"The Effect of Credit Risk on Corporate Profitability: The Moderating Role of Cyber Risk in EGX 30"

Yassin Sherif Nazmy El Sayed

Faculty of Management, Modern university for technology and information,

Cairo, Egypt
Email: yassinnazmy@gmail.com

تأثير مخاطر الائتمان على ربحية الشركات: الدور المعتدل للمخاطر السيبرانية في "البورصة المصرية ٣٠"

Abstract

This research evaluates how cyber risk functionalities to link credit risk indicators with the profitability of Egyptian corporates operating in the EGX30 index. The investigation details cyber risk how this risk translates to changes in the relationship between Non-Performing Loans Ratio (NPLR) including Debt Ratio with Corporate performance results like Return on Assets (ROA) and Return on Equity (ROE). This study analyzes data from Egyptian Exchange (EGX30) listed corporates through quantitative secondary findings. The research explores 93 observations while using an approach which combines feasible generalized least squares modeling with panel-specific AR(1) correlation structure along with heteroskedasticity control. A comprehensive study of risk-profitability connections in the

Egyptian corporate sector uses multiple risk components and their mutual interactions. The study demonstrates that credit risk indicators generate negative impact on corporate performance profitability metrics and cyber risk functions as an essential respondent. The research demonstrates cyber risk increases the negative influence of credit risk on ROA but displays different patterns regarding ROE relationships. The study provides essential knowledge about present-day risk phenomena within corporate sectors of emerging markets.

Keywords: Corporate profitability, Credit risk, Cyber risk, Non-performing loans, Debt ratio, Egyptian Corporates, EGX30, Return on Assets, Return on Equity, Risk moderation.

ملخص البحث:-

يقيّم هذا البحث كيفية توظيف المخاطر السيبرانية لربط مؤشرات مخاطر الائتمان ويوضح البحث بالتفصيل .EGX30 بربحية الشركات المصرية العاملة في مؤشر المخاطر السيبرانية كيف تترجم هذه المخاطر إلى تغيرات في العلاقة بين نسبة بما في ذلك نسبة الديون مع نتائج أداء الشركات مثل (NPLR) القروض المتعثرة تحلل هذه الدراسة .(ROE) والعائد على حقوق الملكية (ROA) العائد على الأصول من خلال النتائج (EGX30) بيانات من الشركات المدرجة في البورصة المصرية الثانوية الكمية. يستكشف البحث ٩٣ ملاحظة أثناء استخدام نهج يجمع بين نمذجة الخاص باللوحة إلى (1) AR المربعات الصغرى المعممة المجدية مع هيكل ارتباط جانب التحكم في التغاير في المطاطة غير المتجانسة. دراسة شاملة للصلات بين المخاطر والربحية في قطاع الشركات المصرية باستخدام مكونات المخاطر المتعددة وتفاعلاتها المتبادلة. توضح الدراسة أن مؤشرات المخاطر الائتمانية تولد تأثيرًا سلبيًا

على مقاييس ربحية أداء الشركات وأن المخاطر السيبرانية تعمل كمستجيب أساسي. وتوضح الدراسة أن المخاطر السيبرانية تزيد من التأثير السلبي لمخاطر الائتمان على العائد على الأصول، ولكنها تظهر أنماطًا مختلفة فيما يتعلق بالعلاقات بين العائد على حقوق المساهمين. توفر الدراسة معرفة أساسية حول ظواهر المخاطر الحالية في قطاعات الشركات في الأسواق الناشئة.

الكلمات المفتاحية ربحية الشركات، مخاطر الائتمان، المخاطر السيبرانية، المخاطر السيبرانية، العائد EGX30، القروض المتعثرة، نسبة الديون، الشركات المصرية، على الأصول، العائد على حقوق المساهمين، اعتدال المخاطر.

1. Introduction

Financial research has recognized the vital importance of risk interconnections to Corporate performance throughout the last few years (Syrová and Špička, 2022). The Corporate sector operates under various challenges including credit and cyber risk while these risks produce parallel impacts on profitability measurement systems (Eling et al. 2021). The Corporate sector in Egypt functions as a distinct emerging markets complex for risk-performance examination because of its rapid digital development and transforming security conditions (Evans et al. 2023; Rodriguez, 2024).

This study identifies and evaluates multiple relationships between credit risk variables and cyber risk effects which impact profitability levels in Egyptian corporate organizations (Elnagar et al. 2024). The research evaluates how cyber risk influences the relationships between typical credit risk factors and Corporate performance metrics. The primary research question explores:

"How does cyber risk influence the relationship between credit risk indicators and Corporate profitability in Egyptian Corporates?"

This investigation evaluates how cyber risk influences the connection between credit risk indicators Non-Performing Loans Ratio and Debt Ratio and Corporate profitability measures Return on Assets and Return on Equity (Madegwa, 2024). This research stems from the Egyptian Corporate services digitalization trend and the resulting increase in cyber threats and hence the crucial need to study the relationship between contemporary risks and established Corporate risks (Saeed et al. 2023).

The research data demonstrates many important associations between variables. Profitability through ROA experiences slightly significant negative influence from cyber risk (-0.01623) and demonstrates negative relations with NPLR (-0.0111449) and Debt Ratio (-9.02E-06). These relationships experience negative moderation because cyber risk produces such an effect of -0.030348. ROE data shows comparable negative effects from NPLR (-0.10651), Debt Ratio (-0.2791483), and the variable cyber risk (-0.15875). The influence of cyber risk shows contrasting results according to the analysis method between ROA and ROE particularly when considering its relationship with NPLR.

The established research findings generate several important implications which affect Corporate practice together

with policy. The analysis demonstrates that Egyptian Corporates must build risk management systems which unite credit risk management and new cyber security threats. Strategic risk management approaches should be customized to match the performance targets because the study shows that ROA and ROE experience different effects. The research has been organized into four sections starting from Section 1. Introduction and Background then 2. Literature Review and Theoretical Framework. Moving to 3. The paper unfolds through four sections beginning with Methodology and Data Collection followed by Results and concluding with the section on Conclusion. The analysis in each section covers all aspects sufficiently without losing focus on credit risk and cyber risk interactions with corporate performance in Egypt.

2. Literature review:

2.1Credit risk

According to Corporate operations the fundamental core challenge involves credit risk which describes the risk of borrowers defaulting on payments to lenders (Guerreron et al. 2025; Ismael et al. 2023). A Corporate faces risks from default risk combined with exposure risk and recovery risk which strongly affect both financial stability and operational sustainability. Today's credit risk management has evolved into sophisticated systems through complex assessment models developed by Corporates to track their assets (Shi et al. 2025).

Credit risk management continues to evolve through substantial advancements within prescribed regulatory systems as well as within private Corporate institutions (Addy et al. 2024). The Basel Accords have standardized credit risk evaluations together with capital requirements throughout the entire Corporate sector. Global risk management standards brought forth better risk practices that integrated credit scoring models and portfolio diversification and stress testing methods (Van Greuning and Bratanovic, 2020).

Credit risk management in Egypt's developing economy operates under one-of-a-kind hurdles from its unstable economy alongside its regulatory policies and market framework functions (Ahmad, 2023). Corporate businesses need to overcome existing challenges before they can achieve profitable lending gains while ensuring risk control efficiency remains in place. Credit risk assessment in these markets needs supplemental evaluation components because of informal economic activities alongside restricted credit history data together with regional economic conditions (Duho et al. 2020).

2.2Cyber risk

The essentiality of cyber risk management in Corporate operations results from their expanding digital infrastructure and technology-based service provision (Saeed et al. 2023). Cyber risk consists of three components which include information systems security and data protection as well as operational

stability but extends to basic data breaches and system breakdowns as well as complex cyber assault methods. Digitalization in Corporate services operations presents Corporates with both expanded threat exposure areas along with new vulnerabilities to handle (Luque et al. 2021).

Financial institutions encounter progressive challenges while handling cyber risk because they must protect customer data while maintaining system integrity while ensuring business continuity (Djenna et al. 2021). The intricate nature of cybersecurity demands that Corporates establish multilayered security platforms integrating technological implementing and programmatic staff development and emergency response development (Tahmasebi, 2024). Companies should invest a substantial amount of funds in cybersecurity because it protects their customers and adherence to regulations.

Corporate operations that combine with cyber risks create complex situations for which traditional risk management systems require improvement (Colicchia et al. 2019). Organizations need to maintain a proper equilibrium between implementing digital development and enhancing security features to protect their customers (Burton, 2025). Striking equilibrium proves vital for businesses operating in developing markets since they experience fast digital Corporate growth while their cybersecurity systems and governing frameworks require development (Morshed and Khrais, 2025).

2.3Corporate Performance

Success metrics covering financial and operational aspects constitute the Corporate sector measurement of institutional performance achievement. The analysis of corporate performance relies on two main categories: profitability ratios consisting of ROA and ROE along with efficiency metrics together with market performance indicators (Abdelraouf et al. 2025; Allam and Abdelraouf, 2023). These performance metrics grant stakeholders vital information about how well a Corporate functions in its operations along with its financial performance (Dwekat et al. 2025).

Organizations now evaluate their corporate achievement through non-financial measurements which capture a Corporate's complete impact and sustainability outcomes (Winarsih et al. 2025). The considered performance metrics consist of customer satisfaction alongside market share while innovation capacity and environmental social governance (ESG) factors play a role. Various performance indicators when integrated present stakeholders with a complete picture of corporate overall performance together with potential future success (Abbas et al. 2025).

Contemporary Corporate performance measurement requires proper analysis of market conditions together with multiple risk elements. Corporates need to show their ability to generate profits while effectively supervising numerous risks together with adhering to regulatory standards. The

comprehensive assessment method is essential now because of rising market intricacy as well as stakeholder requirements (Kumar, 2025).

2.4Credit risk and Corporate Performance

Corporate operations face a crucial essential relationship between credit risk and performance which determines financial stability together with profitability. Studies demonstrate that increased credit risks which appears mainly through non-performing loans substantially decline Corporate profitability alongside capital adequacy measures. The association sharpens itself especially in times of economic downturn as credit quality usually worsens (Saiz-Sepúlveda and Hernández-Tamurejo, 2025).

The optimal business performance requires corporates to handle credit expansion activities while maintaining effective risk management practices (Pipyros and Liasidou, 2025). High levels of credit risk force organizations to establish higher loan loss provisions while reducing their earnings and potentially diminish their capital foundation (Shekhar, 2025). Excessive caution in lending operations reduces both business growth potential and potential profitability. Risk models for corporations become more effective because organizations can create suitable risk appetite models and lending plans after learning about this relationship (Gitelman et al. 2025).

Different market environments and economic situations create various effects of credit risk on corporate performance

(Goodell et al. 2025). Emerging market situations in Egypt create a unique relationship between credit risk and business performance that becomes affected by economic uncertainty in addition to regulatory rules and market environment characteristics (Salem and Walid, 2025; Abdelraouf and Muharram, 2024). Local conditions demand corporate organizations to adjust their credit risk management approaches but they should maintain acceptable operational results during this process (Vera et al. 2025).

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2.6Cyber risk and Credit risk

Corporate risk management recognizes cyber risk and credit risk intersection as an escalating threat area (Xu and Chen, 2025). Cyber incidents damage credit risk by breaking down payment systems while also compromising credit assessment processes alongside stealing sensitive financial information. Corporates need to create synchronized methods for risk management since these interconnected threats exist together (Pipyros and Liasidou, 2025).

The growing digitization of credit assessment procedures enhances credit and cyber risk interplay because Corporates use digital systems to monitor and evaluate creditworthiness (Henkler and Schubart, 2025). The integrity of credit data

becomes compromised through cyber attacks because these events lead to effects on risk assessment models which can result in incorrect lending decisions. Market actors must implement strong security solutions to protect their credit management systems because of this scenario (Razaque et al. 2025).

Corporates are now focusing on how cyber risk incidents activate and strengthen Credit risk problems in Corporate business operations (Pipyros and Liasidou, 2025). A significant cyber incident creates two risks for a Corporate: reduced loan portfolio monitoring efficiency and payment processing interruptions which restrict borrowers from making their financial obligations (Ranjan, 2025). Knowledge of these interactions serves as a basis to create successful risk management approaches which handle both established and upcoming risks throughout Corporate operations and reduce perceived job insecurity (Zaydi et al. 2025; Abdelraouf and Muharram, 2024).

2.7 Previous studies in Egypt

Abdelraouf et al. (2024) mentioned that they investigated the impact that cyber risk has on the earnings of a number of corporations in Egypt. The primary objective of this study was to determine the extent to which cyber-Risks have an impact on financial performance indicators for the Corporation. The examined indicators are ROA and gross profit margin (GPM). The research showed cyber risk had an extensive negative

influence which diminished profitability for the studied corporations. The study results showed that as cyber risk levels increase it causes ROA and GPM to decrease simultaneously. Several financial risks exist because of the identified threats which pose substantial economic threats to companies. The research outcomes lead to a conclusion that organizations should direct substantial attention to implementing efficient risk management systems for protecting against cyber threats and challenges to reliability and financial health.

The study discusses hypotheses that attempt to explain relationships between corporate profitability and credit risk and cyber risk. The objective behind this step is to strengthen the theory framework. The BCG developed the resource-based view (RBV) when it became one of the newest theoretical approaches (Çelik, 2025). This framework derives entirely from analyzing organizational internal capabilities and capabilities. Ferreira and Ferreira (2025) define the notion based on the principle that businesses must maintain excellent operational outcomes from valuable exclusive non-substitutable internal resources (Shi and Zailani, 2025). On the other hand, agency theory focuses on the issues that present themselves as a result of the fact that possession and control of organizations are not united. In the process of doing so, it investigates a variety of elements, including conflicts of interest between principals (shareholders) and the agents that are being studied (managers), as well as

problems involving asymmetrical information (Yolanda and Mita, 2025).

Therefore, the following hypothesis was made:

H1: Credit risk has a significant effect on Corporates profitability

H2: Cyber risk moderates the relationship between credit risk and Corporates profitability

2.8 Conceptual Model

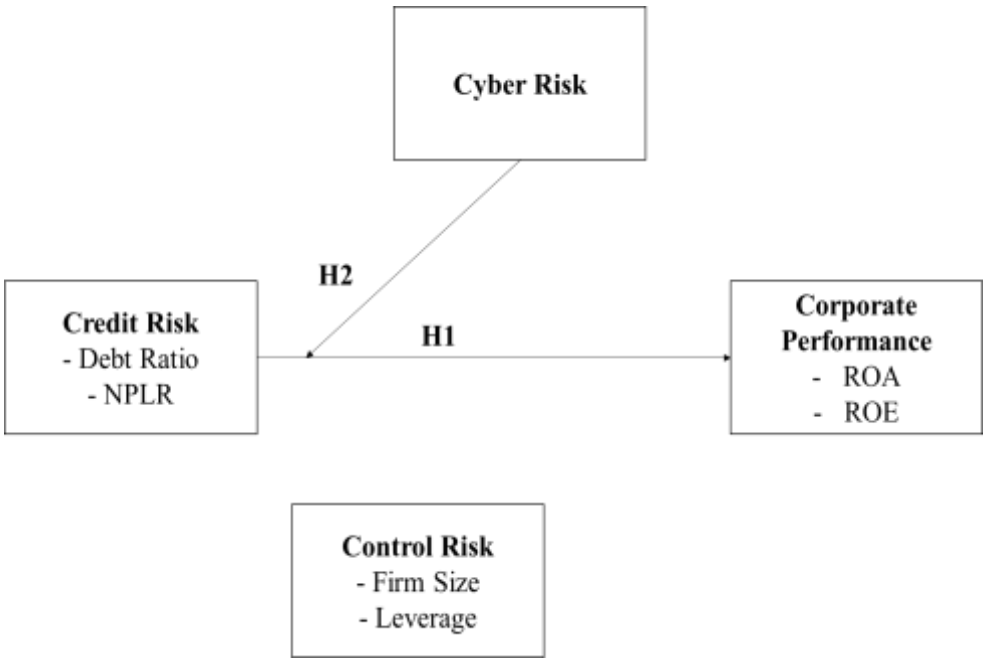

Figure (1.1)

Source: Developed by the author

3. Methods

The research depends on secondary data which uses historical data extracted from annual reports from 2018 to 2024. Reliability in research findings increased because the study added financial institution website data to its data collection process. All data used for this study originates from secondary sources while giving precedence to previous records documented in historical formats. The annual reports of 30 different Egyptian Corporates list on the EGX (30) provided the data collection records.

3.1 Sampling technique

The entire population faces examination under census methodology according to Sharma (2017) because this approach ensures complete inclusion of all population entities. Applications from this method extend across the entire population structure because it removes selection biases while delivering complete analysis information. The nature of a census approach excludes the need for probability calculations because it includes every unit in the population. When performing a census research Nanjundeswaraswamy and Divakar (2021) discussed sample size determination but this subject becomes unnecessary because every element of the population receives analysis.

$$n = \frac{z^2 \times p \times (1-p)}{e^2} = \frac{(1.65)^2 \times (0.5)(0.5)}{0.1^2} \approx 68.0625 \approx 68 \quad \textbf{(1)}$$

Therefore, the sample needs to exceed 68 respondents to obtain a margin of error of 0.1.

A total of 30 Corporates underwent study as members of the target research sample within Egypt. This study examined Egyptian Corporates. To determine the sample only corporates meeting certain requirements were selected: companies needed to publish complete financial reports from 2018 to 2024 and include a cyber risk index in their reports and offer available analytical data. Financial data from 30 Corporates across seven years formed the basis of the final analysis together with NPLR and Debt Ratio as independent variables and cyber risk as the moderating element while ROA and ROE served as dependent variables for corporate profitability.

STATA 17 was utilized for data analysis through a feasible generalized least squares model that included panel-specific AR(1) correlation structure in tandem with heteroskedasticity control. The analysis drew its data from the financial statements of the Corporates. This thorough analytical model served to evaluate direct credit risk effects on corporate profitability and to determine how cyber risk influences these relationships. Thorough data selection methods and statistical procedures in the study produced valid results to understand the impact of these risk factors on Egyptian Corporate performance accurately.

Independent variable:

***i)* Debt to asset**

$$\frac{Total\ debt}{Total\ Assets} \quad (2)$$

***ii)* NPL**

$$\frac{Non\ performing\ loans}{Total\ loans} \quad (3)$$

Moderator variable:

iii) Cyber risk ratio

- Key words of annual reports and interpreting it by using gunning fog index

$$0.4[\left(\frac{total\ words}{total\ sentences}\right) + 100\ (\frac{complex\ words}{total\ words})] \quad (4)$$

The text reading level is measured through the Gunning Fog Index (FOG) which follows equation 4. The FOG index obtains its values from counting both sentence length in words and complicated word percentages in all text. In accordance with Loughran and McDonald (2014) and Świeczkowski and Kułacz (2021) complex words have three or more syllables.

The cyber risk ratio shows elevated levels of cyber risk disclosures when a Corporate document displays higher FOG indices. Research indicates that the Corporate receives an increased number of cyber threats based on data from Gao et al. 2020. The research team evaluated cyber risk ratio through Fog Index methodology which analyzes complex language and

reading levels of texts. The analysis of cyber risk disclosures in Corporate annual reports made use of this concept through its implementation to detect cyber threats in Table 1 results.

Dependent variable:

- ROA

$$\frac{\text{Net income}}{\text{Total assets}} \quad (5)$$

- ROE

$$\frac{\text{Net income}}{\text{Total Equity}} \quad (6)$$

In this study the, the following control variables are adopted by the study:

i) **CAR**

$$\frac{\text{Total Debt}}{\text{Total Equity}} \quad (7)$$

Corporate size

- Log to total assets

Table (1): Measurement of variables

Variables	Measurement	Sources
Independent variable • **Credit risk ratio** 1) **Debt ratio** 2) **NPL**	**Checklist from annual reports for each Corporate**	**- Akhter and Roy, (2017)**

Moderator variable **3) Cyber risk ratio**	**Checklist from annual report based on the following Keywords** **- "Cyber-attack, cyber security, cybercrime, cyber risk, hacking, swift attack, internet hacking or crimes)**	**- Thach et al. (2021); Alber and Nabil (2016)**
Dependent variables • **ROA** • **ROE**	**Checklist from annual reports for each Corporate**	**- Rahmani (2020); Shakoor et al. (2014)**
Control variables • **Leverage** • **Corporate size**	**Checklist from annual reports for each Corporate**	**- Fauziah and Fadhilah (2022)**

To test the research hypotheses, the researcher identifies the following empirical models:

$$ROA = \beta_0 + \beta_1 Debt\,ratio + \beta_2 NPL + \beta_3 Cyber\,Risk + \beta_4 Leverage + \beta_5 Firm\,Size + \varepsilon_i \quad (8)$$

$$ROE = \beta_0 + \beta_1 Debt\,ratio + \beta_2 NPL + \beta_3 Cyber\,Risk + \beta_4 Leverage + \beta_5 Firm\,Size + \varepsilon_i \quad (9)$$

The study models presented as equations (8) (9) analyze how corporate profitability measures ROA and ROE relate to debt ratio and NPL along with cyber risk and leverage and firm size variables. These equations outline the hierarchical relationships among these variables and their impact on corporate

profitability, with a particular emphasis on cyber risk as a moderating factor. The models acknowledge that credit risk factors (debt ratio and NPL) may have a direct influence on profitability measures, while cyber risk acts as a moderator affecting the relationship between credit risk and corporate profitability.

Given the panel structure of our dataset, which integrates both cross-sectional and temporal characteristics, we employed an appropriate panel data analysis technique to capture the individual corporate characteristics and time-varying effects across our sample of 13 corporations over a seven-year period. We understand the significance of handling firm-specific diversity along with financial indicator temporal changes following the approach outlined by Hsiao (2022).

Our main estimation approach is Feasible Generalized Least Squares (FGLS) because it offers robust and reliable results. The FGLS method provides optimal results for panel data analysis because it addresses both heteroskedasticity and autocorrelation thus surpassing Fixed or Random Effects models (Arellano and Honoré, 2001). The implemented approach verifies our estimates through its ability to handle cross-sectional dependence effects and corporate characteristic heterogeneity. FGLS provides enhanced data analysis accuracy because it correctly addresses the temporal as well as the cross-sectional aspects of our data.

4. Results

Descriptive Statistics

Table (2): Descriptive Statistics for the variables in phenomenon

Variable	Obs.	Mean	Std. dev.	Min	Max
Debt ratio	91	32.72	8.49	18	50
NPLR	91	0.484577	0.412908	-0.25638	1.240301
Cyber Risk	91	0.426598	0.2104639	0	1.38
ROA	91	0.019407	0.0108983	0.000412	0.048927
ROE	91	0.215945	0.1020201	0.00841	0.44417

Source: STATA V.17 OUTPUT

The descriptive statistics show fundamental Corporate data across 91 observations in this table. The financial data demonstrates significant variances in performance measurements since the debt ratio has a large mean value of 32.72% spanning from 18% to 50%. NPLR demonstrates an average value of 0.48 whereas Cyber Risk measurements follow an average of 0.43 together with a highest recorded value of 1.38 which implies diverse cybersecurity vulnerabilities exist in these institutions. Observed Corporate institutions produce modest profit returns based on ROA averaging at 1.94% but ROE reaches 21.59% while both measurements show substantial performance differences through their standard deviations and min-max ranges.

Table (3): Pearson correlation coefficients for the variables in phenomenon

	ROA	ROE	Debt Ratio	NPLR	Cyber Risk
ROA	1				
ROE	0.806	1			
Debt Ratio	-0.619	0.563	1		
NPLR	-0.302	-0.460	-0.909	1	
Cyber Risk	-0.596	0.206	-0.490	0.739	1

Source: STATA V.17 OUTPUT

The Pearson correlation coefficient serves as an indicator of linear relationship force and direction between variables. A Pearson correlation coefficient evaluation yields essential outcomes that show direct and indirect relationships between independent and dependent variables. At a 95% confidence level, the ROA had a positive, strongly significant relationship with the ROE. At a 95% confidence level, the ROA had a negative, moderate significant relationship with the Debt ratio. At a 95% confidence level, the ROA had a negative, weak significant relationship with the NPLR. At a 95% confidence level, the ROA had a negative, moderate significant relationship with the Cyber Risk. We should further investigate this relationship with the inclusion of other control variables in the modelling process. Furthermore, there appears to be no multicollinearity, as the independent variables had no Pearson correlation coefficient greater than 0.8.

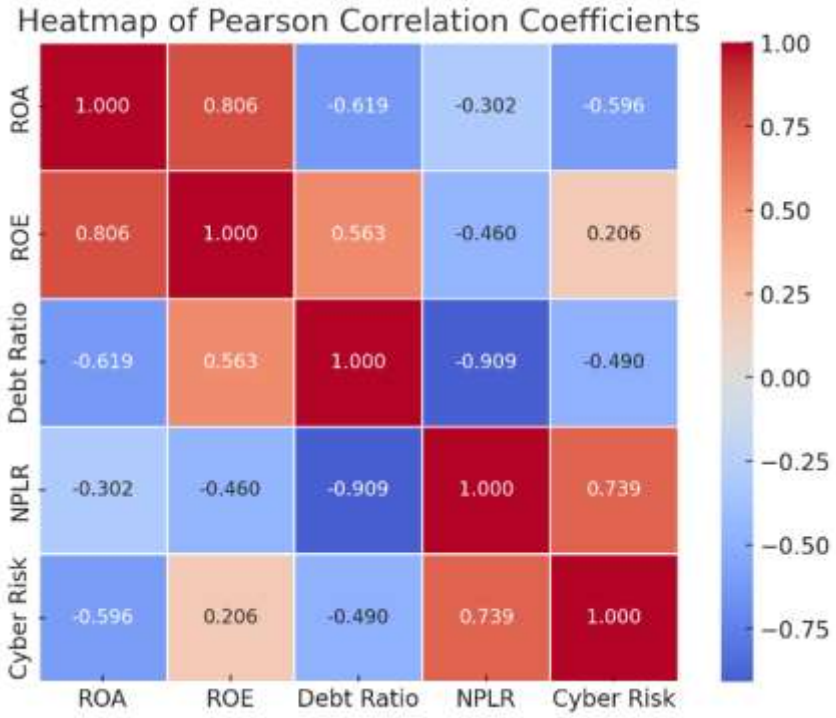

Figure (2): Heat map

Source: STATA V.17 OUTPUT

The strength and direction of key financial variables relationships can be observed through the visual representation of Pearson correlations within figure (2). Businesses with higher return on assets data show a positive connection to return on equity performance (having .806 as their coefficient value). The data reveals Debt Ratio has a powerful negative relationship to NPLR with a value of -0.909 since Corporates with increased

debt ratios maintain lower non-performing loan ratios. Higher cyber risk levels lead to both lower return on assets (-0.596) and decreased debt ratio utilization (-0.490). The variables of Cyber Risk and NPLR show moderate joint association through their positive relationship (0.739) which establishes an increasing trend between cyber risk exposure levels and non-performing loan ratios. The financial risk factor analysis through heatmap reveals significant relationships that should be studied in more detail.

Table (4): Stationarity test of the variables in phenomenon

	Test statistic	P-value	Decision
ROA	4.3319	1.0000	Stationary
ROE	5.0067	1.0000	Stationary
Debt Ratio	-1.5140	0.0650	Stationary
NPLR	-160.0000	0.0000	Stationary
Cyber risk	-1.9096	0.0281	Stationary

Source: STATA V.17 OUTPUT

Before further analysis, some assumptions should be considered. To test stationarity of the variables, the Levin Lin Chu test statistic was calculated. It was found that all variables were stationarity since p-value was less than 0.05 except Debt ratio which is at 90% confidence level which still acceptable. Thus, rejecting the non-stationarity assumption of the variables.

Table (5): Model testing to determine the appropriate model

Variables	VIF	1/VIF	Kolmogorov-smirnov	SHAPIRO-WILK
Corporate size	1.204	0.830	ROA: (0.083)	ROA: (0.074)
leverage	1.002	0.998		
debt ratio	1.144	0.874		
nplr	1.189	0.841	ROE: (0.097)	ROE: (0.218)
cyber risk	1.007	0.993		

Source: STATA V.17 OUTPUT

The model testing results indicate strong statistical validity for the analysis. All variables show VIF (Variance Inflation Factor) values well below the critical threshold of 5, with values ranging from 1.002 to 1.204, and corresponding 1/VIF values between 0.830 and 0.998, indicating minimal multicollinearity among the predictors (Corporate size, leverage, debt ratio, NPLR, and cyber risk). The normality tests using both Kolmogorov-Smirnov and Shapiro-Wilk methods for ROA (p=0.083 and 0.074 respectively) and ROE (p=0.097 and 0.218 respectively) show p-values greater than 0.05, suggesting that both profitability measures follow a normal distribution, thus satisfying key assumptions for parametric statistical analysis.

Table (6): Feasible generalized least square coefficient model in phenomenon

ROA	Coefficient	Std.	z	P>z
NPLR	-0.0111449	0.0056881	-1.96	0.05
Debt RATIO	-9.02E-06	4.80E-06	1.881	0.03
Cyber risk	-0.01623	0.009636	-1.68	0.092
CYBER RISK AS MOD. OF DEBT RATIO AND ROA	-0.030348	0.0126477	2.4	0.016
CYBER RISK AS MOD. OF NPLR AND ROA	-0.030348	0.012648	2.4	0.016
_cons	0.024985	0.004214	5.93	0
Coefficients	Generalized least squares			
Panels	Heteroskedastic			
Correlation	panel-specific AR(1)			
Number of observations	91			
Number of groups	13			
Time periods	7			
Prob > chi2	0			

Source: STATA V.17 OUTPUT

Several essential connections emerge between variables and ROA through the feasible generalized least squares analysis. Corporate profitability decreases according to the -0.0111449 negative coefficient value recorded for NPLR (p=0.05). As per the results the Debt Ratio has a very small negative coefficient of -9.02E-06 (p=0.03) which indicates that there is a statistically significant but minimal negative relationship between this ratio and ROA. Cyber risk shows a marginally significant negative relationship (-0.01623, p=0.092) with ROA.

Importantly, the moderation effects of cyber risk are significant (p=0.016) for both relationships. Cyber risk moderates the relationship between Debt Ratio and ROA with a coefficient of -0.030348, and similarly moderates the NPLR-ROA relationship with the same coefficient. The coefficients show a negative relationship because cyber risk increases the strength of negative associations between credit risk factors (NPLR and Debt Ratio) and profitability.

This study uses a model structure which sustains through panel-specific AR(1) correlation structure alongside heteroskedasticity control across 91 observations distributed across 13 groups and 7 time periods. The highly significant Prob > chi2 value (p=0) confirms the model's overall statistical validity. This analysis differs from the previous results by showing that cyber risk acts as a significant negative moderator, amplifying rather than mitigating the adverse effects of credit risk on Corporate profitability.

Table (7): Feasible generalized least square coefficient model in phenomenon when moderator is added

ROE	Coefficient	Std.	z	P>z
NPLR	-0.10651	0.0531822	-2	0.045
Debt RATIO	-0.2791483	0.0737946	-3.78	0.000
Cyber risk	-0.15875	0.0900947	1.762	0.039
CYBER RISK AS MOD. OF DEBT RATIO AND ROA	-0.000175	0.0001018	1.717	0.043
CYBER RISK AS MOD. OF NPLR AND ROA	0.184827	0.1182517	1.563	0.059
_cons	0.231105	0.0393951	5.87	0.000

Coefficients	**Generalized least squares**
Panels	**Heteroskedastic**
Correlation	**panel-specific AR(1)**
Number of observations	**91**
Number of groups	**13**
Time periods	**7**
Prob > chi2	**0**

Source: STATA V.17 OUTPUT

The feasible generalized least squares model identifies significant correlations that exist between risk elements and Corporate ROE. The coefficient value of -0.10651 in NPLR results (p=0.045) indicates non-performing loans to have a negative impact on Corporate ROE. Research data shows that Debt Ratio negatively affects ROE to such a degree that its coefficient reaches -0.2791483 (p=0.000), producing significant evidence for debt levels causing substantial ROE declines in Corporates. Cyber risk negatively affects ROE to the extent of -0.15875 (p=0.039) according to the analysis.

The study reveals significant moderation through Cyber risk because it weakens the relationship between Debt Ratio and ROE while showing a negative strength of -0.000175 (p=0.043). The research shows a marginally significant positive result regarding NPLR-ROE moderation with a 0.184827 coefficient value (p=0.059). Cyber risk acts to raise the harmful effect of debt ratio on ROE while potentially easing the negative link between NPLR and ROE.

The statistical model presents reliable estimations through a design using panel-specific AR(1) autocorrelation adjustments with heteroskedasticity treatment across 91 observed data points which represent 13 distinct groups distributed across seven time intervals. The highly significant Prob > chi2 value (p=0) confirms the model's overall statistical validity, with a constant term of 0.231105 (p=0.000). These findings differ notably from the ROA analysis, particularly in the magnitude of coefficients and the opposing directions of cyber risk's moderating effects on NPLR versus debt ratio relationships with ROE.

4.1 Discussion

The empirical findings of this study reveal complex relationships between credit risk, cyber risk, and corporate performance in Egyptian corporations, both supporting and extending previous research in several key areas. According to the research findings, NPLR and Debt Ratio credit risk variables negatively affect corporate profitability and these results match the results of previous studies on Egyptian businesses by Salem and Walid (2025) and Abdelraouf and Muharram (2024). Saiz-Sepúlveda and Hernández-Tamurejo (2025) demonstrated that greater credit risks decrease Corporate profitability according to the estimated NPLR coefficients of (-0.0111449) for ROA and (-0.10651) for ROE. Corporate institutions in emerging markets such as Egypt face distinctive

problems from economic uncertainty and regulatory environments making this relationship extremely important. Results from Cyber risk exposure studies show that it negatively impacts ROA by -0.01623 while affecting ROE through -0.15875 which supports the research conducted by Abdelraouf et al. (2024) regarding Egyptian corporate profitability metrics under cyber risk impacts. Contemporary corporate operation cyber risk management strengthens the business importance of cybersecurity through fundamental research done by Saeed et al. (2023) and Tahmasebi (2024).

The study proves the existence of cyber risks in the relationship between credit risk indicators and profitability measurement criteria. The analysis presented in Xu and Chen (2025) demonstrated conformity between their study of information security risks and their discovery of a negative -0.030348 significance value between NPLR-ROA and Debt Ratio-ROA. Building on Pipyros and Liasidou (2025) research this study establishes quantitative data demonstrating how security incidents enhance the impact of credit risk on organizational performance.

The study reveals how various forms of online security threats regulate financial result associations. The impact of Debt Ratio on ROE experiences a negative increase from -0.000175 as cyber risk intensifies yet it simultaneously generates a positive and marginally significant moderation (0.184827) on the NPLR-

ROE relationship. The discovery of these detailed results extends beyond what Ranjan (2025) mentioned about how cyber events activate and escalate credit hazard problems throughout corporate systems. Different performance indicators show distinctive effects from the combined influence between cyber risks and credit risks.

The research data validates the theoretical concepts presented by scholars from the previous year. Failures in risk management lead to the deterioration of internal resources while damaging profitability thus confirming the resource-based analysis in Çelik (2025) and Ferreira and Ferreira (2025). Agency theory proves correct according to Yolanda and Mita (2025) when information asymmetry is shown alongside its influence on risk management framework.

Based on Morshed and Khrais (2025) the study shows how companies need to resolve particular difficulties while quickly digitizing markets that have weak cybersecurity systems. The substantial negative effects of both traditional and digital risks on profitability show the necessity of combining risk management approaches as Burton (2025) recommends for markets like Egypt which need to manage simultaneous traditional and digital risks effectively.

Modern business operations demonstrate increased interdependencies among various risks according to Zaydi et al. (2025) as confirmed by this study. Cyber risk plays a substantial

moderating role which supports the findings of Henkler and Schubart (2025) regarding digital credit evaluation procedures because they increase the synergy between credit risks and cyber risks thus demanding advanced risk management solutions.

5. Conclusion

The research data shows conclusive evidence about how credit risk intersects with cyber risk to affect corporate performance measurements in Egyptian companies. The analysis shows credit risk and cyber risk act as major factors affecting corporate profitability yet cyber risk reinforces credit risk impacts on ROA and produces different effects on calculating ROE. The actual data shows that higher non-performing loan levels together with higher debt ratios negatively impact profitability while these negative effects become more pronounced through the influence of cyber risks. Such discoveries demonstrate essential applications for academic research and practical risk management by showing that organizations need unified approaches which understand financial risk relationships with technological threats. The study underlines the need for developing comprehensive risk management structures that merge credit risk and cyber risk management for corporate managers and policymakers in developing economies since both risks actively affect organizational performance.

5.1 Academic implications

The research provides meaningful additions to academic research concerning corporate risk management combined with performance analysis. The study enhances research about the intricate relationship between corporate credit risk and cyber risk specifically in developing regional economies such as Egypt. New theoretical boundaries are extended through discoverable evidence which demonstrates financial risks uniting with new technological dangers in present-day corporate risk operations. The research provides evidence about cyber risk moderation of credit risk-profitability linkages concerning ROA and ROE which advances risk management knowledge and underscores the necessity of integrated frameworks for interrelated threat assessment.

Academic scholars gain better knowledge about risk measurement practices in emerging markets through the research's quantitative analysis of how distinct risks impact performance measurement across multiple channels. Analysis comparing ROA and ROE shows different effects which enhance research about performance measurement practices and risk assessment methods. The study expands resource-based view and agency theory in risk management by showing how their core concepts could be integrated to explain present-day corporate risk patterns effectively.

The research methods used in this study containing panel AR(1) structures with heteroscedasticity control mechanisms will guide upcoming investigations. This study expands academic knowledge about meaningful methods to study complicated risk relationships in corporate environments because developing economies encounter difficulties with data quality and availability.

5.2 Practical implications

These study results hold wide practical value for management teams in corporations and financial sector regulators and investors. The research reveals to corporate managers that they need to create unified risk management systems which tackle credit risks together with cyber risks. Organizations should merge their risk assessment models that analyze cyber and credit risks because their powerful negative correlations with profitability indicators show isolated risk assessment produces insufficient data.

The analysis highlights the critical nature of developing robust cybersecurity infrastructure because it plays an integral role in all-encompassing credit risk control. Electronic security systems which help businesses perform credit assessment and monitoring need careful evaluation from executives since the current evidence shows cyber risk can escalate credit risk impacts against profitability levels.

This research highlights to both policymakers and regulators in developing markets about creating extensive regulatory guidelines that focus on understanding various related corporate risks. The research demonstrates that regulatory systems need to abandon rigid risk management boundaries by creating assessment systems which track how risks between different categories interact with each other.

Businesses require actionable advice about their investments which prompted the research to tell companies they should examine how cyber risk management programs protect assets and how these initiatives affect debit risk management and overall business revenue. This financial discovery directs companies to distribute their resources better while developing risk management strategies that specifically address emerging markets since resources remain scarce.

Corporate stakeholders together with investors can use the research findings to better assess performance because it shows the combined importance of cyber and credit risk metrics. Stakeholders need to develop performance evaluation approaches which integrate comprehensive assessments of various corporate risk effects on both ROA and ROE metrics to ensure appropriate measurement of organizational performance.

Data availability: The data generated and/or analysed during the current study are available from the corresponding author on request.

Competing interests: The author report no conflicts of interest.

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Appendix A

```
import matplotlib.pyplot as plt
import seaborn as sns
import numpy as np
import pandas as pd

# Define the correlation matrix from the table
data = {
"ROA": [1, 0.806, -0.619, -0.302, -0.596],
"ROE": [0.806, 1, 0.563, -0.460, 0.206],
"Debt Ratio": [-0.619, 0.563, 1, -0.909, -0.490],
"NPLR": [-0.302, -0.460, -0.909, 1, 0.739],
"Cyber Risk": [-0.596, 0.206, -0.490, 0.739, 1]
}# Convert to DataFrame
df_corr = pd.DataFrame(data, index=["ROA", "ROE", "Debt Ratio", "NPLR", "Cyber Risk"])
# Plot the heatmap
plt.figure(figsize=(8, 6))
sns.heatmap(df_corr, annot=True, cmap="coolwarm", center=0, fmt=".3f", linewidths=0.5, square=True)
# Title
plt.title("Heatmap of Pearson Correlation Coefficients")
# Show the plot
plt.show()
```