Assessing the Risk Contribution of Gross Claims from Different Lines of Businesses within the Nigerian Insurance Sector: An Application of the CAPM Model

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Abstract

At the industry-level, premiums and claims are realized from different lines of insurance businesses. Although the premiums are used by the government and other stakeholders to promote economic growth, the frequency and volume of claims accumulated can drastically impede this growth. Hence in this paper, we consider gross claims from six lines of insurance businesses at the macro-scale drawn from a two-year company-based series. We further assume that they form a portfolio of industry-level gross claims and use the total gross claims as a proxy for the claims market. The Capital Asset Pricing Model is then applied to estimate the degree of risk contributed by each line of business to the portfolio based on the linear regression technique. As a measure for comparison, a multiple linear regression model that incorporates size and value, which are proxied by gross premiums and claims ratio, is employed. The specific and systematic risks are estimated and an optimization operation on the gross claims, using simulated data, is performed. The findings show that the oil&gas line of business displays the highest sensitivity with the claims market and hence possesses the largest systematic risk, while engineering displays the lowest sensitivity. From the optimization analysis, the simulated industry portfolio with the highest expected claim has its highest weight assigned to oil&gas. This industry-level analysis, with its added policy implications, can serve as a benchmark for individual insurance companies in Nigeria who cover multiple lines of insurance policies.

Keywords: Portfolio Optimization, Systematic Risk, Insurance Businesses, Sharpe Ratio

1 Introduction

The Nigerian insurance market is a growing and dynamic sector that plays a crucial role in mitigating risks and promoting economic stability. Insurance policies in Nigeria cater to a wide range of needs, with eight main primary lines of business dominating the market. Six of them addressed in this paper include motor vehicle insurance, fire insurance, marine and aviation insurance, general accident insurance, engineering insurance, and oil and gas insurance. Each line addresses specific risks, driven by unique demand factors and operating on varying scales.

Augustine and Ayoni (2021) noted that motor vehicle insurance is one of the most prominent and widely purchased insurance policies in Nigeria. It provides coverage for losses and liabilities arising from vehicle ownership and operation. Typical policies include third-party liability, collision, comprehensive coverage, personal injury protection (PIP), and uninsured/underinsured motorist coverage. The scale of motor vehicle insurance is large, given the widespread use of vehicles in urban areas. Demand is primarily driven by legal mandates for third-party liability coverage, increasing vehicle ownership among the middle class, and growing awareness of financial protection against accidents. However, this line faces significant risks, such as high accident rates due to poor road infrastructure, repair cost inflation, vehicle theft, and the prevalence of fraudulent claims.

Fire insurance addresses the need to protect properties from damage caused by fire and related risks such as explosions and certain weather events (Fadun et al., 2024). Policies typically include property damage coverage, compensation for loss of use, and extended coverage for additional risks. While its business scale is moderate, it is particularly relevant in urban and industrialized areas where fire incidents can have devastating financial impacts. The demand for fire insurance is driven by rapid urbanization, industrial growth, and heightened awareness of property risks and factors such as high population density, electrical faults, and poor adherence to fire safety standards increase the risk profile of this line of business (Momoh and Ajiboye, 2018).

Marine insurance provides protection for ships, cargo, freight, and associated liabilities, while aviation insurance addresses risks related to aircraft, passengers, and third-party liabilities. The scale of marine and aviation insurance is moderate to large, reflecting Nigeria's status as a trade hub and the growth of its aviation sector. Demand is fueled by expanding international trade, reliance on imports, and increased air travel and cargo transport (Isimoya and Akindipe, 2022). However, risks such as port inefficiencies, piracy in the Gulf of Guinea, adverse weather conditions, and operational safety challenges in aviation pose significant concerns. General accident insurance, on the other hand, covers a range of risks, including accidental injuries, property damage, and other unforeseen events unrelated to health or life insurance. The business scale of this line is relatively small to moderate, depending on sector-specific needs and public awareness. Demand is driven by the increasing frequency of workplace accidents, growing liability awareness, and the need for financial protection against unforeseen incidents. Nonetheless, high claim frequency, fraudulent activities, and legal liabilities present challenges for insurers operating in this segment.

Engineering insurance is crucial for Nigeria’s growing construction and infrastructure sectors. It provides comprehensive coverage for risks associated with construction projects, installation activities, and machinery or equipment failures. Policies such as construction all risks and erection all risks are common. The business scale of engineering insurance is expanding, driven by government infrastructure investments and private sector projects. Increased focus on renewable energy and the adoption of advanced technologies also contribute to demand. However, the sector is exposed to risks such as project delays, corruption in execution, natural disasters, and technical equipment failures, which can lead to substantial claims. The oil and gas insurance represents one of the most specialized and critical lines in Nigeria, given the country’s dependence on the energy sector. This line covers risks associated with exploration, production, refining, and distribution of oil and gas. It typically includes property damage, business interruption, liability and environmental coverage. The business scale is high, reflecting Nigeria's position as a major oil producer. The demand for such policies is driven by the high stakes of the industry, regulatory requirements, and the need to manage financial exposure to operational risks. However, this line faces considerable challenges, including political instability, environmental liabilities, fluctuating oil prices, and the high risk of operational accidents (Andabai, 2017).

Markets in general, display different types of risks. For instance, in financial markets around the world, the asset pricing models, particularly the Capital Asset Pricing Model (CAPM) models and its variants, have been applied by several scholars to investigate the level of risk in various assets in the stock markets (for example, see Coffee (2012); Garg (2019); Nel (2011); Novak (2015); Janssen (2014); Raza et al. (2011); Bajpai & Sharma (2015); Herbert et al. (2017); Afolabi et al. (2017); Oseni & Olanrewaju (2017); Karp & van Vuuren (2017)). However, in the insurance markets, fewer scholars have considered same.

Binghua & Hui (2020) analyzed the insurance industry stock for China. Their results indicated that overall volatility of the industry asset is higher than the market volatility. In addition, a significant risk premium was observed in comparison to that of the market. The application of CAPM to insurance premiums and/or claims is extremely rare. Chen et al. (2003) stands out in this regard. They examined how the insurance price should be fairly adjusted when insurer`s default risk is considered, thus developing a model which showed that fair insurance premiums are lower when firms have a positive probability of being insolvent. By making use of property liability insurers dataset for the period 1943-1999, they further estimated the effects of the insolvency risk on insurers underwriting profit rate. Their results showed that the incorporation of the default risk of insurers in the model significantly reduced the required price for insurance which would lead to lower profit potentials.

This paper seeks to contribute to the CAPM literature in relation to insurance claims using Nigeria as a case study. Gross claims from different lines of businesses (LoBs) can be considered as a portfolio of losses at the macro level. Some lines of business (LoB) may contribute more volatility or uncertainty to the whole portfolio, while some may contribute less. For the Nigerian government, insurance regulators and other relevant stakeholders to know which line of business it should give more attention to, in terms of resource allocation, policy decisions, regulatory demands, profit optimization and so forth, the knowledge of how much risk a given LoB contributes to the portfolio of lines of businesses is absolutely important. Moreover, risk identification and diversification are critical bases for insurance and investment, hence understanding the impact of systematic risk, for example, on the portfolio's risk profile, is pertinent to volatility analysis and in designing future strategies that will mitigate against adverse repercussions caused by the contagion effect that may arise. To this end, the CAPM approach is adopted to measure how risky a given LoB is in comparison to the portfolio of the gross claims of several lines of businesses of the insurance industry in Nigeria. The total gross claims is considered as the proxy for the claims market. A multiple linear regression is employed for comparison.

The remaining sections of this paper are as follows. Section 2 briefly discusses the CAPM methodology. Section 3 covers the analysis of the portfolio of gross claims with focus on six lines of businesses. Section 4 provides the implications of the findings for insurance policymakers and regulators. We conclude in Section 5.

2 Methodology

2.1 CAPM method

The formula for the CAPM method (which is a single index model) is given by

$$r_s = \alpha + \beta * r_M \tag{1}$$

for the case where excess return is assumed to be zero. r_s and r_M represent the individual stock values and the market proxy values respectively. Adopting it to fit the gross claims context for this study, r_s will represent the individual line of business, while the claims market (gotten from the company-based total gross claims) will be the substitute for r_M. The α and β values respectively are the intercept and the slope of equation (1). β has a special interpretation as the measure of the volatility (or systematic risk) of a security or portfolio compared to the market as a whole.

Using motor line of business as an example, the CAPM explicitly becomes:

$$motor\ LoB = \alpha + \beta *\ claims\ market \tag{2}$$

The least squares regression is used to estimate α and β values.

2.2 Multiple linear regression

Drawing insights from the Fama-French 3-factor (FF3) model (Fama and French, 1992), we also employ a multiple linear regression to capture size and value dynamics specific to the insurance sector. The gross premiums and loss ratios are used to serve as the proxies for size and value respectively. However, we do not consider the 'large minus small' and 'high minus low' aspects of FF3. By including these perspectives, we want to know if the volatility profile of the given LoB remains the same or not. This is expressed as:

$$motor\ LoB = \alpha + \beta *\ claims\ market + \gamma *\ MGP + \mu *\ MLR \tag{3}$$

where MGP is motor gross premium with coefficient γ and MLR is motor loss ratio with coefficient μ.

2.3 The efficient frontier and Sharpe ratio

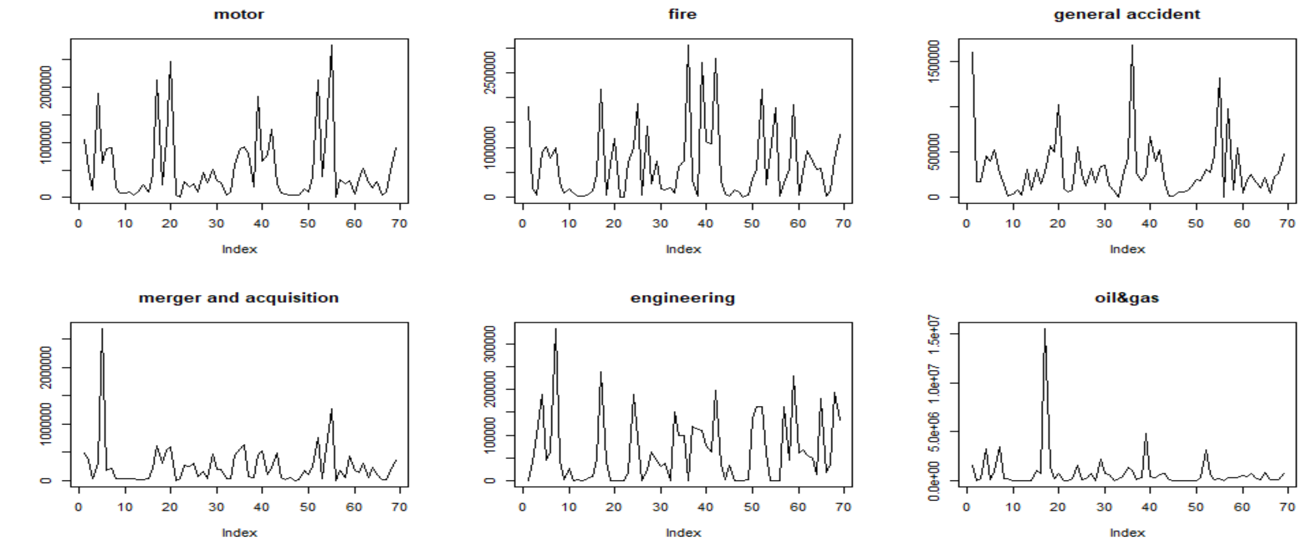
This frontier is constructed by plotting the risk-return graph. The portfolio expected return is computed as

$$\text{portfolio expected return } = \sum_i probability(i) * rate\ of\ return(asset(i)) \tag{4}$$

The standard deviation serves as the measure of risk on the x-axis and $i = 1, \dots, n$ represents the number of assets (which is replaced by claims in this study). The Sharpe ratio is the ratio between the expected return of an investment with its risk. This is given by the formular, $\frac{\text{expected return}}{\text{standard deviation}}$. Thus, a low Sharpe ratio indicates a risky LoB or portfolio.

3 Industry Gross Claims Portfolio Analysis

The gross claims paid non-life insurance business dataset, as well as the gross premiums and claims ratios, are obtained from the Nigeria Insurance Digest (NIA) for the years 2018 and 2019 (*https://www.nigeriainsurers.org/*). Each row of a given LoB denotes an insurance company's gross claims data (in millions of naira) for that line. There are 8 LoBs (motor, fire, general accident, M&A (marine and aviation), oil&gas, WC (workers compensation) and miscellaneous. Only the first 6 were used and the last 2 were left out for lack of data entries. The combination of all the claims of a LoB is taken as the annual claims entry at the insurance industry level. Thus, we have a 2-year company-based series made up of 69 insurance gross claims observations for each of the 6 LOBs. It is important to note that since the data is not a time-series, we do not find the relative changes of the claims. However, to give it a feel similar to asset returns, and to make it easier to analyze and interpret, it is the down-scaled claims and premiums that are applied. Specifically, the actual data is divided by 10 million to scale it down to values between 0 and 1. The actual claims are displayed in Figure 1 along with the density plots. The oil&gas LoB possesses the longest tail and the sharpest peak.



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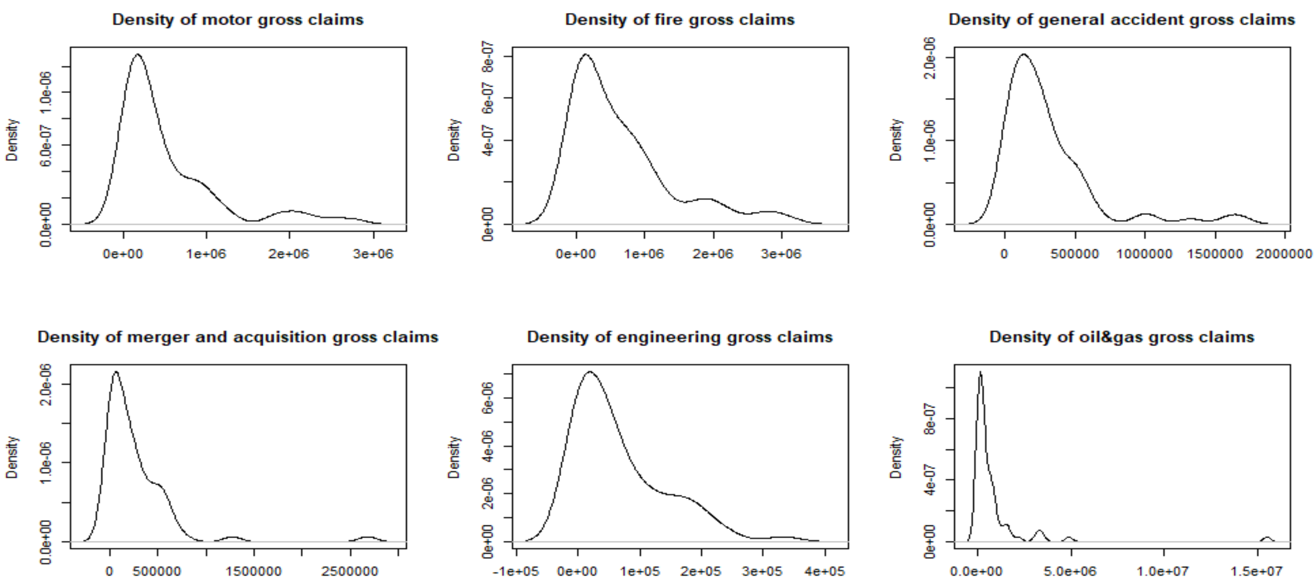

b

Figure 1: Actual observed claims plot (a) and the corresponding density plots (b) for each LoB (motor, fire, general accident, merger&acquisition, engineering and oil&gas)

3.1 Tests of significance

The Augmented Dickey-Fuller (ADF) test is implemented to check for stationarity. The p-values are motor (0.01), fire (0.024), general accident (0.083), M&A (0.01), engineering (0.01) and oil&gas (0.01). Only the general accident LoB is slightly greater than 0.05. All the others are stationery.

3.2 CAPM estimation

The linear regression technique is applied to estimate the parameters of the CAPM model. A multiple linear regression (MLR) is also employed for comparison. Table 1 indicates the LoB specific parameters (alpha and beta) for both methods. Column A results are from CAPM regression analysis while B is obtained using the MLR method.

Table 1: Linear regression CAPM estimation for each LoB gross claims and the MLR results which capture size and value dynamics. The standard errors are in parentheses.

Insurance LoB (gross claims)	**alpha (α) (₦'000)**		**beta (β)**	
	CAPM Regression A	**MLR B**	**CAPM Regression A**	**MLR B**
Motor	132,130 (61,710)	-323,510 (38,030)	0.151 (0.015)	0.0176 (0.007)
Fire	223,360 (81,720)	-149,260 (79,630)	0.167 (0.020)	0.06 (0.02)
General accident	174,750 (46,880)	-107,600 (39,840)	0.051 (0.012)	-0.003 (0.009)
M&A (Marine & Aviation)	113,190 (51,840)	-198,410 (43,530)	0.058 (0.013)	0.0095 (0.011)
Engineering	39,160 (10,360)	39,330 (14,202)	0.0105 (0.003)	0.0104 (0.003)
Oil&gas	-610,700 (158,400)	-597,800 (205,400)	0.552 (0.039)	0.552 (0.04)

All the beta values are below one (Table 1). However, the oil&gas claims exhibits the highest beta estimate. This implies that it is the most sensitive to the claims market. It also has a negative α based on the CAPM analysis. Given that we are dealing with losses, it implies that a negative loss is a gain. So the -α can be interpreted as gain of 610,700,000 naira in the absence of the market risk. However, market risk is always present, hence the α value will most likely not be realizable. Thus, the oil&gas claims are prone to falling in the tails, giving rise to large (but not extreme) losses. This observation aligns with the density plot in Figure 1 (for oil&gas), where heavy tails are observed. As a comparative measure, when the size and value dynamics are incorporated using the gross premium and claims ratio proxies (Table 1), in order to capture a wider range of characteristics, similar beta values are observed as well (with the exception of general accident LoB). Oil&gas still has the highest beta value. The alphas are mostly negative. We further observe from our results, that the size and value factors are not significant characteristics for the engineering and oil&gas LoBs (not show here), which coincidentally possess the lowest and highest risk, respectively.

Based on the CAPM findings, the different LoBs are also ranked using the ratio α/β and Sharpe ratios (Table 2). Again oil&gas has the lowest Sharpe ratio implying it has the highest risk. In contrast, the engineering LoB has the highest Sharpe ratio.

Table 2: Ranking the lines of insurance business with respect to their alpha-beta and Sharpe ratios.

LoBs	**ranking (α/β)**	**Sharpe ratio**
Engineering	3,733,469.3	0.894
General accident	3,458,200.9	0.898
M&A	1,943,236.1	0.694
Fire	1,339,402.4	0.879
Motor	877,060.6	0.840
Oil&gas	-1,106,305.7	0.399

The R-squared values of the CAPM regression results represent the systematic risk for each LoB (Table 3). It reveals that the oil&gas sector has the highest systematic risk followed by motor claims. This implies that these two sectors are the LoBs that expose the industry portfolio of gross claims to non-diversifiable risks (like interest and exchange rates), given that these types of risks cannot be reduced.

Table 3: Systematic and specific risks of each LoB.

Insurance LoB (gross claims)	**Systematic (Proportion of non-diversifiable risk)**	**Specific (Proportion of diversifiable risk)**	**Correlation with claims market**
Motor	0.594	0.41	0.771
Fire	0.505	0.495	0.711
General accident	0.222	0.78	0.471
M&A	0.237	0.76	0.486
Engineering	0.201	0.799	0.448
Oil&gas	0.749	0.251	0.865

Gross claims from the engineering sector has the highest proportion of diversifiable risk, which implies that about 83% (Table 3) of the risks are specific to the sector, hence the risks can be reduced. Its beta value is also the smallest (Table 1).

3.3 Correlational analysis

In general the correlation across the LoBs fall between very low to medium (Table 4). Motor and oil&gas gross claims exhibit the highest interdependence, this is followed closely by fire and oil&gas. Additionally, the interdependency of every other line with oil&gas is the highest, for example, the covariance of M&A and oil&gas is the highest compared to its covariance other LoBs.

Table 4 : The covariance variance matrix.

	Motor	Fire	General accident	M&A	Engineering	Oil&gas
Motor	1.006	0.548	0.363	0.375	0.345	0.667
Fire	0.548	1.007	0.335	0.346	0.319	0.615
General accident	0.363	0.335	1.012	0.229	0.211	0.408
M&A	0.375	0.346	0.229	1.011	0.218	0.421
Engineering	0.345	0.319	0.211	0.218	1.011	0.388
Oil&gas	0.667	0.615	0.407	0.421	0.388	1.004

In order to inspect finer details of the interdependency of the LoBs we plot the covariance matrix of the claims and initiate an automatic clustering mechanism on the covariance residual observations in Figure 2. We observe that the claims fall into a much broader sector of the LoBs. This suggests that these LoBs share some similar characteristics. On the other hand, motor and fire gross claims are each in their own distinct classes.

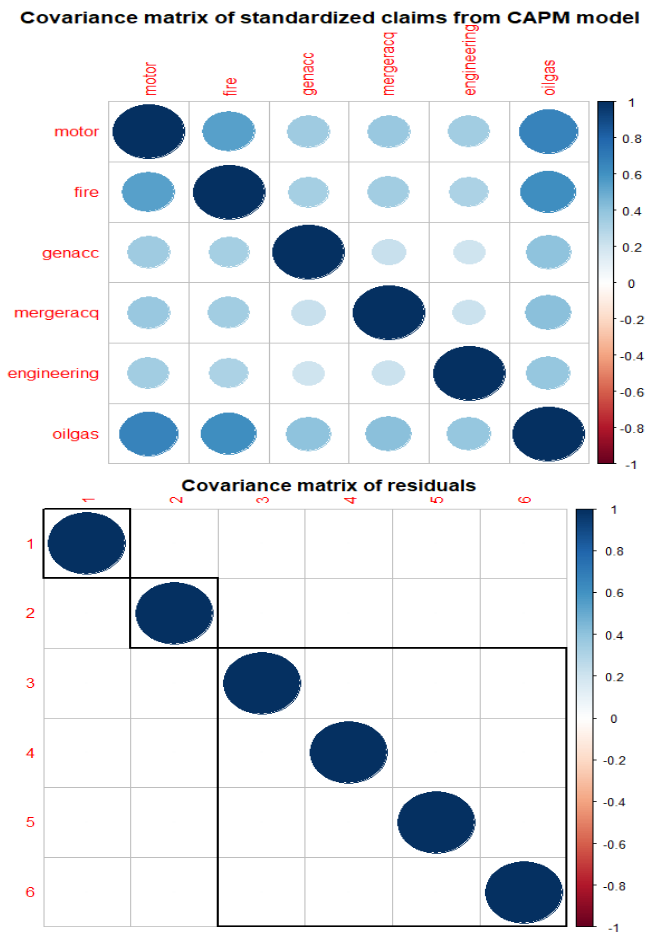

Figure 2: covariance matrix plot of claims (left) and plot of the residual (right).

The observed low correlations, which are dominant between LoBs in the Nigerian insurance industry (as seen in Table 4 and Figure 2) most likely do arise from the distinct characteristics and dynamics that define each category. These correlations provide insights into how diverse risk factors, market structures, and external influences shape the behavior of claims across the industry. A key reason for the observed correlations lies in the differences in risk exposure and claims triggers across LoBs. Each LoB is driven by unique factors that minimize simultaneous claim occurrences. For instance, motor insurance claims are predominantly driven by localized factors such as road accidents, vehicle theft and vandalism, oil & gas insurance claims are linked to industry-specific risks, including pipeline explosions, exploration failures, and environmental disasters, while fire insurance losses are typically tied to property-related hazards, such as fire outbreaks or electrical faults. These varied risk profiles and claim triggers reduce the likelihood of overlap between LoBs.

Additionally, the market structure, customer demographics and operational scope of each LoB also play a significant role in maintaining low correlations. Motor insurance serves a broad customer base, ranging from individual car owners to commercial fleet operators, while oil and gas insurance caters to a niche market involving high-value assets and specialized coverage. Fire insurance is generally limited to fixed property assets, whereas M&A and oil & gas insurance involve movable and operational assets, such as cargo, ships, and drilling equipment.

There is the aspect of the diversity in economic and regulatory influences which also contribute to the distinctive claim patterns of the LoBs. For instance, motor insurance is strongly affected by local economic factors such as income levels, road infrastructure, and vehicle ownership trends, oil & gas insurance is heavily influenced by global commodity prices, technological advancements, and stringent sector-specific regulations, while fire Insurance is shaped by urbanization trends, building safety codes, and the availability of fire prevention mechanisms.

The existence of medium correlations observed among certain LoBs can be attributed to factors such as shared risk exposures, operational dependencies, and broader macroeconomic influences. These correlations reveal underlying relationships between seemingly distinct insurance categories and are vital for risk assessment and portfolio management. For instance, the motor and oil & gas lines share risks associated with infrastructure conditions, such as poorly maintained roads or pipelines. Transportation of oil products via road links these two sectors, making accidents or operational damage a common risk, and contributing to moderate correlations in claims. Similarly, fire and oil & gas insurance exhibit notable interdependence due to the high susceptibility of oil and gas facilities, including refineries and storage units, to fire-related hazards. This overlap in exposure underscores the importance of understanding shared risks in underwriting decisions.

The cross-sector, macroeconomic and operational linkages between industries can also drive correlations among LoBs. For example, M&A and oil & gas insurance are often interconnected because many oil and gas companies rely heavily on marine or aviation transport for their operations. Damage or losses in one sector, such as oil spills during marine transport, can spill over into claims in the other, resulting in medium levels of correlation. Likewise, motor and fire insurance may be linked in urbanized or industrialized regions where vehicle fires in garages or industrial accidents can simultaneously trigger claims under both categories. Economic downturns, on the other hand, may lead to delayed asset maintenance, increasing the likelihood of claims in both motor and fire insurance lines. Environmental factors give rise to systemic influences. Natural disasters, such as floods, can simultaneously impact multiple sectors by damaging insured vehicles (motor claims) and causing property fires (fire claims).

3.4 Optimal gross claims portfolio

An insurer may be interested in examining a given LoB gross claims allocation within a portfolio of LoBs. Thus, in this section we solve for the minimum variance and tangency gross claims portfolios. In other words, we seek for the weights for each LoB that will provide the targeted portfolios, noting that the portfolio with the highest Sharpe ratio gives the tangency portfolio. This is achieved by performing an optimization operation on the gross claims using simulated data of size n=1000. First, random weights from a uniform distribution are generated for each of the LoBs, with the constraint being that the sum of the weights must be equal to one. Negative weights are not allowed. The mean claims for each LoB is calculated and the portfolio value is computed as

$$\text{portfolio expected claims } = \sum_{i=6} weight * mean(LoB)$$

The portfolio claims is then converted to a monthly data series using the transformation

$$\text{portfolio expected claims} = (\text{portfolio expected claims } + 1)^{12} - 1$$

The portfolio risk is computed using the weights and the covariance matrix. Finally, the ratio of the portfolio expected claims to that of its risk provides us with the portfolio Sharpe ratios. Table 5 displays the observations for the maximum risk and minimum variance portfolios, as well as the tangency portfolio (TP). These last two portfolios are represented by the orange and red dots (respectively) in Figure 3, which displays the plot of all the 1000 random gross claims portfolios.

The weights that were obtained from the observed data, based on the proportion of each LoB (green dot in Figure 3) are 0.202, 0.254, 0.119, 0.102, 0.026 and 0.314 respectively for motor, fire, general accident, M&A, engineering and oil&gas. It indicates that within the period, oil&gas had the highest proportion of claims.

Table 5: Minimum variance and tangency portfolios with their LoB-assigned weights.

	Motor	Fire	General accident	M&A	Engineering	Oil&gas	Portfolio expected claims (₦'000)	Portfolio risk (₦'000)	Sharpe ratio
Minimum variance portfolio (MVP)	0.035	0.132	0.275	0.079	0.464	0.014	3,553,716	218,987.2	16.22
Tangency portfolio (TP)	0.290	0.183	0.364	0.112	0.049	0.0008	6,466,906	369,252.8	17.51
Maximum risk portfolio	0.126	0.097	0.149	0.089	0.016	0.521	11,091,650	1,190,872	9.31

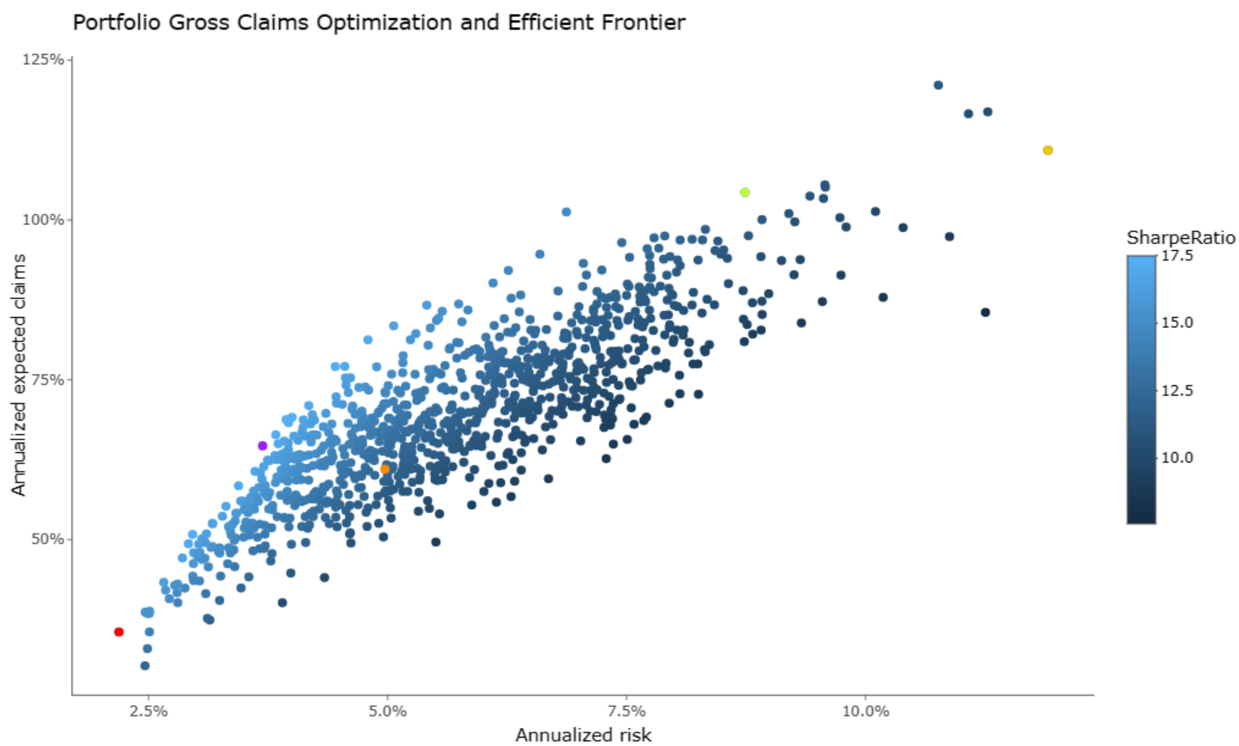

Figure 3: A simulation of 1000 gross claims portfolios having different LoB weight allocations. Five distinct portfolios highlighted by the colored dots are the minimum variance portfolio (red), equally weighted portfolio (orange), maximum risk portfolio (yellow), portfolio with weights that are based on the proportion of observed LoB gross claims from the given original dataset (green) and tangency portfolio (purple).

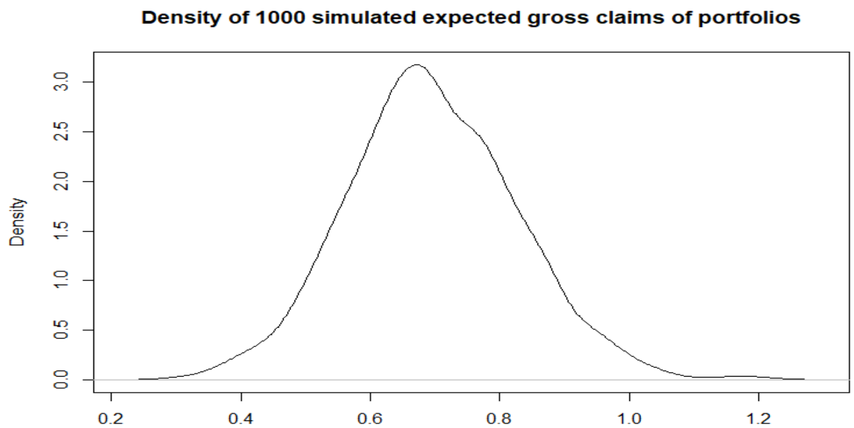

Figure 4: Density plot of the simulated portfolios expected gross claims.

It can be observed from the risk-return space that the efficient frontier of the expected (industry-level) claims portfolios hold the portfolio with the highest Sharpe ratio (Figure 3, purple-dotted portfolio). As expected, the analysis indicates that the lowest weight should be assigned to oil&gas and motor LoB in order to obtain the MVP with portfolio risk of 218,987,200 naira. This fully aligns with the results on Tables 1 and 3, which show that oil&gas contributes the highest risk to the portfolio of gross claims and this is followed closely by the motor LoB. Again for the TP, which is the optimal case, a much lower weight is assigned to the oil&gas LoB (than in the MVP case). The TP provides the combination of weights for each LoB that will give the highest possible expected national gross claims to variance ratio (or simply put, Sharpe ratio) and by implication, the maximum reserves that should be kept to cover the claims (which in this case is 6,466,906,000 naira). The probability density plot of all the simulated claims portfolio closely resembles a normal distribution (Figure 4).

These results from the industry-level portfolio of gross claims can serve as a benchmark. It will provide insights to insurance companies who cover multiple lines of insurance policies to know the expected proportion of claims from each LoB that will enable them make optimal profits (in terms of claims reduction). Also, the amount of reserves to hold in order to optimally cover a claims portfolio with the highest claims can be estimated. In this worse-case scenario (with portfolio Sharpe ratio of 9.31, Table 5), slightly more than half of the policies are seen to cover the oil&gas LoB. One practical implication of this realization, for an insurer at the company level, is that the insurer whose bulk of insurance policies cover the oil&gas sector will become more susceptible to extreme claims. With this knowledge, strategies can be adopted to further reduce the claims coming in from the oil&gas LoB.

4 Implications for Policy in the Nigerian insurance industry

The findings from this study have several important implications for policy within the Nigerian insurance industry. These implications span risk management, resource allocation, and strategic planning for both insurers and regulators. For each implication, a recommendation is provided. The five key policy implications presented are:

4.1 Risk mitigation in high-risk LoBs

Implication: Oil & gas and motor LoBs are identified as the riskiest contributors to the portfolio, with the highest weights in claims variance. This suggests these LoBs are highly volatile and potentially underpriced relative to their risk, thus bringing to the fore the need for sector-specific strategies for these high-risk LoBs.

Policy recommendation: Policies should mandate stricter underwriting standards and risk-based premium pricing for high-risk LoBs. For instance, oil & gas policies might require reinsurance arrangements to transfer excess risks. Regulators can introduce mandatory participation in reinsurance pools to distribute risks and ensure resilience in the face of catastrophic events. Motor insurance could benefit from greater investment in technology (e.g., vehicle tracking), adoption of telematics and AI to manage claims. There is also a need to promote public awareness of vehicle safety and improve road infrastructure to reduce accident rates.

4.2 Minimum variance portfolio strategy

Implication: The MVP provides a benchmark for insurers looking to minimize risk exposure across claims portfolios. Assigning lower weights to oil & gas and motor LoBs can significantly reduce overall portfolio risk.

Policy recommendation: The National Insurance Commission (NAICOM) in Nigeria could develop a risk-adjusted solvency margin framework, where insurers are required to maintain a diversified portfolio with limited exposure to high-variance LoBs.

4.3 Sharpening risk-based supervision

Implication: The efficient frontier analysis underscores the importance of balancing risk and return. Supervisory authorities can use this approach to monitor insurers' risk-return profiles.

Policy recommendation: Risk-based supervision frameworks should incorporate tools like Sharpe ratio analysis to assess insurers' portfolio strategies. Regulators can identify companies with disproportionately high exposure to high-risk LoBs and enforce corrective measures.

4.4 Promoting data-driven decision making

Implication: The resemblance of the simulated claims portfolio distribution to a normal distribution (as seen in Figure 4) suggests that claims data is predictable within certain statistical limits. This enhances the feasibility of adopting advanced quantitative models for forecasting and decision-making.

Policy recommendation: Given the bare landscape in Nigeria with regards to the required quantitative-based expertise (Chukwudum and Ekanem, 2022), policymakers should encourage insurers to invest in data analytics, actuarial science, and predictive modeling to improve claims management and reserve allocation. Training programs and incentives for adopting modern risk assessment tools should also be introduced.

4.5 Impact on premium pricing models

Implication: The alignment of premium pricing with risk exposure is critical, especially for high-risk LoBs.

Policy recommendation: Encourage the use of dynamic pricing models that incorporate claims variance data to ensure premiums reflect the true risk exposure of each LoB.

5 Conclusion

In this study, insights from the CAPM model were applied to analyze the degree of risks exhibited by six different lines of businesses of gross claims, in the Nigerian insurance sector. Despite the model's limitations, tangible results were realized. For instance, it was observed that the oil&gas line of business exhibits the highest systematic risk and the interdependency of every other line with oil&gas is the highest, when compared to their interdependency with other lines. The motor and fire LoBs are next in line with respect to the risks that the exhibit. As expected, the minimum variance simulated industry claims portfolio assigns the smallest weight to the oil&gas business line. Detailed policy implications and their corresponding policy recommendations are provided. As a future path, alternative models can also be applied.

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