Comprehensive Analysis of Credit Risk Determinants in the Egyptian Property and Casualty Insurance Sector: Exploring Macroeconomic, Industrial, and Company Specific Factors

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Comprehensive Analysis of Credit Risk Determinants in the Egyptian Property and Casualty Insurance Sector: Exploring Macroeconomic, Industrial, and Company Specific Factors

Dr. Eslam Abdulhakim Seyam; Dr. Mahmoud Mohamed Elsayed and Dr. Ahmed Nasr

Abstract:

Through risk mitigation, investment encouragement, and financial market stabilization, the insurance sector plays a critical role in promoting economic stability. But there are inherent difficulties in the business, especially when it comes to managing credit risk, which is brought on by things like non-defaulting borrowers, unpaid premiums, and unpaid reinsurance amounts. This study examines how credit risk is affected by macroeconomic, industry-specific, and insurance company specific factors in Egyptian property and liability insurance companies between 2012 and 2022.

In order to examine the relationships between credit risk, which is represented by three components: uncollected premiums, reinsurance, and bonds as dependent variables, and key independent variables like market share, ownership concentration, return on equity, insurance size, premium growth rate, and economic indicators like GDP, inflation, public debt, and unemployment. The study uses a variety of regression models, including pooled, fixed effects, and random effects regressions. Additionally, endogeneity and time persistence in credit risk structures are studied through the use of the Generalized Method of Moments (GMM). The robustness of the dynamic model is validated by the Sargan test and autocorrelation tests (AR (1) and AR (2)) which verify the efficiency of the used tools and the lack of serial correlation.

The findings demonstrate the importance of factors in determining credit risk, including Return on equity (ROE), Premiums growth rate, Insurance Size, Insurance Capitalization, and economic indicators. This study offers insights for credit risk management and strategic decision-making in the insurance industry, furthering our understanding of credit risk in Egyptian markets.

Keywords:

Credit Risk; Property and Casualty Insurance; Macroeconomic determinants; Financial performance; Fixed and random effect; Generalized Method of Moments (GMM).

JEL Classification: G2; G3; O11.

1. Introduction:

The insurance industry is essential for the economy because it is a pillar in risk reduction and risk management. It promotes stability and confidence by enabling people and companies to transfer their financial risks of unforeseen events to insurance companies (O'Hare et al., 2016). Economic growth depends on this stability because it encourages investment and entrepreneurial activities. The insurance sector is crucial in directing savings towards investments which supports many economic sectors (Haiss and Sümegi, 2008). It also serves as a basis for the credit system which facilitates borrowing for both individuals and companies (Kartasheva, 2014). The industry also generates employment opportunities which boost economic output (Rao and Srinivasulu, 2013).

Furthermore, insurance companies contribute to financial market stabilization through their significant investment portfolios as key players in the market. In addition, industry contributes to government revenue through taxes that highlighting its importance within the framework of the economy (Bastola, 2011). Essentially, insurance is a vital component of economic growth, stability, and resilience rather than merely an assurance against possible losses.

Credit risk refers to the possibility of suffering financial loss as a result of a borrower's inability to fulfil contractual obligations or a decline in a counterparty's credit standing (Allen, 2003). Insurance companies invest their premiums in a variety of financial instruments which is one way that this risk appears in investment activities such as bonds. The insurer's financial stability may be severely impacted by the issuers of these securities defaulting or experiencing a reduction in their creditworthiness. Furthermore, there is a chance that the insurer could fail to collect the compensation from the reinsurer causing the primary insurer to encounter uncovered risk and make the company financially vulnerable.

In the case of trade credit insurance for example the insurers control the risk of missing payments for policyholders (Yang et al., 2021). An insurance company's credit rating is also very important; a downgrade can result in higher capital costs and a negative impact on business relationships besides a reduction in consumer trust. Insurance companies use careful credit analysis, investment diversification, partner selection for reinsurance, and ongoing creditworthiness monitoring to mitigate these risks.

This strategy seeks to reduce default risks in addition to maintaining financial stability and the ability to pay policyholder claims. Due to the higher volatility and less maturity of the financial markets in developing countries, credit risk has a substantial effect on the insurance industry (Kong and Singh, 2005). These unstable conditions can amplify the effects of credit risk and raise the default rates on investments that insurance companies make which could lead to significant financial losses. Furthermore, there are usually fewer feasible investment options available in these markets which forces insurers to be in the dilemma of taking on greater risk or accept lower returns on investments. This dilemma may become a barrier to the expansion and the financial success of insurance firms.

An insurance company's stability and profitability can be severely impacted by credit risk in a number of ways. It reduces investment returns, increases claims when more borrowers default, and decreases premiums in an unstable economic climate (Cummins and Weiss, 2013). In addition, increased credit risk lowers the insurer's credit rating, requires higher reserves, and directs the insurer's attention away from growth prospects and towards credit risk management.

Credit risk in insurance firms has a profound broad effect on the overall economy. First, insurance companies have a significant financial market investment portfolio which be used in investing in a wide range of financial instruments such as government bonds, real estate, and stocks using the collected premiums (Haiss and Sümegi, 2008). Insurance companies may suffer substantial losses if these investments collapse due to elevated credit risk. By this way the total investment in financial market will be reduced which could have an impact on their stability and liquidity of the economy.

Moreover, insurance companies capacity to pay claims may be harmed if they incur large losses as a result of credit risk (Schich, 2010). This scenario is especially concerning in the event of major events or disasters as the inability of insurance companies to provide sufficient coverage for losses can have catastrophic effects for both individuals and businesses. Reduced insureds confidence and investing can result from such a circumstance which may hinder economic growth.

Credit risk can have a greater impact in developing countries where the insurance industry is still growing. For these countries to sustain economic growth the insurance industry stability and growth are crucial (Arena, 2008). A high credit risk may hinder the insurance market expansion and limit its ability to support economic development.

There are many cases from the past of insurance companies experiencing credit risk. During the 2008 financial crisis, AIG is the most well-known example Because of its deep involvement in mortgage-backed securities (MBS) and credit default swaps (CDS) which is a large amount of credit risk (Peirce, 2014).

In addition, during the 2008 financial crisis bond insurer Ambac Financial Group encountered significant difficulties. Millions of mortgage-backed securities and other high-risk debt instruments were insured by the company. The Financial Group encountered massive claims as the real estate market crashed and defaults increased which make a significant losses and credit rating downgrade (Moldogaziev, 2013). HIH Insurance company which is an Australian second biggest insurance company collapses in 2001 due to inadequate risk management and inadequate reserves for potential claims (Baranoff, 2014). One of Australia's largest corporate collapses is a reminder of the risks that insurance companies face including credit risk.

The Financial Regulatory Authority (FRA) in Egypt which ensure the stability and integrity of financial markets takes several measures to mitigate and manage credit risk. The Financial Regulatory Authority issued Decision No. 193 of 2022 regarding the controls on underwriting of credit insurance policies for property and liability insurance companies. It stated that property and liability insurance companies, wishing to contract with a credit granting entity to issue credit and guarantee insurance policies, must adhere to the following restrictions.

First, participation of the credit granting entity in the risk by imposing a mandatory retention rate on all credit and guarantee insurance policies of not less than 25% of the value of the loan if the insured risk occurs.

Second, the person responsible for underwriting and the person responsible for compensations in the insurance company must have sufficient technical expertise suitable for this type of insurance coverage.

Third, preparation of separate financial accounts for credit insurance and separate their own revenue and expense accounts within the company's financial statements from other insurance lines.

Fourth, ensuring the signing of reinsurance agreements with more than one reinsurance company approved by The Financial Regulatory Authority to prevent concentration of business with a single reinsurance company and ensuring that these companies have previous experience in working in the Egyptian market to ensure their ability to understand the risk and pay compensations.

Lastly, verification of the client's credit status before accepting the request to issue the policy, through licensed credit inquiry companies.

The Financial Regulatory Authority states that the Egyptian Insurance Federation must work to standardize the terms of credit insurance policies in all insurance companies after reviewing and approving them.

Additionally, the beneficiary's right to compensation is forfeited if the financing entity breaches the lending policy and credit studies or if any amendments are made to the terms of the credit study during the validity of the policy without obtaining written approval from the insurance company. Including a cancellation clause in the insurance policies issued to clients who have obtained credit.

The Federation is also obliged to include a special section for distressed clients on the insurance clients' electronic platform, containing all the basic data of distressed and non-paying clients to be available to all companies for inquiry before accepting the request to issue credit insurance policies. Insurance companies have started to exercise caution when underwriting credit risk policies attributing this to the current economic conditions the world is experiencing including inflation and economic recession due to various global crises.

That has impacted all economic aspects and reflected on the financial solvency of all companies and institutions leading to an increase in default rates.

This research paper main objective is to comprehensively analyze and identify the factors that affect credit risk in property and casualty Egyptian insurance companies. This investigation will cover a wide range of variables which will be divided into three main categories: macroeconomic variables, particular financial ratios of insurance companies, and characteristics inherent in the insurance industry in Egypt.

This research seeks to give professional and academic insights for better understanding of credit risk in the Egyptian insurance sector which could help insurance companies effectively mitigate their credit risk. In order to fully investigate the research question, our methodology will involve an in-depth analysis of all property and casualty insurance companies in Egypt. By this way, we hope to shed light on the complex relationships that exist between external economic factors, insurance Industry characteristics, and company specific strategies and how these factors interact to affect the credit risk environment. The scarcity of prior studies in this area emphasizes the significant contribution for this research.

2. Literature Review and Hypotheses:

The economic is greatly influenced by the financial stability and performance of insurance companies especially in emerging markets such as Egypt. This review of the literature carefully examines the various factors that influence credit risk in financial institutions. Macroeconomic variables, insurance-specific variables, and industry specific determinants are all covered, offering stakeholders in the Egyptian insurance market a comprehensive picture that is crucial. The review summarizes findings from different research studies. Each of them offers a distinctive viewpoint on a variety of aspects affecting credit risk in financial institutions using a variety of methodologies and analytical frameworks.

Louzis et al. (2012) analyze the Greek banking industry to offer a basic understanding how bank-specific factors and macroeconomic variables interact across various loan categories using dynamic panel data methods. They examine the intricate relationship between the state of the economy and loan quality.

Vouldis and Louzis (2018) further expand on the understanding of macroeconomic effects by identifying industrial production and market variables as important predictors of nonperforming loans in the Greek context. Their research uses a quasi-AIM methodology which gives credit risk forecasting a new perspective.

Radivojevic and Jovovic (2017) extend this analysis to many countries which focus on emerging countries. Using panel data from 25 countries their methodology highlights the importance of bank specific factors, GDP, and inflation rate in influencing non-performing loans.

A comprehensive examination of the Spanish banking sector by Salas and Saurina (2002) shows how institutional distinctions between savings and commercial banks influence credit risk. According to them the findings highlight the significance of macroeconomic variables as well as bank characteristics like growth rate, indebtedness, and inefficiency for evaluating credit risk. conducted an analysis of 181 banks between 1999 and 2004. They demonstrated that government- and mutually owned banks were less profitable than private banks and found that mutual banks displayed lower risk and better loan quality while public sector banks demonstrated worse loan quality. These results imply that various ownership types adopt different financial intermediation models influenced by the composition of their funding and assets.

Moving the focus to the MENA area, Jabbouri and Naili (2019) investigate the factors that influence credit risk in developing economies. Their analysis included 98 banks and points out how macroeconomic variables, bank size, capital adequacy and operational effectiveness influence nonperforming loans.

Messai and Jouini (2013) looked into the variables that affected non-performing loans in 85 banks located in Greece, Italy, and Spain between 2004 and 2008 especially in the wake of the subprime crisis in 2008. They examined bank specific variables such as return on assets, change in loans, and loan loss reserves to total loans ratio in addition to macroeconomic variables like GDP growth rate, unemployment rate, and real interest rate. By using panel data analysis, they found that non-performing loans had positive correlations with real interest rates, loan loss reserves to total loans, unemployment rates, and GDP growth, but negative correlations with bank asset profitability and GDP growth.

Maryem and Younes (2022) examined the major factors that contribute to non-performing loans (NPLs) in emerging markets from 53 banks in five Middle East and North African between 2000 and 2019 using a panel approach and dynamic data estimates through Generalized Methods of Moments (GMM). The GDP growth, unemployment, bank capitalization, performance, operating inefficiency, ownership concentration, inflation, sovereign debt, and bank size were among the key factors that the study found to be associated with non-performing loans (NPLs).

Schaeck et al. (2009) assess competition in the banking systems of 45 countries and determine how it affects systemic crises. They utilized the Panzar and Rosse H-statistic in their research. They examined the relationship between banking competition and the probability and timing of systemic crises and discovered that banking systems with higher levels of competition had longer periods without systemic crises and were less likely to encounter them. The results highlight how policies that encourage competition can improve systemic stability in banking.

Wani and Dar (2015) offer an analysis of the Indian insurance market with a particular emphasis on the connection between performance and financial risk. In assessing the financial performance of insurance companies, their research emphasizes the significance of capital management, solvency, and liquidity risk.

Burca and Batrinca (2014) investigate the insurance market in Romania and find that the growth of gross written premiums, company size, and financial leverage are important factors that influence financial performance. Their findings highlight the importance of both internal business factors and external market conditions in influencing performance.

Amal (2012) examines the insurance industry in Jordan which highlighting the importance of management skill, liquidity, and leverage on financial performance. This research establishes a critical connection between effective internal management techniques and company performance.

Omasete (2014) looks into how risk management procedures affect Kenyan insurance companies' financial performance. Using an exploratory research design and a combination of primary and secondary data the study finds that the implementation of risk management practices improves financial performance.

Adrian (2014) examines the relationship between financial risk and the financial performance of Kenyan insurance companies. It demonstrates how important financial risk management is to these companies' financial performance using multiple regression analysis.

Patrick (2015) evaluates how risk management techniques affect Kenyan life insurance companies' financial results. Using a survey approach, it discovers that these firms' financial performance is significantly impacted by their risk management practices.

Mirie (2015) pinpoints the variables influencing Kenyan general insurers' profitability. By using multiple linear regression the results show that ownership structure and size have a negative correlation with profitability while leverage, equity capital, and management competence have a positive correlation.

The characteristics of credit risk in insurance companies in the United States and Europe are examined in the study by Liliana and Lorenzo (2014). The study concludes that for insurers in both regions credit default swap (CDS) spreads are significantly determined and predicted by equity volatility. The analysis also shows that although cash holdings are more important for US insurers, and macroeconomic factors have a significant impact on credit risk for European insurers. Cash can lower credit risk in some situations but the relationship between cash holdings and credit risk is complicated. This analysis shows how equity and credit markets for major insurers quickly incorporate relevant information about creditworthiness.

The combined knowledge from these studies offers an in-depth comprehension of the factors that influence credit risk in the banking and insurance industries which highlighting the important roles played by industrial variables, macroeconomic factors, and company specific characteristics. This wide range of research that covers numerous nations and economic environments provides an adequate basis for analyzing the credit risk of Egyptian property insurance companies. The following are the main hypotheses that the researchers developed for this research:

Main Hypothesis (H0): Financial ratios of insurance companies, characteristics of the insurance industry, and macroeconomic variables, significantly have an impact on Insurance company credit risk.

The main areas of concentration for credit risk which represents research dependent variable are Uncollected premiums, Due from reinsurance, and Bonds (NBE, 2010). Hence, we use these variables as a percent of Gross premiums for Uncollected premiums and as a percent of Net assets for Due from reinsurance and Bonds.

Sub-hypotheses:

H0-1: Insurance company credit risk is not significantly impacted by return on equity (ROE).

A higher ROE indicates solid financial health which reduces credit risk perception because the insurer is considered to be able to generate enough returns.

H0-2: Insurance company credit risk is not significantly impacted by assets size.

Large insurance companies could benefit from straightforward access ability to capital markets when it comes to credit risk management due to the ability to raise effectively capital to cover possible losses.

H0-3: Insurance company credit risk is not significantly impacted by Premiums growth rate.

A higher Premiums growth rate indicates that a company has more premiums written and this might be a signal of higher credit risk because the company in this way relies more on premium income to cover its risks.

H0-4: Insurance company credit risk is not significantly impacted by loss ratio.

The efficiency of an insurance company's underwriting procedure is demonstrated by the loss ratio. A high loss ratio might be a sign of poor underwriting procedures or ineffective pricing strategies because it reflects that the company is paying large number of claims compared to the premiums it receives. This situation can lead to increased credit risk as it directly impacts the company's profitability.

H0-5: Insurance company credit risk is not significantly impacted by Return on Investment (ROI).

A higher ROI indicates the company is making a profit from its investments which means a lower credit risk.

H0-6: Insurance company credit risk is not significantly impacted by Insurance Capitalization.

A higher ratio indicates that the company is highly dependent on premium revenue which could lead to an increase in leverage. Leverage can be helpful in growing operations and profitability, but if there isn't a large enough equity base and an excessive reliance on premiums, there is an increased credit risk to the company.

H0-7: Insurance company credit risk is not significantly impacted by Ownership Concentration.

Positive growth rates in shareholder equity typically indicate higher profitability and potential asset base expansion for the company. This increase in financial stability can reduce credit risk by strengthening the business ability to meet its financial obligations such as claims and cover unpayment debts.

H0-8: Insurance company credit risk is not significantly impacted by GDP growth.

A growing GDP could be reflected in new businesses and industries which might present new underwriting opportunities for insurance companies that lead to risk diversification and potentially reduce credit risk.

H0-9: Insurance company credit risk is not significantly impacted by inflation rate.

Inflation leads to increased costs of goods and services which means higher claim payouts for insurance companies especially in lines like property insurance and that might potentially affect its profitability and solvency and increase the credit risk.

H0-10: Insurance company credit risk is not significantly impacted by public debt.

Higher public debt in an economy could leads to increase in government focus on financial stability in economy by tighten regulation on financial institutions because failure of these institutions could have profound consequences and that affect insurance companies' investment returns and underwriting profitability which are key components of their credit risk.

H0-11: Insurance company credit risk is not significantly impacted by unemployment rate.

High unemployment can lead to a decrease in demand for insurance services because people could not be able to afford premiums which leads to reduction in revenue for insurance companies and elevate their credit risk.

H0-12: Insurance company credit risk is not significantly impacted by company’s market share.

A larger market share usually means a broader insureds base and that allows for better risk diversification which mitigate the impact of large, unexpected claims and by this way credit risk can be reduced.

3. Research Methodology

3.1 Variables and research data

This study makes use of a sample of 17 property insurance providers in Egypt between 2012 and 2022. Because life insurance companies have different business models, the sample is specifically focused on property insurance and does not include life insurance companies. The macroeconomic data is taken from the official World Bank database and the other data is taken from the Egyptian Financial Supervision Authority's annual insurance statistical book. The final dataset covers the years 2012–2022, with 187 observations from the 17 insurance companies which is all the property insurance companies in Egypt. The following table presents the research variables used in this study:

Table 1: Dependent and independent variables

Dependent variables:		
Variable	**Definition**	**Equation**
UNCOLL	Uncollected premiums to Gross premiums	Uncollected premiums / Gross premiums
ReIN	Due from reinsurance to net assets	Due from reinsurance / Net Assets
BON	Bonds to net assets	Bonds / Net Assets
CR	Credit risk	UNCOLL + ReIN + BON
Independent variables:		
Variable	**Definition**	**Equation**
1- Company Specific Factors		
ROE	Return on equity (ROE)	Net return / Shareholder equity
IS	Insurance Size	Natural log of Assets size
PG	Premiums growth rate	Δ Gross premiums
LR	loss ratio	Paid out claims / Gross premiums
ROI	Return on Investment (ROI)	Total investments/Total Assets
IC	Insurance Capitalization	Total Premiums/Shareholder Equity
OC	Ownership Concentration	Δ Shareholder equity
2- Macroeconomic variables		
GDP	GDP growth rate	Δ GDP
Inf	Inflation rate	
PD	Public Debt	
UnEm	Unemployment rate	
3- Industrial variables		
MS	Company's Market Share	Company's gross premiums / gross premiums of all insurance companies

3.2 Descriptive Analysis:

Table 2 shows the descriptive statistics of the dependent variables for non-life insurance in the Egyptian insurance market from 2012 to 2022, the mean uncollected premium rate is 0.191 with a standard deviation of 0.094, the average reinsurance premium rate is 0.095 with a standard deviation of 0.127, the average rate of Treasury bills and bonds is 0.631 with a standard deviation of 0.619, and the mean credit risk ratio is 0.916 with a standard deviation of 0.655.

Table 2: Descriptive statistics for dependent and independent variables for non-life insurance in the Egyptian insurance market from 2012 to 2022:

	UnColl	ReIn	Bon	CR	ROE	IS	PG	LR	ROI	IC	OC	GDP	Inf	PD	UnEm	MS
Minimum	0.020	0.000	0.000	0.090	-0.060	18.010	-0.310	-0.200	0.390	0.230	-2621304	0.020	0.050	69.860	17.10	0.000
Maximum	0.500	1.300	3.400	3.590	0.440	24.530	0.920	0.840	0.910	4.490	9452520	0.070	0.230	97.80	34.380	0.580
Range	0.48	1.30	3.40	3.50	0.500	6.52	1.230	1.040	0.520	4.260	12073824	0.050	0.180	27.940	17.280	0.580
Mean	0.191	0.095	0.631	0.916	0.174	20.502	0.166	0.507	0.755	1.604	141064.47	0.041	0.128	85.120	27.42	0.056
St.Dev.	0.094	0.127	0.619	0.655	0.090	1.156	0.184	0.150	0.094	0.813	889276.73	0.014	0.055	7.110	7.120	0.113
Skewness	0.607	5.30	1.54	1.22	0.068	1.265	0.831	-1.615	-0.928	0.780	7.309	0.675	0.471	-0.369	-0.402	3.752
Kurtosis	0.279	4.709	3.328	1.853	-0.109	2.850	1.818	4.787	1.046	1.032	70.163	-0.233	-0.436	0.072	-1.665	12.926

Source: Statistical analysis of dependent and independent variables in non-life insurance calculated by the **Stata** program.

Furthermore, the distribution of incurred dependent variables exhibits positive skewness, and the two variables (uncollected premiums and credit risk) are found to be leptokurtic, while the two variables (reinsurance premiums, Treasury bills and bonds) are platykurtic.

The table also shows the descriptive statistics of the independent variables, where the average rate of return on equity is 0.174 with a standard deviation of 0.090, the average size of the insurance company is 20,502 with a standard deviation of 1,156, the average premium growth rate is 0.166 with a standard deviation of 0.184, the mean loss rate is 0.507 with a standard deviation of 0.150, and the mean rate of return on investment is 0.755 with a standard deviation of 0.094, The average capital adequacy ratio is 1,604 with a standard deviation of 0.813, and the average change in shareholders' equity is 141064.47 with a standard deviation of 889276.73.

The average GDP rate is 0.041 with a standard deviation of 0.014, the average inflation rate is 0.128 with a standard deviation of 0.055, the average public debt rate is 85,120 with a standard deviation of 7,110, the average unemployment rate is 27.42 with a standard deviation of 7,120, and the average market share rate is 0.056 with a standard deviation of 0.113.

In addition, the distribution of incurred independent variables exhibits negative skewness for the following independent variables: loss rate, rate of return on investment, public debt, and unemployment rate, while the rest of the variables are positively skewed.

The table also shows that the distribution is leptokurtic for each of the following independent variables: rate of return on equity, size of the insurance company, premium growth rate, rate of return on investment, capital adequacy rate, GDP rate, public debt, and unemployment rate, while the rest of the variables are platykurtic distributions.

Table 3: Pearson's Correlation Matrix between dependent and independent variables:

UnColl	1.00															
ReIn	-0.0615	1.00														
Bon	0.0144	0.1217	1.00													
CR	0.1451	0.3001	0.9726	1.00												
ROE	-0.1471	-0.0297	0.2415	0.2019	1.00											
IS	0.2476	0.0488	0.0948	0.1347	0.0261	1.00										
PG	0.0436	-0.0002	-0.0530	-0.0445	0.2066	-0.0007	1.00									
LR	-0.2332	0.1123	0.1282	0.1098	0.1111	0.1086	0.1784	1.00								
ROI	-0.5332	-0.0812	0.0022	-0.0902	0.0744	0.1070	-0.2164	0.0395	1.00							
IC	-0.0001	0.2875	0.3808	0.4167	0.3871	0.0590	0.1568	0.3107	-0.2373	1.00						
OC	0.0186	-0.0456	-0.0845	-0.0859	-0.0355	0.3894	0.0537	-0.0485	0.1599	-0.1595	1.00					
GDP	0.1616	-0.1153	0.0302	0.0294	0.1076	0.2980	0.1326	-0.1531	-0.0391	-0.0049	0.0185	1.00				
Inf	-0.0198	0.0972	0.0177	0.0337	0.0929	-0.0451	0.2885	-0.0232	0.0010	-0.0092	0.1028	0.2424	1.00			
PD	0.2211	-0.0275	0.0783	0.1007	0.2788	0.2469	0.2894	-0.2020	-0.1163	-0.0600	0.1658	0.2637	0.4489	1.00		
UnEm	-0.2349	0.1807	-0.0184	-0.0149	-0.1332	-0.3850	0.0535	0.1855	0.0756	0.0222	0.0001	-0.5662	0.4615	-0.2242	1.00	
MS	0.0103	-0.0016	-0.0913	-0.0853	-0.0045	0.7843	-0.0528	0.1663	0.2538	-0.1511	0.4392	-0.0091	0.0091	-0.0076	0.0188	1.00

Source: Person Correlation Matrix between dependent and independent variables in non-life insurance calculated by the **Stata** program.

Table 3 shows Pearson's correlation coefficients matrix between dependent and independent variables, where most correlation coefficients are weak, whether negative or positive.

The stacked bar chart in **Figure 1** below, titled "Stacked Bar Mean of UNCOLL, Mean of RelN, Mean of BON", show the average values of three dependent variables for all property insurance companies in our research. The mean values, which range from 0.25 to 2, are displayed on the y-axis. The chart shows a comparison between these companies based on the mean values of the three variables, with some companies like "Egyptian Takaful", "Royal Insurance" and "Suez canal" having notably higher mean values.

The UNCOLL variable represented by the blue portions indicates that this metric is a minor to moderate portion of the total mean value for the majority of companies and none of the companies have this metric as their dominant category. The BON variable is the dominant category for many companies suggesting that due from reinsurance to net assets ratio constitutes a significant proportion of their Credit Risk. Generally speaking, the red segments—which represent the ReIN variable—make up the smallest portion, but for a few companies, they make up an important portion.

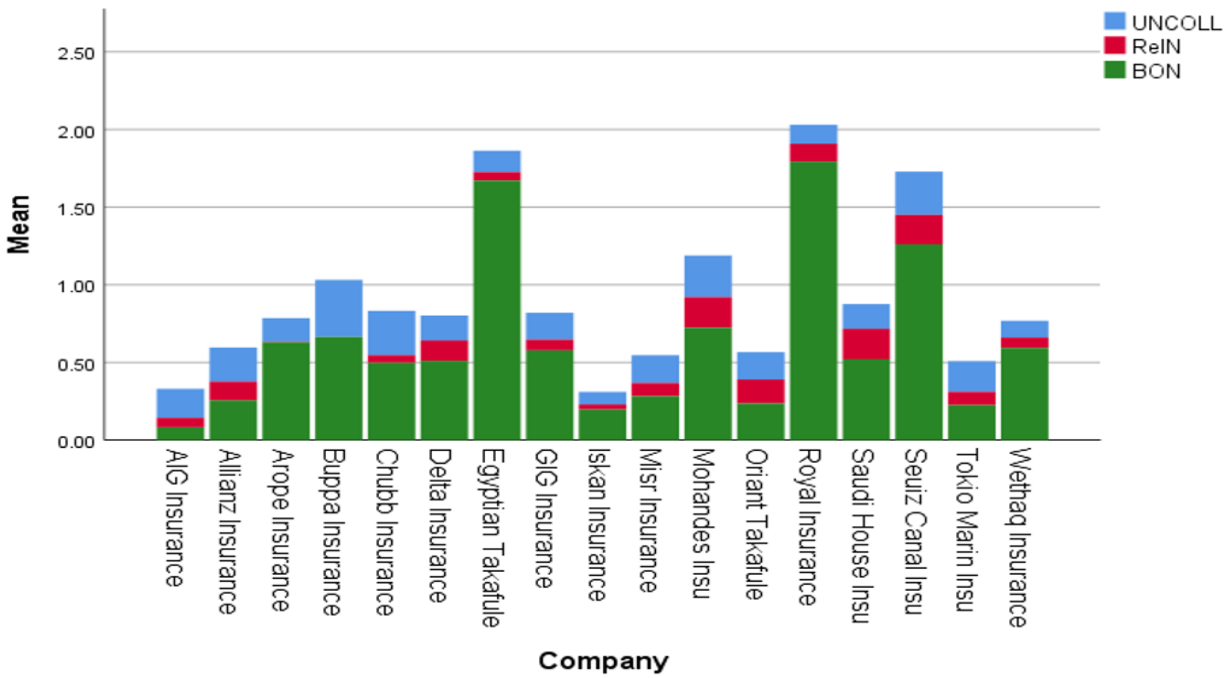

Figure 1: Stacked Bar Mean of UNCOLL, Mean of RelN, Mean of BON.

Figure 2 illustrates the components of UNCOLL, ReIN, and BON in credit risk as a percentage. It is an important chart illustrating the development of credit risk for property and casualty Egyptian insurance companies from 2012 to 2022. UNCOLL represents uncollected data premiums as a percentage, staying almost stable at around 23% till 2016. Then, it increased sharply in 2020; this increase may be due to the COVID-19 period in Egypt affecting the ability to collect premiums. Afterward, it returned to the normal level in 2022.

ReIN represents the due reinsurance, decreasing gradually in a continuous manner to a minimum value of 50% in 2021. Lastly, BON begins at approximately 23% and then increases until 2016, decreasing to around 40% in 2020, possibly due to the significant increase in bond returns resulting from high levels of interest rates recently. This was followed by a sharp increase to approximately 70% in 2022. We can conclude that the main component of credit risk over the entire research period is bonds.

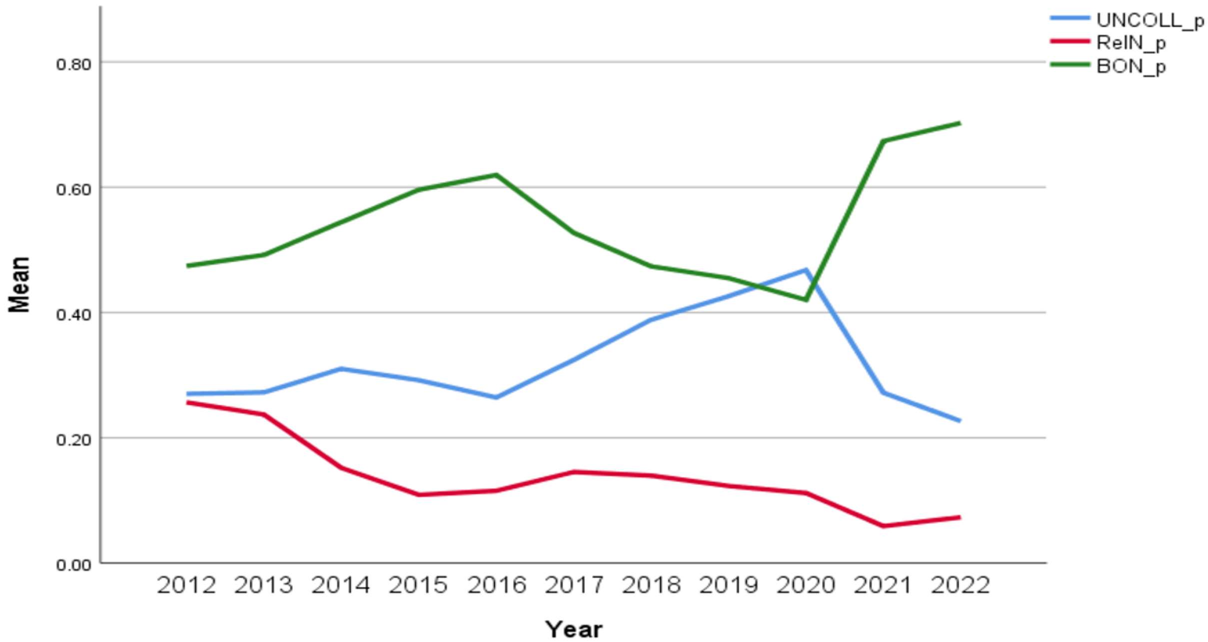

Figure 2: Simple Line Mean of UNCOLL, Mean of ReIN, Mean of BON as a percent of credit risk.

3.3 Empirical Results

To accomplish the objectives of the study, both pooled and panel data analysis approaches are employed, with panel data analysis utilizes fixed effects and random effects methodologies.

The fixed effect model is capable of addressing unobserved heterogeneity, which reflects individual-specific effects that are not captured by observed variables. The term "fixed effects" refers to the assumption that, while the intercept may differ between persons (firms), each individual's intercept remains constant over time; that is, it is time invariant.

In random effects models, unobserved effects are captured by the error term (ε_{it}) consisting of an individual specific one (u_i) and an overall component (v_{it}) that is the combined time series and cross-section error. The Random Effects Model is estimated using the Generalized Least Squares (GLS) approach. As the GLS approach considers the distinct correlation structure of the error component in the random effects model (Gujarati, 2004).

In a pooled model, all observations are combined, and the regression coefficients indicate the overall influence, rather than specific temporal or individual features. It presumes that the error term captures the variations between the firms (cross-sectional units) across time.

To determine the most suitable model our analysis, the Hausman test is employed. This test examines differences in parameter estimates between fixed and random models, as well as any relationship between unit effects and independent variables (Hausman, 1978). In our case, the Hausman test indicates that the random effect is most appropriate for this study, because the difference in coefficients is systematic and the error terms are correlated with the regressors.

In this study, a panel data analysis is be performed. We are investigating the impact of insurance-specific, macroeconomic, and industry-specific variables on the level of UnColl (Eq.1.1, 2, 3), ReIn (Eq.2.1, 2, 3), Bon (Eq.3.1, 2, 3), and CR (Eq.4.1, 2, 3).

The regression examining the impact of insurance-specific, macroeconomic, and industry-specific variables on the level of independent variables takes the following form:

$$UnColl_{Model\ 1} = \beta_\circ + \sum_{k=1}^{7} \beta_k Insu. + \varepsilon_i \quad \text{(Eq.1.1)}$$

$$UnColl_{Model\ 2} = \beta_\circ + \sum_{k=1}^{7} \beta_k Insu. + \beta_8 Indus. + \varepsilon_i \quad \text{(Eq.1.2)}$$

$$UnColl_{Model\ 3} = \beta_\circ + \sum_{k=1}^{7} \beta_k Insu. + \beta_8 Indus. + \sum_{k=9}^{12} \beta_k Macro + \varepsilon_i \quad \text{(Eq.1.3)}$$

$$ReIn_{Model\ 1} = \beta_\circ + \sum_{k=1}^{7} \beta_k Insu. + \varepsilon_i \quad \text{(Eq.2.1)}$$

$$ReIn_{Model\ 2} = \beta_\circ + \sum_{k=1}^{7} \beta_k Insu. + \beta_8 Indus. + \varepsilon_i \quad \text{(Eq.2.2)}$$

$$ReIn_{Model\ 3} = \beta_\circ + \sum_{k=1}^{7} \beta_k Insu. + \beta_8 Indus. + \sum_{k=9}^{12} \beta_k Macro + \varepsilon_i \quad \text{(Eq.2.3)}$$

$$Bon_{Model\ 1} = \beta_\circ + \sum_{k=1}^{7} \beta_k Insu. + \varepsilon_i \quad \text{(Eq.3.1)}$$

$$Bon_{Model\ 2} = \beta_\circ + \sum_{k=1}^{7} \beta_k Insu. + \beta_8 Indus. + \varepsilon_i \quad \text{(Eq.3.2)}$$

$Bon_{Model\ 3} = \beta_{\circ} + \sum_{k=1}^{7} \beta_k Insu. + \beta_8 Indus. + \sum_{k=9}^{12} \beta_k Macro + \varepsilon_i$ (Eq.3.3)

$CR_{Model\ 1} = \beta_{\circ} + \sum_{k=1}^{7} \beta_k Insu. + \varepsilon_i$ (Eq.4.1)

$CR_{Model\ 2} = \beta_{\circ} + \sum_{k=1}^{7} \beta_k Insu. + \beta_8 Indus. + \varepsilon_i$ (Eq.4.2)

$CR_{Model\ 3} = \beta_{\circ} + \sum_{k=1}^{7} \beta_k Insu. + \beta_8 Indus. + \sum_{k=9}^{12} \beta_k Macro + \varepsilon_i$ (Eq.4.3)

Tables 4, 5, 6, and 7 display the outcomes of the random effects and fixed effects regressions with UnColl, ReIn, Bon, and Credit Risk as dependent variables. In addition, we provide the p-value of the Hausman statistics for the random effect models as a specification test, and the p-value of the F-test for Pool Regression model.

In table 4 the variables PG, PD, and UnEm in Model 3 have positive coefficients in at least one of the three regression methods, suggesting a possible forward relationship with uncollected premiums. Conversely, all three regression methods have negative coefficients for ROI and IC. Model 1 explanation of the variance in uncollected premiums is indicated by the Adjusted R^2 value of 0.4447, and the overall statistical significance is suggested by the F-Stat for of 22.28. Market Share (MS) and Ownership Concentration (OC) are two more variables that are included in Model 2. Remarkably, MS exhibits a negative coefficient in both pooling and random effect models, suggesting that a greater market share is linked to reduced uncollected premiums; however, this outcome is not consistence amongst the three models (fixed, random, and pooling) with high standard errors. In this model, the Adjusted R^2 rises to 0.4739 suggesting a marginally improved fit. In order to evaluate the Random Effects model's validity in comparison to the Fixed Effects model, the Hausman test is used. The Random Effects model (p-values of 0.00) is not preferred in Models 1 and 2 and contrary preferred in model 3 according to the Hausman test.

In All model 3, ROE (Return on Equity) coefficients are negative indicating that there may be an inverse relationship between ROE and reinsurance. Insurance Size (IS) coefficients are positive suggesting that larger insurance companies might have higher reinsurance levels. The Premiums Growth Rate (PG) has negative coefficients indicating that reinsurance tends to decline as premiums rise. Positive coefficients for Market Share (MS) are observed in the three methods indicating a negative correlation between increased market share and decreased reinsurance levels. The models only partially explain the variance in Reinsurance, according to the Adjusted R-squared value of 0.1180. In table 6 the Adjusted R squared value of 0.1761 suggests that the models explain a small proportion of the variance in Bonds.

The regression results presented in Table 7 indicate a statistically significant positive effect, with a confidence level of at least 90% of IS, IC, PD, and UnEm on predicting credit risk in the insurance industry. On the other hand, the credit risk is negatively impacted by ROE and PG with a confidence level of at least 90%. These results are strengthened by the consistent patterns found in the three models. That means that we reject hypotheses number 1, 2, 3,6,10, and 11 and accept the rest of the research hypotheses.

Table 4: Pool Regression, Fixed Effects Model, and Random Effects Model for the first dependent variable uncollected premiums (UnColl):

Model 1			
Variables	Pool Regression	Fixed Effects	Random Effects
$\beta_{\circ}$	0.062486 (0.1090189)	-0.5669194* (0.1596805)	-0.3008351** (0.1386764)
ROE	-0.156719** (0.0655999)	0.028905 (0.0602054)	-0.0107854 (0.0610236)
IS	0.0316922* (0.0050082)	0.0484646* (0.006789)	0.0399008* (0.006111)
PG	0.0031125 (0.0300229)	0.0367182 (0.0238444)	0.0298728 (0.0246908)
LR	-0.143594* (0.0369934)	0.0617954 (0.0382471)	-0.0003926 (0.0377386)
ROI	-0.5484025* (0.059909)	-0.3035933* (0.0639173)	-0.3860019* (0.0627109)
IC	-0.0041183 (0.0075674)	-0.0305371* (0.0114645)	-0.0232945** (0.0099748)
OC	$-7.12E^{-9}$ ($6.49E^{-9}$)	$9.05E^{-10}$ ($4.86E^{-9}$)	$-1.66E^{-9}$ ($5.10E^{-9}$)
Adjusted R^2	0.4447		
F-Stat	22.28 (0.0000)		
Hausman	49.72 (0.0000)		
Model 2			
Variables	Pooling Regression	Fixed Effect	Random Effect
$\beta_{\circ}$	-0.3582566** (0.1656786)	-0.5711343* (0.1574292)	-0.4520341* (0.1503344)
ROE	-0.1980953* (0.0650671)	0.0232841 (0.0610071)	-0.0098345 (0.0601136)
IS	0.0515077* (0.0077254)	0.0484268* (0.0068022)	0.0467267* (0.0066915)
PG	0.0015308 (0.0292271)	0.0357099 (0.0239459)	0.030697 (0.024263)
LR	-0.11384* (0.0371155)	0.0573372 (0.038998)	0.0221651 (0.0380681)
ROI	-0.5081971* (0.0595675)	-0.3009358* (0.0641846)	-0.3667128* (0.062205)
IC	-0.0096028 (0.0075503)	-0.0316437* (0.0116261)	-0.0242518** (0.0099471)
OC	$-3.37E^{-9}$ ($6.42E^{-9}$)	$1.18E^{-9}$ ($4.89E^{-9}$)	$-7.79E^{-10}$ ($5.01E^{-9}$)
MS	-0.2726333* (0.0824579)	0.1447754 (0.2351019)	-0.2430043** (0.1088342)
Adjusted R^2	0.4739		
F-Stat	21.94 (0.0000)		
Hausman	33.31 (0.0000)		
Model 3			
Variables	Pooling Regression	Fixed Effect	Random Effect

$\beta_\circ$	-0.6578112** (0.252376)	-0.6640268** (0.2734253)	-0.6030834** (0.2495563)
ROE	-0.2065179* (0.0672155)	0.0145919 (0.0645807)	-0.0179919 (0.0635735)
IS	0.0638457* (0.0112574)	0.0499038* (0.0130638)	0.0516314* (0.0118983)
PG	0.0015857 (0.0312391)	0.0362257 (0.0258745)	0.0296379 (0.026093)
LR	-0.1222185* (0.0383729)	0.0556626 (0.0420303)	0.016223 (0.0403579)
ROI	-0.5038883* (0.0601777)	-0.291641* (0.0666819)	-0.3631686* (0.0643507)
IC	-0.0121558 (0.00803)	-0.0301188** (0.0120174)	-0.0230236** (0.0101934)
OC	$-4.91E^{-9}$ ($6.51E^{-9}$)	$7.77E^{-10}$ ($5.00E^{-9}$)	$-1.50E^{-9}$ ($5.13E^{-9}$)
MS	-0.3704066* (0.1058106)	0.1456751 (0.2440757)	-0.2768562** (0.1299624)
GDP	-0.2700283 (0.6993895)	-0.0459317 (0.5308386)	-0.0940756 (0.5487398)
Inf	-0.0360247 (0.2065973)	-0.09413 (0.155876)	-0.0760563 (0.1614708)
PD	0.0003647 (0.0011719)	0.0006413 (0.000937)	0.0005214 (0.0009574)
UnEm	0.0015851 (0.0018216)	0.0005386 (0.0014919)	0.0007898 (0.0015008)
Adjusted R^2	0.4725		
F-Stat	14.89 (0.0000)		
Hausman	11.45 (0.4066)		

Source: Pool Regression, Fixed Effects Model, and Random Effects Model for the first dependent variable uncollected premiums calculated by the **Stata** program. Note: The standard errors are enclosed in parentheses alongside the coefficients. If a coefficient is statistically significant, it is denoted by (*) at a 99% level of confidence, (**) at a 95% level of confidence, and (***) at a 90% level of confidence.

Table 5: Pool Regression, Fixed Effects Model, and Random Effects Model for the second dependent variable Reinsurance (ReIn):

Model 1			
Variables	Pool Regression	Fixed Effects	Random Effects
$\beta_\circ$	-0.1214802 (0.1908515)	0.1938837 (0.3430675)	0.0188422 (0.252383)
ROE	-0.2513201** (0.114841)	-0.3840078* (0.1315737)	-0.3336826* (0.121491)
IS	0.0078703 (0.0087675)	0.0057978 (0.0148368)	0.0084187 (0.0112802)
PG	-0.012791 (0.052559)	-0.0316123 (0.0521098)	-0.0232672 (0.050193)
LR	0.0156923 (0.0647617)	-0.012915 (0.0835857)	0.0129325 (0.0736184)
ROI	0.0078474 (0.1048783)	-0.3293697** (0.1396858)	-0.1822986 (0.1218313)
IC	0.0543167* (0.0132477)	0.068268* (0.0250547)	0.0601301* (0.018059)
OC	$-3.36E^{-9}$ $(1.14E^{-8})$	$-3.05E^{-9}$ $(1.06E^{-8})$	$-2.43E^{-9}$ $(1.05E^{-8})$
Adjusted R^2	0.0765		
F-Stat	3.20 (0.0032)		
Hausman	6.19 (0.40119)		
Model 2			
Variables	Pooling Regression	Fixed Effect	Random Effect
$\beta_\circ$	-0.129206 (0.2988142)	0.19631 (0.3444225)	0.0612269 (0.3026561)
ROE	-0.25208** (0.1173536)	-0.3807722* (0.1334739)	-0.3279974* (0.1220189)
IS	0.0082342 (0.0139334)	0.0058196 (0.0148819)	0.00061708 (0.0137308)
PG	-0.01282 (0.0527133)	-0.0310319 (0.0523888)	-0.0226995 (0.0503752)
LR	0.0162387 (0.0669406)	-0.0103487 (0.0853196)	0.0087491 (0.0754716)
ROI	0.0085857 (0.1074346)	-0.3308995** (0.1404227)	-0.1801416 (0.1228021)
IC	0.054216* (0.0136175)	0.068905* (0.0254356)	0.0602893* (0.017955)
OC	$-3.29E^{-9}$ $(1.16E^{-8})$	$-3.21E^{-9}$ $(1.07E^{-8})$	$-2.76E^{-9}$ $(1.06E^{-8})$
MS	-0.0050068 (0.1487193)	-0.0833387 (0.5143545)	0.0517411 (0.1804293)
Adjusted R^2	0.0713		
F-Stat	2.79 (0.0063)		
Hausman	7.17 (0.4118)		
Model 3			
Variables	Pooling Regression	Fixed Effect	Random Effect
$\beta_\circ$	-1.028333** (0.4430149)	-1.903098* (0.5501167)	-1.264774* (0.4670298)
ROE	-0.2727498** (0.1179885)	-0.3677266* (0.1299328)	-0.3442636* (0.122322)

IS	0.0513845** (0.019761)	0.114084* (0.0262837)	0.0745611* (0.0220793)
PG	-0.0211335 (0.0548364)	-0.0916051*** (0.0520581)	-0.0529473 (0.051157)
LR	-0.0107559 (0.0673588)	-0.1429693*** (0.0845627)	-0.0617381 (0.0759605)
ROI	0.0115885 (0.1056346)	-0.4179759* (0.1341603)	-0.2393941** (0.1210033)
IC	0.0444547* (0.0140957)	0.0919506* (0.0241784)	0.0584187* (0.0180511)
OC	$-8.43E^{-9}$ $(1.14E^{-8})$	$-1.02E^{-8}$ $(1.01E^{-8})$	$-9.35E^{-9}$ $(1.02E^{-8})$
MS	-0.3479917*** (0.1857375)	-0.6391977 (0.4910668)	-0.4498922** (0.2224592)
GDP	-1.134291 (1.227692)	-1.582103 (1.068018)	-1.306949 (1.090305)
Inf	0.2078961 (0.3626561)	0.2576678 (0.3136139)	0.2421485 (0.03116671)
PD	-0.0002697 (0.0020571)	-0.0019271 (0.0018852)	-0.0009364 (0.0018864)
UnEm	0.003981 (0.0031976)	0.0071** (0.0030016)	0.0053372*** (0.0029417)
Adjusted R^2	0.1180		
F-Stat	3.07 (0.0006)		
Hausman	17.03 (0.1069)		

Source: Pool Regression, Fixed Effects Model, and Random Effects Model for the second dependent variable reinsurance calculated by the **Stata** program. Note: The standard errors are enclosed in parentheses alongside the coefficients. If a coefficient is statistically significant, it is denoted by (*) at a 99% level of confidence, (**) at a 95% level of confidence, and (***) at a 90% level of confidence.

Table 6: Pool Regression, Fixed Effects Model, and Random Effects Model for the third dependent variable Bonds (Bon):

Model 1			
Variables	Pool Regression	Fixed Effects	Random Effects
$\beta_{\circ}$	-0.8535976 (0.8937533)	-3.925042* (1.85367)	-3.358889* (1.091104)
ROE	0.7480823 (0.5377977)	-0.9919621** (0.4546136)	-0.8140581*** (0.4450369)
IS	0.0340795 (0.0410581)	0.2104139* (0.051264)	0.1802773* (0.0473927)
PG	-0.40276 (0.2461325)	-0.4189821** (0.1800498)	-0.4159918** (0.177805)
LR	0.0681094 (0.3032778)	0.2726211 (0.2888054)	0.2329259 (0.2792718)
ROI	0.3461174 (0.4911429)	0.0718079 (0.4826424)	0.0755917 (0.4654303)
IC	0.2692389* (0.0620387)	0.1823494** (0.0865691)	0.206186* (0.0786768)
OC	-3.51E^{-8} 5.32E^{-8})	-7.15E^{-9} (3.67E^{-8})	-1.18E^{-8} (3.65E^{-8})
Adjusted R^2	0.1475		
F-Stat	5.60 (0.0000)		
Hausman	5.89 (0.4358)		
Model 2			
Variables	Pooling Regression	Fixed Effect	Random Effect
$\beta_{\circ}$	-3.436313** (1.376454)	-4.016682* (1.178568)	-3.519486* (1.130262)
ROE	0.494061 (0.5405764)	-1.11417** (0.4567197)	-0.8253008*** (0.4452545)
IS	0.1557329** (0.0641826)	0.2095921* (0.0509239)	0.1885229* (0.04946)
PG	-0.4124705*** (0.2428179)	-0.4409042** (0.1792674)	-0.4147739** (0.1776499)
LR	0.2507785 (0.3083546)	0.175693 (0.2919522)	0.2582515 (0.2846397)
ROI	0.5929509 (0.4948854)	0.1295873 (0.4805078)	0.0821587 (0.4664287)
IC	0.2355675* (0.0627277)	0.1582907*** (0.0870371)	0.2055054** (0.0793021)
OC	-1.21E^{-8} (5.33E^{-8})	-1.17E^{-9} (3.66E^{-8})	-1.12E^{-8} (3.64E^{-8})
MS	-1.673779** (0.6850586)	3.147649*** (1.760052)	-0.418741 (1.025463)
Adjusted R^2	0.1705		
F-Stat	5.78 (0.0000)		
Hausman	10.15 (0.1800)		
Model 3			
Variables	Pooling Regression	Fixed Effect	Random Effect
$\beta_{\circ}$	-6.615752* (2.08699)	-9.259829* (1.944012)	-8.146405* (0.1835334)

ROE	0.3583557 (0.5558295)	-1.354049* (0.4591568)	-1.08635** (0.4507492)
IS	0.2313091** (0.0930915)	0.3753811* (0.0928819)	0.324298* (0.0876936)
PG	-0.5039562*** (0.2583276)	-0.6730431* (0.1839639)	-0.6268716* (0.1827641)
LR	0.2442116 (0.3173192)	0.014217 (0.2988291)	0.1409434 (0.2907509)
ROI	0.641 (0.4976319)	0.154059 (0.4940979)	0.1116915 (0.4630488)
IC	0.2261067* (0.0664031)	0.2348602* (0.0854422)	0.2607792* (0.0782966)
OC	$-2.75E^{-8}$ ($5.39E^{-8}$)	$-2.30E^{-8}$ ($3.56E^{-8}$)	$-3.28E^{-8}$ ($3.56E^{-8}$)
MS	-2.269597** (0.8749871)	2.355651 (1.735341)	-1.179271 (1.124711)
GDP	3.454098 (5.783509)	2.221346 (3.774181)	2.520366 (3.796155)
Inf	-1.395276 (1.708429)	-1.23416 (1.108254)	-1.20626** (1.115862)
PD	0.0124493 (0.0096909)	0.0139236** (0.006662)	0.0144274** (0.0066673)
UnEm	0.0242258 (0.0150637)	0.0289681* (0.010607)	0.0270334 (0.0105262)
Adjusted R^2	0.1761		
F-Stat	4.31 (0.0000)		
Hausman	5.31 (0.9154)		

Source: Pool Regression, Fixed Effects Model, and Random Effects Model for the third dependent variable bonds calculated by the **Stata** program. Note: The standard errors are enclosed in parentheses alongside the coefficients. If a coefficient is statistically significant, it is denoted by (*) at a 99% level of confidence, (**) at a 95% level of confidence, and (***) at a 90% level of confidence.

Table 7: Pool Regression, Fixed Effects Model, and Random Effects Model for the fourth dependent variable Credit Risk (CR):

Model 1			
Variables	Pool Regression	Fixed Effects	Random Effects
$\beta_\circ$	-0.9098636 (0.9301322)	-4.303109* (1.262143)	-3.59768* (1.153662)
ROE	0.341464 (0.559688)	-1.344445* (0.4840589)	-1.155789** (0.4737244)
IS	0.0735479*** (0.0427293)	0.2645329* (0.0545844)	0.2279929* (0.0501848)
PG	-0.4149796 (0.256151)	-0.4162828** (0.1917116)	-0.4136369** (0.1894442)
LR	-0.0597216 (0.3156223)	0.3231806 (0.3075113)	0.2570704 (0.296923)
ROI	-0.1967692 (0.5111342)	-0.5542043 (0.5139032)	-0.5510503 (0.4947262)
IC	0.3197822* (0.0645639)	0.2209003** (0.0921762)	0.2473987* (0.0831879)
OC	$-4.51E^{-8}$ ($5.54E^{-8}$)	$-8.76E^{-9}$ ($3.91E^{-8}$)	$-1.50E^{-8}$ ($3.89E^{-8}$)
Adjusted R^2	0.1727		
F-Stat	6.55 (0.0000)		
Hausman	6.77 (0.3422)		
Model 2			
Variables	Pooling Regression	Fixed Effect	Random Effect
$\beta_\circ$	-3.922231* (1.426317)	-4.39683* (1.255863)	-3.851464* (1.200041)
ROE	0.0451844 (0.5601591)	-1.469429* (0.486673)	-1.167366** (0.4735145)
IS	0.2154392* (0.0665077)	0.2636924* (0.0542632)	0.2407983* (0.0525999)
PG	-0.4263055*** (0.2516142)	-0.4387029** (0.1910244)	-0.4116722** (0.1890898)
LR	0.1533356 (0.3195249)	0.2240508 (0.3110995)	0.2987701 (0.3025462)
ROI	0.0911267 (0.5128129)	-0.4951125 (0.5120212)	-0.5387797 (0.4956555)
IC	0.2805093* (0.065)	0.1962951** (0.0927453)	0.2468507* (0.0838731)
OC	$-1.83E^{-8}$ ($5.52E^{-8}$)	$-2.65E^{-9}$ ($3.90E^{-8}$)	$-1.39E^{-8}$ ($3.88E^{-8}$)
MS	-1.952224* (0.7098752)	3.219149*** (1.875483)	-0.6547349 (1.064769)
Adjusted R^2	0.2020		
F-Stat	6.89 (0.0000)		
Hausman	9.61 (0.2118)		
Model 3			

Variables	Pooling Regression	Fixed Effect	Random Effect
$\beta_\circ$	-8.337609* (2.137102)	-11.87988* (2.005593)	-10.44655* (1.897565)
ROE	-0.1198163 (0.5691759)	-1.705752* (0.4737034)	-1.439625* (0.4663789)
IS	0.3474963* (0.0953268)	0.5405954* (0.0958242)	0.4744129* (0.0906699)
PG	-0.5272968** (0.2645304)	-0.7333603* (0.1897914)	-0.6751127* (0.1891366)
LR	0.1111908 (0.3249386)	-0.0729202 (0.3082952)	0.0677698 (0.300762)
ROI	0.1461517 (0.5095809)	-0.5492892 (0.4891159)	-0.585208 (0.4790115)
IC	0.2584966* (0.0679975)	0.297975* (0.0881488)	0.3158102* (0.0808993)
OC	$-4.05E^{-8}$ ($5.51E^{-8}$)	$-3.20E^{-8}$ ($3.67E^{-8}$)	$-4.32E^{-8}$ ($3.68E^{-8}$)
MS	-2.996858* (0.895997)	1.864656 (1.790311)	-1.981989*** (1.158095)
GDP	2.137156 (5.922381)	0.6814233 (3.893936)	1.062555 (3.929382)
Inf	-1.239127 (1.749451)	-1.08764 (1.14336)	-1.051927 (1.155046)
PD	0.0126322 (0.0099236)	0.0127521*** (0.006873)	0.013536*** (0.0069005)
UnEm	0.030131*** (0.0154254)	0.0375704* (0.010943)	0.0348492* (0.01008929)
Adjusted R^2	0.2259		
F-Stat	5.52 (0.0000)		
Hausman	11.65 (0.3908)		

Source: Pool Regression, Fixed Effects Model, and Random Effects Model for the fourth dependent variable credit risk calculated by the **Stata** program. Note: The standard errors are enclosed in parentheses alongside the coefficients. If a coefficient is statistically significant, it is denoted by (*) at a 99% level of confidence, (**) at a 95% level of confidence, and (***) at a 90% level of confidence.

To address endogeneity and account for the time persistence in the credit risk structure, a robustness assessment is conducted using the Generalized Method of Moments (GMM). This approach allows for the instruments, which can considerably improve the model's efficiency (Roodman, 2009). Furthermore, in our dynamic model, we make sure to compensate for unobserved heterogeneity, simultaneity, and dynamic endogeneity.

Tables 8, 9, 10, and 11 show the estimated coefficients of the system and difference GMMs, the Sargan test, and the autocorrelation tests, AR (1) and AR (2). The Sargan over-identification test shows that all instruments are valid. The AR (1) test rejects the null hypothesis of no first-order serial correlation while not rejecting the null hypothesis of no second-order serial correlation. As a result, all the test conditions are met as indicated by the p-values, confirming the consistency of our dynamic model. Our dynamic model analysis shows that UnColl, ReIn, Bon, and CR persist over time. The findings from variants estimation strategies are relatively similar, and the coefficient estimates are consistent throughout.

Table 8: *Regression analysis using GMM estimation techniques for the first dependent variable uncollected premiums (UnColl):*

Variables	One-Step System GMM	Two-Step System GMM	One-Step difference GMM	Two-Step difference GMM
LagUNCOLL	0.3754373 (0.1841859)	-0.1485503* (1.011176)	-0.073204* (0.1976297)	-0.5600798* (0.3634201)
$\beta_\circ$	0.5204186 (0.5333603)	-0.6819389* (2.210576)	-	-
ROE	-0.1448492* (0.2246497)	-0.2941084* (1.282034)	0.1686562 (0.2349456)	0.8989615 (4.044971)
IS	0.028226** (0.031877)	0.0550041*** (0.0705771)	0.0191822** (0.0250211)	0.0626294*** (0.0858484)
PG	0.0923013*** (0.0792807)	0.2168633 (0.0855093)	0.148959 (0.0556251)	0.1598862 (0.6668038)
LR	-0.0744544* (0.1049168)	-0.3316612* (0.1824739)	0.1206514 (0.1250782)	0.4237542 (2.274747)
ROI	-0.6698904* (0.2279651)	-0.4875063* (0.6391992)	-0.468033* (0.288786)	-0.2648162* (0.6348874)
IC	-0.0530233* (0.0324537)	-0.1175224* (0.1561761)	-0.0709252* (0.0667959)	-0.1711231* (0.186079)
OC	$1.78E^{-8}$* ($2.56E^{-8}$)	$-2.20E^{-8}$* ($8.23E^{-8}$)	$2.17E^{-8}$* ($2.69E^{-8}$)	$-3.40E^{-8}$* ($1.31E^{-7}$)
MS	-0.1469835* (0.270267)	10.8784 (9.603155)	-1.434065* (2.95661)	4.747705 (6.142798)
GDP	-1.372545* (0.8761649)	-0.7657795* (1.008214)	-0.7367709* (0.8675319)	1.022857 (3.501772)
Inf	0.3214447 (0.1916328)	-0.2665497* (0.4833134)	0.1083681 (0.2147461)	-0.5516757* (0.4330078)
PD	-0.0031223* (0.0022248)	0.0005873* (0.0092089)	-0.0020034* (0.0025615)	0.0025699* (-)
UnEm	-0.0018146* (0.0019738)	-0.002946* (0.0050012)	-0.001942* (0.0025233)	-0.0000551* (0.0030317)
No. of Obs.	170	170	153	153
No. of Comp.	17	17	17	17
Time Effect	YES	YES	YES	YES
Sargan test P-value	46.39 (0.037)	46.39 (0.037)	30.68 (0.131)	30.68 (0.131)
Hansen test P-value	5.36 (1.000)	5.36 (1.000)	6.91 (1.000)	6.91 (1.000)
AR (1), P-value	Z= -2.68 (0.007)	Z= 0.61 (0.543)	Z= -1.28 (0.199)	Z= -0.04 (0.972)
AR (2), P-value	Z= -1.17 (0.243)	Z= 0.33 (0.741)	Z= -1.54 (0.123)	Z= -0.72 (0.472)

Source: Regression analysis using GMM estimation techniques calculated by the **Stata** program. Note: The standard errors are enclosed in parentheses alongside the coefficients. If a coefficient is statistically significant, it is denoted by (*) at a 99% level of confidence, (**) at a 95% level of confidence, and (***) at a 90% level of confidence.

Table 9: *Regression analysis using GMM estimation techniques* for the second dependent variable Reinsurance (ReIn):

Variables	One-Step System GMM	Two-Step System GMM	One-Step difference GMM	Two-Step difference GMM
LagREIN	0.3911888 (0.1780435)	-0.8430753* (0.7019623)	0.0941302*** (0.2894626)	-0.0693761* (1.494249)
$\beta_\circ$	-0.2559343* (0.4188264)	0.3444675 (1.234823)	-	-
ROE	-0.2344299* (0.1495512)	-0.9433835* (0.5306222)	-0.3367363* (0.234038)	-0.2145669* (0.7757007)
IS	0.0010058* (0.0201498)	-0.210389* (0.1711578)	0.0149098** (0.0222661)	0.0376358** (0.0860825)
PG	0.0295957** (0.1082933)	-0.1689659* (0.1054234)	-0.0048114* (0.1645756)	0.0082151* (0.7530462)
LR	-0.0274733* (0.0906797)	-0.8695194* (0.6098571)	-0.1044697* (0.1486546)	0.5186848 (0.6546004)
ROI	-0.0214822* (0.1859548)	3.326214 (2.26741)	-0.4296481* (0.3111738)	-0.8170236* (2.364051)
IC	0.0226952** (0.0193534)	0.3715586 (0.273338)	0.0796625*** (0.0380852)	0.0214042** (0.7529677)
OC	$2.72E^{-8}$* ($4.65E^{-8}$)	$1.33E^{-7}$* ($1.05E^{-7}$)	$5.81E^{-8}$* ($7.55E^{-8}$)	$-4.80E^{-8}$* ($1.11E^{-7}$)
MS	0.1186622 (0.3699648)	17.35506 (10.80803)	-2.007171* (1.91029)	-1.646806* (3.344049)
GDP	1.266767 (1.092121)	2.06351 (1.423763)	0.2579102 (1.072479)	-0.8612379* (2.260878)
Inf	-0.4125098* (0.2328773)	-0.6565402* (0.4112162)	-0.1062608* (0.163105)	0.164175 (0.353329)
PD	0.0021831* (0.0015461)	0.0098493* (0.0080565)	-0.0020271* (0.0019703)	-0.0021193* (0.0096956)
UnEm	0.0044853* (0.0026653)	-0.0060587* (0.0102352)	0.0057493* (0.0032956)	0.0053487* (0.004466)
No. of Obs.	170	170	153	153
No. of Comp.	17	17	17	17
Time Effect	YES	YES	YES	YES
Sargan test P-value	9.14 (1.000)	9.14 (1.000)	6.90 (1.000)	6.90 (1.000)
Hansen test P-value	5.30 (1.000)	5.30 (1.000)	5.44 (1.000)	5.44 (1.000)
AR (1), P-value	Z= -1.17 (0.244)	Z= -1.07 (0.286)	Z= -1.06 (0.287)	Z= -0.34 (0.731)
AR (2), P-value	Z= 0.78 (0.434)	Z= -0.84 (0.400)	Z= -0.65 (0.518)	Z= -0.18 (0.855)

Source: Regression analysis using GMM estimation techniques calculated by the **Stata** program. Note: The standard errors are enclosed in parentheses alongside the coefficients. If a coefficient is statistically significant, it is denoted by (*) at a 99% level of confidence, (**) at a 95% level of confidence, and (***) at a 90% level of confidence.

Table 10: Regression analysis using GMM estimation techniques for the third dependent variable Bonds (Bon):

Variables	One-Step System GMM	Two-Step System GMM	One-Step difference GMM	Two-Step difference GMM
LagBON	0.8687771 (0.0908733)	1.396269 (0.3716573)	0.748153 (0.1352026)	1.386777 (0.5457553)
$\beta_\circ$	-0.0846991* (2.568703)	-1.560776* (6.140447)	-	-
ROE	-1.52636* (0.4395733)	-1.65283* (1.413248)	-2.93189* (0.9420806)	-12.24702* (14.56226)
IS	-0.0543886* (0.1390453)	-0.0728451* (0.2951962)	-0.0568387* (0.1630353)	-0.7964043* (1.148124)
PG	-0.256734* (0.2891766)	-0.6354649* (0.09949268)	-0.6856496* (0.5048963)	-4.234337* (3.71599)
LR	1.217225 (0.5982823)	-2.732035* (2.066801)	0.1259452 (1.306245)	-3.013187* (2.093685)
ROI	0.5328196 (0.4939344)	2.30004 (3.320069)	1.701691 (1.680107)	10.6924 (6.092175)
IC	0.1086823 (0.1279159)	0.5500957 (0.406886)	0.1681688 (0.2555586)	3.249362 (4.467437)
OC	$-9.52E^{-8}$* ($1.05E^{-7}$)	$-6.77E^{-8}$* ($1.55E^{-7}$)	$-1.24E^{-7}$* ($1.08E^{-7}$)	$3.26E^{-7}$* ($4.83E^{-7}$)
MS	0.6497585 (1.291652)	12.77899 (12.92662)	5.552803 (4.694126)	5.086959 (3.24608)
GDP	-0.7283862* (2.309307)	-0.6293294* (5.464546)	3.226637 (5.215104)	11.2189 (8.01073)
Inf	-1.610439* (0.9905031)	-1.217064* (1.057648)	-1.967032* (0.8024776)	0.0136539** (7.291099)
PD	0.0105867** (0.0090039)	0.0264565** (0.022462)	0.0222551** (0.0190387)	0.0922777*** (0.0601221)
UnEm	-0.0088707* (0.0095455)	-0.0297034* (0.0140471)	0.0020531* (0.0107705)	-0.0806802* (0.1177635)
No. of Obs.	170	170	153	153
No. of Comp.	17	17	17	17
Time Effect	YES	YES	YES	YES
Sargan test P-value	29.52 (0.542)	29.52 (0.542)	24.24 (0.390)	24.24 (0.390)
Hansen test P-value	4.80 (1.000)	4.80 (1.000)	1.53 (1.000)	1.53 (1.000)
AR (1), P-value	Z= -3.12 (0.002)	Z= -1.60 (0.110)	Z= -2.69 (0.007)	Z= -1.11 (0.265)
AR (2), P-value	Z= -1.44 (0.149)	Z= 0.41 (0.684)	Z= -1.74 (0.082)	Z= -0.79 (0.428)

Source: Regression analysis using GMM estimation techniques calculated by the **Stata** program. Note: The standard errors are enclosed in parentheses alongside the coefficients. If a coefficient is statistically significant, it is denoted by (*) at a 99% level of confidence, (**) at a 95% level of confidence, and (***) at a 90% level of confidence.

Table 11: *Regression analysis using GMM estimation techniques* for the fourth dependent variable Credit Risk (CR)*:*

Variables	One-Step System GMM	Two-Step System GMM	One-Step difference GMM	Two-Step difference GMM
LagCR	0.7780883 (0.0792213)	0.5451711 (0.9055569)	0.4749022 (0.1455262)	0.6111839 (0.8065845)
$\beta_\circ$	-2.192327* (2.487013)	9.401632 (10.14443)	-	-
ROE	-1.903946* (0.6161184)	-14.57892* (8.355598)	-2.284085* (0.5990949)	-6.917272* (6.026091)
IS	0.0092952* (0.1151074)	-0.7879416* (1.004438)	0.2118834 (0.1707715)	-0.055661* (0.487285)
PG	-0.7572978* (0.3702241)	-0.4216258* (1.949515)	-1.004641* (0.3862713)	-1.480368* (1.346348)
LR	0.7104218 (0.415269)	-3.400458* (2.114728)	0.936843 (0.8166618)	-0.7942381* (2.013929)
ROI	0.6628037 (0.5398568)	6.585344 (10.40121)	-0.9806401* (0.989382)	-1.138829* (5.877036)
IC	0.1045674 (0.1124641)	0.2612788 (1.705414)	-0.1070725* (0.2591072)	0.7924509 (1.795485)
OC	-4.55E^{-8}** (6.26E^{-8})	-2.02E^{-7}* (2.71E^{-7})	-4.43E^{-9}* (6.71E^{-8})	5.81E^{-8}* (1.46E^{-7})
MS	0.0114293** (0.9737205)	5.95654 (12.29657)	13.78349 (11.40862)	12.13042 (20.19679)
GDP	1.673677 (3.232988)	8.098226 (22.81458)	2.199565 (3.971159)	-2.073327* (6.976603)
Inf	-1.515745* (1.157973)	-0.5246796* (3.544592)	-1.204334* (1.05069)	1.103074 (1.726444)
PD	0.0216177** (0.0064714)	0.0791522*** (0.0889088)	0.0148078** (0.0127132)	0.0231864** (0.0357425)
UnEm	-0.0015624* (0.010953)	-0.043521* (0.0259501)	0.0181106** (0.0142718)	-0.0164453* (0.0473468)
No. of Obs.	170	170	153	153
No. of Comp.	17	17	17	17
Time Effect	YES	YES	YES	YES
Sargan test P-value	31.16 (0.458)	31.16 (0.458)	24.70 (0.366)	24.70 (0.366)
Hansen test P-value	3.31 (1.000)	3.31 (1.000)	6.66 (1.000)	6.66 (1.000)
AR (1), P-value	Z= -3.10 (0.002)	Z= -1.30 (0.195)	Z= -2.57 (0.010)	Z= -1.01 (0.312)
AR (2), P-value	Z= -0.68 (0.497)	Z= 0.000 (0.000)	Z= -0.62 (0.532)	Z= -0.38 (0.701)

Source: Regression analysis using GMM estimation techniques calculated by the **Stata** program. Note: The standard errors are enclosed in parentheses alongside the coefficients. If a coefficient is statistically significant, it is denoted by (*) at a 99% level of confidence, (**) at a 95% level of confidence, and (***) at a 90% level of confidence.

4. Conclusions and recommendations:

This study has shed important light on evolution of credit risk in the Egyptian property insurance market between 2012 and 2022. The results show how macroeconomic, industry, and insurance specific factors are intricately correlated and affect bonds, unpaid premiums, reinsurance, and total credit risk. The industry need for strategic risk management is highlighted by the persistent character of credit risk.

The research has effectively employed diverse regression models such as pooled, fixed and random effects regressions providing comprehensive examination of the variables impacting credit risk. Furthermore, the dynamic models credibility has been solidified by the robustness assessment using the Generalized Method of Moments (GMM) which addresses endogeneity and time persistence issues. The results highlight the significance for several elements in assessing credit risk such as economic indicators, insurance size, insurance capitalization, premium growth rate, and return on equity (ROE). This study adds to our understanding of credit risk in Egyptian markets by providing insights for strategic decision making and credit risk management in the insurance market.

To gain a more comprehensive understanding of industry practices and risk management strategies future research could expand the analysis to compare credit risk dynamics in the Egyptian property insurance sector with international counterparts. Also, further research might investigate how external crises like pandemics, sudden inflation or economic recessions which affect credit risk in the insurance industry and evaluate how resilient risk management techniques supposed to be in light of the fragile condition of the world economy. Lastly, a good point to be considered for future research is to examine the long term impacts on credit risk management of regulatory decisions such as Decision No. 193 of 2022 by evaluating their adaptability and long-term efficacy.

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تحليل شامل لمحددات مخاطر الائتمان في قطاع تأمينات الممتلكات والمسئوليات المصري: استكشاف عوامل الاقتصاد الكلي والصناعة والعوامل الخاصة بالشركة

د. إسلام صيام؛ د. محمود السيد؛ د. أحمد نصر

المستخلص :

يلعب قطاع التأمين دوراً كبيراً في تعزيز الاستقرار الاقتصاد من خلال تخفيف المخاطر وتشجيع الاستثمار واستقرار الأسواق المالية. ولكن هناك بعض الصعوبات التي تعيق تحقيق ذلك، وخاصة عندما يتعلق الأمر بإدارة مخاطر الائتمان، والتي تسببها عوامل تتعلق بالمقترضين المتعثرين، والأقساط غير المدفوعة، ومبالغ إعادة التأمين غير المدفوعة. تبحث هذه الدراسة في كيفية تأثر مخاطر الائتمان بعوامل الاقتصاد الكلي والصناعة وكذلك بعض العوامل الخاصة بشركات التأمين، بالتطبيق على شركات تأمينات الممتلكات والمسئوليات بالسوق المصري خلال الفترة من ٢٠١٢ وحتى ٢٠٢٢.

من أجل تحقيق الهدف الرئيسي للبحث يمكن دراسة العلاقات بين العناصر المؤثرة في مخاطر الائتمان، والتي تتمثل في ثلاثة مكونات: الأقساط غير المحصلة وإعادة التأمين والسندات كمتغيرات تابعة، أما المتغيرات المستقلة الرئيسية تتمثل في الحصة السوقية، وتركز الملكية، والعائد على حقوق الملكية، وحجم الشركة، معدل نمو الأقساط، والمؤشرات الاقتصادية مثل الناتج المحلي الإجمالي، التضخم، الدين العام، والبطالة. تستخدم الدراسة مجموعة متنوعة من نماذج الانحدار، بما في ذلك التأثيرات المجمعة والثابتة والانحدار ذو التأثيرات العشوائية. بالإضافة إلى ذلك، تم دراسة التجانس الداخلي في هياكل مخاطر الائتمان من خلال استخدام طريقة العزوم المعممة (GMM). كما تم التحقق من قوة النموذج الديناميكي من خلال اختبار Sargan واختبارات الارتباط الذاتي ((1) AR و (2) AR) التي تتحقق من كفاءة الأدوات المستخدمة وعدم وجود ارتباط تسلسلي.

وتظهر النتائج أهمية العوامل في تحديد مخاطر الائتمان، بما في ذلك العائد على حقوق الملكية، ومعدل نمو الأقساط، وحجم الشركة، وتركز الملكية، والمؤشرات الاقتصادية. كما تقدم هذه الدراسة رؤى لإدارة مخاطر الائتمان واتخاذ القرارات الاستراتيجية في صناعة التأمين، مما يعزز فهمنا لمخاطر الائتمان في الأسواق المصرية.

الكلمات المفتاحية:

مخاطر الائتمان؛ تأمينات الممتلكات والمسئوليات ؛ محددات الاقتصاد الكلي؛ الأداء المالي؛ التأثيرات الثابتة والعشوائية ؛ طريقة العزوم المعممة (GMM).