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Factors Influencing Solvency Margin of the Egyptian Insurance Companies

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Abstract

This study investigates the primary factors affecting the solvency margin of Egyptian insurance companies through analyzing various dynamics that influence this margin. The study period is from 2012 to 2021 for 30 (17 non-life and 13 life) insurance companies. The insurers' solvency margin ratio has been utilized as a dependent variable. The analysis focused on eight independent variables: Return on Assets (ROA), asset size, premium growth, liquidity ratio, investment ratio, uncollected premium ratio, reinsurance ratio, and shareholders to policyholder equity ratio. The results revealed a significant relationship between the solvency margin ratio, as a dependent variable, and specific explanatory variables, namely: asset size, investment ratio, liquidity, and the ratio of shareholder equity to policyholder equity. The study provides recommendations for Egyptian insurance companies and regulators. It suggests that several insurance companies should increase their capitalization base. Furthermore, the regulator could improve the capitalization requirement and implement a risk-based capital approach.

Keywords

Solvency margin, Capitalization, insurance companies, Egypt, Financial Regulatory Authority (FRA).

Article history

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1. Introduction

Insurance significantly participates in countries' financial stability and economic growth. Insurance supervisors acknowledge the significant role of insurance entities and endeavor to guarantee the policyholders' rights and beneficiaries through implementing the appropriate legislation that organizes the conduct of markets and strengthens the financial positions of insurers, thereby decreasing the probability of company distress. Furthermore, regulators aim to confirm the adequacy of admissible assets to cover the expected outstanding liabilities and maintain a buffer against unexpected losses to avoid insolvency risk and prevent bankruptcy. Consequently, insurers' solvency is considered an essential factor for insurance companies to fulfill their obligations toward policyholders.

The solvency margin model for insurance companies, similar to the capital adequacy model for banks, reflects the financial strength and capital adequacy of insurers. As a result, insurance regulators are constantly developing comprehensive rules for solvency margin requirements and calculation principles to ensure the adequacy of insurers' capitalization. In this study, the Solvency Margin Ratio (SMR) is calculated through dividing the available solvency margin (Admissible Assets minus liabilities) by the required solvency margin, as stipulated by Article 39 of the Egyptian Insurance Law No. 10 of 1981 and its amendments.

The study is divided into six sections. The introduction is followed by Section Two, which reviews the solvency background in insurance and the relevant previous empirical studies in several regions. Section Three explains the problem statement and developing hypotheses. Section Four highlights the methodology and statistical model. Section Five demonstrates the empirical analysis. Finally, Section Six illustrates the implication and suggests directions for future research.

2. Literature Review

This section aims to underscore the solvency background and recent developments in the literature concerning the main factors affecting the solvency margin for insurance companies.

2.1. Solvency Background

The insurers' solvency regulatory approach is constantly evolving. The international techniques developed from simple ratio-based methods to a comprehensive risk-based approach. In Europe, the initial efforts for solvency assessment were introduced in the form of the first non-life insurance directive in 1973, followed by a directive for life insurance in 1979. These directives utilized basic formulas to estimate the required minimum solvency margin and simple solvency factors based on adjusted accounting results including reinsurance considerations. Although this regime was simple to apply and manage, it did not adequately reflect risks aspects. As a result, it was incapable of coping with the increasing market complexity and rising customer protection demands.

The limitations of this solvency regime were detailed in the Müller report of 1997. Consequently, Müller's findings led the European Union (EU) to improve the earlier solvency regulations and develop the Solvency I regime in 2002, which introduced additional parameters and incorporated risk considerations into solvency assessments to enhance policyholder protection (Shekhar et al., 2008).

For further evolution, the EU established "Solvency II", a more advanced and complex risk-sensitive regime designed to assess the financial stability of European insurance companies. Solvency II involves an enterprise-wide view of risks and employs a risk-based quantitative method for calculating the required solvency capital. It is more complex than standard solvency requirements, and involves more significant oversight.

Solvency II directives are structured similarly to Basel II for banks, including three main pillars. Pillar 1 considers the quantitative capital requirements. Pillar 2 covers the qualitative requirements, such as a supervisory review process, and Pillar 3 focuses on disclosure requirements and enhanced market discipline. This critical transition in the adoption of Solvency II represents a fundamental change in the approach, evolving into a principle-based system established on a risk-based capital framework.

For the Egyptian insurance market, the required solvency margin is determined by Article 39 of Law 10, 1981. For non-life property and liability insurance business, the value of an insurance or reinsurance company's assets must exceed its liabilities at any given time by 20% of net premiums or 25% of net incurred claims from the previous year. The calculation indicated that, during the determination of these ratios, the deduction for outward reinsurance transactions must not exceed 50% of the gross premiums.

For personal life insurance business, the required solvency margin specifies that assets must exceed liabilities for personal insurance and capital redemption by the following ratios:

a) 0.3 % of the exposure funds of insurance contracts, including reinsurance, with a reduction of up to 50% for reinsurance business.

b) 4% of the mathematical reserves, including reinsurance, with a reduction of up to 15% for reinsurance.

In both life and non-life insurance classes, the required increase in the value of assets over liabilities must not be less than the paid-up capital, which is currently set at 60 million EGP.

2.2.Previous Empirical Studies

Several market studies were conducted to observe the factors affecting insurers' solvency margin. In Palestine, a study conducted by Fares and Nour (2023) explored the factors influencing insurers' solvency. The study identified the seven insurance companies, listed on the Palestine Exchange (EX) during the period from 2012 to 2019,

and concluded that profitability and liquidity had no impact on solvency, whereas financial leverage, investment and claims significantly and positively impacted solvency. Similarly, Jawad and Ayyash (2019) examined the solvency of insurance companies in Palestine over the period from 2010 to 2017. The results revealed that financial leverage was negatively related to solvency, while claims exhibited a positive correlation. However, both liquidity and investment demonstrated an insignificant impact on solvency.

Across the EU, Siopi et al. (2023) analyzed the effect of regulation on the solvency of 29 European insurers from 2016 to 2020. Their findings revealed that reinvestment rate, cash and equivalents, long-term investment, as well as losses, benefits, and adjustment expenses were the most reliable indicators of insurers' solvency, emphasizing the factors that enable insurance companies to maintain adequate solvency capital requirement ratios.

In Sri Lanka, VK et al. (2021) investigated the factors influencing the solvency of 11 licensed insurance companies between 2010 and 2019. The findings confirmed the significant positive influence of profitability and economic growth on the insurers' solvency, as well as a significant negative impact of leverage on the solvency of the insurance sector. Furthermore, firm size, premium growth, and inflation were observed to have an insignificant impact on the determination of solvency in the Sri Lankan insurance sector.

In Indonesia, Afiqah and Laila (2021) examined the determinants of solvency for Sharia Life Insurance Company from 2015 to 2109, as proxied by Risk Based Capital. The study concluded that company size had a significant positive effect on solvency, while premium growth, investment returns, and liquidity revealed an insignificant influence. The study analyzed 10 companies during this period, revealing the positive effect of company size on solvency, whereas liquidity did not significantly impact the solvency of Sharia Life Insurance in Indonesia.

In Spain, Moreno et al. (2020) analyzed the factors determining insurers' solvency margins from 2008 to 2015, and identified several influencing firm-specific factors, including assets size, profitability as proxied by return on assets, reinsurance use, and investment risk, which was assessed through dividing the share of equity securities by total assets. Additionally, underwriting risk, long-tailed business measured by the ratio of technical provisions or loss reserves to incurred losses, and organizational form reflecting ownership structure, were considered. The determinants also encompassed industry structure and macroeconomic factors. The study concluded a significant correlation between actual solvency margins and underwriting risk, profitability, as well as mutual-type organization, whereas size, long-tailed business, and reinsurance exhibited a negative correlation. Moreover, less concentrated market structure and economic crisis, characterized by declining GDP, led to decreased solvency margins; conversely, investment portfolio risk and interest rates were observed to be insignificant.

In Ethiopia, Abera and Yirsaw (2020) noted the impact of independent firm specific factors: firm size, liquidity ratio, operating margin, loss ratio, expense ratio,

premium growth, as well as reinsurance and actuarial practices on solvency margin as the dependent variable. The study utilized multiple regression analysis over the period from 2008 to 2017, focusing on nine private general insurance companies. The results revealed a positive significant influence of firm size, liquidity ratio, as well as reinsurance and actuarial practices on insures' solvency margin, while the other variables were statistically insignificant. The study recommended that regulators develop clear directives regarding reinsurance arrangements and establish the minimum insurance premiums for each class of business.

In the UK, Caporale et al. (2017) assessed the insolvency risk of 515 general insurance companies over a 30-year period. The study utilized firm-specific variables such as leverage, profitability, growth, firm size, reinsurance, claims, capital, liquidity, the annual change in gross premium, combined ratio, and line-of-business concentration. In addition, the study indicated UK macroeconomic variables such as GDP growth, changes in foreign direct investment, net inflows, the real interest rate, the real effective exchange rate, and change in credit provided by financial institutions as a percentage of GDP. The findings revealed a positive relationship between liquidity, reinsurance, leverage, underwriting risk, and organizational structure with insurers' insolvency. However, firm size and growth rate were not statistically significant to the solvency of insurers. Another study by Shiu (2005) focused on the UK's life insurance sector from 1986 to 1999, categorizing the determinants affecting insurers' solvency into firm-specific and macroeconomic factors. The findings confirmed a negative relationship between solvency and factors such as size, leverage, inflation, and market competition. However, a positive correlation between solvency and both the equity-to-asset ratio and the asset-to-bond ratio was observed.

Todevski and Fotov (2017) identified the factors influencing the solvency margin in the Macedonian insurance sector through separately examining life and non-life insurance classes. The solvency margin value was employed as the dependent variable, while capital, losses, premium, provisions, and costs were utilized as independent variables, covering the period from 2010 to 2014. The study concluded that capital influences solvency and risk in the Macedonian insurance sector, along with losses paid, premiums, provisions paid, and administrative costs. In addition, the results revealed a positive statistical relationship between capital, administrative costs, intermediary provisions paid, and the solvency margin. Conversely, losses paid and premiums showed a negative statistical impact on the solvency margin.

In Germany, a study by Rauch and Wende (2015) examined the factors affecting the regulatory solvency ratio for property and liability insurance companies from 2004 to 2011. The study developed a prediction model to classify insurers based on their financial strength. According to German regulatory law, the insolvency ratio was employed as the dependent variable in the model. Two-year lags were applied to all independent variables, including solvency ratio, investment risk, premium growth, operational leverage, ROA, combined ratios, and business mix. The study concluded that the prior solvency ratio is a reliable indicator of the insurers' future solvency. Furthermore, it confirmed that high premium growth negatively impacts insurers'

solvency, and indicated that investment risk is negligible for the solvency of German insurers.

In India, a study conducted by Rameshchandra (2013) analyzed the solvency of 12 Indian non-life insurance companies. The study identified solvency ratio as the dependent variable and examined seven independent variables; firm size, operating margin, investment yield, liquidity, claim ratio, combined ratio, and market share. The findings indicated that a higher claim ratio negatively impacts the insurer's solvency, whereas the firm size significantly affects it.

In Malaysia, Yakob et al. (2012) addressed the firm-specific factors that may influence insurers' solvency from 2003 to 2007 using the random effects regression for panel data. The study identified a significant negative relationship between the three factors; liquidity, leverage, and surplus ratio, in addition to insurer's solvency. The findings were consistent with the studies conducted in the UK by Caporale et al. (2017) and Shiu (2005), which also concluded that leverage adversely affects insurers' solvency.

In Kenya, a study by Komen (2012) explored the determinants of insurers' solvency from 2001 to 2010. The study emphasized that insurers' solvency is positively influenced by liquidity and surplus growth, but negatively impacted by claims ratio and investment income ratio to premiums . Additionally, there is no statistically significant relationship between insurers' size and solvency.

In the USA, Carson and Hoyt (2000) examined 1,900 US life insurance companies. They utilized a logistic regression model to identify the most critical variables influencing financial distress, and assess the risk of insurers' insolvency from 1984 to 2000. The results demonstrated that insurers' insolvency is negatively impacted by capital, surplus, and geographic concentration, while it is positively impacted by leverage and liabilities to current assets. These results are consistent with Shiu (2005), regarding the positive impact of capital on the insurers' solvency, and are also compatible with Caporale et al. (2017), concerning the negative impact of leverage.

In conclusion, previous studies have revealed a disparity results; some showing a positive relationship between the insurers' solvency and independent variables, while others indicate an inverse relationship. Furthermore, some studies determining the independent variables consider firm specific factors such as asset size, liquidity, and profitability. Other studies emphasize macroeconomic factors, including GDP, interest rates, and inflation. Although some studies accepted solvency I norms, others implemented solvency II. However, many studies, including the current one, rely on the solvency requirements provided in state legislation.

3. Statement of the Problem and Development of Hypotheses

This section addresses the study problem and focuses on defining the study objectives.

3.1. Statement of the Problem

Due to the accelerating increase in global risks, insurance companies play a significant role in protecting individuals and businesses against financial losses. Therefore, insurers must be capable of fulfilling their liabilities to policyholders. Consequently, the solvency margin becomes an essential measure of an insurer's financial strength. This study aims to analyze and examine the significance of the factors affecting the solvency margins of Egyptian insurance companies. Accordingly, the study problem statement can be stated as follows: "Identifying and analyzing the factors affecting the solvency margins of Egyptian life and non-life insurance companies."

3.2. Developing Research Hypotheses

Prior literature demonstrated significant correlations between the independent variables and Solvency Margin Ratio (SMR). Therefore, the study preliminarily examines the significance and direction of the correlation between the independent variables; profitability ratio, assets size, premium growth, investment ratio, uncollected premium ratio, liquidity ratio, reinsurance ratio, shareholder equity to policyholder equity, and SMR in the Egyptian insurance companies. Accordingly, the first hypothesis can be stated as follows:

> **H1: "There is a significant correlation between SMR as a dependent variable and the study's independent variables."**

As the expected influence for each independent variable on SMR may vary, a bivariate correlation may not comprehensively reflect the combined effect of these variables on the variance in solvency margin. Thus, the second hypothesis can be stated as follows:

> **H2: All the independent variables collectively have an equal relative effect on SMR.**

4. Methodology

This section outlines the research methodology and presents the study model that will be tested in the subsequent section.

4.1 Data Source and Sample

A financial database was collected and designed for 30 Egyptian insurance companies, comprising two public and 28 private sectors, out of a total of 39. Insurance companies that had not been in operation for a period exceeding seven years were

excluded. Data were collected from Financial Regulatory Authority (FRA) and the Egyptian insurance companies for the period from 2012 to 2021.

4.2. Statistical Model

This study investigates the factors influencing the solvency margin ratio of Egyptian insurance companies. Based on the findings from the literature review and market conduct analysis, eight variables were selected explaining firms' solvency margins. The solvency margin ratio of insurance companies operating in Egypt relies on ROA, as a profitability ratio, as well as asset size, premium growth, investment ratio, uncollected premium ratio, liquidity ratio, reinsurance ratio, and the ratio of shareholder equity to policyholder equity. The following equation illustrates the relationship between the independent variables and SMR:

$$SMR\ it = \alpha + \beta 1\ (ROA\ it) + \beta 2\ (ln\ Assets\ it) + \beta 3\ (\Delta\ premiums\ it) + \beta 4\ (Investments/Assets\ it) + \beta 5\ (uncollected\ premium\ /total\ premiums\ it) + \beta 6\ (liquid\ assets/policyholder's\ equity\ it) + \beta 7\ (Reinsurance\ ceded\ premiums\ to\ total\ premiums\ it) + \beta 8\ (shareholder's\ equity/policy\ holder's\ equity\ it) + \mathcal{E}i$$

where:
α is a constant.
(β1: β8) are the parameters for the explanatory variables.
The subscript (i) refers to the insurance companies' number.
The subscript (t) denotes the period.
(Ɛi) represents the unobservable individual heterogeneity and the remainder disturbance of the usual disturbance in the regression model that varies with individual units and time.

Variables used in the analysis are summarized in Table 1 as follows:

Table 1: Dependent & Independent Variables

Variable's category	Variables	Measurement	References	Expected impact to SMR
Dependent variable	Firm's solvency margin ratio	SMR=Available solvency margin (admitted assets – liabilities) /Required solvency margin according to Egyptian law.	(Todevski, D., & Fotov, R., 2017) (Rameshchandra, P. O., 2013) (Rauch, J., & Wende, S., 2015) (Komen, D. K., 2012) (Shiu, Y. M., 2005)	-
Independent variables	Profitability ratio	ROA (Net profit/total Owner's Equity)	(VK, M.et al.,2021) (Moreno et al., 2020) (Caporale et al.,2017) (Rauch, J., & Wende, S., 2015)	**positive**
	Assets size	Natural logarithm of total assets	(Afiqah, Y. W., & Laila, N., 2021) (VK, M.et al., 2021) (Abera, H. B., & Yirsaw, T. D., 2020) (Moreno et al., 2020) (Caporale et al., 2017) (Ramesh chandra, 2013) (Komen, D. K., 2012)	**Positive**

	Premium gross	Year-to-year percentage change in new premiums	(Afiqah, Y. W., & Laila, N., 2021) (VK, M.et al., 2021) (Abera, H. B., & Yirsaw, T. D., 2020) (Caporale et al., 2017) (Todevski, D., & Fotov, R., 2017) (Rauch, J., & Wende, S., 2015)	**Positive**
	Investment ratio	Total Investment to total assets	(Burca & Batrinca, 2014) (Tesfaye, T., 2017)	**Positive**
	Liquidity ratio	A current asset (liquid assets) to current liability (policyholder's equity)	(Fares, Z., & Nour, A. N. I., 2023) (Afiqah, Y. W., & Laila, N., 2021) (Abera, H. B., & Yirsaw, T. D.,2020) (Jawad, Y. A. L. A., & Ayyash, I., 2019) (Caporale et al., 2017)	**positive**
	Uncollected premium ratio	Uncollected premium/Gross premium	(Yakob et al., 2012) (Carson, J., & Hoyt, R., 2000)	**Negative**
	Reinsurance ratio	(1-(Net Written Premium/Gross Written Premium))	(Abera, H. B., & Yirsaw, T. D.,2020) (Moreno et al., 2020) (Caporale et al., 2017)	positive
	The shareholder tights to policy holder's rights ratio	Shareholder's rights divided by Policy holder's rights ratio	(Chandra Shekhar ,2013) (Jawad, Y. A. L. A., & Ayyash, I., 2019) (Caporale et al., 2017) (Yakob et al., 2012) (Carson, J., & Hoyt, R., 2000)	positive

Source: Prepared by the researchers

5. Analysis

5.1 Descriptive Statistics and Normality Test

Table 2: Descriptive Statistics of the Study Variables

	Min.	Max.	Mean	Std. Dev	Jarque-Bera-prob
Dependent Variable (Y)					
(SMR)	0.01	17.307	2.510	2.368	0.000
Independent variables (X's)					
ROA	-0.213	0.144	0.047	0.048	0.000
Log asset size	16.990	24.41	20.562	1.425	0.000016
Premium growth ratio	-0.337	0.918	0.179	0.197	0.000
Investment ratio	0.323	0.987	0.789	0.119	0.000
Liquidity	0.964	4.039	1.7973	0.631	0.000
Uncollected premium/ Gross premium ratio (CR-Risk)	0.01	0.502	0.142	0.097	0.000
Reinsurance Ratio	0.017	0.838	0.327	0.215	0.000358
Shareholder's equity to Policy holder's equity	0.035	6.218	0.882	0.957	0.000

Source: Developed by the researchers from EViews® 10 extracted outputs

Table 2 illustrates the descriptive statistics of the study variables. The observed descriptive statistics consist of minimum, maximum, mean, standard deviation, and Jarque – Bera probability for testing normality. The gaps in data between minimum

and maximum for some variables are due to the large size of public insurance companies, such as Misr Insurance and Misr Life Insurance. Both insurance companies possess a significant market share in their assets, premiums, and both policyholder and shareholder equity.

The results of Jarque-Bera statistics which asses the normality assumption, indicate that the data is not normally distributed. Based on the Jarque-Bera statistics and p-value, this assumption is rejected at a 5% significance level for variables. However, this problem of the data non-normality is addressed by the large number sample size of 300 observations, as explained by Field (2005).

5.2. Pearson Correlation Matrix Between DVs and IVs

Pearson Correlation Matrix is applied to test the relationship and explore the direction and significance between the insurers' solvency margin and the independent variables of the designed model. The magnitude and direction of the relationship are explained by the coefficient of Pearson correlation matrix, indicating whether such relationship is a strong or weak signal, and positive or negative. Although correlations reveal the relationships between variables, they do not imply causation (Field, 2000). Additionally, the correlation matrix is employed to examine the multicollinearity, which tests whether independent variables are highly correlated with each other. However, as will be displayed hereafter, multicollinearity is tested by the Variance Inflation Factor (VIF).

5.3. Multicollinearity Test and Variance Inflation Factor (VIF) Test

Multicollinearity exists when a regression model exhibits a strong linear correlation between two or more independent variables; consequently, the correlation matrix examines multicollinearity and detects any high correlation above 0.80 or 0.90 (Field, 2000). The threshold value of VIF is ten, signifying the absence of multicollinearity.

Table 3 demonstrates the correlations between the independent variables. The severity of this multicollinearity problem is examined using the VIF test to assess whether the data and variables should be retained or removed from the model. According to Field (2005) a VIF value greater than 10 raises concern. Furthermore, Hair et al. (2006) noted that a maximum acceptable VIF value is 10, with values exceeding this threshold suggest a problem with multicollinearity. Table 4 presents the Variance Inflation Factor (VIF) test.

Table 4 demonstrates the absence of multicollinearity based on VIF indicators (VIF <10) for the independent variables associated with the insurers' solvency margin ratio. Therefore, the analysis will proceed with the given data and the proposed explanatory variables without modification.

Table 3: Correlations Matrix Between Independent Variables

Prob.	(X1) ROA	(X2) Log Assets	(X3) Prem. G.	(X4) Inv. Ratio	(X5) Liquidity	(X6) Cr. Risk	(X7) Reinsurance	(X8) SH/PH
(X1) ROA	**1**							
(X2) Log Assets	**0.211*** **	**1**						
(X3) Prem. G.	**-0.073**	**-0.066**	**1**					
(X4) Inv. Ratio	**0.024**	**0.422*** **	**-0.174*** **	**1**				
(X5) Liquidity	**0.151** **	**-0.324*** **	**-0.022**	**-0.594*** **	**1**			
(X6) Cr. Risk	**0.222*** **	**0.027**	**-0.051*** **	**-0.533*** **	**0.438*** **	**1**		
(X7) Reinsurance.	**0.351*** **	**-0.252*** **	**-0.072**	**-0.548*** **	**0.608*** **	**0.499*** **	**1**	
(X8) SH/PH	**0.104***	**-0.426*** **	**0.020**	**0.525*** **	**0.646*** **	**0.224*** **	**0.349*** **	**1**

Source: Developed by the researchers.

***. Correlation is significant at the 0.01 level (2-tailed).

**. Correlation is significant at the 0.05 level (2-tailed).

*. Correlation is significant at the 0.1 level (2-tailed).

Table 4: VIF Test- Insurance Companies – SMR

Variable	Coefficient Variance	Uncentered VIF	Centered VIF
ROA	7.215957	2.961869	1.398332
Log Asset size	0.009109	348.4169	1.58518
Premium Growth Ratio	0.32526	2.127611	1.105181
Investment ratio	2.229913	128.1185	2.700895
Liquidity	0.072832	23.52662	2.565741
Uncollected premium/ Gross premium ratio (CR-Risk)	2.412104	5.93138	1.828529
Reinsurance Ratio	0.625224	7.714408	2.287316
Shareholder equity to Policyholder equity	0.028082	3.835729	2.079982

Source: Developed by the researchers from E Views® 10 extracted outputs.

5.4. First Hypothesis Testing

H1: "There is a significant correlation between SMR, as a dependent variable, and the study's independent variables."

Table 5 tests the first hypothesis and explains the correlations between independent variables and the Solvency Margin Ratio (SMR) as the dependent variable.

Table 5 reports correlations between the independent variables and the dependent variable. A correlation of 1 or-1 signifies a perfect positive or negative direction. Although correlations indicate the relationship between the variables, they do not imply causation (Field, 2000). In the sample statistics of IBs, a statistically significant correlation is observed between SMR, as a solvency margin measurement, and ROA, as a profitability measurement. Similarly, the solvency margin demonstrates a statistically significant correlation with size, liquidity, credit risk ratio, and reinsurance.

Conversely, the solvency margin ratio does not exhibit a significant correlation relationship with premium growth, investment ratio, or shareholder equity relative to policyholder equity.

Table 5: IBs - SMR - Pearson Correlation Rank, Sign and Magnitude

Independent Variables	Pearson Correlation SMR Corr. Coefficient	Sign
ROA	**0.206**	+***
Log asset size	**0.542**	+***
Premium growth ratio	**-0.083**	NS
Investment ratio	**0.126**	NS
Liquidity	**0.165**	+**
Uncollected premium/ Gross premium ratio	**0.223**	+***
Reinsurance ratio	**0.141**	+**
Shareholder equity to Policyholder equity	**0.046**	NS

Source: Developed by the researchers

***. Correlation is significant at the 0.01 level (2-tailed).

**. Correlation is significant at the 0.05 level (2-tailed).

*. Correlation is significant at the 0.1 level (2-tailed).

5.5. Testing the Second Hypothesis

H2: "All the independent variables, collectively, exhibit an equal relative impact on the insurer's SMR".

A panel regression model was conducted to explore the determinants of the solvency margin ratio. Panel data involves pooling observations on a cross-section of variables over several periods from 2012 to 2021. This approach is beneficial as it increases the number of data points and degree of freedom, while reducing collinearity among the explanatory variables, thereby improving the quality of results (Abor, 2008). The analysis was conducted using Eviews software version 10.

Table 6: Multiple Regression Analysis Results (2012 to 2021)

Variable	Coeff.	Std.Error	t.Statistic	sig.
SMR (-1)	0.705	0.0382	18.27	0
ROA	-1.493	1.799	-0.829	0.407
Log Asset size	0.430	0.073	5.842	0***
Premium Growth Ratio	0.212	0.352	0.603	0.546
Investment ratio	2.410	0.943	2.554	0.011**
Liquidity	0.395	0.179	2.209	0.0281**
Uncollected premium/ Gross premium ratio (CR-Risk)	0.201	0.983	0.204	0.8378
Reinsurance Ratio	0.863	0.539	1.599	0.1112
Shareholder's equity to Policy holder's equity	0.303	0.114	2.647	0.008***

R-squared	**0.774**
Adjusted R-squared	**0.765**
SE of regression	**1.162**
Durbin-Watson stat	**2.045**

*** Significant at 0.01, ** significant at 0.05, * significant at 0.10

Table 6 presents the results of the multiple regression and the model's goodness-of-fit statistics. The analysis provides the following results:

i. The Generalized Method of Moments (GMM) model employs lagged variables as instrumental variables to explain the volatility of the dependent variables and address the problem of autocorrelation.
ii. GMM incorporates fixed and random effects to address heterogeneity and heteroscedasticity in the model.
iii. A one lag time is utilized to address serial correlation.
iv. Random effects are employed to address heterogeneity.

This approach is beneficial as it increases the number of data points and degree of freedom, reduces collinearity among the explanatory variables, and thus improves the quality of results (Abor, 2008). Consequently, Table 6 demonstrates the following results:

i. R-squared explanatory power equals 77.4%, and the adjusted R-squared is 76.5%, which means that the independent variables can explain 76.5 % of the variation in the dependent variable (SMR). Furthermore, the Durbin-Watson (DW) statistic is 2, indicating that the regression model is accepted. In addition, the results indicate overall model significance, as the GMM model's t-statistic shows a p-value less than 0.01.
ii. Half of the independent variables show a significant t-test indicating an effective explanatory model for the insurers' solvency margin ratio: asset size, investment ratio, liquidity, and shareholder to policyholder equity.
iii. Some variables exhibit insignificant t-test probability: ROA, premium growth, uncollected premium to gross premium, and reinsurance. Their t-test probabilities are insignificant, indicating a p-value > 0.05. Thus, the hypothesis H_0 is accepted, suggesting a random chance relationship, while the alternative hypothesis Ha s rejected, suggesting no significant relationship.

➢ The optimal model to explain an insurers' solvency margin (SMR) is presented in the following equation:

Equation 5-1: SMR Regression Model Equation for The Egyptian insurance companies prior to excluding the insignificant variables.

Substituted Coefficients:

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Y_1_SMR = 0.705*Y_1_ SMR (-1) – 1.493*X_1_ROA + 0.430*X_2_ LOG_A + 0.213*X_3_PR. G + 2.41*X_4_ INV_R + 0.395*X_5_LIQ. + 0.201*X_6_Cr. _ R + 0.863*X_7_Re_Ins. + 0.303*X_8_Sh_Ph + e

Based on the current solvency margin requirement set by the Egyptian insurance regulations, the study sample revealed that most Egyptian insurance companies

maintain adequate solvency margins. Companies that retain their profits with a low level of capital are able to expand their business without negatively impacting the solvency margins due to the increase in shareholder equity. Conversely, companies with retained losses and frequently increased capital remain compliant with solvency margin requirements, provided that their paid-up capital exceeds the minimum required by law.

The insurer-specific independent variables deployed in the econometric modelling include: asset size, profitability, investment ratio, premium growth, liquidity, uncollected premium to gross premium (as a proxy of credit risk), reinsurance, and shareholder to policyholder equity. Generally, the analysis period from 2012 to 2021, asset size, investment ratio, liquidity, and shareholder to policyholder equity positively impacted the solvency margin ratio. However, profitability, premium growth, uncollected premium to gross premium (as a proxy of credit risk), and reinsurance did not influence the solvency margin ratio during the study period.

Previous Solvency Margin Ratio

Based on the regression results, the past Solvency Margin Ratio (one-year lag of SMR) demonstrates a significant effect on the current solvency margin. This effect may be attributed to a reduction in dividend distribution, which increases retained earnings and shareholder equity, thereby mitigating the potential shortage of funds required for current operations. The regression coefficient from table 6 is 0.705, with a t-statistic of 18.2, including a p-value of 0.000. Therefore, H_1 is accepted. This result indicates that a one-unit change in the previous year's capital adequacy ratio of insurance companies increases the current year's capital by an average of 0.705 units, holding other variables constant. The high value of the coefficient for the lagged dependent variable signifies strong persistence in the solvency margin.

This finding is supported by the empirical evidence from VK et al. (2021), which indicated that the previous solvency margin had a significant positive impact on the solvency of the insurance companies in Sri Lanka . Additionally, Rauch and Wende (2015) examined the factors influencing the regulatory solvency ratio for property and liability insurance companies in Germany from 2004 to 2011. Their study developed a prediction model to classify insurers based on financial strength, and concluded that the prior solvency ratio is a reliable indicator of future solvency.

Asset size

A larger asset size enables insurance companies to absorb unexpected losses associated with varying risk levels and reduces the financing costs. The regression results indicate that firm size, measured by the natural logarithm of assets, exhibits a significant effect on the insurers' solvency margin. The regression coefficient from Table 6 is 0.430, with t- statistic of 5.8 and a p-value of 0.000. Therefore, H_1 is accepted.

This result is consistent with the results of Afiqah and Laila (2021), Bouzouita et al. (1998), Adams et al. (2003), and Yakob et al. (2012). However, Moreno et al. (2020) noted a negative impact on insurers' solvency, and Caporale et al. (2017) reported no significant impact on solvency in the UK.

Insurers' Investment

A higher percentage of insurers' investment in total assets enhances the quality of the admitted assets, which positively influences the insurers' capitalization. This increased investment percentage reflects higher investment returns, and decreases the probabilities of default, as it enables the insurers to fulfill their obligations toward policyholders.

The regression result indicated that insurers' investment, measured by investment to total assets, emphasized a significant effect on insurers' solvency margin. The regression coefficient from Table 6 is 2.410, with t-statistic of 2.55, including p-value of 0.011. The results are consistent with those demonstrated by Siopi et al. (2023) and Rauch and Wend (2015). In contrast, the study by Misas et al. (2017) found no statistically significant impact of investment risk on the regulatory solvency of insurance companies.

Liquidity Ratio

Liquidity refers to the extent to which debt obligations becoming due in the next twelve months can be settled using cash or assets that are convertible into cash. It reflects the firm's ability to manage working capital, when maintained at normal levels, through the rapid conversion of assets into cash. This study confirms the positive influence of the liquidity ratio, measured by the ratio of current assets to current liabilities, on the solvency margin ratio, since a high liquidity ratio enables the insurer to meet its short-term obligations.

The regression coefficient from Table 6 is 0.395 with t-statistic of 2.209 including p-value of 0.0281. The results are consistent with Caporale et al. (2017). However, studies by Yakob et al. (2012), Hsiao and Whang (2009), and Komen (2012) confirm the negative, statistically significant impact of liquidity on the solvency of insurance companies. Conversely, the studies by Fares and Nour (2023), as well as Jawad and Ayyash (2019) found no significant relationship between liquidity and insurers' solvency.

Shareholder Equity to Policyholder Equity

The ratio of shareholder equity to policyholder equity positively influences the insurers' solvency margin ratio, as it reflects a reduction in the leverage used to finance assets, and an increase in capitalization. Therefore, insurers with lower financial leverage are more likely to reduce the probability of insolvency.

The regression coefficient from Table 6 showed 0.303, with t-statistic of 2.647, including p-value of 0.008. The result corresponds to the results of Jawad and Ayyash (2019), Caporale et al. (2017), Shiu (2005), Carson and Hoyt (2000), Yakob et al. (2012), and Rauch and Wende (2015). Although Mwargi and Murigu (2015) found no

statistically significant effect of operational leverage on an insurer's regulatory solvency, much empirical literature concludes a positive relationship between profitability and capitalization (Caporale et al., 2017; Kleffner & Lee, 2009; Moreno et al., 2020; Rauch & Wende, 2015; Shim, 2010; VK et al., 2021). However, this study did not find a significant impact of the ratio of shareholder equity to policyholder equity on insurers' solvency margin for Egyptian insurance companies.

Additionally, the study results did not reveal a significant impact of the change in the gross premium on the insurer solvency margin for Egyptian insurance companies. This result is consistent with the findings of VK et al. (2021) as well as Afiqah and Laila (2021), but contrasts with the previous empirical studies that indicated a negative impact of increasing gross written premiums on insurers' solvency. Such studies suggest that the new business growth might be achieved through underwriting standards and mispricing strategies (Adams et al., 2003). In their studies, Borde et al. (1994) and Pottier (1997) noted that rapid growth in premiums could lead to increased uncertainty, since the rise in gross premiums reflects the financial management of the insurers' core business.. However, the rapid growth in gross premiums increases the insurers' risk portfolio, potentially leading to considerable future losses and an increased probability of insolvency. In particular, excessive premium growth becomes problematic if the insurer tends to underprice insurance policies.

Reinsurance is a fundamental risk management strategy. Insurers transfer part of their risks to third parties to mitigate expected future losses, and enhance their risk capacity. Consequently, according to previous studies, reinsurance reduces solvency requirements (Abera & Yirsaw, 2020; Carayannopoulos & Kelly, 2004; Moreno et al., 2020; Shiu, 2011). Moreover, reinsurance enables insurers to maintain sufficient risk capacity and accept new business (Upreti & Adams, 2015). Although insurance firms widely use reinsurance to reduce capital requirements, it exposes them to counterparty risk (Caporale et al., 2017), potentially resulting in higher default probabilities for insurers. This study found no impact of reinsurance on the insurer solvency and is inconsistent with the previous empirical studies.

Finally, the increase in the ratio of uncollected premiums to gross premium refers to poor asset quality and consequently exhibits a negative impact on the insurer's solvency. However, the data analysis included both life and non-life insurance classes, which may lead to an insignificant correlation with the solvency margin.

Therefore, according to the regression analysis results, the second hypothesis can be rejected, as not all independent variables jointly exhibit a significant impact on the insurer's SMR. The proposed model, after excluding the insignificant variables, is as follows in Equation (5-2);

$$Y_1\_SMR = 0.705*Y_1\_\ SMR\ (-1) + 0.430*X_2\_\ LOG\_A + 2.41*X_4\_\ INV\_R + 0.395*X_5\_LIQ. + 0.303*X_8\_Sh\_Ph + e$$

5.6. Illustration of Other Independent Variables not Included in the Study

Table 6 presents the results of the independent variables from the regression model. The overall model is highly significant (P-value = 0.000) with R^2 of 0.774 and an adjusted R^2 of approximately 0.765. The overall regression results indicate that approximately four independent firm-specific variables, such as firm size, investment, liquidity, and the ratio of shareholder equity to policyholder equity, in addition to the past solvency margin ratio (one-year lag of SMR) have a significant effect on the current solvency margin ratio. However, profitability, premium growth, reinsurance dependence, and the credit risk ratio were observed to be insignificant. Therefore, the independent variables collectively explain 76.5 % of the variation in the dependent variable (SMR), with the remaining percentage attributable to other factors that are not included in this model.

Some independent variables may be considered firm-specific factors, such as investment returns (Afiqah & Laila, 2021; Fares & Nour, 2023; Jawad & Ayyash, 2019), combined ratio (Caporale et al., 2017; Rameshchandra, 2013; Rauch & Wende, 2015), expense ratio (Abera & Yirsaw, 2020), and line-of-business concentration (Caporale et al.,2017). Other independent variables belong to macroeconomic indicators, such as GDP, inflation (Shiu, 2005; VK et al., 2021), and interest rates (Caporale et al., 2017; Moreno et al., 2020).

6. Implications and Future Research

This section of the study aims to identify and classify the most critical challenges facing the Egyptian insurance market, focusing on challenges directly pertinent to the research field.

6.1 Theoretical Implication

The results reveal that most Egyptian insurance companies currently maintain adequate solvency margins. Companies that retain their profits with low capital can expand their operations without adversely affecting the solvency margin due to an increase in the shareholder's equity. However, companies with retained losses and frequent capital increases are not impacted by solvency margin requirements provided that the paid-up capital exceeds the legally required minimum capital.

6.2 Management Implication

Since the insurance penetration among Egyptian insurance companies remains low, with premiums representing less than 1% of GDP, the prospects for Egypt's insurance market are encouraging. Insurance companies can significantly expand their activities if their paid capital is increased, enabling them to assume more significant risks and secure more advantageous reinsurance agreements.

Even though most insurance companies comply with the capitalization requirements according to the Egyptian insurance law, it is recommended that many insurance companies increase their issued and paid-up capital to align with the

proposed minimum capital requirements of the new insurance law currently under discussion in Parliament.

At the management level of the insurance companies, it is recommended for insurers to follow the best practices regarding corporate governance, especially with particular emphasis on internal audit and compliance. Furthermore, establishing a robust risk management system is essential for developing an effective risk management framework, improving risk control, and implementing the scientific methods required for pricing insurance policies.

6.3 Policymaker Implications

The Financial Regulatory Authority (FRA) regulates the insurance sector in Egypt. Currently, the regulatory framework regarding capital adequacy is still evolving and remains relatively simple compared to developed insurance markets. The capitalization requirement is based solely on a minimum issued capital of EGP60 million. Solvency measurements continue to be reliant on simple calculations that do not recognize risks, such as those introduced in developed insurance markets. Therefore, it is recommended to develop capitalization requirements using more advanced solvency measurements based on risks.

Due to the absence of legal requirements for risk management and corporate governance principles for Egyptian insurance companies, it is advised that the regulator impose regulations of corporate governance to improve their risk management functions, as well as the control functions such as internal audit and compliance.

This section of the study focuses on identifying the most critical challenges confronting the Egyptian insurance market.

6.4 Future Research:

The following topics are proposed for future research:

- A comparative analysis of the determinants of solvency for life and non-life insurance companies.
- A comparative analysis of the determinants of capital adequacy for Egyptian insurance companies and Egyptian banks.
- A regional study exploring solvency determinants for insurance companies in the Middle East.

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