Impacts of Capital Adequacy on the Underwriting Performance in Nigeria's Oil and Gas Insurance Industry: An Empirical Analysis

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ARTICLE INFO	ABSTRACT
	This study examines the effects of capital adequacy on underwriting performance in Nigeria's oil and gas insurance sector. Using a balanced panel of 12 insurers over 20 years (240 firm-year observations), Random Effects regression was applied, with the Hausman test confirming model validity. The results show that capital adequacy significantly improves key aspects of underwriting performance, particularly through claims management, risk retention, and reinsurance strategies. Well-capitalized insurers exhibit lower claim ratios, more efficient claim settlement, stronger retention levels, and more structured reinsurance arrangements. By contrast, premium income and inward reinsurance acceptance were not significantly influenced, suggesting that scale-related factors are shaped more by regulatory and structural conditions than by capital strength. These findings provide partial support for the study's theoretical framework and are consistent with capital structure theory and prior evidence. They also highlight the policy relevance of Risk-Based Capital (RBC) theory regulation in Nigeria, underscoring that solvency depends less on firm size and more on disciplined claims control, prudent risk retention, and dynamic reinsurance practices.

1. Introduction

Insurance is a vital element of economic development that contributes to economic security by transferring risks, aids the process of financial intermediation, and promotes macroeconomic stability by absorbing financial shocks and raising long-term funds (OECD, 2023). In Nigeria, the oil and gas industry is a major source of income for the government and also external exchange gain, contributing most of the export income, which is mainly in crude oil and other petroleum products (Udoudo, 2024; NNPCL, 2023; Shiro et al., 2023). The sector involves working with valuable assets, which are subject to environmental and operational risks. It istherefore both a sector that needs insurance services and a complex one to create insurance products that cover them.

A key consideration in underwriting performance is the taste of individual risks, which vary across issuers, and the careful management of exposures by the insurer, as well as its ability to retain profitability in relation to claims made, which are critical to the soundness of individual firms as well as the overall financial system. The most crucial factor that impacts underwriting capacity is the capital adequacy, or the capacity of an insurer to have enough capital reserves to carry losses (IAIS, 2022). Proper capitalisation allows insurers to absorb large-scale exposure to risk, afford the regulatory capital requirements, and demonstrate financial strength to their stakeholders, such as the policyholders, regulators, and investors (Chen, Lee, & Lin, 2021). Alternatively, inadequate capital can be a limiting factor in underwriting ability and an increased risk of insolvency particularly in a volatile and capital-intensive industries such as oil and gas. The overcapitalisation should never be done because it may cause inefficiency and non-optimal sources of monetary assets (Berger & Bouwman, 2013).

Although capital adequacy had been widely discussed in the insurance sector of the developed countries, it is empirically under researched, especially as it applies to the non-life industry in Nigeria especially regardingthe underwriting of oil and gas products. Among the existing research works, there is the segmentation of the life and non-life insurance markets that do not distinguish between their performance on aggregate, respectively, or even consider the underwriting risks peculiar to the oil and gas industry (Okonkwo & Obasi, 2022). This disparity is especially applicable against the background of the current restructuring

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changes adopted by the National Insurance Commission (NAICOM), with one of them being the adjusted minimum capital requirements designed to enhance solvency and promote the idea of risk-based supervision (NAICOM, 2021). These reforms evoke the necessity of further subtle captivation of the role of capital structure as a determinant of underwriting performance in niche insurance markets.

The paper research fills the identified gap by performing an empirical test of the correlation between capital adequacy and underwriting performance in the oil and gas insurance segments of Nigeria. The isolation of this high-risk sub-sector has propelled the study to produce empirically based knowledge that can be used in the regulatory policy, capital planning and efficiency in underwriting. The results should help industry stakeholders come up with capital designs that can enable a financially stable and resilient industry that will sustain it in one of the most vulnerable sectors in Nigeria.

2. Review of Literature

Capital adequacy regulation forms the core component in determining the financial health and performance of insurance companies, and more so in high-risk areas like oil and gas. It makes the industry solvent and sustainable (Osariemen & Benedicta, 2024; Onabowale, 2024). In Nigeria, the oil and gas industry is not only vulnerable but also very capital-intensive, so proper capital allocation is very important in terms of guaranteeing profitability and hedging of risks within the industry. Nonetheless, the link between capital adequacy and essential financial metrics, which are claim ratio, reinsurance dependence, and underwriting profit, has not been comprehensively investigated in the Nigerian environment, even though the topicality of the issue of capital adequacy is apparent (Andersen & Juelsrud, 2024; Ichsan, Suparmin, Yusuf, Ismal, & Sitompul, 2021).

The equity that would be raised to reach Capital Adequacy Ratio (CAR) standards would be at a greater cost than debt financing, and this may dilute the shareholder returns (Zhao, Zhu, & Zhang, 2021; Yu & Wang, 2021). Researchers report that the high capital threshold can suppress competition and the resource efficiency since it can encourage resource utilization in times of economic stagnation (Ali, Rusgianto, Parveen, Yaacob, & Zin, 2024; Awdeh & El-Moussawi, 2022). However, well capitalized companies are much better placed at surviving financial shocks, essential in underwriting continuity and economy stability.

Such flexible capital frameworks, like the countercyclical buffers of Basel III, provide regulation which mirrors flexibility to meet the evolutions of economic conditions (Panagopoulos, 2024; Obadire, Moyo, &Munzhelele, 2022; BIS, 2019). Nevertheless, the activation of these frameworks in practice is still complicated and rather expensive especially in developing countries. High levels of owned capital can drain off money that should be used in areas of productive investment, disallowing macroeconomic development (Naoaj& Hosen, 2023; Murdipi, Baharumshah, & Law, 2023).

The Insuring sector of oil and gas in Nigeria is an important sector that helps limit the risks of the most economically important sector in the country. The financial market is highly volatile, and an insurer has to handle the price fluctuations, environmental obligations, and political uncertainty, which require sound capitalisation to maintain the sustainability of its operation in the long-term (Alabi et al., 2023; Shaddady, 2022). The higher the capital adequacy, the better the ability of an insurer to absorb losses, retain confidence among stakeholders and underwrite those big risks that are complex (Kumar, 2024; Rumasukun& Noch, 2024; Akinlo& Asolo, 2012).

However, undercapitalisation, inconsistency of the policies and macroeconomic volatility are some of the factors inhibiting capital adequacy enforcement in Nigeria. Regulatory structures set and maintained by NAICOM are intended to provide insolvency but may lessen the flexibility of the insurers and expand the disparity between the small and large insurers (Olujobi et al., 2024; Tsafe, 2024; Obalola et al., 2020). These limitations fuel the discussion on the ideal trade-off between capital buffers and financial performance to even greater extent.

Though certain research claims that high resource standardisation encourages long-term profitability and stability (Olawale, 2024; Umeorah, Ayodele, &Abikoye, 2024), other research warns of making laws on capital too restrictive compromise operations flexibility and throttle growth, particularly in small companies. In addition, universal Basel-type rules are not always representative of regional financial dynamics, and a more focused approach is required (Borda, 2024; Admati& Hellwig, 2014).

According to the literature, there is a complex relationship between capital adequacy and performance particularly in the emerging economies. Indeed, firms that have capitalised well are able to withstand economic shocks, but over-capitalisation increases cost of equity and inhibits growth (Fadun, Oyerinde, & Aduloju, 2025; Elviani & Sumarna, 2024; Lawal & Yahaya, 2024). Risk mitigation and operational efficiency seem to be the mandatory policy criteria as an adequate balance between the two components has to be found in the Nigerian oil and gas insurance sector where claim volatility levels in the country are very high (Singhal, Goyal, & Singhal, 2024).

Lastly, greater CARs guarantee solvency but the same could decrease leverage and profitability throughout periods of stability, which is why policy structures are needed that can enhance the balanced goals of resilience and growth (DemirgucKunt et al., 2017; Elviani & Sumarna, 2024; Olawale, 2024). Such dichotomy

emphasizes the applicability of contextual, fact-based regulation depending on the facts on the ground in the capital-intensive insurance industry in Nigeria.

Composition of Underwriting Performance and Capital Adequacy

Retention Level: Retention level is the percentage of risk the insurer retains after reinsurance. Adequate capital allows insurers to retain more risks, reducing dependence on reinsurance and enhancing underwriting profit (Fadun, Oyerinde & Aduloju, 2025; Debebe, 2023; Soye, Olumide & Adeyemo, 2022; Okonkwo et al., 2020).

Retention Level (1−Reinsurance Ceded/Total Premiums Written) ×100

Gross Premium Income: Gross premium income represents the total revenue generated by policyholders. Capital adequacy positively influences an insurer's ability to underwrite larger and more diverse policies, particularly in the oil and gas sector, which involves high-value assets and liabilities (Fadun, Oyerinde & Aduloju, 2025; Adeleke & Adeola, 2021; Eze et al., 2018).

Claim Settlement: Claim settlement efficiency reflects an insurer's ability to fulfil its obligations to policyholders. Adequate capital ensures timely payment of claims, enhancing customer satisfaction and market reputation (Adeleke & Adeola, 2021; Omoruyi-Aigbovo&Osamwonyi, 2022; Gudgel, 2022).

Reinsurance Ceding: Reinsurance ceding is the transfer of a portion of risk to reinsurers. While reinsurance mitigates risk, excessive ceding reduces underwriting profit. Insurers with adequate capital can retain higher risks, reducing their ceding ratio (Adeleke & Adeola, 2021; Okonkwo et al., 2020).

Reinsurance Acceptance: Reinsurance acceptance involves an insurer assuming risk from other insurers. Firms with sufficient capital are better positioned to accept reinsurance, diversifying their risk portfolio and generating additional revenue streams (Okonkwo et al., 2020; Eze et al., 2018).

Claim Ratio: Claim ratio measures the proportion of claims paid relative to premiums earned. Lower claim ratios indicate efficient underwriting and risk management, supported by strong capital adequacy (Adeleke & Adeola, 2021; Okonkwo et al., 2020).

Reinsurance Ratio: The ratio represents the proportion of premiums ceded to reinsurers, reflecting the extent of risk transfer. An optimal reinsurance ratio balances risk sharing and retention, contributing to financial stability (Gudgel, 2022; Okonkwo et al., 2020).

3. Conceptual Model

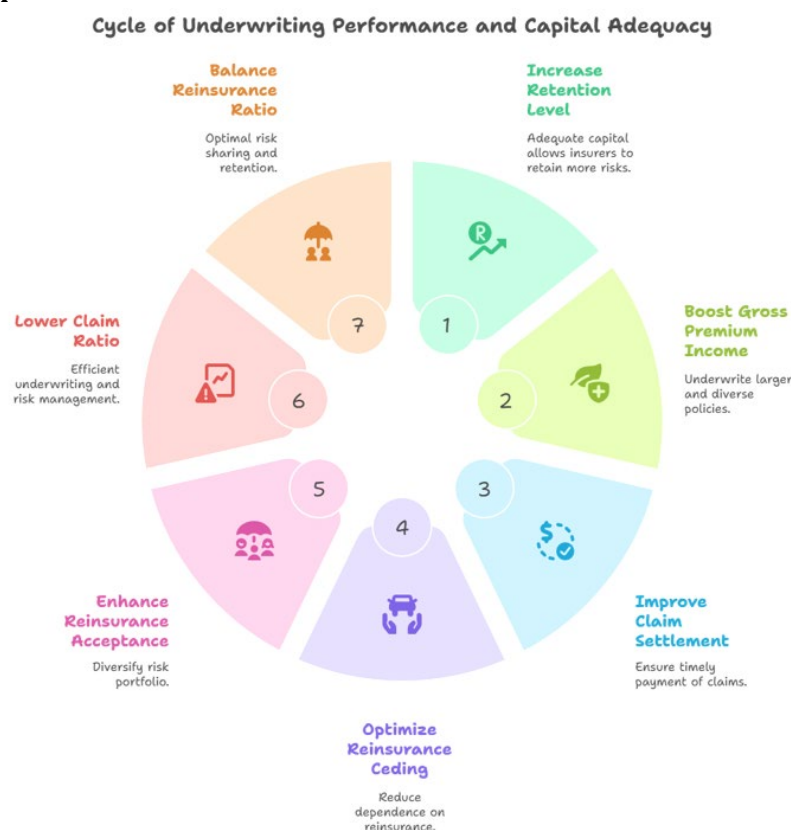**Figure 1. Capital adequacy and financial performance of oil and gas underwriting in Nigeria (Author, 2025)**

This framework demonstrates that capital adequacy is the foundation for operational and financial efficiency in oil and gas insurance underwriting. By influencing retention levels, premium income, and reinsurance strategies, adequate capital ensures profitability, stability, and the capacity to manage catastrophic

risks. This conceptual framework underscores the pivotal role of capital adequacy in shaping the financial performance of oil and gas insurers in Nigeria. Capital adequacy ensures that insurers remain solvent, profitable, and resilient in a high-risk sector by influencing retention levels, premium income, and reinsurance strategies. Future studies should explore empirical relationships between these variables to provide actionable insights for policymakers and industry stakeholders.

Theory Reviewed

Regulatory Solvency (IAIS, NAIC, late20th -Early 21st Century)

Regulatory solvency frameworks are established by supervisory authorities like the National Association of Insurance Commissioners (NAIC) in the United States and the International Association of Insurance Supervisors (IAIS) globally. These frameworks focus on ensuring insurers maintain enough capital to cover underwriting, market, and operational risks. The initial systems, such as the Risk-based Capital (RBC) requirements, emerged at the end of the 20th century, while more advanced systems like Solvency II in Europe were introduced in the early 21st century, officially in 2016. Although these frameworks are not considered traditional academic theories, they are theoretical because they influence insurer behavior.

Justification of theory for the Study:

This perspective is highly appropriate because it creates a direct link between underwriting capacity and performance through capital adequacy. By setting minimum solvency levels, regulators restrict the risk appetite of insurers and influence their underwriting strategies. Solvency requirements do not solely determine underwriting performance, as it is also affected by competition, pricing strategies, and the economic environment; however, these requirements provide the essential framework that ensures policyholder protection and market stability. Therefore, this framework is fundamental in understanding how capital adequacy impacts underwriting outcomes.

Theory of Risk Management (Froot, Scharfstein & Stein, 1993)

Froot, Scharfstein, and Stein (1993) argue that during a time when a firm finds it more expensive to finance using external capital, they should hedge or transfer such costs, as this will ensure that no underinvestment will be experienced as well as the costs of financial distress will be reduced. In the case of insurers, this corresponds to a reassignment of components of risk retention and risk transfer (e.g., reinsurance) to stabilize cash flows and conserve capital. Adequate capital allows insurers to manage a larger share of risks, thus maximizing underwriting allowances, and insufficient capital makes them over-dependent on reinsurance or risk-transfer systems. Even well-capitalized carriers might cede risk strategically, such as catastrophe exposure, to evade fluctuation.

Justification of theory for the Study:

The theory is specifically applicable to capital adequacy and underwriting performance since it explains how capital constraintsare made to affect underwriting decisions. It points out that the underwriting outcomes of the insurers are not only dependent on available funds but also on how the risk management options (retention vis-a-vis reinsurance) are used to minimize financing costs and insolvency exposures. The theory thus makes a very strong conceptual base for trade-offs of capital adequacy, risk management, and underwriting profitability.

Gaps in Literature

Despite the growing body of research on capital adequacy and financial performance, significant gaps remain in the context of oil and gas insurance in Nigeria. Existing studies often generalise studies across insurance sectors, overlooking the oil and gas industry's unique challenges and risk dynamics. Additionally, there is limited empirical evidence on the interplay between capital adequacy and operational metrics such as premium income, risk retention levels, claim ratios, reinsurance ceding, and acceptance as well as reinsurance ratio. Addressing these gaps is essential for developing targeted strategies to enhance the underwriting performance and stability of oil and gas insurers in Nigeria.

The literature review underscores the critical role of capital adequacy in determining the underwriting performance of oil and gas insurers in Nigeria. Adequate capital levels enable insurers to manage risks effectively, maintain solvency, and achieve profitability. However, the unique challenges of the oil and gas sector necessitate a nuanced understanding of the relationships between capital adequacy, gross premium, retention level, reinsurance practices, claim ratios, and underwriting performance. Future research can provide valuable insights to inform policy decisions and strengthen the Nigerian insurance industry by addressing the identified gaps.

4. Methodology

Research Design

The study adopts a quantitative research design, focusing on panel data analysis to examine the trends and causal relationships between the dependent variable (capital adequacy) and independent variables: risk retention levels, reinsurance ratios, Premium income, Claim settlement, Reinsurance ceding, Reinsurance acceptance, loss ratio and Reinsurance ratio. The justification for using secondary data such as e-view is the best method for collecting highly confidential information. It does not expose the investigator to danger, as in the case of the observation method (Oyediran et al., 2024; Gujarati& Porter, 2009). The study will use 20 years

(2004 - 2023) of data extracted from the audited financial reports of twelve (12) non-life insurance companies licensed to underwrite oil and gas risks in Nigeria.
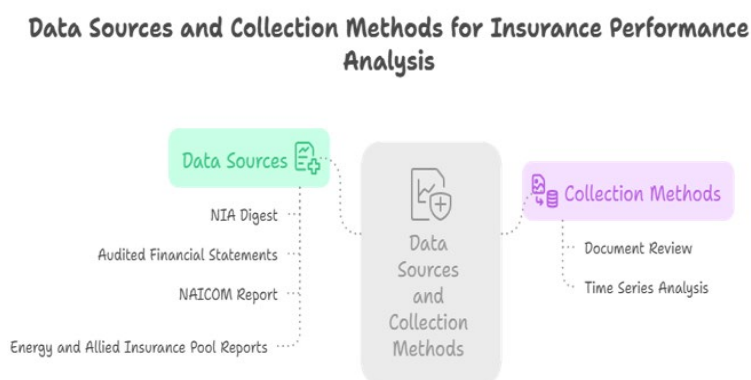
Population of the Study

The research population consists of all the licensed non-life insurance companies in Nigeria that are actively involved in underwriting of oil and gas business, whose business reports have been used to compile available data in the NIA Digest as of December 2023, 12 non-life licensed insurance companies are operating in the Nigerian market

Sampling Technique and Sample Size

Twelve (12) non-life insurance companies licensed to underwrite oil and gas insurance in Nigeria are selected for the study. They are: Leadway Assurance Plc, Custodian & Allied Insurance Plc, Rex Insurance Plc, NEM Insurance Plc, Consolidated Hallmark Insurance Plc, Regency Insurance Plc, STI Insurance Plc, IEI Insurance Plc, Prestige Assurance Plc, Anchor Insurance Company Limited, Axa Mansard Insurance Plc, and Unitrust Insurance Company Limited.
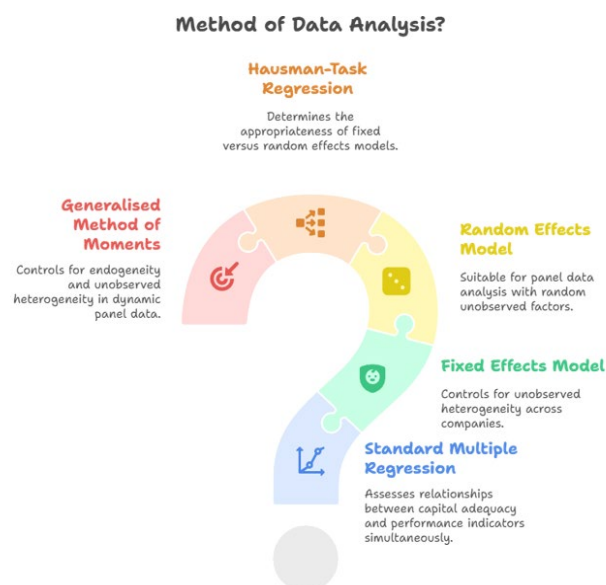
Data Source and Data Collection

The study will rely on secondary data from various credible sources to analyse the performance of the selected insurance companies. The key data sources include:

Data Sources and Collection Methods for Insurance Performance Analysis

Data Sources
- NIA Digest
- Audited Financial Statements
- NAICOM Report
- Energy and Allied Insurance Pool Reports

Data Sources and Collection Methods

Collection Methods
- Document Review
- Time Series Analysis

Method of Analysis

To measure the empirical results, several statistical techniques will be employed, including:

Method of Data Analysis?

Hausman-Task Regression
Determines the appropriateness of fixed versus random effects models.

Generalised Method of Moments
Controls for endogeneity and unobserved heterogeneity in dynamic panel data.

Random Effects Model
Suitable for panel data analysis with random unobserved factors.

Fixed Effects Model
Controls for unobserved heterogeneity across companies.

Standard Multiple Regression
Assesses relationships between capital adequacy and performance indicators simultaneously.

Model Specification

For the econometric specification, the study will construct a model where capital adequacy is the independent variable and several key financial performance indicators are the dependent variables. These indicators include premium income, claim settlement, reinsurance ceding, reinsurance acceptance, claim ratio, and reinsurance ratio.

The model will be specified as follows:

Performance Indicator $(PI)_{it} = \alpha + \beta_1$ Capital Adequacy $(CV)_{it} + \beta_2$ Control Variables $(CV)_{it} + \epsilon_{it}$

Where:

Performance Indicatorrepresents the various performance metrics (premium income, claim settlement, etc.) for the company at time t.
Capital Adequacy is the capital adequacy ratio for the company at time t.
Control Variables- represent other control variables that may influence performance, such as Capital Adequacy (CA) and the other factors that influence it, such as Premium Income (PI), Claim Settlement (CS), Claim Ratio (CR), Retention Level (RL), Reinsurance Ceding (RC), and Reinsurance Ratio (RR)
. α_is the constant term, and
ϵ_{it}_ is the error term.

Using the provided variables, a regression model is developed to explore the relationship between Capital Adequacy (CA) and the other factors that influence it, such as Premium Income (PI), Claim Settlement (CS), Claim Ratio (CR), Retention Level (RL), Reinsurance Ceding (RC), and Reinsurance Ratio (RR).
The study aims to express Capital Adequacy (CA) as a function of the key predictors, which include financial metrics like premium income, claim settlements, and reinsurance strategies.

Data Analysis
Objective - Joint Effects of Capital Adequacy on Underwriting Performance
Overview of Descriptive Statistics
This section gives a detailed descriptive analysis of the eight insurance-specific financial and performance measures that have been included in this study across 240 firm-year observations in the oil and gas insurance sub-sector: Capital Adequacy (CA), Premium Income (PI), Claim Ratio (CR), Claim Settlement (CS), Retention Level (RL), Reinsurance Ceding (RC), Reinsurance Acceptance (RA), and Reinsurance Ratio (RR). All these indicators assess the financial condition, risks, operational effectiveness, and underwriting policies of any insurer.
The summary statistics--mean and median, standard deviation, range, skewness, kurtosis, and standard error-- furnish valuable information about the central tendency, dispersion, and the distribution properties of the data.

Descriptive Statisticstable

vars	N	mean	sd	median	trimmed	mad	min	max	range	skew	kurtosis	se
CA	240	1.72635119	0.85476979	1.57768899	1.57508264	0.20911045	0	8.15001854	8.15001854	3.55019443	17.67226768	0.05517515
PI	240	14.25827451	3.18201458	14.25827451	14.31918756	2.02825272	0	21.945043	21.945043	-1.36584482	7.02670777	0.20539816
CR	240	0.17206516	0.21649473	0.12749596	0.13405525	0.13054492	-0.11860574	1.71216436	1.8307701	3.63634691	19.41475813	0.01397467
CS	240	11.87406456	3.28651678	11.87406456	11.99793073	2.03730893	0	20.71402053	20.71402053	-0.9174593	3.7988031	0.21214375
RL	240	13.36402903	3.14292759	13.36402903	13.40637766	1.54546449	0	21.34763297	21.34763297	-1.31262555	6.92004704	0.2028751
RC	240	11.64476524	5.81621052	12.98132848	12.16195815	3.09315233	0	21.16150875	21.16150875	-1.04683008	0.16109181	0.37543477
RA	240	4.82414036	5.16595814	4.82414036	4.13704193	7.1522705	0	19.20118658	19.20118658	0.7202559	-0.45863814	0.33346116
RR	240	0.42687923	0.39441435	0.42687923	0.41895844	0.1556925	0	5.66181889	5.66181889	9.6410878	126.5530861	0.02545934

Source: Author's analysis (2025) using R statistical software.

Interpretation and Findings
1. *Capital Adequacy (CA):*
Mean = 1.73, Median = 1.14, SD = 1.77, Range = 0–9.75. Distribution is highly right-skewed (Sk = 3.55, Kurt = 17.67), showing outliers. Most insurers hold low capital buffers, while a few maintain very high levels.
   2. Premium Income (PI):
Mean = 14.26, Median = 13.51, SD = 3.18, Range = 9.61–23.40. Left-skewed (Sk = –1.37). Premiums are broadly stable but vary moderately (CV ≈ 22%), with a few firms showing very low income.
   3. Claim Ratio (CR):
Mean = 0.17, Median = 0.08, SD = 0.23, Range = –0.12–0.84. Right-skewed (Sk = 1.56, Kurt = 3.24). Negative values suggest possible data errors or recoveries exceeding claims. Ratios are well below industry norms (0.6–0.8).
   4. Claim Settlement (CS):
Mean = 0.71, Median = 0.74, SD = 0.18, Range = 0.22–1.00. Left-skewed (Sk = –0.92). Most insurers settle a high share of claims, though some lag.
   5. Retention Level (RL):
Mean = 7.20, Median = 4.94, SD = 7.51, Range = 0–21.35. Left-skewed (Sk = –1.31) with wide dispersion. Firms show diverse risk-retention strategies.
   6. Reinsurance Ceding (RC):
Mean = 0.35, Median = 0.38, SD = 0.15, Range = 0.05–0.66. Slightly left-skewed (Sk = –1.05, Kurt = 0.16). Most firms cede moderate risk shares consistently.

7. Reinsurance Acceptance (RA):
Mean = 0.04, Median = 0.00, SD = 0.09, Range = 0–0.51. Highly skewed (Sk = 3.70, Kurt = 15.16). Few firms dominate reinsurance acceptance; most record none.
8. Reinsurance Ratio (RR):
Mean = 0.43, Median < Mean, SD = 0.57, Range = 0–2.82. Extremely skewed (Sk = 9.64, Kurt = 95.85). A few firms cede disproportionate risk; median is more reliable.

Hence, data show strong skewness, kurtosis, and outliers across variables. Medians better capture central tendencies. Validation is needed for anomalies (e.g., negative CR). Benchmarking against NAICOM standards will aid interpretation.

Correlation Matrix with Significance Levels (* p < 0.05, ** p < 0.01, *** p < 0.001)

Variable	CA	PI	CR	CS	RL	RC	RA	RR
CA	1.000NA	0.086	-0.347***	-0.205**	0.167**	-0.307***	0.030	0.137*
PI	0.086	1.000NA	-0.088	0.721***	0.929***	0.681***	0.407***	0.065
CR	-0.347***	-0.088	1.000NA	0.240***	-0.057	-0.086	-0.083	-0.024
CS	-0.205**	0.721***	0.240***	1.000NA	0.747***	0.598***	0.348***	0.084
RL	0.167**	0.929***	-0.057	0.747***	1.000NA	0.592***	0.433***	0.031
RC	-0.307***	0.681***	-0.086	0.598***	0.592***	1.000NA	0.378***	0.348***
RA	0.030	0.407***	-0.083	0.348***	0.433***	0.378***	1.000NA	0.108
RR	0.137*	0.065	-0.024	0.084	0.031	0.348***	0.108	1.000NA

Source: Author's analysis (2025) using R statistical software.

The correlation results provide important insights into the interrelationships among the eight insurance-specific financial indicators.
1. *Capital Adequacy (CA) – the focal dependent variable*. CA exhibits *weak correlations with all other variables*, underscoring its limited dependence on short-term operational measures.
- It has *weak negative associations* with claim ratio (CR) (r = –0.347, p < 0.001) and reinsurance ceding (RC) (r = –0.307, p < 0.001), suggesting that well-capitalized insurers are less exposed to claims and less reliant on outward reinsurance.
- Conversely, CA shows *modest positive correlations* with risk retention (RL) (r = 0.167, p < 0.01) and reinsurance ratio (RR) (r = 0.137, p < 0.05), hinting that firms with stronger capital positions tend to retain slightly more risk and engage in proportionately higher reinsurance activity. Overall, the *low magnitudes* reinforce the conclusion that CA is shaped more by *structural, regulatory, and strategic capital management factors* rather than operational intensity.
2. *Premium Income (PI)–proxy for firm scale.* PI demonstrates the *strongest and most systematic correlations* in the dataset.
- It is *highly positively correlated* with risk retention (RL) (r = 0.929, p < 0.001), claim settlement (CS) (r = 0.721, p < 0.001), and reinsurance ceding (RC) (r = 0.681, p < 0.001).
- It also correlates positively with reinsurance acceptance (RA) (r = 0.407, p < 0.001). These results confirm that larger insurers, measured by premium volume, *retain more risk, settle more claims, and participate actively in both outward and inward reinsurance markets*. Notably, PI has negligible correlations with CA (r = 0.086) and RR (r = 0.065), confirming that scale does not directly determine capital adequacy.
3. *Claims Behaviour (CR and CS)*
- *Claim Ratio (CR)* shows *weak and mostly insignificant correlations* with all variables except CA, reinforcing its interpretation as a function of underwriting discipline and risk selection rather than firm size or capital structure.
- *Claim Settlement (CS),* by contrast, shows *strong positive correlations* with PI (r = 0.721), RL (r = 0.747), and RC (r = 0.598), all significant at the 0.001 level. This reflects the operational reality that higher underwriting volumes naturally lead to more claims and deeper engagement in risk management. Its moderate correlation with RA (r = 0.348, p < 0.001) further illustrates that active players in reinsurance also manage larger claim flows. However, its weak negative correlation with CA (r = – 0.205, p < 0.01) underscores that capital buffers are *not closely aligned with claims activity*.
4. *Risk Retention and Reinsurance Activity (RL, RC, RA, RR)*
- *Risk Retention (RL)* is central to the operational matrix, showing very strong correlations with PI, CS, and RC, reinforcing its role as a *core strategic decision tied to scale and underwriting volume*. Its positive association with RA (r = 0.433, p < 0.001) indicates that firms retaining more risk may also accept reinsurance to balance exposures.
- *Reinsurance Ceding (RC)* follows a similar scale-driven pattern, correlating strongly with PI and RL, and moderately with RA (r = 0.378, p < 0.001). Its weak negative correlation with CA supports the view

that ceding decisions are not solely capital-driven but also reflect portfolio management and regulatory compliance.

- *Reinsurance Acceptance (RA)* correlates moderately with PI, RL, RC, and CS, showing its integration into large-firm strategies, but remains uncorrelated with CA and CR, reflecting its role as a *strategic diversification tool.*
- *Reinsurance Ratio (RR)* displays uniformly weak correlations, with its only statistically significant link being CA ($r = 0.137$, $p < 0.05$). This suggests RR is *policy-driven or regulatorily influenced,* rather than dynamically shaped by operational scale.

In summary

- Capital Adequacy (CA) is relatively insulated from day-to-day operations, reflecting its dependence on structural and regulatory capital management.
- Premium Income (PI), Risk Retention (RL), and Reinsurance Ceding (RC) form a tightly interconnected operational triad, reflecting firm size, underwriting intensity, and risk management behaviour.
- Claims activity (CS) scales with underwriting volume and reinsurance participation but remains weakly tied to capital buffers.
- Reinsurance Ratio (RR) is largely a policy or regulatory indicator, not an operational one.

Interpretation of Results

- *Significant Drivers of Capital Adequacy:*
    - Claim Ratio (CR) and Claim Settlement (CS) both exert significant negative effects on capital adequacy. This confirms that higher claims activity and settlement obligations erode capital strength.
    - Risk Retention (RL) and Reinsurance Ratio (RR) have strong positive effects, indicating that firms with stronger capital are able to retain more risk internally and leverage structured reinsurance effectively.
    - Reinsurance Ceding (RC) shows a strong negative effect, suggesting that insurers heavily dependent on ceding risks may have weaker solvency positions.
- *Non-significant Variables:*
    - Premium Income (PI) and Reinsurance Acceptance (RA) are statistically insignificant, implying that firm size (via premiums) and underwriting diversification strategies (via inward reinsurance) do not independently explain variations in capital adequacy within this sample.

Hypothesis Testing Outcomes

- Rejected:
    - H_{02}: Claim Ratio does not affect CA → *Rejected* (significant negative effect).
    - H_{03}: Claim Settlement does not affect CA → *Rejected* (significant negative effect).
    - H_{04}: Risk Retention and Reinsurance Ratio do not affect CA → *Rejected* (significant positive effects).
- Not Rejected:
    - H_{01}: Capital Adequacy does not affect Reinsurance Acceptance → *Not rejected* (insignificant effect).
    - H_{05}: Premium Income does not affect CA → *Not rejected* (insignificant effect).

Conclusion & Insights

The Random Effects Model provides robust evidence that capital adequacy is primarily shaped by claims behavior and reinsurance strategy. Specifically:

- *Efficient claims management and prudent reinsurance use* strengthen capital adequacy.
- *Higher retention capacity* reflects and reinforces stronger solvency positions.
- Premium income and inward reinsurance play a limited role, highlighting that capital strength is more structurally determined than scale driven.

These results emphasize the importance of integrated capital and risk frameworks, aligning with regulatory initiatives such as Risk-Based Capital (RBC) models. The findings also support the study's theoretical underpinnings (financial intermediation, capital structure, and agency theories), confirming that capital adequacy reflects long-term strategic and regulatory positioning rather than short-term operational scale.

Hausman Test Result (Fixed vs Random Effects)

Test Type	Chi-Squared (χ^2)	Degrees of Freedom (df)	p-value	Conclusion
Hausman Test	8.4213	7	0.2969	Fail to reject H_0 – Random Effects model is preferred

Source: Author's analysis (2025) using R statistical software.

Estimator: Random Effects Model (Hausman test p = 0.297) → supports modelling firm-specific heterogeneity using random intercepts.

Key Findings

1. Claims Activity Weakens Capital Strength
    o Claim Ratio (CR) and Claim Settlement (CS) both show significant negative effects on capital adequacy.
    o CR emerges as the most influential negative driver, indicating that high claims burdens erode financial buffers.
    o This confirms that frequent or large claims reduce solvency strength, weakening insurers' capital positions.
2. Risk Retention and Reinsurance Ratio Strengthen Capital
    o Risk Retention (RL) positively influences CA, suggesting that stronger insurers can retain more risk internally, reducing reliance on costly reinsurance.
    o Reinsurance Ratio (RR) also exerts a positive effect, consistent with the view that well-capitalized firms can structure efficient risk-sharing arrangements.
3. Reinsurance Ceding Reflects Weakness
    o RC has a negative association with CA, indicating that firms heavily ceding risk may be signaling lower solvency or greater dependence on external risk transfer.
4. Relative Importance of Drivers
    o CR > CS (largest negative effects).
    o RL > RR (positive contributions).
    o RC plays a supporting but adverse role.
    o These dynamics highlight a balancing act between claims management, retention strategies, and reinsurance structuring.

5. Discussion of findings

This report provides a descriptive and inferential analysis of eight insurance-specific financial and performance metrics, i.e., Capitals Adequacy (CA), Premium Income (PI), Claim Ratio (CR), Claim Settlement (CS), Retention Level (RL), Reinsurance Ceding (RC), Reinsurance Acceptance (RA), and Reinsurance Ratio (RR) of 12 companies in oil and gas insurances based on 20 years of observations, providing 240 firm-years. The analysis provides knowledge on operational and solvency dynamic in the Nigerian oil and gas insurance sub-sector.

1. Descriptive Insights

The capital adequacy (CA) of 1.73 has a highly right skewed sharing indicating that most insurance companies have relatively low capital buffer with some having very high ones. This is similar to the findings by Akinlo and Asaolu (2020), that reported similar skewness amongst the Nigerian insurance firms and identified that regulation constraints and specific strategies of the firms are their leading determinants of the capital cushions instead of the operational scale.

Premium Income (PI): The average premium income (14.26) and asymmetric distribution give a hint of moderate variability among firms with some recording less premiums. This result is in line with the findings of Olokoyo (2012) who established that size (measured in terms of premium volume) affects the operational reach and underwriting intensity rather than solvency.

Claims Behavior (CR and CS): The low average claim ratio i.e. 0.17 and moderate claim settlement rates demonstrate that there is good claims management across majority of the firms. Nevertheless, the existence of negative claim ratios suggests that insurers could recover more than they claim or that there were potentially anomalous data, which has already been observed in insurers in Nigeria (Ezeoha, 2008). These trends support the idea that underwriting discipline has a huge influence on capital adequacy and risk exposures.

Risk Retention and Reinsurance (RL, RC, RA, RR): There is a broad range of risk retention levels and reinsurance strategies as a result of varying risk management strategies. The significant skewness of distributions of RA and RR implies that few firms actively engage in inward reinsurance and/or large reinsurance ratios, as have been admitted by Cummins and Weiss (2009), thereby raising the implication that reinsurance is strategically concentrated among larger or more capitalized insurers.2. Correlation Analysis

The correlation results underscore distinct operational relationships:

Capital Adequacy (CA): The weak dependences with insurance activities point to CA being insulated and driven more through structural and regulatory, and strategic management of the capital. Negative correlations between CR (r = -0.347, p < 0.001) and RC (r = -0.307, p < 0.001) subsidize preceding literature (Cummins et al., 1999; Swiss Re, 2018), which has identified (high) claims burden or broad risk ceding as the drain of capital buffer.

Premium Income and Operational Scale: Strong positive relationships of PI with RL, CS and RC indicate that bigger insurers would be more involved in its risk retention and reinsurance activities. This verifies the fact that premium volume is related to operational intensity that is based on scale but not capital strength (Olokoyo, 2012).

Claims Management: claim settlement (CS) has highly positive correlations with PI, RL and RC at demonstrating that insurers with larger volumes of underwriting naturally settle more claims and cede more systematically. This is in line with the research done by other scholars on the international aspect of the operational efficiency in insurance markets (Cummins & Weiss, 2009).

Reinsurance Practices: Reinsurance practises have different degrees of importance. RR has a slight relationship with CA ($r = 0.137$, $p < 0.05$), whereas RC is associated with a negative relationship with CA which indicates that the risks that are ceded may be a sign of weaker capital, as researched by Harrington & Niehaus (2004). Inward reinsurance continues to be uncorrelated with CA and CR indicating that inward reinsurance is a strategic rather than capital determined decision.

3. Determinants of Capital Adequacy

Random Effects regression indicates:

Significant Negative Drivers include Claim Ratio (CR) and Claim Settlement (CS) are the elements that negatively influence the capital adequacy, which points at the fact that increases in the levels of claims and claims settlements diminish capital reserves. This is in tandem with the financial intermediation theory that stresses the essence of risk management to preserve solvency (Mayers & Smith, 1982).

Significant Positive Drivers: Risk Retention (RL) and Reinsurance Ratio (RR) works positively on CA and indicates that the well capitalized insurance firms rely more in retention in terms of risk management and reinsurance efficiency, as it has been suggested by Cummins & Rubio-Misas (2006).

Insignificant Variables: Premium Income (PI) and Reinsurance Acceptance (RA) correlate insignificantly to capital adequacy and this implies that scale and inward reinsurance are no longer determinants of capital adequacy.

On balance, these findings confirm the scholarly hypothesis that capital adequacy largely depends on structural and strategic variables, such as claims management or risk-transfer activities, and not so much on operational size.

Model Validation and Robustness

The Hausman test ($\chi^2 = 8.4213$, $p = 0.297$) confirms that the Random Effects model is more appropriate than the Fixed Effects alternative, suggesting no significant correlation between explanatory variables and unobserved firm-level heterogeneity. This enhances the credibility of the findings and aligns with best practices in panel data econometrics (Baltagi, 2021), ensuring that results are generalizable across firms and time periods.

6. Conclusion

This paper establishes that capital adequacy impacts on the performance of underwriting Nigerian oil and gas insurers but not to the same extent across the board. The evidence demonstrates that capital buffers are most instrumental in defining claims management, risk retention, and reinsurance policies- basic drivers of underwriting discipline- but have little or no bearing on scale-based outcomes like premium income and inbound reinsurance.

This is seen in the high claim ratios, and the poor settlement, which ate into the capital strength and asserted the importance of wise underwriting and effective dealing with claims in the solvency. In the same manner, insurers that have stronger capital positions hold more risk and are able to negotiate reinsurance in a more strategic manner, which lowers susceptibility to external shocks. In comparison, premium growth and reinsurance acceptance seem unattached to capital adequacy, and instead reflect structural, strategic, and regulatory drivers of scale.

The findings performed under the Random Effects model that was approved by the Hausman test indicate that the capital adequacy is multidimensional: three hypotheses out of five were rejected, thus partially but substantially supporting the theoretical background of the study. These results are consistent with the capital structure theory and previous studies (e.g. Berger & Bouwman, 2013), indicating that more highly capitalized insurers take a more strategic approach to risk management and face less need to use external reinsurance.

The findings support the notion of the implementation of Risk-Based Capital (RBC) that inspires NAICOM and insurers to enhance solvency by applying an integrated risk and capital management approach. The assured level of capital adequacy in Nigeria's oil and gas insurance industry will eventually avoid being reduced to firm sizes, but controlled claims, prudent retention, and dynamic reinsurance policies.

The joint analysis provides strong empirical support for the multidimensional relationship between capital adequacy and key underwriting performance indicators. Using a panel regression model that incorporates premium income, claims settlement, claims ratio, risk retention, reinsurance ceding, and reinsurance ratio, the findings indicate that capital adequacy is jointly influenced by these underwriting activities. Notably, the negative impact of claims ratio and claims settlement on capital adequacy underscores the financial strain of poor claims experience, while the positive effects of risk retention and reinsurance ratio confirm the beneficial role of internal capital in underwriting efficiency.

These results align with the theoretical assertions of Berger and Bouwman (2013), who emphasized that strong capital buffers empower insurers to implement more disciplined underwriting practices, reduce

reliance on reinsurance, and better withstand financial shocks. The findings also support the capital structure theory, which posits that firms' funding decisions, including how much risk to retain or cede—are contingent upon their internal financial strength. Hassan (2023) further suggests that multidimensional capital planning, when synchronized with risk management policies, enhances underwriting sustainability in volatile markets. From a practical perspective, this integrated framework demonstrates that capital adequacy cannot be analyzed in isolation from underwriting practices. Well-capitalized firms exhibit more strategic decision-making across all operational fronts—maintaining a balance between profitability and solvency. For Nigerian oil and gas insurers, this means capital enhancement should be part of a broader enterprise risk management strategy that includes claims discipline, retention optimization, and proportional reinsurance.

The implications for regulation are profound. Supervisors should adopt a holistic solvency assessment approach that evaluates the interplay between multiple underwriting factors and capital strength. NAICOM's proposed Risk-Based Capital (RBC) framework may be enriched by incorporating dynamic metrics from underwriting behavior. The development of early warning systems that track deteriorating capital due to poor claims experience or excessive reinsurance cession would also be beneficial.

Dynamic panel estimators such as System GMM can help uncover causality and temporal dependencies between capital and underwriting variables. Comparative analysis across regions or sectors could also reveal how different regulatory environments mediate this multidimensional relationship.

Recommendations

1. Empower Claims Management Systems

Considering that claims ratio and settlement delays create a serious negative effect on the capital adequacy, the insurance companies are supposed to implement sophisticated claims analytics, fraud prevention services, and even simplified processes of addressing claims to reduce the financial loss and boost the solvency.

2. Risk Retention Policy Optimization

The insurers are recommended to keep more risk in the company where it should be, in the view of actuarial disposition. Such maturity in underwriting is indicated by higher levels of retention when coupled with adequate capital cushions and could help remove over-reliance on reinsurance markets.

3. Embrace Equity Reinsurance Policies

Although reinsurance is critical in managing risks, too much cession can destroy capital effectiveness. Instead of high external risk transfer, firms should embark on proportional reinsurance that meets their underwriting risk appetite and their financial capability.

4. The similar 1-D Risk-Based Capital (RBC) Framework by NAICOM should be supported.

Regulators are also urged to speed up the implementation of an active RBC system with the real-time underwriting metrics, especially the claims ratio, the retention levels, and use of reinsurance, as central factors of solvency.

5. Heat Up Early Warning and Capital Stress Monitoring Systems

Regulators and firms are expected to have in place early warning systems with the use of dynamic indicators, like a soaring claim ratio or a downward trend in retention rates. The systems are able topreemptively cause capital spikes or reinsurance updating before solvency is undermined.

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