing reliance on oil revenues for recurrent expenditure, and channelling resources into long-term capital projects that enhance sectoral growth and sustainability.

References

1. Adelegan, O. J. (2007). Infrastructure and economic growth in Nigeria. *African Development Review, 19*(3), 465–491.
2. Agbugba, I. K. (2023). Energy sector productivity and economic growth in Nigeria. *International Journal of Energy Economics and Policy, 13*(2), 45–56.
3. Akinlo, A. E. (2012). How important is oil in Nigeria's economic growth? *Journal of Sustainable Development, 5*(4), 165–179.
4. Apergis, N., & Payne, J. E. (2010). Energy consumption and growth in South America: Evidence from panel cointegration analysis. *Energy Economics, 32*(6), 1421–1426.
5. Ayadi, F. S., & Ayadi, F. O. (2008). The impact of oil production on Nigeria's economic growth. *Journal of Energy and Development, 33*(2), 195–210.
6. Barney, J. (1991). Firm resources and sustained competitive advantage. *Journal of Management, 17*(1), 99–120. https://doi.org/10.1177/014920639101700108
7. Bennett, N., & Lemoine, G. J. (2014). What VUCA really means for you. *Harvard Business Review, 92*(1/2), 27–42.
8. Burns, T., & Stalker, G. M. (1961). *The management of innovation*. Tavistock Publications.
9. Central Bank of Nigeria. (2023). *Statistical bulletin*. https://www.cbn.gov.ng
10. Ehinomen, C., & Adeleke, A. (2012). Oil exploration and environmental degradation in the Niger Delta region of Nigeria. *Journal of Environmental Science and Engineering, 1*(6), 567–575.
11. Ekpo, A. H. (2014). Public investment and economic growth in Nigeria: An empirical investigation. *Journal of Economic and Sustainable Development, 5*(12), 123–134.
12. Energy Information Administration. (2023). *International energy statistics*. https://www.eia.gov
13. Ezeani, E. O. (2012). Deregulation policy in Nigeria's downstream oil sector: Challenges and prospects. *Journal of Economics and Sustainable Development, 3*(7), 56–62.
14. Gbadebo, O. O., & Okonkwo, C. (2009). Does energy consumption contribute to economic performance? Evidence

from Nigeria. *Journal of Economics and International Finance, 1*(2), 44–58.

15. Hamilton, J. D. (2009). Causes and consequences of the oil shock of 2007–08. *Brookings Papers on Economic Activity, 40*(1), 215–261.
16. International Energy Agency. (2022). *Africa energy outlook 2022*. https://www.iea.org
17. Iyoha, M. A., & Oriakhi, D. E. (2002). Explaining African economic growth performance: The case of Nigeria. *African Economic Research Consortium*.
18. KPMG. (2021). *Oil and gas in Nigeria: Industry outlook*. https://home.kpmg/ng
19. Mordi, C. N. O., Englama, A., & Adebusuyi, B. (2010). *The changing structure of the Nigerian economy*. Central Bank of Nigeria.
20. National Bureau of Statistics. (2023). *Nigerian gross domestic product report*. https://www.nigerianstat.gov.ng
21. Nigerian National Petroleum Company Limited. (2023). *Annual statistical bulletin*. https://www.nnpcgroup.com
22. North, D. C. (1990). *Institutions, institutional change and economic performance*. Cambridge University Press.
23. Nwanna, I. O., & Chinwudu, E. (2016). Financial liberalization and economic growth in Nigeria. *Journal of Economics and Finance, 7*(2), 11–18.
24. Odularu, G. O. (2008). Crude oil and the Nigerian economic performance. *Oil and Gas Business Journal*, 1–29.
25. Okonkwo, O. N., & Egbunike, C. F. (2016). Financial development and economic growth in Nigeria. *Journal of Policy and Development Studies*, *10*(2), 45–56.
26. Olayungbo, D. O. (2012). Effects of global oil price on exchange rate, trade balance and reserves in Nigeria. *Journal of Economic International Finance, 4*(4), 95–103.
27. Onafowora, O. A., & Owoye, O. (2008). Oil prices and real exchange rate volatility in Nigeria. *Energy Economics, 30*(2), 850–867.
28. Onyeiwu, S. (2012). Monetary policy and economic growth of Nigeria. *Journal of Economics and Sustainable Development, 3*(7), 62–70.
29. Organisation of the Petroleum Exporting Countries. (2023). *Annual statistical bulletin*. https://www.opec.org
30. Organization for Economic Cooperation and Development (OECD). (2020). *OECD business climate indicators*. https://www.oecd.org
31. PwC. (2022). *Global energy transformation: Nigeria perspective*. https://www.pwc.com/ng
32. Sambo, A. S. (2009). Strategic developments in renewable energy in Nigeria. *International Association for Energy Economics*, 15–19.
33. Sanni, M. R. (2015). Corporate governance and financial performance of listed oil and gas firms in Nigeria. *Journal of Accounting and Taxation, 7*(2), 34–45.
34. Seplat Energy Plc. (2023). *Annual report and accounts*. https://www.seplatenergy.com
35. Solow, R. M. (1956). A contribution to the Theory of economic growth. *Quarterly Journal of Economics, 70*(1), 65–94.
36. TotalEnergies Marketing Nigeria Plc. (2023). *Annual report and financial statements*.
37. Udoh, E., & Ogbuagu, U. R. (2012). Financial sector development and industrial production in Nigeria. *Journal of Applied Finance and Banking, 2*(4), 49–68.
38. United Nations Development Programme (UNDP). (2022). *Human development report: Nigeria*. https://www.undp.org
39. World Bank. (2020). *Doing business 2020: Comparing business regulation in 190 economies*. World Bank Publications. https://doi.org/10.1596/978-1-4648-1440-2
40. World Bank. (2023). *World development indicators*. https://data.worldbank.org
41. World Economic Forum. (2022). *Global competitiveness report*. https://www.weforum.org