

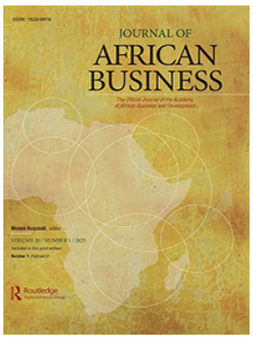
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Factors Influencing Underwriting Performance of the Life and NonLife Insurance Markets in South Africa Exploring for Complementarities Nonlinearities and Thresholds

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Factors Influencing Underwriting Performance of the Life and Non-Life Insurance Markets in South Africa: Exploring for Complementarities, Nonlinearities, and Thresholds

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ABSTRACT

Underwriting is crucial for insurers' performance and sustainability, yet empirical evidence on factors influencing its performance has received limited attention. Therefore, this study investigates this phenomenon considering South Africa's life and non-life insurance sectors between 2013–2019. Using the generalized method of moments and the bootstrap quantile regression techniques for analysis, the findings show that insurance size, market share, and investment income significantly and positively impact underwriting performance. However, premium growth weakens the underwriting performance of both sectors. Also, non-life insurance shows a positive relationship for reinsurance, while life insurers present an inverse relationship. Underwriting risk negatively impacts non-life performance across quantiles, while life insurer risk was negative in higher quantiles. More so, initial solvency levels weaken underwriting performance, while extreme increase improves it, implying a direct U-shaped relationship. Hence, highly solvent insurers are more likely to succeed in underwriting operations. Additionally, market share complements return on assets in promoting underwriting performance. Policy recommendations are discussed.

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1. Introduction

The insurance industry is a large economic contributor due to the volume of premiums it collects, the magnitude of its investment, and, more importantly, the fundamental social and economic function it provides by insuring individual and commercial risks. Insurance offers financial security to people and corporations against various losses or damages (Hofmann & Sattarhoff, 2023). They do so by assessing the risks of insuring someone or something and issuing policies to clients following their evaluation. Hence, the insurance company and the insured are parties to a legal contract known as the policy. Without insurance, the existing business environment would not be adequate since risky businesses cannot absorb all sorts of risks they encounter throughout

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operations. In this view, a well-developed insurance industry is beneficial for economic growth. This is because it enables businesses to carry on with their operations without worrying about an extraordinary event that would restrict their production ability (Camino-Mogro & Bermúdez-Barrezueta, 2019).

Insurance provides two primary services: investment and underwriting. Insurers provide underwriting services that cover the risks of individuals and organizations. This provides peace and stability to the financial market and promotes trade and development (Camino-Mogro & Bermúdez-Barrezueta, 2019). Unlike the banking industry, which encourages risk selling when it loans businesses and makes money from interest rates, the insurance industry assumes the risk generated by banks and engages in investment activities to ensure long-term financial stability (Akotey et al., 2022). Additionally, the insurance industry faces several risks that do not always relate to the banking sector but directly affect businesses and individuals who want to lower their risk of losing assets or health. In these circumstances, insurance underwriting is essential. Underwriting is evaluating risks and establishing the conditions and costs of insurance contracts (Hodula et al., 2021). Without sound underwriting, the underwriter would overcharge some clients while undercharging others for assuming risk. Effective underwriting guarantees that insurers can pay for possible claims while continuing to be profitable. This is essential because, without sound underwriting, an insurer may not be able to secure the business volume required to enable the pooling of all insurance risks under the law of large numbers, which is the foundation of the insurance industry. In light of this argument, the question remains: What drives the underwriting performance of the insurance industry?

The existing literature presents several studies on the insurance industry. One strand considers the determinants of insurance profitability (Camino-Mogro & Bermúdez-Barrezueta, 2019; Horvey et al., 2024; Vojinović et al., 2022; Zainudin et al., 2018) and reveals several factors from the micro and macro environment as significant predictors of insurance profitability. Others also considered the relationship between intellectual capital and insurance performance (Asare et al., 2017; Kuttu et al., 2023), corporate governance and insurers' risk-taking (Elamer et al., 2018), efficiency and productivity of the insurance market (Mamatzakis et al., 2024). Kusi et al. (2020) explored the relationships between regulation, risk, and profitability and found that regulations considerably reduce underwriting risk's detrimental effects on increasing profitability. Other studies also examined the relationship between market structure, competition, efficiency and profitability (Alhassan & Biekpe, 2016; Alhassan et al., 2015). Despite the concerted efforts made by scholars to understand the insurance industry, empirical investigations on the factors influencing the underwriting performance of the insurance industry remain elusive. Comprehending this is essential due to its impact on insurers' performance and business stability. Alhassan and Biekpe (2016) posit that effective underwriting enhances insurance growth. Hence, there is a need to explore the underlying factors provoking its performance.

From the literature, it can be inferred that only a limited number of scholars have made such attempts to explore this relationship. Chugh et al. (1987) provided one of the pioneering studies on the determinants of underwriting performance of property and liability insurers in the United States, highlighting that cost-effectiveness and competition promote underwriting performance. Following this, Adams et al. (2019) examined the impact of product market strategy on underwriting performance among property-liability insurers in the United Kingdom. As far as we know, the focus has been on developed economies, with scholars

expressing interest in property and liability insurers in the non-life business segment. Hence, a significant gap remains in other global regions, such as Africa, including the life insurance market. A more recent study by Akotey et al. (2022) stands out from this pattern by exploring the factors accounting for the high underwriting losses in the insurance industry by centering on Africa, particularly Ghana and found that the sector may be charging disproportionately low rates for the risks it underwrites, which does not improve underwriting performance. However, their study suffers from several limitations. This includes the small sample size and inability to determine the sectoral differences in the drivers of the life and non-life insurance underwriting performance. Despite operating in the same industry, the life and non-life markets have unique and specialized products that may be impacted differently (Camino-Mogro & Bermúdez-Barrezueta, 2019). For instance, non-life insurance contracts are often short-term than life insurance contracts, giving insurance companies more flexibility to change the prices for non-life contracts over the business cycle. Again, the demand for non-life insurance primarily correlates with economic performance, whereas life insurance is more closely tied to household wealth and distribution (Hodula et al., 2021). Hence, the factors driving their underwriting performance may not be the same. When these issues are resolved, assessing the policy importance of underwriting in the life and non-life insurance industry will be possible.

Again, despite the efforts made in literature, there are still other important factors which remain silent. One noticeable gap is the non-consideration of how solvency and the profit situation of insurers influence underwriting performance. Solvency is a crucial component that defines the insurers' operational and financial sustainability and reflects insurers' obligations to policyholders (Horvey et al., 2024). Hence, understanding how solvency levels impact underwriting profitability is crucial for efficient risk management. However, the precise relationship between solvency and underwriting performance remains unexplored. Additionally, Horvey et al. (2024) argue that a significant increase in insurance solvency may increase performance and vice-versa, depicting nonlinear effects. Nevertheless, empirical evidence to validate this relationship with underwriting performance remains nonexistent in the literature. Therefore, we extend knowledge in this area by examining the threshold level at which solvency affects underwriting performance. Also, the literature suggests that underwriting performance is an outcome of insurers' operational success, as firms with higher profitability tend to experience higher underwriting performance (Liu et al., 2024). Thus, insurers with higher profitability could have enough financial resources to spend on underwriting resources, such as recruiting talent and utilizing innovative risk assessment methods for improved underwriting. Hence, this study acknowledges the importance of profitability and further argues that its impact on underwriting performance is contingent on market share. This is important because studies suggest that market share drives profitability, ultimately affectingunderwriting performance (Alhassan et al., 2015). In the highly competitive insurance sector, larger market shares might benefit businesses in terms of economies of scale (Cummins et al., 2017). Analysing the interaction between profitability and market share might shed light on the competitive dynamics affecting insurers' market performance and underwriting. In light of this context, this study contributes to the literature by improving our understanding by examining the factors influencing the underwriting performance of the insurance industry in South Africa. The study further conducts a comparative analysis of the life (long-term) and non-life (short-term) industries to understand the similarities and differences in the factors that provoke underwriting performance. Additionally, it explores

the nonlinearity of solvency and synergy between market share and return on assets in affecting underwriting performance in South Africa.

The South African industry is a good context given that the insurance market is large, intricate, globally engaged, and competitive. Due to the high penetration and density of insurance products, the insurance industry in South Africa has expanded to represent 11.3% of the country's financial sector, which remains the highest in Africa, according to the Swiss Re Sigma report in 2022. Compared to the life insurance market, which accounts for 9.1% of the total premium, the non-life insurance market remains low (2.2%.) As of 2019, the insurance industry has about 74 life insurers and 91 non-life insurers. Again, most insurers are expanding their business operations regionally and globally to expand their underwriting capacity. The total assets as of 2021 were US $251.1 billion, representing an increase of around US$30 billion from the previous year (PwC, 2018). The South African industry generates about 50% of the insurance premium in Africa. In 2022, the total premium for primary life insurers was US$36,863 million, and for non-life insurers was US$8,968 million. However, only the top 5 life and non-life insurance companies earned more than 50% of the profitability, leading to a high disparity in the insurance market (Swiss Re, 2022). Despite the overall underwriting performance, some insurance companies do experience underwriting losses. More so, the high insurance concentration in South Africa has led to price undercutting, likely affecting their underwriting profit (Horvey et al., 2024). This background provides an intriguing context for analysis. Such an analysis is required to give management and regulatory authorities useful information for formulating policies to ensure sound underwriting practices and performance. These regulations would help the market grow and increase its contribution to economic expansion. Table 1 presents an overview of the performance of the life and non-life insurance industry in South Africa.

The contribution of this study is as follows. Since effective regulation requires the comprehension of the underwriting practices of insurers and their drivers, regulators would better understand the dynamics of underwriting in the insurance industry to formulate policies to promote underwriting performance. Also, as far as South Africa is concerned, this study is the first to examine the causes of the underwriting performance of the insurance industry. Knowing the important factors influencing the underwriting health of insurers is compelling because underwriting is paramount to the insurance business. This is crucial for the development of the industry and the stability of their financial systems. Also, studying the interplay among some variables improves our understanding of how they complement each other to influence underwriting performance. Thus, we interact market share with return on assets (ROA) and further explore the nonlinear effect of solvency to determine the level at which it influences performance. By examining the interplay between market share and ROA, researchers and policymakers can better understand the importance of financial performance, market dynamics and competitive strategies to determine insurers' profitability. Again, comprehending the threshold effect of solvency is important to regulators and policymakers in establishing appropriate solvency levels. With the use of established critical solvency criteria, regulatory frameworks that balance insurance performance, financial stability, and consumer protection may be established more easily. Generally, insights gained from this study can inform strategic decisions, regulatory policies and investor perceptions, which will foster insurance growth and underwriting performance. Since the South African industry is the most advanced and developed in Africa, several lessons could be drawn from this study by

Table 1. Stylised Facts of the Life and Non-Life Insurance Industry in South Africa.

South Africa (R M)	Industry	2013	2014	2015	2016	2017	2018	2019
Balance sheet								
Total Assets	Life	2,121,847	2,414,726	2,567,147	2,652,277	2,914,534	2,993,436	3,054,223
	Non-Life	113,815	116,352	121,875	131,831	152,498	149,882	201,453
Total Liabilities	Life	1,993,320	2,273,451	2,416,090	2,498,443	2,757,373	2,630,845	2,786,406
	Non-Life	64,040	72,202	76,742	82,350	86,394	85,097	99,0245
Income Statement								
Gross Premiums	Life	403,309	447,442	468,595	485,610	475,935	134,362	504,567
	Non-Life	93,148	98,962	109,901	116,722	128,557	29,407	46,772
Investment Income	Life	290,927	283,834	198,593	164,206	16,343	−76,999	673,003
	Non-Life	5,035	5,665	6,281	7,759	8,283	366	9,456
Claims								
Total Claims	Life	13,725	14,998	16,073	16,521	415,388	106,426	306,576
	Non-Life	40,722	43,679	44,581	46,840	49,067	12,083	37,034
Registered Insurers	Life	74	73	74	72	71	65	74
	Non-Life	97	92	90	90	89	70	91

All monetary values are in South African Rand; Source: Extracted from the annual reports of the FSCA.

other African countries relating to insurance underwriting. The rest of the paper is structured as follows. Section 2 discusses the theories and empirical literature. Section 3 explains the data, methodology and empirical strategies. Section 4 analyses and discusses the empirical result, and Section 5 provides a conclusion and policy implications.

2. Literature review

2.1. Theoretical perspective

A successful insurance organization relies on its ability to underwrite effectively. Underwriting, the core function of insurers, is to evaluate and value customer risk (Ivantsova & Leverty, 2022). The objective is to charge policyholders reasonable premiums that reflect their risk exposure while making distinctions based on their risk level. An insurance contract is based on evaluating its (risk) premium, a more instinctive type of experience which explains its underwriting process. The underlying presumption of this method is that risk should be equitably distributed by actuarial computation, which implies charging different rates to different people. However, most insurers aim to accept most risks at normal rates, but they nonetheless apply modified premiums for risks that do not adhere to the norms, especially in a high-competitive market. The traditional industrial economics theory explains this, stating that insurers in a competitive market are more likely to adopt low pricing and premium undercutting than pursuing growth strategies (Alhassan & Biekpe, 2019). Hence, poor risk selection can lead to huge losses and insurer failure (Browne & Kamiya, 2012). This makes it challenging to arrive at an actuarially fair risk pricing and raises the possibility that insurers will not have enough money to cover unforeseen claims and bankruptcy risk. Consequently, lowering rates and easing underwriting rules may lead to higher claim costs and declining/poor underwriting outcomes (Toshmurzaevich, 2020).

Insurance companies claim that the underwriting discipline forms the basis of their operating strategy (Hofmann & Sattarhoff, 2023). Hence, sound underwriting

procedures, such as precise risk exposure evaluation and pricing for insurance, are essential to an insurance company's success. This argument is supported by Ivantsova and Leverty (2022, p. 1), who explain that to achieve underwriting profitability, "Set a premium that, on average, will deliver a profit after both prospective loss costs and operating expenses are covered" and be determined to "walk away if the appropriate premium cannot be obtained," even if that means losing market share." This suggests that the premiums collected on an insurer's policies must exceed the losses and expenses resulting from those policies for the insurer to achieve an underwriting profit. The success of an insurance underwriting efficiency depends on several factors (Akotey et al., 2022). This is explained by the resource-based theory, which states how a company's internal resources and competencies affect its operations and performance and, by extension, underwriting performance. The concept emphasizes how important it is to understand the connections between the firm's resources, competences, competitive advantage, and profitability in order to ensure long-term appropriateness.

When applied to the insurance market, it demonstrates the importance of an insurer's internal resources and capabilities as essential factors in determining its underwriting performance. According to this theory, several factors drive the underwriting function, and these components provide insurers with a competitive edge and increase their capacity for profit. Hence, insurers who manage their resources well are better positioned to assess and manage risk, ultimately boosting underwriting profitability. Based on this argument, this study considers the factors influencing the underwriting performance of insurance companies in South Africa.

2.2. Literature review on the determinants of underwriting performance

The literature reveals information on the underwriting standards used by insurers and explains why insurers' underwriting guidelines vary over time (Toshmurzaevich, 2020). In a nutshell, the literature suggests that underwriting involves several processes and its performance is influenced by many factors (Browne & Kamiya, 2012). Despite the importance of underwriting, there is a lack of literature investigating the factors that could affect its performance. Until recently, the insurance literature largely focused on insurance companies' determinants, competition, solvency and profitability (Alhassan et al., 2015; Kusi et al., 2020; Vojinović et al., 2022) without explicitly focusing on the factors driving underwriting performance; which remains the cornerstone of the insurance business. However, emerging empirical studies show the importance of underwriting and the need to explore the factors accounting for its profitability/loss. The determinants of underwriting performance have not largely been explored. However, information gleaned from the literature provides some information on the factors affecting underwriting performance and their potential impacts. These are discussed below.

2.2.1. Insurance size

Insurance size explains an insurance business's growth level and is measured as the natural logarithm of total assets (Born et al., 2023). Scholars reveal that large companies may reduce labor costs through economies of scale, which are the most

significant factor in producing insurance services (Horvey et al., 2024). This is because large insurers have a greater capacity to deal with adverse market fluctuations compared to smaller insurers and enjoy high-efficiency gains (Shiu, 2004; Srbinoski et al., 2021). Also, large insurers have greater bargaining power and are more likely to experience higher underwriting performance (Born et al., 2023). Because of their size, prominence in the market, brand recognition, and other firm-specific characteristics, large insurers can achieve good underwriting outcomes (Shim, 2011). This is not without empirical support. According to Kumar et al. (2022), an expansion of an insurance company's size, including the construction of additional branches and the use of new technology, enables insurers to underwrite more policies and boosts their financial position. Similarly, Adams et al. (2019) found that size improves insurers performance. Similarly, Killins (2020) affirms that size positively and significantly influences performance, of which underwriting performance is an outcome. Larger businesses can usually underwrite larger deals and take on more risks since they have better access to financing. With this access, businesses might engage in a wider range of underwriting activities and benefit from more lucrative market opportunities, thereby improving underwriting performance. This suggests that large insurers are more likely to perform better in underwriting than small insurers (Born et al., 2023). Consequently, we hypothesize that:

H_1: There is a positive relationship between insurers' size and underwriting performance

2.2.2. Profitability

Scholars argue that firms with higher profitability are more likely to experience higher underwriting performance (Liu et al., 2024). This is because companies with higher returns are more equipped to implement robust risk management procedures, improving underwriting performance. These procedures might involve investing in risk reduction techniques, enforcing stricter underwriting guidelines, and developing efficient pricing schemes. Consequently, these companies can frequently get better underwriting results, such as reduced loss ratios and increased profitability. As a result, Xie et al. (2020) explain that less profitable firms are more vulnerable to poor underwriting, which affects performance, while companies with higher profitability could have easy access to resources and finance, which would enable them to take advantage of market opportunities for growth and underwrite greater volumes of business. Profitability is measured by return on assets, which is defined as the ratio of net profit to total assets (Horvey et al., 2024). Companies that effectively manage their financial health and align underwriting operations with strategic goals will have a more substantial chance of achieving long-term underwriting success in the competitive and evolving insurance and financial services sectors. Based on this, we hypothesize that:

H_2: There is a positive relationship between profitability and underwriting performance

2.2.3. Reinsurance

Reinsurance is a business arrangement in which one insurance provider (the ceding company) pays a premium to another insurance provider (the reinsurer) in order to transfer a portion of its risk exposure and is measured as the ratio of ceded insurance premium to the total premium. This is one of the primary risk management techniques employed in the insurance business, which transfers assumed risks, boosts underwriting capability, and helps accomplish significant strategic financial goals (Kader et al., 2010). Insurers often take out reinsurance to boost underwriting capacity, stabilize profitability, and guard against catastrophic losses. As a result, reinsurance is anticipated to enhance underwriting performance by lowering risk and uncertainty, raising risk-bearing capacity, and producing other strategic benefits (Adams et al., 2019). Hence, insurance companies with higher underwriting risk operations seek additional reinsurance to lessen the impact of unforeseen underwriting losses, maintain earnings stability, enhance their writing capacity, and avoid insolvency. Cummins et al. (2017) and Kramarić et al. (2019) have found a favorable correlation between the adoption of reinsurance and insurers' financial strength. This implies that reinsurance aids in risk diversification and enhances the underwriting capability of insurers.

Akotey et al. (2022) explain that reinsurance reduces risk and uncertainty, increases risk-bearing capacity, and offers strategic benefits. It aids insurers in avoiding crises during multiple claim payments. Kader et al. (2010) also posit that reinsurance is an important risk-management strategy in the insurance industry, lowering assumed risks, increasing underwriting capacity, and achieving financial objectives like better solvency and tax management. However, reinsurance can be expensive and encourage excessive risk-taking, potentially degrading underwriting performance (Adams et al., 2019). Thus, reinsurance comes with a cost, which is likely to deplete insurers' performance (Kader et al., 2010). Reinsurers can determine the cost at which insurers buy insurance since the insurance markets are less centralized and competitive (Horvey et al., 2024). According to Eling and Jia (2019), reinsurance inflates the sum ratios of life and non-life insurers. This aligns with Siopi and Poufinas's (2023) argument that reinsurance can be expensive and/or encourage excessive risk-taking, which might worsen underwriting performance. Therefore, reinsurance may be negatively related to underwriting performance. Hence, the study hypothesizes that:

H_3: There is a positive relationship between reinsurance and underwriting performance

2.2.4. Investment income

Adams et al. (2019) note that investment income is a key factor that affects an insurance company's profitability. Investment income is the profit that insurers make by making investments. Insurers make investments in a variety of asset portfolios to boost their revenue and performance. Because the premiums they receive might not be enough to cover all the liabilities incurred as a consequence of claims made against the policies they underwrite, insurers invest a portion of their premiums in a range of asset classes in order to maximize their profits (Horvey et al., 2024). Thus, the underwriting procedures used by insurance management may also be directly impacted by investment returns. It is

believed that investment returns contribute to the growth of insurance firms. The nature of the insurance business, particularly the life insurers' liabilities, demands investment strategies (Srbinoski et al., 2021). Managers may be inclined to cut profit margins by reducing underwriting requirements, for instance, if the earnings on invested assets exceed market average or other strategic benchmark. Therefore, we anticipate that insurers with low investment profits will do better in underwriting than insurers with large investment earnings. The manner in which insurers approach underwriting is influenced by investment returns (Adams et al., 2019). Managers may reduce underwriting requirements if earnings on invested assets exceed the market average or another strategic benchmark. Hence, Browne and Kamiya (2012) suggest that insurers must improve profitability through better underwriting, especially when investment performance is subpar. Because strong underwriting outcomes typically correlate with low returns on investments.

H_4: There is a negative relationship between investment yield and underwriting performance

2.2.5. Underwriting risk

Akotey et al. (2022) suggest that a key factor influencing underwriting success is the cautious selection of risks. Underwriting risk arises when claims surpass the premiums paid, which is frequently proxied as the loss ratio. This is measured by the ratio of earned premiums to incurred claims (Zainudin et al., 2018). According to Öner Kaya (2015), sound underwriting procedures and laws are crucial for assessing the financial performance of insurance firms as they minimize the additional risk associated with underwriting operations and increase shareholder returns by instituting strict management guidelines. According to the underwriting risk, the industry sets abnormally low rates for the risks it insures. This can be a sign that certain insurers are underpricing to attract more clients. The underwriting risk indicator significantly and negatively influences underwriting performance in both industries. It validates the findings of Alhassan et al. (2015) and Kusi et al. (2020); however, it contradicts Hemrit's (2020) findings. The conclusion implies that certain insurers undercharge disproportionately through price undercutting or overpaying for the premiums they receive in an attempt to grow their market shares and premium income. It also suggests that the sector's risk and return pattern differs from the risk and return theory found in finance. Hence, Kusi et al. (2020) and Kumar et al. (2022) recommend strong regulation of insurance underwriting activities to reduce underwriting risk's negative effects on performance. Based on the above narrations, the study posits the following hypothesis:

H_5: There is a negative relationship between underwriting risk and underwriting performance

2.2.6. Solvency

Insurance solvency is a measure of a sound financial system. It is the ability of an insurance firm to meet its financial commitments when they fall due. As a result,

a company's long-term financial viability is evaluated using this criteria (Morara & Sibindi, 2021). In a company's assets, a solvency margin acts as a safety net to offset one or more of the theoretical solvency requirements set forth by regulators (Sandström, 2016). According to the literature, solvency improves the insurance performance (Siopi & Poufinas, 2023). Hence, financial soundness is deemed to be greater for insurance companies with larger solvency margins. In South Africa, insurers need to have more assets than liabilities. The management of insurance companies is responsible for ensuring that capital and solvency are managed, liquidity is maintained, and net income growth is sustained (Horvey et al., 2024). Theoretically, insurers with strong financial standing are better equipped to attract potential customers (Shiu, 2004). As a result, high solvency can enhance an insurer's underwriting performance since more stable insurers tend to draw better risks and are better equipped to generate higher premium income. Based on these assertions, the study states that:

H_6: There is a positive relationship between solvency and underwriting performance

2.2.7. Premium growth

Premium growth, which is the annual rise in premiums, is a measure of an insurance company's market penetration rate. The acceleration of the premium-generating process might indicate increased insurer productivity as a result of distribution network enhancements and technology breakthroughs (Srbinoski et al., 2021). This suggests that premium growth enhances insurance underwriting performance (Killins, 2020). However, Horvey et al. (2024) argue that excessive premium increases might harm insurers' financial stability since it would encourage excessive risk-taking. This aligns with Eling and Jia (2019), who explain that premium growth negatively influences insurance performance. Similarly, Akotey et al. (2022) found a negative relationship between premium growth and underwriting profitability, arguing that insurers' underwriting profit declines significantly due to high premium growth. Despite the importance of premium growth to insurance companies, there is a need to ensure prudent underwriting decisions because insurers who cannot maintain sustainable premium growth are more vulnerable to decreased profits (Xie et al., 2020). Oscar Akotey et al. (2013) state that premium growth without sufficient price validation can harm insurers' performance. This requires thorough assessments by insurers during the underwriting process (Akotey et al., 2022). Based on these arguments, the study hypothesizes the following:

H_7: There is a negative relationship between premium growth and underwriting performance

2.2.8. Market share

The relative market power theory states that insurers with greater market power would profit more from raising customer premiums (Srbinoski et al., 2021). This is supported by Ansah-Adu et al. (2011), who indicate that market share drives insurance efficiency because a diverse customer base often corresponds with a larger market share. However, Akotey et al. (2022) state that increasing market share adds no value to insurers'

underwriting. This is validated by their empirical findings, which suggest an inverse relationship, that insurers' efforts to increase their market shares via underwriting more premiums do not maximize their underwriting profit but rather increase their risk situation. This aligns with Grmanová and Pukala (2018), who show that market power does not impact the effectiveness of insurers. Again, Akotey et al. (2022) argue that most industry participants prioritize private benefits, underwriting more premiums than those that maximize profit. This is less than ideal, as most insured premiums do not increase underwriting profit. They further found that market share gain through overtrading and price undercutting does not improve underwriting profitability, as market shares may not always indicate profitability. The above findings lead to the hypothesis that:

H_8: There is a negative relationship between market share and underwriting performance

3. Methodology

3.1. Data and model specification

The study uses balanced panel data from 2013–2019 for the life and non-life insurance sectors in South Africa, sourced from the annual insurance report by the Financial Sector Conduct Authority. The data begins in 2013 because, for previous years, this information was not publicly available, and the last year is 2019 as the dataset's cutoff year to eliminate the COVID-19 pandemic's confounding effects on financial data and any potential biases in its skewing of the paper's major result. The study follows the approach of Camino-Mogro and Bermúdez-Barrezueta (2019) and Hodula et al. (2021) to perform separate analyses for the life and non-life insurers due to the non-homogeneous nature of the insurance industry. Changes in the life and non-life insurance sectors are likely influenced by different factors, making it difficult to model them together. Given this, the panel data consists of a final sample of 62 life insurers and 71 non-life insurers. This procedure produces solid and reliable statistical conclusions. Thus, the panel data strategy produces more reliable, accurate, and consistent results than just the cross-sectional or time series techniques (Brooks, 2019). As a result, the generic panel data model is specified as:

$$Y_{i,t} = \alpha_{ij} + \gamma_{tj} + \beta X_{i,t} + \varepsilon_{i,t} \tag{1}$$

Such that i and t represent the cross-sectional (insurance companies), i = 1 ... N and time-series component, $t = 1 \ldots T$; $Y_{i,t}$ represents the explained variable; α_i represents the scalar and constant term for all periods (t) and specific to the insurer fixed effect (i); γ_t represents the time fixed effects; β is a k × 1 vector of parameters to be estimated, and $X_{i,t}$ is 1 × k observations on the independent variables made up of input variables in the model; $\varepsilon_{i,t}$ is the error term.

The model is further expressed in its functional form where underwriting profit is expressed as a function of its determinants:

$$UP = f\left(Size, ROA, REINS, INV, UR, SOLV, SOLV^2, PG, MS, ROA * MS\right) \quad (2)$$

Where UP represents underwriting performance; SIZE represents insurance size; ROA is the return on assets, which serves as a profitability indicator; REINS represents reinsurance premium; INV represents investment income; UR represents underwriting risk; SOLV and $SOLV^2$ are the linear and quadratic terms of insurance solvency; PG represents premium growth; MS represents market share and ROA*MS is the interaction between return on assets and market share. As earlier presented, higher market share have the propensity to increase insurers ROA, ultimately affecting underwriting performance. Also, Cummins et al. (2017) further highlight that larger market shares may provide insurers with advantages in terms of economies of scale, pricing power, and brand awareness, which might affect their ROA and, ultimately, their underwriting performance. The study, therefore, takes cues from the functional equation to develop the specific model as:

$$\begin{aligned} UP_{it} = {} & \beta_1 Size_{it} + \beta_2 ROA_{it} + \beta_3 REINS_{it} + \beta_4 INV_{it} + \beta_5 UR_{it} + \beta_6 SOLV_{it} + \beta_7 SOLV_{it}^2 \\ & + \beta_8 PG_{it} + \beta_9 MS_{it} + \beta_{10}(ROA * MS)_{it} + \varepsilon_{it} \end{aligned} \quad (3)$$

3.2. Estimation strategy

Regarding estimation techniques, the study first employed the generalized method of moments (GMM) for analysis. Arellano and Bond (1991) introduced this estimation technique, which helps evaluate linear and moderating relationships. The econometric literature explains that GMM outperforms the static model because it can account for unobserved firm-specific effects. It also addresses omitted variables, measurement errors, heteroscedasticity and endogeneity. According to Akotey et al. (2022), an insurer's previous underwriting performance is likely to have an impact on how well it performs both now and in the future. Hence, introducing the past values of underwriting performance in the model may create endogeneity issues. This is supported by Arellano (2003), who argues that endogeneity is introduced in the models by including the lags of the outcome variable. Because the lagged dependent variable depends on the error term, which is a function of the firm-specific effects, incorporating the lagged term of the dependent variable in the regression model may result in endogeneity problems. As specified in the equations above, the one-period lag of the outcome variable is dependent on the error term, a function of the firm-specific effect. Using this method, the study confirms the usage of the dynamic system GMM estimator by building a model where the dependent variable depends on its lag and a vector of observations for the independent variables. Another endogeneity issue is the reverse causality between the independent and dependent variables; the independent variables are also determined endogenously. As the literature suggests, this study has a high possibility of endogeneity in the model. For instance, the literature indicates that solvency, return on assets, and size can influence underwriting performance and vice-versa (Akotey et al., 2022; Morara & Sibindi, 2021; Öner Kaya, 2015; Scordis, 2019). Hence, failure to address this may produce inconsistent and biased estimates of the coefficients. To address this problem,

the study employs the generalized method of moments (Arellano & Bond, 1991). This equation is further specified as:

$$UP_{it} = \beta_1 UP_{it-1} + \beta_2 Size_{it} + \beta_3 ROA_{it} + \beta_4 REINS_{it} + \beta_5 INV_{it} + \beta_6 UR_{it} + \beta_7 SOLV_{it} + \beta_8 SOLV_{it}^2 + \beta_9 PG_{it} + \beta_{10} MS_{it} + \beta_{11}(ROA * MS)_{it} + \varepsilon_{it} \quad (4)$$

Such that UP_{it-1} represents the lag of the dependent variable. Following Arellano and Bond (1991) and other extant studies, such as Horvey et al. (2023), we control for endogeneity by relying on internally generated instruments. Thus, we employ two lags of our explanatory variables as instruments in the first difference equation to estimate our models, considering that all the explanatory variables can be endogenous. However, for the level equation, one lag of the first difference of the explanatory variables is introduced as instruments. The following criteria were observed to ensure the robustness of the GMM result. First, there should be no second-order serial correlation. Second, the Hansen and Sargan test results are used in relation to the test of over-identifying constraints to validate the instruments chosen. The rejection of the alternative hypothesis supports the validity of the instruments used in the estimation under the null hypothesis of no over-identifying limitations. Also, the number of instruments must be less than the number of groups. The results reported in Tables 5 and 6 confirm the results' robustness based on these specifications.

One major weakness of the GMM technique is that it only provides an estimation of the average effect of the determinants, thereby ignoring the differential impact of the factors affecting underwriting performance across different quantiles. In other words, the drivers of underwriting performance may vary, which the GMM and previous studies ignore. The study employs the bootstrap quantile regression estimate technique to address this limitation. As Koenker (2008) explained, the bootstrap quantile regression technique assumes that a set of independent variables does not impact the dependent variable uniformly. With this study, the independent factors are expected to have varying effects on underwriting performance at different levels (10^{th}, 25^{th}, 50^{th}, 75^{th}, 90^{th} and 95^{th}). Hence, different coefficients should be computed at various distributions of the dependent variable (Alhassan & Biekpe, 2019). Another reason for adopting this technique is that the bootstrap quantile regression can overcome outliers and non-normality in the model (Koenker, 2008). The insurance industry in South Africa has great disparity, with the top 5 companies of the life and non-life sectors covering more than 50% of its assets and premiums. As a result, the variances can lead to outliers, impacting the outcomes' precision and dependability. Also, it provides a robust econometric technique for comparing multiple features of any form of result distribution across diverse covariate patterns more thoroughly than the mean alone (Orsini & Bottai, 2011). Further, it helps to identify the precise thresholds for the factors at various quantile levels of the model.

3.3. Definition of variables

This sub-section describes the variables recruited in the regression model, which are further summarised in Table 2.

Table 2. Summary of Variables.

Variables	Sign	Measurement	*A priori*
Underwriting Performance	UP	The ratio of net premiums earned over total expenditure (claims incurred, management expenses and commission).	
Insurance Size	Size	Natural log of total assets	+
Return on Assets	ROA	Ratio of net profit over total assets	+
Reinsurance	REINS	Reinsurance premium ceded divided by the overall premium	+
Investment Income	INV	Natural log of total investment returns	–
Underwriting Risk	UR	The proportion of total claims to earned premiums	–
Solvency	SOLV	Net income divided by total liabilities	+
Premium Growth	PG	$\frac{GWP_t - GWP_{t-1}}{GWP_{t-1}}$	–
Market Share	MS	The ratio of an insurer's gross premium to the total gross premium of the sector	–

Underwriting Performance (UP): Underwriting performance, which reflects how successfully underwriters manage risk and expenses, is a crucial statistic for evaluating the stability and profitability of insurance companies. This shows the percentage of each insurer's total written premiums to determine its overall profitability (Akotey et al., 2022). This is measured as the ratio of net premiums earned over total expenditure (claims incurred, management expenses and commission).

Insurance Size (Size): Size explains the extent of expansion inside the insurers' commercial activities (Ahmeti & Iseni, 2022). There are different ways to measure firm size, such as total assets, total sales, and market value of equity. This study follows the approach in the literature by calculating firm size as the natural logarithm of insurance total assets.

Return on Assets (ROA): This measures the insurer's operational effectiveness in asset management by illustrating its capacity to make a profit relative to the entire assets (Horvey & Ankamah, 2020). It clarifies, in other words, how well the business makes money off of its current assets. This is proxied as the ratio of net profit over total assets.

Reinsurance Ratio (REINS): To mitigate the effects of unexpected underwriting losses, maintain profit stability, increase underwriting capacities, and avoid insolvency, insurance companies with greater underwriting risk operations must seek additional reinsurance. This variable is calculated as the reinsurance premium ceded divided by the overall premium (Morara & Sibindi, 2021).

Investment Income (INV): This demonstrates the financial performance of the insurance company's investments (Ahmeti & Iseni, 2022). It is similar to premium earnings in that it is regarded as an insurance company's output. Its financial stability is largely based on the performance of its investments. The regression analysis used log-transformed investment income.

Underwriting Risk (UR): The risk associated with underwriting is defined as underwriting risk. The performance of insurance companies depends on sound underwriting rules and procedures, which in turn depend on the risk appetite of the insurance companies. Insurance companies anticipate a rise in premiums while seeing a decline in the number of claims they must settle (Öner Kaya, 2015). This is measured as the proportion of total claims to earned premiums (Sasidharan et al., 2023).

Solvency (SOLV): An insurance company's financial performance depends heavily on its level of solvency. An insurer's solvency, or the least excess of its assets over liabilities, is

subject to regulation. This is determined by net income divided by total liabilities (Morara & Sibindi, 2021; Öner Kaya, 2015).

Premium Growth (PG): This variable captures the changes in a company's premium increase. An increase in the growth rate of insurers' premiums suggests growth and an increase in their market share. This is a key source of income for insurers; therefore, it is anticipated that it will positively impact underwriting profit (Akotey et al., 2022). It is measured as:

$$Premium\ Growth = \frac{GWP_t - GWP_{t-1}}{GWP_{t-1}} \tag{5}$$

where GWP represents the gross written premium.

Market Share (MS): Market share is a key indicator for insurance companies to evaluate their market competitiveness. This is proxied as the ratio of an insurer's gross premium to the total gross premium of the sector (Akotey et al., 2022). The formula enables firms to quantify their relative market presence in percentage terms.

4. Results and discussions

4.1. Descriptive statistics

The descriptive statistics in Table 3 provide some fascinating information about the principal variables used for analysis. As seen in the Table, both the life and non-life insurers made underwriting profit over the period under investigation, with the life insurers (11.876) making more profit than the non-life (9.965). It can also be noted that there is a huge variation among insurers' underwriting profitability. The average total assets of the life insurers is 40 million South African Rand, while the non-life records an average of 1.7 million South African Rand. Similarly, the average values of ROA imply that life insurers made more profit than non-life insurers. This indicates that the life insurance sector is larger and more financially stable than the non-life sector. This is plausible since there is a higher need for long-term financial protection and health insurance than non-life insurance products. Hence, individuals in South Africa prioritize life insurance above the other types of insurance.

The results further reveal that the life insurers rely more on reinsurance to manage their risk than the non-life insurers. Again, the results indicate that life insurers record higher investments than non-life insurers. The reason is that due to the long-term nature of life insurance, they are more able to invest in long-term assets, which generates higher investment returns than the non-life. It can also be seen that the non-life sector (0.735) records more underwriting risk than the life sector (0.43). Regarding solvency, the results suggest that both sectors are solvent. Thus, their assets are more than their liabilities. Also, the growth rate of premiums for both sectors is positive, displaying an increase in insurance premiums over the sample period. The market share is, on average, 1.594 for the life insurers and 1.327 for the non-life insurers. The study further tests whether multicollinearity exists among the independent variables. The results are presented in the correlation analysis in Table 4. The results indicate no presence of multicollinearity among the independent variables; hence, all the variables are fit to be used in the regression model. The variance inflation factor (VIF) affirms this, showing values

Table 3. Descriptive Statistics.

	Life Insurance						Non-life Insurance					
Life Insurance	Obs	Mean	Std. Dev.	Min	Max	SWILK	Obs	Mean	Std. Dev.	Min	Max	SWILK
Underwriting Profit	434	11.876	1.844	5.209	14.956	0.139	497	9.865	1.878	5.771	14.669	0.078
Insurance Size	434	40,758,384	111,400,000	12,380	653,400,000	0.000	497	1,751,116	3,404,010	20,810	21,117,108	0.000
Return on Assets	434	0.837	8.012	0.002	158.247	1.218	497	0.571	0.474	0.034	9.035	0.378
Reinsurance	434	0.186	0.335	0.318	0.999	0.312	497	0.033	0.389	0.019	0.976	0.342
Investment income	434	3,590,000	10,400,000	168	71,000,000	0.000	497	103438.5	266402.3	1234	3674255	0.000
Underwriting Risk	434	0.430	1.930	0.009	19.457	0.145	497	0.735	2.412	0.093	0.921	0.417
Solvency	434	26.582	496.508	0.595	10316.95	0.013	497	14.303	170.345	5.712	3726.048	0.001
Premium Growth	434	3.903	70.775	−0.998	1473.766	2.573	497	3.110	7.147	−0.5442	38.301	1.321
Market Share	434	1.594	3.462	0.001	18.537	1.345	497	1.327	2.739	−0.014	20.273	1.125

Table 4. Correlation Matrix.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	VIF
Life Insurance										
(1) Underwriting Profit	1.000									
(2) Insurance Size	0.347	1.000								3.15
(3) Return on Assets	0.080	−0.030	1.000							1.41
(4) Reinsurance	−0.082	−0.011	0.004	1.000						1.17
(5) Investment Income	0.277	−0.018	0.016	0.015	1.000					1.03
(6) Underwriting Risk	−0.337	0.010	0.006	0.016	0.010	1.000				1.13
(7) Solvency	0.439	−0.035	−0.023	0.167	−0.044	0.413	1.000			1.28
(8) Premium Growth	−0.333	0.205	−0.004	−0.022	−0.012	−0.010	−0.005	1.000		1.16
(9) Market Share	0.516	0.601	−0.035	0.021	0.022	−0.009	−0.057	0.199	1.000	3.24
Non-life Insurance										
(1) Underwriting Profit	1.000									
(2) Insurance Size	0.549	1.000								2.25
(3) Return on Assets	−0.030	−0.180	1.000							1.07
(4) Reinsurance	−0.060	−0.126	0.030	1.000						1.10
(5) Investment Income	0.072	0.187	−0.289	−0.050	1.000					1.09
(6) Underwriting Risk	−0.051	−0.027	−0.017	0.010	−0.022	1.000				3.11
(7) Solvency	−0.056	−0.026	−0.016	0.009	−0.016	0.593	1.000			3.54
(8) Premium Growth	0.111	0.085	0.021	−0.026	0.075	−0.006	−0.006	1.000		1.03
(9) Market Share	0.478	0.571	−0.112	−0.004	0.030	0.009	0.003	0.118	1.000	2.29

below the 5-point threshold. The results from the correlation analysis reveal different directions of the factors affecting underwriting performance, which are further subjected to a rigorous empirical analysis in the subsequent sub-section.

4.2. Regression results

This section reports the estimated coefficient values of the GMM and quantile regression of the factors predicting the underwriting performance of the life and non-life insurers in South Africa. All the assumptions underlining GMM are met. Tables 5 and 6 report the results for the life and non-life sectors, respectively. Ten models are estimated for each Table. Models (1)-(4) are estimated using the GMM, whereas Models (5)-(10) are estimated using the quantile regression. Every Table reports the results of the quantiles (10th, 25th, 50th, 75th, 90th and 95th). All the models include year-fixed effects. The significant values of the lagged dependent variable in the GMM results indicate the persistence of underwriting performance over time.

The results in Tables 5 and 6 show that insurance size improves underwriting performance. This is evidenced by the significant positive coefficient estimates of the GMM technique, and the effect appears in the entire quantile distribution. The result supports the assertion that large firms are more likely to attain higher underwriting performance. This is not surprising, given that larger insurers can usually underwrite larger deals and take on more risks since they have better access to financing. With this access, insurers might engage in a wider range of underwriting activities and benefit from more lucrative market opportunities, thereby improving underwriting performance. The positive relationship is supported by Srbinoski et al. (2021) and Born et al. (2023), who state that large insurers have a greater capacity to deal with adverse market fluctuations than smaller insurers. They enjoy high-efficiency gains and have greater bargaining power, which positively impacts underwriting performance. Again, larger insurers enjoy economies of scale (Siopi & Poufinas, 2023) and have the resources to underwrite

Table 5. Factors Affecting Life Insurance Underwriting Profitability – GMM and Quantile Regression.

Variables	(1) GMM	(2) GMM	(3) GMM	(4) GMM	(5) 10%	(6) 25%	(7) 50%	(8) 75%	(9) 90%	(10) 95%
Lag of Insurance Size	0.272***	0.266***	0.318**	0.310**						
	(0.144)	(0.146)	(0.137)	(0.142)						
Insurance Size	0.523***	0.527***	0.511***	0.515***	0.605***	0.682***	0.409***	0.552***	0.678***	0.0740***
	(0.174)	(0.173)	(0.172)	(0.172)	(0.209)	(0.128)	(0.032)	(0.132)	(0.126)	(0.052)
Return on Assets	0.529*	0.525*	0.428*	0.432*	−0.018	0.101	0.112	0.106**	0.064**	0.067*
	(0.264)	(0.270)	(0.218)	(0.220)	(0.015)	(0.024)	(0.027)	(0.098)	(0.003)	(0.039)
Reinsurance	−0.222	−0.214	−0.210	−0.210	0.046	0.077	−0.008	−0.042	−0.123	−0.110
	(0.579)	(0.581)	(0.556)	(0.564)	(0.448)	(0.274)	(0.028)	(0.083)	(0.107)	(0.103)
Investment Income	0.009**	0.009**	0.008*	0.008*	0.056**	0.077**	0.005**	0.012**	0.019*	0.041*
	(0.004)	(0.004)	(0.004)	(0.004)	(0.007)	(0.004)	(0.003)	(0.003)	(0.004)	(0.002)
Underwriting Risk	0.482	0.500	0.533	0.551	0.056	0.155	0.225	−0.286	−0.119	−0.534**
	(0.631)	(0.653)	(0.584)	(0.610)	(0.016)	(0.021)	(0.141)	(0.243)	(0.012)	(0.056)
Solvency	−0.112**	−0.128	−0.104**	−0.110	−2.129***	−1.413***	−0.941***	−0.501***	−0.294***	−0.144***
	(0.043)	(0.112)	(0.050)	(0.113)	(0.144)	(0.088)	(0.090)	(0.090)	(0.086)	(0.036)
Solvency^2		0.134		0.353	0.057***	0.036***	0.022***	0.016***	0.019***	0.009***
		(0.013)		(0.012)	(0.004)	(0.002)	(0.003)	(0.003)	(0.003)	(0.001)
Premium Growth	−0.009	−0.011	−0.003	−0.003	−0.0305	−0.050*	−0.044	−0.078***	−0.050*	−0.089***
	(0.083)	(0.088)	(0.100)	(0.102)	(0.024)	(0.027)	(0.028)	(0.028)	(0.026)	(0.011)
Market Share	0.365	0.371	0.916	0.923	0.622	0.661	0.437	0.039	0.090	0.703
	(0.976)	(0.989)	(1.230)	(1.240)	(0.028)	(0.196)	(0.027)	(0.028)	(0.080)	(0.411)
Return on Assets*Market Share			0.387	0.400	0.242**	1.111**	1.216	1.120*	0.704**	0.666**
			(0.103)	(0.104)	(1.602)	(0.979)	(1.010)	(1.011)	(0.965)	(0.404)
Inflection		11.034***		10.987**	19.220***	18.632***	20.862***	15.182***	7.484***	7.626***
Net Effect			1.044***	1.069***	0.367**	1.871*	2.050*	1.891**	1.186*	1.128**
No. of instruments	14	15	15	16						
AR(1)	0.008	0.003	0.005	0.002						
AR(2)	0.811	0.837	0.689	0.684						
Sargan P-values	0.196	0.192	0.136	0.129						
Hansen P-values	0.499	0.501	0.453	0.448						
Observations	112	112	112	112	148	148	148	148	148	148

Standard errors in parentheses; ***$p < 0.01$, **$p < 0.05$, *$p < 0.1$.

Table 6. Factors Affecting Non-Life Insurance Underwriting Profitability – GMM and Quantile Regression.

Variables	(1) GMM	(2) GMM	(3) GMM	(4) GMM	(5) 10%	(6) 25%	(7) 50%	(8) 75%	(9) 90%	(10) 95%
Lag of Insurance Size	0.802***	0.943***	0.749***	0.923***						
	(0.155)	(0.105)	(0.221)	(0.270)						
Insurance Size	0.307*	0.130**	0.330***	0.186**	0.915***	1.001***	0.973***	0.981***	0.853***	0.793***
	(0.182)	(0.123)	(0.194)	(0.315)	(0.151)	(0.128)	(0.091)	(0.061)	(0.059)	(0.069)
Return on Assets	0.350	0.017	0.706	0.284	0.217	0.236	1.426***	1.511***	1.961***	2.030***
	(0.344)	(0.310)	(0.586)	(0.776)	(0.373)	(0.318)	(0.226)	(0.151)	(0.148)	(0.171)
Reinsurance	0.013	0.017***	0.017**	0.017**	−0.001	0.007	0.014	0.010	0.021**	0.021**
	(0.009)	(0.005)	(0.008)	(0.007)	(0.023)	(0.019)	(0.013)	(0.009)	(0.010)	(0.011)
Investment Income	0.042	−0.538	−0.184	−0.298	1.247	0.717*	0.042**	0.644**	0.842*	1.086**
	(0.565)	(0.415)	(0.376)	(0.619)	(1.117)	(0.951)	(0.037)	(0.413)	(0.443)	(0.512)
Underwriting Risk	−0.003**	−0.003*	−0.004*	−0.003	−0.041	−0.015	−0.006**	−0.008***	−0.003	−0.004*
	(0.002)	(0.001)	(0.002)	(0.002)	(0.004)	(0.003)	(0.002)	(0.002)	(0.002)	(0.002)
Solvency	−0.016**	−0.016***	−0.019*	−0.020**	−0.019	−0.026	−0.033**	−0.043***	−0.022**	−0.027**
	(0.007)	(0.006)	(0.010)	(0.008)	(0.0236)	(0.0201)	(0.0143)	(0.009)	(0.008)	(0.011)
$Solvency^2$		0.000***		0.000***	0.005	0.012	0.011	0.024***	0.015***	0.029**
		(0.000)		(0.000)	(0.004)	(0.003)	(0.001)	(0.000)	(0.004)	(0.001)
Premium Growth	−0.018	−0.010	−0.005	−0.012	0.061*	−0.058*	−0.040**	−0.041*	−0.048**	−0.063**
	(0.016)	(0.009)	(0.022)	(0.012)	(0.001)	(0.001)	(0.019)	(0.000)	(0.001)	(0.002)
Market Share	0.026	0.009	0.128*	0.103	−0.221	0.162	0.131	0.167	0.301**	0.361**
	(0.054)	(0.032)	(0.070)	(0.113)	(0.184)	(0.157)	(0.112)	(0.074)	(0.073)	(0.084)
Return on Assets*Market Share			0.303**	0.233	0.748*	0.473**	0.313***	0.479**	0.563***	0.645***
			(0.129)	(0.201)	(0.450)	(0.383)	(0.272)	(0.183)	(0.178)	(0.206)
Inflection		12.452		13.010	19.132	16.643	13.705	14.623	11.345**	8.345**
Net Effect			1.108**	0.417*	0.221	0.162*	0.131*	0.167**	0.300***	0.361***
No. instruments	13	14	14	16						
AR(1)	0.000	0.004	0.003	0.001						
AR(2)	0.162	0.212	0.241	0.217						
Sargan P-values	0.961	0.697	0.487	0.732						
Hansen P-values	0.763	0.334	0.397	0.733						
Observations	256	256	256	256	349	349	349	349	349	349

Standard errors in parentheses; ***$p < 0.01$, **$p < 0.05$, *$p < 0.1$.

a wider variety of products across different business lines and geographical areas (Adams et al., 2019). By spreading out the risk and lessening the effect of losses from any one region, diversification promotes more stable and successful underwriting.

The study further reveals that ROA positively impacts non-life insurance underwriting performance and is statistically significant at 1% from the 50^{th} quantile. For the life sector, the study reports an inverse relationship at its lower quantile (10^{th}) but shows a positive impact from the 25^{th} quantile, showing statistical significance at the extreme level. The initial inverse relationship between ROA and underwriting performance can be due to the company's expansion period, substantial asset base, and first investment in underwriting. However, the relationship tends to improve as the insurance company grows, becomes more efficient, and streamlines its processes, demonstrating its ability to profit from underwriting (Akotey et al., 2022). This is further affirmed by Liu et al. (2024) that highly profitable firms achieve higher underwriting performance. This is because insurers with higher ROA could have easier access to resources and finance, which would enable them to take advantage of market opportunities for growth and underwrite greater volumes of business (Xie et al., 2020). It is further reported that investment income, which assesses the returns insurers receive on their investment positively and significantly impacts underwriting performance across all quantile levels for both sectors. This contradicts our research hypothesis, which predicts a negative relationship. Intuitively, higher investment income contributes to insurers' profitability, which helps to offset any underwriting losses. The results align with Adams et al. (2019), who argue that investment returns positively affect insurers' underwriting performance. The reason is that higher returns on investment provide insurers with more financial resources to enter new and more profitable lines of insurance business, which will likely improve their underwriting performance.

For reinsurance, its impact varies at different levels for life insurers. Specifically, the study presents a positive impact up to the 25^{th} quantile and a negative relationship afterward. This suggests that the behavior we observe in the GMM model is not driven across all distribution paths. This implies that life insurance firms that rely significantly on reinsurance typically give reinsurers a sizable share of their premiums in exchange for transferring risk. As a result, they may retain less premium income, which could affect their underwriting profitability. This supports Siopi and Poufinas (2023) assertion that reinsurance may be costly, inefficient, and have a long-term impact on the profitability of insurance companies. Hence, Vojinović et al. (2022) suggest that insurers must identify an adequate retention level and strike a balance between lowering the risk of insolvency and possible profits. Contrarily, non-life insurers show a positive relationship between reinsurance and underwriting profitability, suggesting that reinsurance increases the underwriting capacity of non-life insurers. The implication is that non-life insurers frequently deal with risk types that are more volatile and uncertain due to the short-term nature of their business. As a result, reinsurance aids in distributing these risks and minimizes the effects of significant claims and underwriting outcomes. This affirms Ahmeti and Iseni's (2022) claim that companies that purchase more reinsurance have more consistent performance, resulting in higher risk-adjusted returns. Similarly, Akotey et al. (2022) argue that reinsurance reduces risk and uncertainty, increases risk-bearing capacity, and offers strategic benefits. It aids insurers in avoiding crises during multiple claim payments, thereby enhancing underwriting performance.

In terms of underwriting risk, the GMM model presents a positive effect on underwriting performance; however, this varies at different levels, showing an inverse relationship at higher quantiles (thus, from the 75th quantile), whereas non-life insurance reveals a negative impact across all levels, including the GMM model. This is obvious given that the non-life sector is highly impacted by higher underwriting risk than the life sector, as evidenced in Table 3. This suggests that higher levels of underwriting risk destabilize underwriting performance (Kusi et al., 2020). The negative relationship can be attributed to the high price undercutting by most non-life insurers; hence, they pay more than what is received. Akotey et al. (2022) support this argument, stating that some insurers lower prices to increase their premiums and market shares, pay excessive amounts for the premiums they get, or charge excessively low rates. The life sector also records a negative relationship from the 75th quantile, affirming the argument that high underwriting risk reduces insurance profitability. Therefore, Kumar et al. (2022) advise that insurers comply with underwriting policies provided by regulators. This will curtail the adverse practices of price undercutting, leading to high underwriting risk.

For solvency, the results for both sectors show a reduction effect on underwriting performance at its initial stages. However, further increases in solvency, thus highly solvent insurers, lead to improved underwriting performance. Following Lind and Mehlun's (2010) approach, the positive values of the inflection points project that the propelling effect of solvency is achieved beyond a certain threshold. This implies a non linear direct U-shaped relationship between solvency and underwriting performance. Intuitively, highly solvent firms can manage any unexpected shocks and potential losses. Hence, they can underwrite more policies, thereby propelling their underwriting capacity and performance. This agrees with Zainudin et al. (2018), who assert that when an insurer's solvency level is high, it can lower leverage risk, which can help it improve its performance. Shiu (2004) also reveals that insurers with strong financial standing are better equipped to attract potential customers. Hence, high solvency can enhance an insurer's underwriting performance since more stable insurers tend to draw better risks and are better equipped to generate higher premium income.

The study further shows an inverse relationship between premium growth and underwriting performance, aligning with Akotey et al. (2022) findings. Additionally, evidence from the quantile regression suggests that this effect appears across the entire distribution. This is not surprising, given that most insurers in South Africa excessively increase their premiums with the aim of increasing their underwriting capacity. However, this must be done with caution because excessive premium increases might harm insurers' financial stability since it would encourage excessive risk-taking and weaken underwriting performance (Horvey et al., 2024). The negative relationship between premium growth and underwriting performance contradicts Pjanić et al. (2023) argument that premium growth leads to higher profit because insurers invest some of the premiums received, which generates higher returns. This study presents that high premium growth creates financial distress, which causes insurance companies to underwrite policies without adequate risk assessments, increasing the possibility that claims will be greater than premium income (Morara & Sibindi, 2021). Therefore, this study suggests that while premium growth is a goal that insurers should strive toward, it must be balanced with responsible underwriting practices. Without considering these issues, an overreliance on quick premium growth may eventually cause underwriting performance to decline. This

aligns with Oscar Akotey et al.'s (2013) assertion that insurer performance may suffer if premium increases occur without sufficient price validation. Hence, insurers need to perform a comprehensive assessment before underwriting to ensure higher underwriting performance (Akotey et al., 2022).

Contrary to the results of Akotey et al. (2022), this study showed a positive relationship between market share and underwriting performance and was statistically significant in the higher quantile dimensions of non-life insurers. The positive relationship supports the argument by Ansah-Adu et al. (2011) that market share drives insurance efficiency because a diverse customer base often corresponds with a larger market share. Because of this diversity, insurers can disperse risks among many different types of policyholders, which lessens the impact of unfavorable occurrences on underwriting performance. However, this was insignificant. Also, its effect becomes more pronounced when interacting with ROA. Thus, market share enhances the impact of ROA on underwriting performance. The significant positive values of both sectors affirm this. The study argues that insurance companies may have an edge over competitors if they have a sizable market share and high ROA. As a result of competitive pricing and an increased customer base, they can grow their underwriting performance further. The net result of market share and return on assets is calculated following the methodology of Brambor et al. (2006). The computed net effect suggests that in the presence of high market share, return on assets promotes underwriting performance among the life and non-life insurers in South Africa. This suggests that higher market share is crucial for enhancing profitability's effect on underwriting performance.

4.3. Diagnostics and robustness checks

To ensure proper generalization of findings from the estimates, the study performs several diagnostic tests and analyses using the Driscoll and Kray estimation technique. Multicollinearity was checked using the correlation analysis in Table 4. Additionally, Kennedy (2008) set the threshold of multicollinearity at 0.7; hence, no evidence of multicollinearity was found, and the VIF confirmed the variables' eligibility. The study further checks for heteroscedasticity (Appendix A), serial correlation (Appendix B) and cross-sectional dependence (Appendix C). The results indicated no evidence of serial correlation and cross-sectional dependence. However, heteroscedasticity was detected; hence, we used the Driscoll and Kraay estimator to address this issue and ensure consistent, unbiased and efficient results, thereby affirming the robustness of the findings. The coefficient estimates of life (Appendix D) and non-life (Appendix E), to a very large extent, affirm the results of the main analysis, suggesting the consistency and dependability of the findings and outcomes. Our models are, therefore, robust and suitable for generalization.

5. Conclusion and recommendations

This study contributes to the ongoing debate on the factors influencing the underwriting performance of the insurance industry by exploring a panel dataset of life and non-life insurance companies in South Africa between 2013–2019. The motivation for this study is based on the premise that empirical research on the factors influencing the

underwriting performance of the insurance sector remains elusive despite the numerous attempts made by scholars to understand the insurance industry. Additionally, the decline in the underwriting performance of some insurers has drawn the attention of insurance regulators to the need to strengthen underwriting practices in South Africa. Hence, to encourage sound underwriting practices and performance, this study provides evidence on the underlying factors affecting underwriting performance using the system GMM and bootstrap quantile regression approach. Complementing the main objective, this paper provides novel evidence by investigating nonlinearities of solvency and the synergetic relationship between return on assets and market share.

The study's findings indicate large insurers are associated with higher underwriting performance for both the life and non-life sectors across all levels, implying that large insurers tend to have better underwriting outcomes than smaller ones. The study further shows that life insurers who rely excessively on reinsurance are less likely to experience underwriting performance. However, the non-life insurers present a positive relationship. The inference is that due to the short-term nature of their business, non-life insurers usually deal with risk categories that are more unpredictable and uncertain. Therefore, reinsurance helps them to minimize the risk of higher claims, resulting in underwriting performance. Also, the effect of underwriting risk on life insurance underwriting performance varies at different levels, showing an inverse relationship at higher quantiles, whereas non-life insurance reveals a negative impact across all levels. Again, premium growth presents a decreasing effect on underwriting performance. Hence, an excessive dependence on rapid premium growth could eventually result in declining underwriting performance.

Also, the study observes that initial solvency levels reduce underwriting performance while the extreme increase in solvency promotes underwriting performance of both the life and non-life sectors in South Africa. This suggests a nonlinear direct U-shape relationship, implying that highly solvent insurers are more likely to reap higher underwriting results. Further, the study shows that market share positively impacts underwriting performance. Similarly, return on assets shows a significant positive relationship from the 50^{th} quantile. This is because highly profitable and large insurers enjoy economies of scale and have the financial stability to underwrite insurance policies effectively. Again, this effect becomes more pronounced when interacting with market share. Thus, market share enhances the impact of return on assets in affecting underwriting performance. This indicates a synergetic-complementarity relationship between market share and return on assets on underwriting performance.

Given that the underwriting performance of the insurance industry has not been stable over time, this study has recommendations for practice and policymaking. First, insurance companies must avoid excessive increases in their premium growth due to their adverse effect on underwriting performance but implement strategies focused on improving their investment income and solvency. Regulators must ensure that insurers with rising premiums have sufficient cash reserves to cover future obligations. For life insurers, regulators must implement and enforce policies on the underwriting practices and implement rules that restrict reinsurance and sustain insurance over time. Also, large insurers can diversify their assets by offering various insurance products. More consistent underwriting performance may be obtained because of this risk-spreading diversification. Regulators should design training

programs and corporate conferences to provide a platform for smaller insurers to learn from the expertise and resources of large insurers for growth, which will ultimately improve their underwriting performance. The evidence of a nonlinear effect of solvency suggests that insurance regulators should enforce policies that mandate insurance providers to maintain adequate solvency margins to guarantee they have sufficient capital to cover their losses. Also, ensuring a higher market share could improve their profitability in promoting underwriting performance.

We acknowledge some inherent limitations which could stimulate future research directions. The study is limited to only the South African insurance market and could be extended to other African insurance markets. Also, the study considered only firm-specific factors; it will also be interesting to consider how macroeconomic factors influence underwriting performance. This will help us understand how the economic landscape shapes underwriting activities and performance. Also, the eight factors may not be exhaustive in covering all the internal factors; hence, as a future direction, studies could include other factors such as governance, leverage, and technological factors for a comprehensive understanding.

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Appendices

Appendix A: Heteroscedasticity

Life Insurance	Non-life Insurance
Ho: Constant Variance	Ho: Constant Variance
chi2 (01) = 52.71	chi2 (66) = 1.6e + 30
Prob>chi2 = 0.0000	Prob>chi2 = 0.0000

Appendix B: Serial Correlation

Life Insurance	Non-Life Insurance
Wooldridge test for autocorrelation in panel data	Wooldridge test for autocorrelation in panel data
H0: no first order autocorrelation	H0: no first order autocorrelation
F(1, 22) = 1.531	F(1, 52) = 1.069
Prob > F = 0.2291	Prob > F = 0.3060

Appendix C: Cross-sectional dependence

Life Insurance	Non-life insurance
Pesaran's test of cross sectional independence = 3.096, Pr = 0.070	Pesaran's test of cross sectional independence = 0.197, Pr = 0.8439
Friedman's test of cross sectional independence = 15.857, Pr = 1.0000	Friedman's test of cross sectional independence = 4.964, Pr = 1.0000
Frees' test of cross sectional independence = 5.351	Frees' test of cross sectional independence = 5.268
Critical values from Frees' Q distribution	Critical values from Frees' Q distribution
alpha = 0.10 : 0.3583	alpha = 0.10 : 0.4127
alpha = 0.05 : 0.4923	alpha = 0.05 : 0.5676
alpha = 0.01 : 0.7678	alpha = 0.01 : 0.9027

Appendix D: Factors affecting life insurance underwriting profitability (Driscoll and Kraay results)

Variables	(1)	(2)	(3)	(4)
Insurance Size	0.767**	0.764**	0.771**	0.765**
	(0.287)	(0.296)	(0.299)	(0.300)
Return on Assets	0.708*	0.695**	0.711*	0.694***
	(0.615)	(0.315)	(0.528)	(0.128)
Reinsurance	0.161	0.160	0.159	0.163
	(0.219)	(0.214)	(0.219)	(0.215)
Investment Income	0.011	0.010	0.009	−0.009
	(0.009)	(0.008)	(0.007)	(0.006)
Underwriting Risk	−1.733**	−1.700*	−1.731**	−1.708*
	(0.691)	(0.713)	(0.703)	(0.720)
Solvency	−0.084**	−0.123*	−0.087**	−0.124
	(0.040)	(0.072)	(0.030)	(0.100)
Solvency^2		0.021***		0.034
		(0.005)		(0.029)
Premium Growth	−0.043	−0.044	−0.041	−0.044*
	(0.021)	(0.023)	(0.020)	(0.022)

(*Continued*)

Variables	(1)	(2)	(3)	(4)
Market Share	1.042**	0.979*	1.106*	0.954*
	(0.382)	(0.404)	(0.761)	(0.580)
Return on Assets*Market Share			0.052***	0.021*
			(0.013)	(0.016)
Inflection Point		10.217		11.965
Net Effect			0.793***	0.988***
Observations	149	149	149	149

Standard errors in parentheses; ***$p < 0.01$, **$p < 0.05$, *$p < 0.1$.

Appendix E: Factors affecting non-life insurance underwriting profitability (Driscoll and Kraay results)

Variables	(1)	(2)	(3)	(4)
Insurance Size	0.465***	0.477***	0.466***	0.469***
	(0.121)	(0.122)	(0.117)	(0.118)
Return on Assets	0.020	0.019	0.021	0.017
	(0.043)	(0.044)	(0.036)	(0.011)
Reinsurance	−0.015	−0.021	−0.018	−0.016
	(0.009)	(0.010)	(0.011)	(0.010)
Investment Income	0.629	0.636	0.629	0.621
	(0.425)	(0.412)	(0.427)	(0.415)
Underwriting Risk	0.001	0.004	0.002	0.003
	(0.002)	(0.003)	(0.002)	(0.002)
Solvency	−0.012	−0.010	−0.008	−0.011
	(0.009)	(0.009)	(0.009)	(0.009)
Solvency^2		0.013***		0.024***
		(0.000)		(0.008)
Premium Growth	−0.011	−0.014	−0.013	−0.010
	(0.009)	(0.010)	(0.010)	(0.009)
Market Share	0.554***	0.521***	0.553***	0.551***
	(0.108)	(0.109)	(0.141)	(0.142)
Return on Assets*Market Share			0.082***	0.071***
			(0.026)	(0.012)
Inflection point		11.987		
Net Effect			0.129***	0.553***
Observations	349	349	349	349

Standard errors in parentheses; ***$p < 0.01$, **$p < 0.05$, *$p < 0.1$.