Moderating Role of Bank Efficiency on the relationship between corporate credit risk and Bank performance

الشركات الدور المعدل لكفاءة البنك على العلاقة بين مخاطر ائتمان وإداء البنك

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الملخص

يختبر البحث تأثيرات المخاطر الائتمانية للشركات على أداء البنوك المصرية وكفاءة البنوك كعامل تعديل لتقديم نماذج تقدير دقيقة وقوية تتنبأ بشكل أفضل بالقيمة المستقبلية لأداء البنوك بناءً على تغير المخاطر الائتمانية للشركات. ولتحقيق هذا الغرض، تم استخدام عينة من ثلاثة وعشرين بنكاً مسجلاً في البنك المركزي المصري، تشمل أحد عشر بنكاً مدرجاً واثني عشر بنكاً غير مدرج في البورصة المصرية خلال الفترة من ٢٠١١ إلى ٢٠٢٠. تم استخدام طريقة الفروق العامة للعزوم (GMM)للكشف عن أي تقديرات مضللة ولتحديد جودة الملاءمة. علاوة على ذلك، كان لنسبة القروض غير

المنتظمة للشركات (CNPL) تأثير سلبي على أداء البنوك من خلال التأثير على العائد على الأصول .(ROA) وأظهرت نتائج طريقة الفروق العامة للعزوم أن كفاءة البنك لم تكن عاملاً معدلاً في تأثير نسبة القروض غير المنتظمة للشركات على العائد على الأصول، وكانت نسبة القروض غير المنتظمة للشركات غير ذات دلالة إحصائية على هامش صافي **الفائدة.(NIM)** .

الكلمات المفتاحية

مخاطر الائتمان للشركات، كفاءة البنوك، الربحية، مصر، العائد على الأصول، صافي هامش الفائدة، مخاطر الائتمان، القروض المتعثرة، البورصة المصرية، البنك المركزي المصري

Abstract:

The research investigates the impacts of the corporate credit risks on the performance of Egyptian accurate and robust estimated models that better predict the future value of bank performance based on the variation of the corporate credit risks. To achieve this purpose, a sample of twenty-three central bank of Egypt (CBE)-registered banks: eleven listed and twelve non-listed banks on the Egyptian stock exchange (EGX) between 2011 and 2020 was used. The Generalized Method of Moments (GMM) was employed to find any misleading estimates and for the goodness of fit. Moreover, the corporate non-performing loan (CNPL) ratio was significant and had a negative effect on bank performance by affecting the return on assets (ROA). The results of the GMM showed that the bank efficiency was not moderated in the banks and moderating efficiency of the banks to provide effect of CNPL on ROA, and CNPL insignificant on net interest margin (NIM).

Keywords: Corporate credit risk, Bank efficiency Profitability, Egypt, ROA, Net interest margin, Credit Risk, Non-Performing Loans, Egyptian stock exchange, Central bank of Egypt.

1.Introduction

The current global climate is extremely dynamic, necessitating greater safety measures and proactive efforts from organizations to improve risk management and stave against bankruptcy risks.

In the last decade, the global economy has fluctuated significantly and negatively affected the companies' financial positions, forcing thousands of firms to go bankrupt. In this respect, the banks become more vulnerable to credit risk, imposing them to inject more capital as a buffer against bankruptcy (Kassem & sakr, 2018).

Credit risk is considered as the most terrifying risk to banks due to its impact size on bank performance. Credit risk is the risk of a borrower's failure to the loan term. In other words, credit risk arises from the borrower's failure to pay back the creditor for the principal and interest that are due.

Therefore, banks have credit risk management that specializes in evaluating the borrower's creditworthiness before accepting or rejecting a loan application to ensure that the credit risk level of the bank is low (Hashem, 2016).

According to the current unstable global conditions, the banks become under a real challenge to protect their assets from devaluation, and they become confused between relaxing or tightening the credit terms of the loans because the economy needs expansion, while the circumstances put the potential borrowers under high level of credit risk. In this respect, the central banks of most of the economies started to increase the capital required ratio to protect their banks from bankruptcy. Therefore, studying the impact of credit and capital risks on bank performance will provide better insights to the professionals about how they affect bank performance and, accordingly, provide better prediction models to the bank performance for achieving better financial results that boost the growth of the economies (Ismael & Ahmed, 2022).

Credit risk is considered one of the most important risks to banks because it has a high probability of occurring and has a severe impact on bank performance compared to the other types of risks

(Medyawati, et al., 2021). Non-performing loan (NPL) ratios of the Corporate non-performing loan (NPL) ratios from the annual reports of the banks of Egypt were collected to conduct a comparative analysis for recognizing how they performed separately during such challenging period of 2011-2020

Figure (1) demonstrate NPL ratios of corporate in Egypt during the period of 2010-2020. The commercial NPL ratio started to reverse the downward trend in 2015, revealing a positive sharp upward trend. As the two NPL ratios do not exhibit the same tendency, their effects on bank performance may differ. Therefore, studying the impact of the corporate credit risk on bank performance in Egypt would provide better insight to professionals and academics for better predication performance.

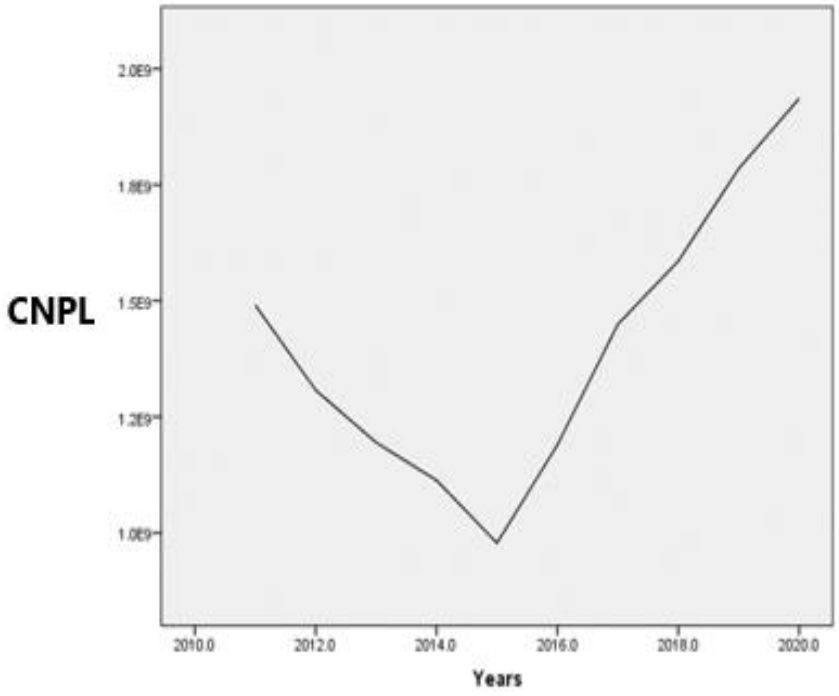

Figure (1)
Corporate NPL ratio in Egypt (2010-2020)
(Source: prepared by the researcher)

Figure (2) shows the bank efficiency in Egypt during the period of 2010-2020. As shown in Figure (2), bank efficiency, which is measured by the operating efficiency ratio, declined sharply in 2018. However, the mean of such a ratio reached 53.5%, showing a poor efficiency level in the banks of Egypt during 2011-2020, which could undermine bank performance. Therefore, the present work is to study the impact of the corporate credit risks on the performance of Egyptian banks to provide better, accurate, customized, and robust estimated models that better predict the future value of bank performance based on the variation of the corporate and credit risks.

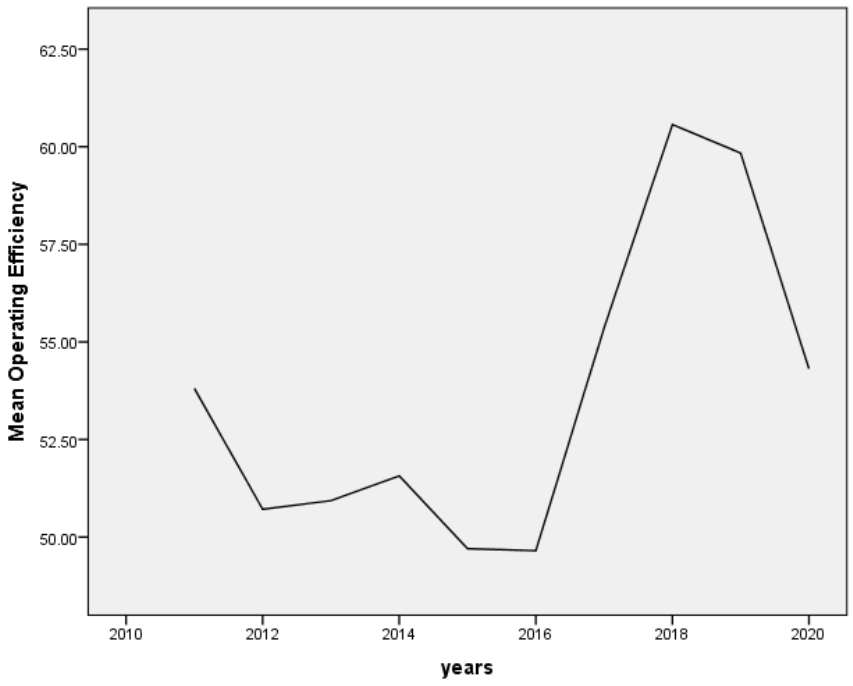

Figure (2)
Bank efficiency (2010-2020)
Source: Prepared by the Author

This paper will be divided into three sections, first focusing on the literature review, following by the research method and data, the last section discusses conclusion and recommendation.

2.Literature Review and Hypotheses development

2.1Corporate credit risk and bank performance

The banks face different types of risks that always hinder their pace of growth and also threaten their survival in the credit markets which consequently slows the growth of the economies. The most common types of risks that always threaten banks' growth and survival in the credit markets are (1) Liquidity risk, (2) Operational risk, (3) Market risk, (4) Solvency risk, (5) Interest rate risk, (6) Foreign Exchange rate risk, (7) Sovereign or Country risk, (8) Credit risk.

The liquidity risk is the risk that the bank may face insufficient funds to meet clients' withdrawals or when the banks don't have sufficient funds to capture new investment opportunities. The banks always have two types of reserves to meet their liquidity needs; (a) Cash reserves and (b) Secondary reserves. If the bank finds that the cash is running out of stock it can sell part of its securities to meet clients' withdrawals or to capture a new attractive profitable investment. Under this situation, selling part of banks' securities could expose the banks to losses since they haven't held till maturity. The liquidity level in the banks is measured by using the loan-to-deposit ratio. In other words, when the banks have such a ratio increases as time passes it means that the banks face a lower level of liquidity compared to the previous year and so on (Ahamed, 2021).

The operational risk is the risk that the bank bears losses due to mistakes made by the people or by the systems. Additionally, the market risk is the risk that occurs when there are spikes in the interest rates, exchange rates, or prices of goods and services leading to deterioration in bank borrowers. The mortgage crisis of 2007-2009 is considered a market risk because the housing bubble hit the economy of the USA affecting negatively the repayment performance of most

of the borrowers and leading to bankruptcy for many banks in the region (Derbali, 2021).

The solvency risk is the risk that the bank doesn't have sufficient equity to cover losses that occurred in the assets which consequently turns the bank into a solvent which means that its liabilities exceed its assets, under this situation, if the bank didn't find any additional fund to be injected in its equity it is probably will go bankrupt. Moreover, the central banks across the globe always set a capital requirement ratio on their banks to ensure that the banks will hold a sufficient amount of equity relative to their risk-weighted assets to avoid any insolvency risk that might threaten their survival and growth in the credit markets (Menicucci & Paolucci, 2016).

The interest rate risk is the risk that changes in market interest rates could affect the profitability and market value of the banks. In other words, the banks in nature issue deposits in short and issue loans in long which always leads to maturity gaps and such gaps make the banks exposed to repricing risks that affect significantly their net interest margins. In this regard, the banks always attempt to narrow the gap between the assets and liabilities to reduce the interest rate risk (Simoens & Vennet, 2021).

Credit risk is the risk that the bank borrowers default on their loans or in other words, the borrowers may probably fail to fulfill their obligations to the banks on time or in full payment. Credit risk is considered the most terrifying type of risk compared to the other types of risks because it frequently occurs and has a rigid impact on banks' survival and growth which forces the banks to carefully study the determinants of credit risk to avoid such threats that leads to catastrophes in the economies around the world. The banks measure the credit risk exposure by using the non-performing loan ratio which is calculated by dividing the NPL by the total gross loans.

In other words, the NPL is a loan that passed the due date without payments for more than ninety days or three months and under such classification, this amount of loans relative to the gross loans will raise the credit risk exposure in the banks (Abiola & Olausi, 2014).

Increases in the NPL ratio mean that the NPLs are increased relative to the gross loans which means that the banks face a higher level of

credit risk than before and such an increase in the ratio has a severe financial and economic implication for the banks and the economy as well. Increases in the NPL ratio mean more loans are about to be written off as bad debt expenses which should be absorbed by the capital held by the bank which is contributed by the stockholders of the equity capital contributor and if the losses exceed the amount which is available in bank's capital will force the bank to become insolvent and increases the probability of the bank to go bankrupt which eventually will weaken the economy and reduces the pace of economic growth (Horobet, et al., 2021).

During the last decade, Egypt faced a continuous decline in the NPL ratio of the banks of Egypt which shows the effectiveness of the bank management in managing their risks to maintain more stable economic conditions in the country. However, Farag et al. (2023) studied the corporate and retail credit risk determinants in the banking sector of Egypt and found that in 2018 the corporate NPL ratio started to reverse the downward line which indicates that the banks of Egypt started to face a higher level of corporate credit risk compared to the retail credit risk which started to struggle the downward line shaping a flat shape.

Farag et al. (2023) argued that most banks provide their financial services to retail and corporate clients. In other words, the retail department of the banks specializes in providing financial services to individual clients who need to open savings accounts or hold an investment certificate to make profits or return on their investments. Additionally, retail or individual clients also ask for personal loans, mortgages, auto loans, credit cards or overdrafts to meet their financial needs.

On the other side, there is a corporate department in the banks that deals with corporate clients who need to open checking accounts and issue checkbooks to support their business transactions and also they ask for industrial and commercial loans to support their business operations.

Accordingly, the bank has two divisions in their credit risk departments one for evaluating, measuring and managing the retail credit risk of the retail clients and the other one for the corporate

clients. In this regard, the risk that individual borrowers might fail to fulfill their obligations to the banks is classified as a retail credit risk while those corporate borrowers who have the risk of failing on their loans are called corporate credit risk. the retail credit risk is measured by dividing the retail NPLs by the total retail loans while the corporate credit risk is measured by dividing the corporate NPLs by the total corporate loans. Increases in such ratios will raise the credit risk exposure in the banks and make the banks more sensitive to the macro- and microeconomic determinants (Farag, et al., 2023).

On one side, Abiola & Olausi (2014) found that credit risk has a positive significant impact on bank performance in Nigeria arguing that there are no regulatory measures in place at commercial banks to manage credit risk effectively. The banks charge other customers higher interest rates on loans as a way of offsetting the cost of loan default.

On the other side, Ruziqa (2013), Gizaw et al., (2015) and Kayode, et al. (2015) argue that credit risk has a negative significant impact on bank performance stating that increases in credit risk means more loan defaults which increase banks' bad debt expenses relative to income and consequently devaluates the performance of the banks along with lower levels of bank profitability.

In addition, In Sri Lanka, Rajkumar & Hanitha (2015) applied the CAMEL model as a proxy for credit risk and found that it has a significant impact on bank performance which is measured by the ROE. In Kenya, Muriithi, et al. (2016) and in Nepalese, Bhattarai (2016) found that credit risk has a significant negative effect on bank performance of commercial banks which indicates that banks with high-quality portfolios will have better financial results than improve their financial performance. Additionally, in Yemen, Almekhlafi, et al. (2016) found that credit risk is negatively related to bank performance.

Kani (2017) found that credit risk is negatively related to bank performance in African countries that are members of the West African Economic and Monetary Union. Additionally, Isanzu (2017) found that credit risk has a negative effect on bank performance in

Chinese banks. Moreover, In Pakistan, Hamza also found the same results as Isanzu which shows the inverse relationship between credit risk and bank performance. Further, In Bangladesh, Noor et al. (2018) found that credit risk is negatively related to the ROI, while in Iran, Ahmadyan (2018) and in Uganda, Serwadda (2018) studied the impact of credit risk on bank performance and found that the NPL ratio is statistically significant and can affect the value of bank performance.

H1: There is a significant impact of corporate credit risk on bank performance in Egypt.

2.2Moderating role of bank efficiency on corporate credit risk and bank performance

Additionally, Ekinci & Poyraz (2019) in Turkey and Islam et al. (2019) in Bangladesh also found that there is a negative relationship between credit risk and bank performance. Additionally, In South Africa, Munangi and Sibindi (2020) found that credit risk is negatively related to bank performance which shows the importance of holding high-quality loans in bank portfolios to enhance the profitability levels of the banks.

Moreover, In Iraq, Al-Husainy & Jadah (2021) employed the Fixed-effect and GMM and In the United Arab Emirates, Zaidanin & Zaidanin (2021) employed the Random-effect model and found that credit risk is negatively related to the ROA. Further, Kwashie et al. (2022) employed the Random-effect model and found that credit risk is negatively related to ROA and EVA used as a proxy for bank performance in the commercial banks of Ghana.

The credit risk is the risk when the borrowers fail to meet their bank obligations. The banks classify the loans in terms of borrowers' repayment performance. In other words, the loans that are repaid on time are classified as performing loans, while the loans that passed the due date for more than 90 days are classified as nonperforming loans (NPL). The banks divide the NPLs by the total loans to see how much loans are doubted to be collected from the outstanding loans

because such a formula helps the banks measure their credit risk exposure (Farag, et al., 2023).

A higher level of NPL ratio would terrify the banks and threaten their survival in the markets. In other words, increases in the NPL ratio would reduce the size of the assets since the loans represent the main assets of the banks thus deteriorating the solvency level of the banks because the equity absorbs any losses that occur in banks' assets and thus threatens banks' solvency and survival (Derbali, 2021). In this regard, increases in credit risk drive the capital risk up, that's why the regulators carefully review the capital adequacy ratio which represents the amount of equity held by the bank relative to the risk-weighted assets to evaluate the solvency level of the bank of whether being able to cover the expected losses or not.

The banks of Egypt disclose the NPL ratio as a whole without disclosing directly the NPL ratio into retail and corporate which seems a little bit strange since some of the papers found that both the retail and corporate credit risks are affected differently by the macro- and microeconomic factors (Farag, et al., 2023). The retail loans represent the loans granted to the individual clients of the banks such as auto loans, mortgages, credit cards, and personal loans while the corporate loans are loans granted to the corporate clients of the banks such as commercial and industrial loans and overdraft loans. The retail and corporate NPL ratios are calculated the same way as the total NPL ratio by dividing the retail and corporate NPLs by their relevant loans to measure the corporate and retail credit risk exposure in the banks (Sarkar & Rakshit, 2023).

In European countries, the effect of bank-specific variables on bank performance has been investigated by employing the regression method using a sample of 35 European banks from 2009 to 2013. The ROA, ROE, and NIM are used as measurements of bank performance while, bank size, capital ratio, loan ratio, deposits, and loan loss provisions were used as the dependent variables. The results found that bank size is statistically significant and has a positive relationship

with the ROA, ROE, and NIM which shows the importance of increasing the size of bank assets to exploit the advantage of the economies of scale to generate more profits. Additionally, increases in bank assets will raise the diversification levels which consequently reduces the unsystematic risks, and thus, more profits will occur.

In Europe, Li, et al. (2014) explored the effect of credit risk on bank performance by using the NPL and capital adequacy ratios as proxies for credit risk while the ROA and ROE as measurements for bank performance using the period of 2007-2012. The results showed that the NPL ratio and bank size were found significant and negatively related to the ROA and ROE while CAR was insignificant which means increases in the NPL ratio indicate a higher level of credit risk exposure in the banks of Europe which affect significantly the size of both the ROA and ROE.

Moreover, the capital ratio has a positive significant impact on bank performance arguing that more capitalized banks will have lower costs of debt and bankruptcy which consequently raises the profitability levels. Furthermore, the loan ratio was found to be significant and has a positive significant impact on NIM, which means that more loans from deposits will raise the profitability levels of the banks in the Euro area. In addition, the deposit ratio was found to be significant and has a positive relationship with the ROA and ROE (Menicucci & Paolucci, 2016).

Abbas et al. (2019) employed the GMM to conduct a comparative study between Asia and the USA in examining the impact of capital risk, liquidity risk and credit risk on bank performance which is measured by the ROA covering the period of 2011-2017. The bank performance was measured by using the ROA and ROE whereas, the equity to risk-weighted assets as a proxy for the capital risk and the liquid assets to total assets as a measurement of the liquidity risk and the provision for loan losses to total risky loans as a proxy for the credit risk. The findings revealed that the capital and liquidity risks have a positive significant impact on bank performance in the Asia

and USA. Additionally, the results revealed that credit risk negatively affects bank performance in both countries, which shows the importance of carefully managing the creditworthiness of the loan applicants to make prudent credit decisions that improve the profitability levels of Chinese and American banks for better economic conditions.

Additionally, non-interest income has a positive association with bank performance which shows more income diversification that consequently raises the level of profitability in banks. Additionally, the capital adequacy ratio was found significant and has a positive relationship with bank performance, arguing that more capitalized banks are bearing low costs of financing, strengthening bank performance.

Moreover, Hasan et al. (2020) studied the determinants of bank performance in Indonesia by using the regression technique for data analysis utilizing a sample of twenty-six banks during 2007-2018. The findings showed that bank efficiency, capital, and liquidity risks are statistically significant which means that they affect bank performance (Hasan, et al., 2020).

The determinants of bank performance have been studied in Central and Eastern Europe (CEE) by using GMM for data analysis during 2009-2018. The empirical results showed that the credit and capital risks as a bank-specific variable are statistically significant and have a negative relationship with bank performance, while the macroeconomic variables such as; inflation, unemployment rate, and budget balance are negatively related to bank performance(Horobet, et al., 2021) .

Moreover, in the United States of America and Europe, the factors that affect the market-to-book (MB) ratio have been studied by using panel regression techniques for data analysis using the period of 2007-2017 utilizing a sample of 112 European and US banks. The results revealed that profitability and cost efficiency are statistically significant and have a positive relationship with the MB ratio, while net interest margin and credit risk are negatively related to the MB ratio (Simoens & Vennet, 2021).

Moreover, the impact of financial technology on bank performance was studied by using a fixed-effect regression technique for data analysis from 2014 to 2020. The ROA is used as a proxy for bank performance, while Automated Teller Machines (ATM), internet, and mobile banking transactions were used as proxies for financial technology. The empirical results found that mobile and internet banking are statistically significant and can affect bank performance (Medyawati, et al., 2021).

H2: There is a significant moderating role of bank efficiency on the relationship between corporate credit risk and bank performance in Egypt.

Upon reviewing the literature, it has been found that there are no studies conducted globally that assess the influence of corporate credit risks on bank performance.

Therefore, studying the impact of corporate credit risk in the commercial banks of Egypt to fill the literature gap. The present study will provide better estimates of the future movement of the corporate credit risk for better credit risk management that can boost the growth of the Egyptian economy.

Also, the present research will give insights to the academics about the importance of classifying the credit risk into corporate to have better comprehension to their impact. This will motivate the academics to work on preparing precautionary plans to provide better financial results to the commercial banks to be more able to survive and grow in the markets.

3.Methods and data

The research design is empirical research since it uses quantitative methods to test the hypotheses of the research and to create an estimated model to estimate the future values of the bank performance based on monitoring the movement of the corporate and retail credit risks during 2010-2020.

The sample size of the research is a sample of twenty-three banks registered in CBE: eleven listed and twelve non-listed banks in the

Egyptian stock exchange (EGX) as shown in Table (1) of the list of banks in the sample.

Table 1: List of banks in the sample

Bank Name
Commercial International Bank (CIB)
Abu Dhabi Islamic Bank (ADIB)
EG Bank
Suez Canal
Credit Agricole Egypt
National Bank of Kuwait (NBK)
Qatar National Bank (QNB) Alahli
Societe Arabe Internationale de Banque (SAIB)
Al Baraka Bank of Egypt
- Arab Banking Corporation (ABC)
- National Bank of Egypt (NBE)
- Ahli Bank of Kuwait (ABK)
- Bank Misr
- Blom
- HSBC
- Arab Bank
- First Abu Dhabi (FAB)
- Ahli United Bank (AUB)
- Arab African International Bank (AAIB)
- Housing and Development Bank (HDB)
- Faisal Islamic Bank of Egypt
- Alex Bank
- FAB

The research used these twenty-three banks in the sample out of thirty-seven banks after excluding the specialized banks as they operate with different versions and policies than the other commercial banks and also because they focus on the commercial level than the individual ones. Moreover, the study period is from 2011 to 2020 because before 2010 no disclosure was found for the NPL ratio and to exclude 2021, 2020, and 2023 because it wants to exclude the pandemic effect from the data to avoid any unbiased estimates of such extraordinary events that haven't continued in our normal events.

The research aims to examine the impact of the corporate credit risk on bank performance using the bank efficiency as the moderating variable to assess its role in strengthening the effect of the classified credit risks on banks performance. To do so, the research employs the GMM method for data analysis to estimate the future value of Egypt's banks' performance. The study is limited to the period of 2010-2020 to avoid the COVID-19 effect, which could lead to biased estimates in the model because the COVID-19 period considered extraordinary events.

Table 2: Research Variables and Measurement

Type	Variable	Symbol	Measurement
Dependent variables	Bank Performance	NIM	Net Interest Margin = (Interest income – interest expenses) / Total assets
Dependent variables	Bank Performance	ROA	Return on Assets (ROA) = Net Income / Total Assets
Independent variables	Corporate Credit risk	CNPL	Corporate Impairment Loan Ratio = Corporate Impairment/Total Loans
Moderating variables	Bank efficiency	BEFF	Efficiency ratio=operating Expense/operating Income

Source: Prepared by the Author

To test hypotheses presents the results of quantitative methods to find answers to the research's early stated questions and attain research objectives. The first section is descriptive statistics, which describes the collected data in terms of observations, mean, standard deviation, minimum, and maximum to ensure that the dataset is free from any strange data or illogical conceptions. In addition, the second section examines the stationary of the research data set to ensure that the data is stationary because it is a prerequisite to be stationary before being GMM to avoid any misleading estimates and for the goodness of fit. The last section shows the results of the GMM to test the hypotheses and provide a detailed discussion between research results and literature findings.

3.1Empirical analysis

Table 3: Descriptive statistics

Variable	Observations	Mean	Standard deviation	Min	Max
NIM	230	0.0413823	0.0145225	0.0106088	0.0821745
ROA	230	0.016698	0.02192	-0.0586985	0.2738
CNPL	230	0.0812931	0.0881903	0.0000806	0.7350476
BEFF	230	0.536454	0.1241633	0.1177307	0.8842827

Source: Authors' calculations using GMM

Descriptive statistical analysis gives an in-depth overview or presentation of data, including measures such as the mean, standard deviation, maximum, and minimum values, Table 3 illustrates the descriptive analysis for each factor examined included in the study. All of the variables applied in this study show an acceptable distribution, empty of any outliers. This can be viewed by the mean values of the factors exceeding the associated standard deviations.

Based upon the outcomes of descriptive statistical analysis, one might conclude that: This section describes the collected data in terms of observations, mean, standard deviation, minimum, and maximum to ensure that the dataset is free from any strange data or illogical conceptions. Table 3 shows that the number of observations is 230 since the research covers 23 banks for a study period from 2011-2020. The mean of the NIM is 4.13%, which means that the average net interest margin is 4.13 % in the banks of Egypt and has a low standard deviation of 0.145225, showing that the dataset of the NIM is stable and has low dispersion from the mean. The maximum NIM is 8.21%, while the Min is 1.06%. Further, the mean of the ROA is 1.67%, which means that the average return on assets is 1.67% in the banks of Egypt and has a standard deviation of .02192, indicating that the dataset of the ROA is stable and has a low dispersion from the mean. The Max ROA is 27.38%, while the Min is -5.86 %.

Moreover, the mean of the CNPL is 8.13%, which means that the average corporate non-performing loan ratio is 8.13% in the banks of Egypt and has a standard deviation of 0.0881903, signifying that

the dataset of the CNPL is stable and has low dispersion from the mean. The Max CNPL is 73.50 %, while the Min is 0.00 %.
Additionally, the mean of the BEFF is 53.6%, which means that the average BEFF is 53.64 % in the banks of Egypt and has a standard deviation of 0.1241633, showing that the dataset of the BEFF is stable and has low dispersion from the mean. The Max BEFF is 88.42% while the Min is 11.77%.
According to the statistical analysis, the research has no illogical dataset and is ready to be analyzed and tested for stationery.

Table (4) presents the correlation coefficient of the statistical measures.

The following findings can be obtained from Table (4)
The correlation coefficient is a statistical measure that describes the strength and direction of the relationship between two variables.

Table 4: Shows the Correlation Matrix of Dependent and Independent Variables

	Net interest	**ROA**	**Operating efficiency**	**CNPL**
Net interest	1			
ROA	0.3957 (0.0000)	1		
Operating efficiency	-0.6280 (0.0000)	-0.2186 (0.0000)	1	
CNPL	-0.3203 (0.0000)	-0.2969 (0.0000)	0.1733 (0.0085)	1

Source: Authors' calculations using GMM

Net interest Margin: It has a positive correlation of 0.3957 with ROA (Return on Assets), indicating a moderate positive relationship. The p-value is 0.0000, which means the correlation is statistically significant. It has a negative correlation of -0.6280 with Operating Expenses, indicating a strong negative relationship,

significant at the 0.0000 level. It has a negative correlation of -0.3203 with Corporate NPL.ROA: It is positively correlated with Net Interest Income (0.3957). It has a negative correlation of -0.2186 with Operating Expenses, which is significant (p = 0.0008). The correlation with Corporate NPL is -0.2969 (significant). Operating Expenses: Negatively correlated with Net Interest Income (-0.6280). Positively correlated with Corporate NPL (0.1733), but this is weaker than other correlations and has a p-value of 0.0085, indicating it's less significant.

Corporate NPL: Negatively correlated with Net Interest Income (-0.3203) and ROA (-0.2969). Positively correlated with Operating Expenses (0.1733) and positively correlated with Corporate NPL (0.3868).

In this section the research used the Augmented Dickey Fuller test to assess the stationary of the data set because it is prerequisite to have stationary data before analyzing the data. Accordingly, as shown in table (4) the research found that some of the data are non-stationary such as ROA, CNPLA and BEFF which resulted in taking the first difference and then retested the data by the ADF test and consequently the data became stationary and ready to be analyzed by the generalized method of moments (GMM) to test the hypotheses.

Table 5 shows stationary test

Variables	P-value Before 1st lag	P-value After After 1st lag
NIM	0.0000	0.0000
ROA	0.1399	0.0000
CNPL	0.2649	0.0000
BEFF	0.4501	0.0027

Source: Authors' calculations using GMM

From table 5 the data becomes stationary and ready for analysis to test the hypotheses and to meet research objectives. Accordingly, the research employed the one-step GMM to create Two models: the first one is to examine the effect of the BEFF on the ROA and NIM
H1: There is a significant impact of corporate credit risk on bank performance in Egypt.

Table (6) shows GMM of CNPL on ROA model

Variable	Coef.	P-value
Constant	0.0017	0.233
CNPL	-0.0742059	0.021
Sig (**Wald Chi-Squared Test**)		0.016
Arellano-Bond		
AR (1)		0.091
AR (2)		0.096
Sargan test		0.295

Source: Authors' calculations using GMM

Wald Chi-Squared The p-value is 0.016, which is statistically significant at the 5% level, indicating that the model as a whole is significant.
Coefficient Estimates Corporate NPL Coefficient: -0.0742: This suggests that a one-unit increase in the lagged value of Corporate Non-Performing Loans (NPL) is associated with a decrease of approximately 0.0742 units in the dependent variable ROA (Return on Assets), holding other variables constant .P>|z| = 0.021: The coefficient is statistically significant at the 5% level (p-value = 0.021), indicating a meaningful relationship between Corporate NPL and ROA .

(Constant): Coefficient: 0.0017: The constant term represents the expected value of the dependent variable ROA when all independent variables are zero. P>|z| = 0.233: The constant term is not statistically significant.

Diagnostic Tests: Arellano-Bond Test for AR(1) and AR(2):AR(1) test (Pr > z = 0.091): The p-value is not significant, indicating no significant first-order autocorrelation in the differenced residuals, which is expected in dynamic models.
AR (2) test (Pr > z = 0.096): The p-value is 0.096, indicating no significant second-order autocorrelation. This is important as the presence of second-order autocorrelation would indicate that the instruments may not be valid.
Sargan Test: Prob > chi2 = 0.295: The Sargan test checks the validity of the instruments. A p-value of 0.295 suggests that the instruments are valid (i.e., they are not correlated with the error term).

H2: There is a significant moderating role of bank efficiency on the relationship between corporate credit risk and bank performance in Egypt.

Concerning to the Return on assets (bank performance)

Table (7) shows GMM of CNPL &BEFF on ROA model

Variable	Coef.	P-value
Constant	0.0017866	0.221
CNPL	-.0669329	0.049
BEFF	-.0.0454266	0.189
CNPL*BEFF	-.023639	0.980
Sig (Wald Chi-Squared Test)		0.015
Arellano-Bond		
AR (1)		0.101
AR (2)		0.111
Sargan test		0.864

Source: Authors' calculations using GMM

Overall Model Significance
Wald test Prob > chi2 = 0.015: This indicates that the overall model is statistically significant at the 5% level, meaning that the independent variables collectively have a significant impact on the dependent variable, which is the lagged Return on Assets (ROA).

Interpretation of Coefficients: Operating Efficiency **(Coefficient: -0.0454266, P > |z| = 0.189)** The coefficient for Operating Efficiency is negative, suggesting that higher operating efficiency (lower costs relative to income) may be associated with lower ROA in the subsequent period, although this effect is not statistically significant (p = 0.189).

Operating Efficiency (Coefficient: -0.0454266, P > |z| = 0.189) The coefficient for Operating Efficiency is negative, suggesting that higher operating efficiency (lower costs relative to income) may be associated with lower ROA in the subsequent period, although this effect is not statistically significant (p = 0.189).

Corporate NPL (Coefficient: -0.0669329, P > |z| = 0.049): The coefficient for Corporate Non-Performing Loans (NPL) is negative and statistically significant at the 5% level (p = 0.049). This suggests that an increase in corporate NPLs is associated with a decrease in ROA in the following period.

Moderating effect Interaction Term (Operating Efficiency, Corporate NPL) (Coefficient: -0.0236369, P > |z| = 0.980): The interaction term between Operating Efficiency and Corporate NPLs is not statistically significant (p = 0.980). The very wide confidence interval (-1.840764 to 1.79349) and the near-zero coefficient suggest that there is no evidence of a moderating effect of Operating Efficiency on the relationship between Corporate NPLs and ROA.

Conclusion: This implies that, based on this model, the effect of corporate credit risk on bank performance is not significantly altered by the level of bank efficiency.

Constant (Coefficient: 0.0017866, P > |z| = 0.221): The constant term is not statistically significant (p = 0.221), indicating that when

all independent variables are zero, the predicted value of the dependent variable (ROA) is not significantly different from zero.

Diagnostic Tests is Arellano-Bond Test for AR (1) and AR (2):

AR (1) Test (P > z = 0.101): The test suggests no evidence of first-order serial correlation in the first-differenced errors.

AR (2) Test (P > z = 0.111): The test indicates no evidence of second-order serial correlation, which is desirable in GMM models.

Sargan Test of Overidentifying Restrictions (P > chi2 = 0.864):

The Sargan test checks for the validity of the instruments. With a p-value of 0.363, the test suggests that the instruments are valid, as we fail to reject the null hypothesis that the instruments are uncorrelated with the error term.

Concerning to the Net interest margin (bank performance)

Table (8) GMM of CNPL &BEFF on NIM model

Variable	Coef.	P-value
Constant	0.0009872	0.097
CNPL	-.0009442	0.946
BEFF	-.0540666	0.000
CNPL*BEFF	0.6171747	0.100
Sig (**Wald Chi-Squared Test**)		0.000
		0.100
Arellano-Bond		0.133
AR (1)		0.524
AR (2)		
Sargan test		

Source: Authors' calculations using GMM

Overall Model Significance, Wald test Prob > chi2 = 0.000: The overall model is highly significant, suggesting that the explanatory

variables collectively have a strong impact on the dependent variable, Net Interest Margin (NIM).

Coefficients Operating Efficiency (Coefficient: -0.0540666, P > |z| = 0.000): The Operating efficiency has a statistically significant negative effect on Net Interest Margin (NIM). The negative coefficient indicates that as banks improve their operating efficiency (reduce costs relative to income), their NIM decreases. This could suggest that more efficient banks either operate with tighter margins or pass on efficiency gains to customers in the form of lower interest margins.

Corporate NPL (Coefficient: -0.0009442, P > |z| = 0.946):The coefficient for Corporate Non-Performing Loans (NPLs) is not statistically significant, indicating that corporate credit risk, as measured by NPLs, does not have a direct and significant impact on NIM in this model.

Interaction Term (Operating Efficiency*CorporateNPL) (Coefficient: 0.6171747,P > |z| = 0.100):The interaction between Operating Efficiency and Corporate NPLs is statistically insignificant, suggesting that the effect of operating efficiency on NIM is moderated by the level of corporate NPLs. A positive coefficient for the interaction term indicates that as corporate credit risk (NPLs) increases, the negative impact of operating efficiency on NIM is reduced.

Constant (Coefficient: 0.0009872, P > |z| = 0.097): The constant term is marginally significant, indicating that when all independent variables are zero, the predicted NIM is slightly above zero but not strongly significant. Diagnostic Test: Arellano-Bond Test for AR (1) and AR (2):

AR (1) Test (P > z = 0.100): No evidence of first-order serial correlation, which is a positive sign for the model's reliability.

AR (2) Test (P > z = 0.133): No evidence of second-order serial correlation, indicating that the model is well-specified with respect to autocorrelation. Sargan Test of Overidentifying Restrictions (Prob > chi2 = 0.885): The high p-value indicates that the instruments

used in the model are valid, as there is no evidence that they are correlated with the error term.

Table (11) Hypotheses Test

Hypotheses	**Accepted/Rejected**
H1: There is a significant impact of corporate credit risk on bank performance in Egypt.	**Accepted**
H2: There is a significant moderating role of bank efficiency on corporate credit risk and bank performance in Egypt.	**Rejected**

4.Discussion

In this section, the current study results are addressed, and the research findings are investigated to clarify and justify the reasoning underlying the research findings. Moreover, research findings are compared with those reported in the literature to confirm the significance of the present findings in filling the gap in the literature

The GMM was employed to test the hypotheses and avoid any unbiased estimates by addressing the endogeneity problem, which always increases the error term in the other regression estimates. The results of the Sargan test proves that the GMM eventually tackled the problem of the endogeneity, increasing from the robustness level of the estimated models to have better prediction performance to the bank performance in terms of the variations in credit risk and operating efficiency.

Consequently, GMM was utilized to investigate the impact corporate credit risk on bank performance using operating efficiency as the moderating variable to assess the role of bank efficiency in affecting bank performance.
The research focused on using the NPL ratios to measure the credit risk exposure in the banks of Egypt. The NPL ratio always plays a very crucial role as an early alert indicator of any coming bad debt expenses as it helps the banks to ensure that they have enough capital ready to absorb any of such losses.

Also, it provides better insights of either relaxing or tightening the credit terms on loans to control over the size of the credit risk, which also drives the insolvency risk and threatens banks survival and growth in the markets and weaken their productivity in supporting the growth of the economies.

Additionally, the research considered all the important proxies of bank performance such as ROA and NIM to increase the robustness of the estimated model and avoid any unbiased estimates. Moreover, it used the expenses to total income ratio to measure the impact of the operating efficiency on the effect of the credit risk on bank performance. This will provide better insights to the professionals to recognize how bank efficiency is important and correlated to the size of the credit risk effect on bank performance.

Therefore, professionals acquire improved efficiency in asset management to have healthier finances and better financial results. In this respect, the research investigates corporate credit risk to increase the accuracy of the results and avoid biased estimates by using the corporate impairment loan ratios as proxies for the independent variables. The present results have revealed that the corporate non-performing loan (CNPL) ratio, which is the proxy for corporate credit risk, is significant and has a negative effect on bank performance by affecting the ROA

On the other side, the results of the GMM also have revealed that the bank efficiency is not moderated in the effect of the CNPL on ROA. Furthermore, the GMM findings also have shown that the CNPL are insignificant on NIM, which means that their variations cannot affect significantly the value of the NIM.

In this regard, the GMM unveiled that the corporate credit risk has a negative significant effect on bank performance which is consistent with the findings of several previous investigations. For example, , Munangi and Sibindi (2020), Simoens & Vennet, 2021, Zaidanin & Zaidanin (2021), Al-Husainy & Jadah (2021), Siddique, et al. (2021), Kwashie et al. (2022), and El-Mahdy (2023) have reported

that that increasing the corporate NPL ratio leads to rises in the bad debt expenses relative to the total expenses, which affect the profitability levels and thereby lowering the value of the profit margins in banks.

Accordingly, the research accepts H1 that the CNPL affects significantly the financial performance of the banks of Egypt. Furthermore, regarding the moderation effect, the findings of the GMM has revealed that operating efficiency plays a sensitive role in strengthening the effect of the credit risk on bank performance, arguing that decreases in credit risk reduce the bad debt expenses relative to income, resulting in increasing the efficiency level of the banks and thus enhancing the profitability levels. In this regard, the research accepts H1, which states that the operating efficiency in the banks plays a significant moderating role in enhancing banks' performance.

5.Conclusion

The purpose of the study is to determine the impact of the corporate credit risk on the financial performance of the banks of Egypt and assessed the role of bank efficiency in strengthening the effect of credit risk on bank performance.

In this respect, the research employed the Generalized Method of Moments (GMM) to test the hypotheses and to avoid any unbiased estimates by addressing the endogeneity problem, which always increases the error term in the other regression estimates.

The results of the Sargan test proves that the GMM eventually *t*ackled the problem of the endogeneity increasing from the robustness level of the estimated models to have better prediction performance to the bank performance in terms of the variations in credit risk and operating efficiency.

Consequently, the research utilized GMM to investigate the impact of corporate credit risk on bank performance using operating efficiency as the moderating variable to assess the role of bank efficiency in affecting bank performance.

The results have revealed that the bank's operational efficiency plays a pivotal role in strengthening the impact of the categorized credit risks on bank performance, which clarifies and confirms the importance of working on enhancing the operational efficiency of the banks to improve the performance and achieve better support in the growth of the economies. Also, it has been found that the corporate non-performing loan (CNPL) ratio, which is the proxy for corporate credit risk, is significant and has a negative effect on bank performance by affecting the ROA.

On the other side, the results of the GMM also have shown that the bank efficiency is not moderated in the effect of the CNPL on ROA. Furthermore, the GMM findings also have revealed that the CNPL is insignificant on NIM, which means that their variations cannot affect significantly the value of the NIM.

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