

Article

Credit Risk Determinants in Selected Ethiopian Commercial Banks: A Panel Data Analysis

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Abstract: The study aims to investigate the factors that contribute to credit risk in Ethiopian commercial banks, considering both macroeconomic and bank-specific factors. The research utilized multiple regression models, a quantitative research approach, and explanatory research designs. A purposive sample technique was used to select 10 commercial banks for the study, and secondary data from audited financial reports were analyzed. The findings of the study reveal a significant positive relationship between credit risk and several variables, including bank size, profitability, efficiency, capital adequacy, and inflation. Conversely, there is an inverse relationship between credit risk and both loan growth and currency rates. Surprisingly, the study found that neither GDP nor interest rates have a significant impact on credit risk. Based on these findings, the study provides recommendations for Ethiopian commercial banks. It suggests maintaining adequate levels of capital, avoiding business in sectors influenced by inflationary pressures, carefully evaluating non-interest income, and adjusting lending policies as necessary. Furthermore, the study advises periodically examining the relationships between GDP growth, interest rates, and credit risk. It also emphasizes the importance of adapting credit risk management practices to changing market conditions and staying vigilant toward emerging trends.

Keywords: credit risk; macroeconomic factors; bank-specific factors; Ethiopian commercial banks



Citation: Muhammed, Seid, Goshu Desalegn, Maria Fekete-Farkas, and Emese Bruder. 2023. Credit Risk Determinants in Selected Ethiopian Commercial Banks: A Panel Data Analysis. *Journal of Risk and Financial Management* 16: 406. <https://doi.org/10.3390/jrfm16090406>

Academic Editor: Thanasis Stengos

Received: 17 July 2023

Revised: 3 September 2023

Accepted: 8 September 2023

Published: 11 September 2023



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1. Introduction

In today's ever-changing and unpredictable business environment, banks face a range of significant risks, including default, liquidity, operational, market, foreign exchange, and interest rate risks (Tole et al. 2019). Indeed, credit risk is a prominent and significant risk that has a substantial impact on the viability and overall performance of financial institutions (Bhattarai 2019). The banking sector's primary goal is to gather public funds to provide credit, support business expansion, and contribute to a thriving economy; however, the risk of borrowers defaulting on their obligations poses a significant challenge for banks, as it has consequences for the overall stability of the financial system (ALrfai et al. 2022). The global financial crisis, the eurozone crisis, and major corporate collapses serve as clear examples that highlight how credit risk can have far-reaching consequences (Bhattarai 2019).

Scholars and institutions have different interpretations of credit risk, but it is generally understood as the likelihood that a borrower will not meet the agreed-upon terms, including timely repayment of both interest and principal (Saunders and Cornett 2008). Inadequate

protocols for assessing credit risk can significantly impact the operational efficiency of financial institutions and potentially lead to liquidity problems (Tesfay 2016). Bank failures and challenges have multiple causes, but commonly cited factors include insufficient credit risk standards for clients and borrowers, ineffective management of credit risk in loan portfolios, and a lack of awareness regarding changes in economic dynamics that could negatively affect counterparty creditworthiness (Raiter 2021).

Ethiopia, a developing country in Africa, also experiences similar circumstances. The banking sector plays a crucial role in Ethiopia's economy, and it accounts for around 93 percent of the total capital in the financial sector and contributes 4.2 percent to Ethiopia's national economy (Abate and Kaur 2023). Ethiopian commercial banks have a significant reliance on loans, which account for a substantial portion of their assets, ranging from 50 to 75 percent, and their primary focus is on providing consumer loans as a means to generate revenue and meet the demand for credit. However, this heavy dependence on loans exposes them to significant risks associated with non-performing loans (NPLs), which can pose harm to the overall financial system (Assfaw 2018). The accumulation of non-performing loans (NPLs) in Ethiopian commercial banks can be attributed to multiple factors. These factors include economic downturns, macroeconomic instability, and specific issues related to individual banks that contribute to credit risk (Kotiso 2018). The macroeconomic factors that affect credit risk include GDP growth, inflation, unemployment, interest rates, and currency fluctuations (Morina 2020). In contrast, certain characteristics such as bank size, lending volume, profitability, deposits, liquidity, and capital adequacy can be considered microeconomic factors that influence credit risk in the banking sector (Naili and Lahrichi 2022).

In order to develop a strong credit risk management framework, it is crucial to conduct empirical investigations that examine current management practices and identify the factors that contribute to credit risk. Despite numerous studies carried out in various countries to explore the determinants of credit risk, the outcomes have displayed inconsistencies. For instance, Carvalho et al. (2022) revealed a negative correlation between GDP growth and credit risk in their examination of macroeconomic determinants within the Eurozone. In contrast, Lu (2013) in research conducted in China, emphasized the substantial influence of inflation, exchange rates, unemployment, and interest rates on credit risk, while observing no discernible impact stemming from GDP growth. Wairimu and Gitundu (2017) observed a positive relationship between loan growth and credit risk in Kenya. However, the impact of the GDP growth rate and lending rates on credit risk appeared to be relatively less significant compared to other factors mentioned. In contrast, the Raiter (2021) study in Ethiopia found that GDP growth, efficiency, and bank size showed inverse relationships with credit risk. In summary, even though the inconsistencies in results could be attributed to variations in the data analysis methods employed by different researchers, as well as differences in the economic conditions of the countries where banking sectors operate, the previous findings' inconsistencies are implications that indicate there is still room for more research.

On the other hand, the previous research on credit risk determinants in Ethiopia has produced a range of findings, indicating the complexity of this aspect in financial analysis. Several esteemed researchers, including Kotiso (2018), Tole et al. (2019), Malede (2014), Dessie (2016), Asfaw and Veni (2015), and Kitila et al. (2020), have contributed valuable insights to this field within Ethiopia. However, it is important to note that certain key variables such as foreign exchange rates, profitability, and capital adequacy were not adequately addressed in these studies. Only Kitila et al. (2020) included capital adequacy as a factor to consider, and Dessie (2016) included profitability as a factor to consider. However, none of the other researchers mentioned these variables or addressed them in depth. Additionally, the variable foreign exchange was overlooked in many earlier studies, highlighting a promising area for exploration.

In conclusion, given the high level of credit risk in Ethiopian commercial banking sectors and the inconsistencies found in previous research findings, as well as the significant

impact of foreign exchange rates on credit risk that has not been explored by previous studies, our objective is to fill these gaps through our research. This study aims to explore credit risk determinants within selected Ethiopian commercial banks by considering variables such as GDP, inflation, interest rates, foreign exchange rates, bank size, capital adequacy ratio (CAR), loan growth efficiency (LGE), and profitability measured by return on equity (ROE). Through this research endeavor, we aim to improve the understanding and management of credit risk within Ethiopia's financial sector.

2. Related Literature Review

According to [Apostolik et al. \(2009\)](#), credit risk refers to the probability that a borrower will fail to meet their obligations as specified in a loan agreement. The greatest risk for commercial banks is credit risk since it puts them in jeopardy of losing money if borrowers fail to pay their debts as agreed ([Saunders and Cornett 2008](#)). To maintain solvency and profitability, banks must identify and monitor their credit risk ([Basle Committee 2000](#)). For banks, poor risk assessment and mitigation can have serious consequences and jeopardize their financial stability ([Abiola and Olausi 2014](#)). The five Cs of credit are five crucial factors that commercial banks have historically used to evaluate credit risk. These five Cs comprise capacity for repayment, capital, conditions of the loans, character of the borrower, and collateral ([Oseni 2023](#)). To address the complexities of risk and technological advancements, financial institutions, economic experts, and interested parties are developing new credit risk evaluation tools. Among these tools are models such as the KMV model, which determines the likelihood of default based on asset value in the market, modern portfolio theory, which allows investors to expand investment portfolios to control risks, and the credit metrics model, which calculates the portfolio-level probability of default by accounting for connections with various borrowers' defaults on their payments ([Matanda et al. 2022](#)). These advanced methodologies have been used across a wide range of businesses in the discipline of finance, particularly by financial institutions and economists.

Combinations of macroeconomic conditions and particular bank-specific factors have an impact on credit risk in commercial banks ([Twum et al. 2021](#)). The macroeconomic factors of GDP growth, inflation, interest rates, currency rates, and profitability may have a considerable impact on credit risk. According to ([Chaibi and Ftiti 2015](#)), when the GDP grows at a faster rate, it is linked to lower credit risk because it enhances borrowers' capacity to repay their debts. This is because as the economy and GDP improve, income levels and business prospects also increase. As a result of this strong economic situation, borrowers can fulfill their loan obligations, thereby reducing credit risk for banks and financial institutions. Similarly, research by [Kharabsheh \(2019\)](#) on Jordanian commercial banks revealed that as the real GDP of these countries rises, there is a corresponding decline in the number of non-performing loans. This indicates a reduction in credit risk and demonstrates how economic growth is essential in reducing credit risk because it increases borrowers' capacity to pay back their obligations. Furthermore, [Mpofu and Nikolaidou \(2018\)](#) state that a stronger economy leads to higher incomes, increased economic activity, and improved financial conditions, and ultimately creates a more favorable environment for loan repayment. These findings emphasize the importance of promoting economic development and stability as effective measures for controlling credit risk within sub-Saharan African banking sectors. [Kotiso \(2018\)](#), found that inflation had minimal impact on default risk. Conversely, high inflation rates can reduce borrowers' purchasing power and income, thereby increasing credit risk ([Ekanayake and Azeez 2015](#)). Interest rate and unemployment trends also have an impact on the determination of commercial banks' default risk. As borrowers' debt levels rise, the banking industry becomes more sensitive to escalating non-performing loans, and the cost of borrowing for individuals and businesses rises, resulting in greater debt loads. As a result, borrowers have a more difficult time that could damage their ability to repay loans, resulting in a greater share of non-performing loans in the banking system ([Morina 2020](#)). Similarly, high unemployment rates weaken the ability of borrowers to

repay loans as cash flows decline, increasing credit risk (Kharabsheh 2019). According to Lin et al. (2016), currency rate volatility in emerging markets causes economic instability. It impacts borrowers' ability to repay debts, as businesses struggle with maintaining local clients and higher costs for imported goods/services. This leads to increased prices for locally sold products. As domestic exchange rates rise, purchasing foreign items becomes more expensive, creating a greater need for bank credit. However, this depreciation reduces firm profitability and makes it challenging to pay off debt interest and principal amounts.

Bank-specific factors, such as management efficiency, profitability, credit growth, and bank size, are important determinants of credit risk. Asfaw and Veni (2015) and Zheng et al. (2018) conducted studies that demonstrated a negative correlation between bank profitability and credit risk. This shows that more profitability may result in lower credit risk. Additionally, efficient management practices are crucial in managing credit risk exposure. Banks with effective management systems and sound lending practices can mitigate the level of credit risk (Asamoah and Adjare 2015). Asfaw and Veni (2015) found that the annual increase in loans and the management methods adopted by these institutions had a significant impact on credit risk. This implies that key factors in determining the overall credit risk of commercial banks include loan expansion rates and efficient management practices. In addition, Kotiso (2018), examined the factors influencing default risk in the Ethiopian banking industry. The research revealed that rapid loan expansion increases the chances of borrowers defaulting, while higher leverage ratios indicate higher credit risk. Furthermore, bank profitability is intrinsically linked to credit risk reduction, stressing the importance of good risk management measures. Maintaining a strong financial position and implementing suitable risk management procedures allows profitable banks to better manage credit risk, decrease the likelihood of credit risk, and preserve the overall stability of bank institutions (Asfaw and Veni 2015; Zheng et al. 2018). The other essential credit risk determinant is a bank's size. Large banks have a diverse set of borrowers from many industries, which helps to decrease concentration risk. This diversification lessens the impact of potential defaults by single borrowers or enterprises and banks' exposure to non-systemic risks, allowing larger banks to deal with credit risk while maintaining the stability of their loan portfolios (Lu 2013). In addition, Martínez-Malvar and Baselga-Pascual (2020) discovered that well-capitalized banks were more susceptible to risk compared to financially challenged ones. Additionally, Malede (2014) also performed research on the factors that influence lending in commercial banks in Ethiopia. The findings show that bank size significantly and positively affects lending behavior. Understanding and effectively managing both macroeconomic and bank-specific factors is crucial for commercial banks in assessing and mitigating credit risk. On the other hand, Kotiso's (2018) research cast a spotlight on Ethiopian commercial banks, elucidating how leverage, operating inefficiency, loan growth, and ownership collectively influence default risk. Meanwhile, an investigation by Kitila et al. (2020) pinpointed the significance of the efficiency ratio. Therefore, the inconsistencies in previous research findings and the absence of important variables motivated our study. We aim to address these gaps by examining how these variables impact credit risk in Ethiopia's financial sector. It is evident that further studies are necessary to better understand the determinants of credit risk in this context. Based on the reviewed literature, the following alternative hypotheses have been developed by the researchers to satisfy the research objective.

- H1.** *Bank size has a positive and significant effect on credit risk.*
- H2.** *Loan growth has a positive and significant effect on credit risk.*
- H3.** *Efficiency ratio has a negative and significant effect on credit risk.*
- H4.** *Profitability (ROE) has a negative significant effect on credit risk.*
- H5.** *Capital adequacy has a positive and significant effect on credit risk.*
- H6.** *GDP has a negative and significant effect on credit risk.*

H7. Inflation has a positive and significant effect on credit risk.

H8. Interest rate has a positive and significant effect on credit risk.

H9. Foreign exchange rate has a positive and significant effect on credit risk.

Based on the above formulated hypothesis for the study. The following Figure 1 of the study shows conceptual framework for the study.

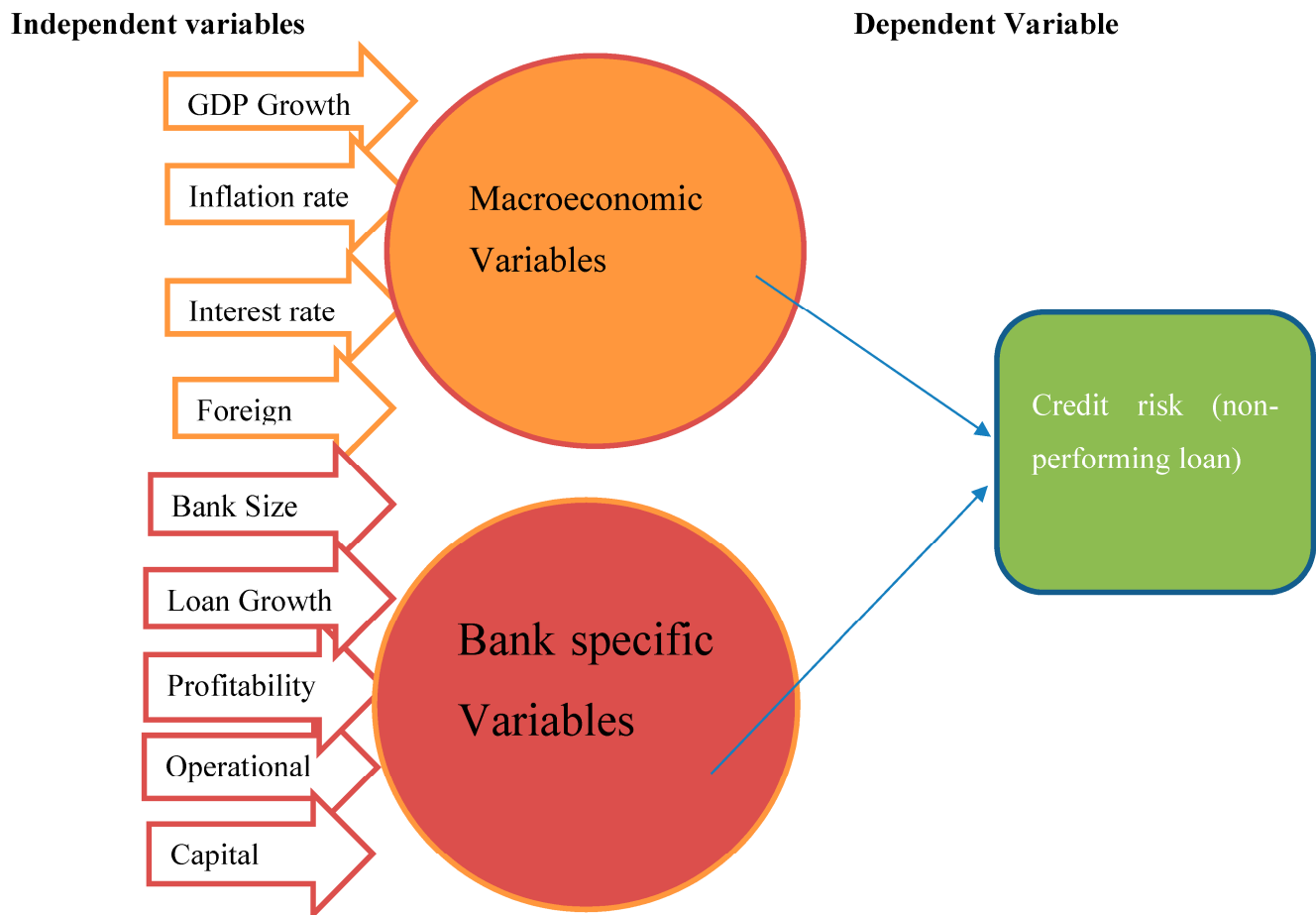


Figure 1. Conceptual Framework. Source: Own construction.

3. Methodology and Material Used

The study employed a multiple regression model with a quantitative research approach and an explanatory research design. According to the [National Bank of Ethiopia \(2023\)](#) report, there are 29 active commercial banks in the country, including one state-owned bank and 28 private banks. Based on the year of establishment and the availability of data, the study purposefully picked 10 commercial institutions from this group. Consequently, banks that were operational before 2009 and had 10 consecutive years of audited financial reports were chosen. Secondary data from audited financial reports from 2010 to 2019 were gathered and analyzed using STATA13 software. A fixed-effect model was used to estimate the connection between the independent and dependent variables. In order to confirm that the model was adequate and matched the criteria for a standard linear regression model, the study also performed diagnostic tests such as normality, heteroscedasticity, and multicollinearity.

Model Formulation

Finally, a model specification was developed for the study to determine how independent variables affected the dependent variable.

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \beta_6 X_6 + \beta_7 X_7 + \beta_8 X_8 + \beta_9 X_9 + \varepsilon$$

where Y = Credit risk measured by non-performing loan ratio

β_0 = Intercept and β_1 – β_9 = Slope of parameter ε = error term

$X_1, X_2, X_3 \dots$ = Independent variables

$$NPL = \beta_0 + \beta_1 BS + \beta_2 LG + \beta_3 EF + \beta_4 ROE + \beta_5 CAD + \beta_6 INF + \beta_7 GDP + \beta_8 INR + \beta_9 FORX$$

where: X_1 = Bank size, X_2 = Loan growth, X_3 = Managerial efficiency, X_4 = Profitability (ROE), X_5 = Capital adequacy, X_6 = Inflation, X_7 = GDP, X_8 = Interest rate, X_9 = Foreign exchange rate.

The following Table 1 of the study shows operational definitions of each variable used in the study.

Table 1. Operational Definitions.

No	Variable	Operational Definition and Proxies
1	Credit Risk	Non-performing loan (NPL)/(Total loan and <i>advance</i>)
2	Bank Size	Measured by its total assets
3	Annual Loan Growth	The ratio of current-year loans to previous-year loans
4	Management Efficiency	The ratio of operating expenses to operating income
5	Profitability (ROE)	ROE = Net profit/Total equity
6	Capital Adequacy	Total equity/Total assets
8	Gross Domestic Product	Annual country GDP rate
9	Inflation Rate	Annual inflation rate
10	Interest Rate	Annual national bank interest rate
11	Foreign Exchange Rate (FOREX)	Annual national bank foreign exchange rate

Source: Adopted from (Kharabsheh 2019).

4. Result and Discussions

4.1. Model Diagnostics Test

The study carefully examined the hypothesis associated with the classic linear regression model (CLRM) to ensure the validity of the research findings. This comprehensive assessment aims to determine the effectiveness and reliability of the results. It is essential to emphasize the importance of maintaining these hypotheses, as any deviation from them may result in biases in the estimation of regression coefficients and, ultimately, lead to erroneous conclusions about the relationship between dependent variables and independent variables.

It is encouraging to note that the results of this study are consistent with all basic assumptions of classical linear regression models. The results are in the attached Appendices A–C.

Furthermore, the following Table 2 of the study shows the result of regression analysis with Fixed-Effect Regression.

4.2. Results of Regression Analysis

$$NPLit = -0.496 + 0.021 \text{ Bank Size} + -0.012 \text{ Loan Growth} + 0.020 \text{ Inefficiency} + 0.03 \text{ ROE} + -0.168 \text{ Capital Adequacy} + 0.001 \text{ GDP} + 0.0003 \text{ Inflation} + 0.002 \text{ Interest Rate} + -0.002 \text{ FOREX} + \epsilon$$

Table 2. Results of Fixed-Effects Regression.

NPL	Coef.	St. Err.	t-Value	p-Value	[95% Conf	Interval]	Sig
Bank Size	0.021	0.004	5.03	0.00	0.004	0.01	***
Loan Growth	−0.012	0.005	−2.48	0.01	−0.012	0.007	**
Efficiency	0.020	0.009	2.11	0.03	0.01	0.044	**
ROE	0.030	0.017	1.73	0.03	0.004	0.071	**
CAD	0.168	0.053	3.17	0.02	0.019	0.186	**
GDP	0.001	0.001	1.49	0.14	−0.001	0.002	
INF	0.0003	0.0001	3.65	0.00	0.0001	0.0005	***
IN Rate	0.002	0.003	0.75	0.45	−0.004	0.009	
FOREX	−0.002	0.007	−3.74	0.00	−0.002	0	***
Constant	−0.0496	0.095	−5.20	0	−0.281	−0.091	***
Mean dependent var		0.021		SD dependent var		0.010	
R-squared		0.61		Number of obs		100	
Chi-square		43.893		Prob > chi2		0.000	
Rho		0.809		Sigma −U		00.15	

N.B: - *** indicates significance at 1% and ** significance at 5% significance level, respectively. To explore the factors that contribute to NPLs in this study, the following model was created based on the information in Table 2 above. *** $p < 0.01$, ** $p < 0.05$.

4.3. Discussion of the Results

In this study, the R-squared statistic, used to measure the extent to which the independent variables explain the variance in the dependent variable, had a value of 0.611 (61.7%). This shows that the variables in the model could account for more than 61.7% of the variation in non-performing loans. With a probability of 0.000, the F-statistic test demonstrated strong statistical significance, supporting the rejection of the null hypothesis and showing that all of the chosen explanatory variables collectively have an effect on the degree of credit risk.

4.4. Bank Size

A popular technique to determine a bank's size is to look at its total assets. The study found that, when other independent variables were maintained constant, a one-birr increase in asset size results in a statistically significant 0.021% rise in credit risk. This positive relationship between the bank size and credit risk is also supported by previous research by [Asfaw and Veni \(2015\)](#), [Malede \(2014\)](#), [Kitila et al. \(2020\)](#), and [Morina \(2020\)](#). These findings imply that bigger banks, motivated by profit maximization, may engage in riskier operations, leading to a higher incidence of substandard loans and credit payment failures. Furthermore, some larger banks may use excessive leverage when lending to riskier borrowers, exposing themselves to further credit risk. In conclusion, the research reveals that a bank's size and degree of credit risk are significantly correlated, as a result of profit-driven behaviors that increase exposure to riskier operations or lending practices with higher-risk borrowers.

4.5. Loan Growth

Loan non-payment becomes more likely when credit expansion accelerates. This is because taking on more debt raises the risk. Alternatively, the outcome demonstrates that rising credit growth causes a significant decline in the credit risk coefficient (−0.015), with a p -value of 0.015, which is significant at the 5% level. The results of the regression diverge from prior studies by [Asamoah and Adjare \(2015\)](#); [Asfaw and Veni \(2015\)](#) and theoretical assumptions. Similar research by [Ekanayake and Azeez \(2015\)](#), [Manab et al. \(2015\)](#), and [Sanyaolu et al. \(2020\)](#) found negative associations between credit risk and loan growth. This could reflect measures by commercial banks to enhance their borrowers' loan repayment ability through the provision of consultants and other services, the development of efficient credit risk cultures, and the development of robust credit risk management systems.

4.6. Operational Efficiency

The ratio of operating expenses to operating income is utilized as a measure of operational efficiency. The study found that efficient banks tend to have lower operating expenses, which are reduced by costs related to nonperforming loans. On the other hand, inefficient banks were characterized by poor credit risk management systems and practices, including inadequate credit analysis and monitoring systems, resulting in poor credit quality. Interestingly, the study revealed a positive correlation between operational inefficiency and credit risk at a significant level of 5%. This means when operational inefficiency rises by one unit (holding other variables constant), nonperforming loans also increase by 0.02 units or 2% in terms of loan ratios. In simpler terms, an increase in inefficiency among commercial banks leads to higher exposure to credit risk. These findings align with previous research conducted by [Kharabsheh \(2019\)](#), [Bhattarai \(2019\)](#), [Zheng et al. \(2018\)](#), and [Asfaw and Veni \(2015\)](#), who obtained similar results regarding the correlation between inefficiency and credit default. Overall, the findings highlight how improving operational efficiency can help mitigate potential risks associated with nonperforming loans for commercial banks.

4.7. Profitability (ROE)

As previously indicated in the literature, commercial banks can make higher profits when dealing with riskier businesses. The regression analysis's findings also showed a positive and significant correlation between credit risk and profitability (ROE). It had a 0.03 estimate coefficient with a significance of 5% (p -value 0.03). This suggests that if a sample bank's profitability ratio (ROE) is modified by one birr while keeping other factors fixed, commercial banks' credit risk will vary by 3% in the same direction. However, this contradicts prior research by [Lu \(2013\)](#). [Sanyaolu et al. \(2020\)](#) showed that bank earnings had a detrimental effect on non-performing loans. Although the first had an adverse impact on credit risk and ROE, theoretical assumptions and other empirical studies concluded that hazardous business practices might be used to maximize commercial bank profits and that this could be because profitable banks had engaged in risky loans. Similarly, [Manab et al. \(2015\)](#) and [Nabila and Younes \(2011\)](#) found a positive correlation between credit risk and profitability.

4.8. Capital Adequacy

The research also looked into the impact of bank capital adequacy on loan defaults or credit risk. The study discovered statistically significant positive correlations between the two variables. In other words, when the capital adequacy ratio rises, so does credit risk. At a 5% significance level, each unit increase in a bank's capital adequacy ratio causes the NPL or loan default ratio to increase by 16%. These findings are supported by previous research by [Raiter \(2021\)](#), [Gezu \(2014\)](#), and [Ishtiaq \(2015\)](#). They are all in agreement that increasing capital levels have a favorable influence on NPL reduction in Ethiopian commercial banks. According to the study's findings, a well-capitalized bank can provide more loans and advances to customers while also making them more sensitive to credit risk.

4.9. Inflation

Inflation reduces a borrower's ability to repay debt, which hurts commercial banks because loans cannot be repaid in accordance with the stated agreements. Inflation and credit risk are inextricably linked. Rising inflation, on the other hand, may reduce the real value of outstanding debts, enhancing borrowers' ability to repay them. Rising prices and stagnant currency rates, on the other hand, may have an impact on borrowers' repayment capacities during inflationary periods. In Ethiopian commercial banks, researchers observed a statistically significant positive link between inflation and credit risk. Inflation of one unit was equivalent to a credit risk increase of 0.03%. This conclusion is consistent with the findings of [Trenca and Bozga \(2018\)](#) on loan default factors in the European banking industry.

4.10. Gross Domestic Product (GDP)

The total annual market value of the final goods and services generated by a country is referred to as its GDP. Increased consumer demand for products and services, increased investment across industries, increased per capita income, and increased savings are all effects of a developing economy that encourage banks to raise their private credit lending. A negative link between credit risk and GDP growth was predicted by the study. The regression results indicated that credit risk increases by 1% in response to an increase in GDP, but this increase was not statistically significant. As a result, it is difficult to prove that credit risk and real GDP are inversely related.

4.11. Interest Rates

As previously indicated in the literature, interest rates have an impact on the costs and expenses of loans incurred by the economy. The study indicated a positive relationship between interest rates and credit risk, although it was not statistically significant. This result is consistent with the findings of [Ekanayake and Azeez \(2015\)](#) and [Wairimu and Gitundu \(2017\)](#). [Malede \(2014\)](#), proposed studies on the beneficial relationship between interest rates and credit risk. The managed rate of interest framework of the Ethiopian National Bank limits commercial banks' discretion in calculating interest rates and provides a minimum relationship between interest rates and credit risk.

4.12. Foreign Exchange Rate

The findings of the regression show that the foreign exchange rate (FOREX) and credit risk have a very strong negative association. According to the study, when all other factors are held equal, a 1% increase in the exchange rate results in a 0.02% decrease in loan default. When the local currency strengthened against foreign currencies, borrowers benefited in repaying loans denominated in foreign currencies. This favorable exchange situation helped mitigate credit risk by aligning with borrowers' repayment capabilities. The following Table 3 of the study shows the summary of Comparison of test results with Expectations.

Table 3. Summary of Comparison of Test Results with Expectations.

Independent Variable	Expected Result	Actual Result	Significant Level	H ₀ Test
Bank size	Positive	Positive	Significant at 1%	Accept
Loan growth	Positive	Negative	Significant at 5%	Reject
Inefficiency ratio	Negative	Positive	Significant at 5%	Reject
Profitability (ROE)	Negative	Positive	Significant at 5%	Reject
Capital adequacy	Positive	Positive	Significant at 1%	Accept
GDP	Negative	Negative	Insignificant	Failed to reject
Inflation	Positive	Positive	Significant at 1%	Accept
Interest rate	Positive	Negative	Insignificant	Failed to reject
Foreign exchange rate	Positive	Negative	Significant at 5%	Reject

5. Conclusions

The aim of this research was to investigate the factors that contribute to credit risk in Ethiopian commercial banks, considering both macroeconomic and bank-specific factors. The study provides a thorough analysis of these determinants and their relationships with credit risk, revealing both positive and negative associations. This examination offers valuable insights into the complex dynamics involved in credit risk within Ethiopian commercial banks.

The findings of the study revealed a significant positive correlation between credit risk and variables such as bank size, profitability, efficiency, capital adequacy, and inflation. Larger banks, with more resources and capabilities, took on riskier ventures and gave loans to high-risk projects in order to increase their profits. This led to an increase in credit risk. Similarly, certain banks pursued higher profitability by taking on more risk in order to

achieve greater returns. This included lending money to borrowers who were more likely to be unable to repay, thereby increasing the likelihood of nonpayment. Concurrently, banks maintained higher capital adequacy ratios to safeguard against losses, allowing them to lend with confidence even to riskier borrowers. Similarly, motivated by their operational agility, efficient banks are willing to engage in a wider range of lending activities, even if some carry higher credit risk. Furthermore, during inflation, borrowing increases as the value of money decreases. This leads to more loans being approved, some with higher credit risk. Borrowers take advantage of the greater borrowing capacity during inflationary periods. However, this increased lending activity has the potential to raise overall credit risk.

On the other hand, the study discovered that credit risk had a negative correlation with loan growth. This was because banks adopted careful lending practices during periods of rapid loan expansion, reducing the likelihood of defaults and mitigating credit risk. Additionally, exchange rates showed a significant negative relationship with credit risk. When the local currency strengthened against foreign currencies, borrowers benefited in repaying loans denominated in foreign currencies. This favorable exchange situation helped mitigate credit risk by aligning with borrowers' repayment capabilities. The study found that GDP and interest rates had no significant impact on credit risk in Ethiopian commercial banks. This suggests that these macroeconomic factors had limited influence on credit risk dynamics, highlighting the importance of other variables and dynamics in shaping credit risk in this context.

5.1. Recommendations

Ethiopian commercial banks should give high priority to implementing sophisticated credit analysis and monitoring systems in order to advance their credit risk management strategies. Large banks may be enticed to enter high-risk areas to maximize earnings, but they should proceed with prudence. Furthermore, given the significant positive relationship between credit risk and variables such as capital adequacy, inflation, bank size, profitability, and efficiency, Ethiopian commercial banks are advised to focus on maintaining adequate capital levels, exercise caution when engaging in high-risk sectors subject to inflationary pressures, and carefully analyze non-interest income sources. Additionally, due to the inverse relationship between credit risk, loan growth, and exchange rates, it is recommended that banks modify their lending practices. Finally, while neither GDP nor interest rates have a significant impact on credit risk, a regular examination of the relationship between GDP growth, interest rates, and credit risk is encouraged.

5.2. Direction for Further Research

Loan growth and interest rates violated theory in this study, implying that these variables should be included in future research. Additionally, many variables were left out, such as the emphasis on political stability, unemployment rate, and liquidity. As a result, more research may include those variables in the model to examine how much they influence credit risk in Ethiopian banking industries.

Author Contributions: Conceptualization, S.M.; methodology, S.M., G.D. and M.F.-F.; software, S.M. and G.D.; validation, S.M. and G.D.; formal analysis, S.M. and G.D.; investigation, G.D.; resources, E.B. and M.F.-F.; data curation, S.M., G.D. and E.B.; writing—original draft preparation, S.M.; writing—review and editing, S.M., E.B. and M.F.-F.; visualization, M.F.-F.; supervision, E.B.; project administration, S.M. and E.B.; funding acquisition, M.F.-F. All authors have read and agreed to the published version of the manuscript.

Funding: This research received no external funding.

Data Availability Statement: The data can be obtained upon request via seidmuhammedhamid@gmail.com or goshudasalegn@gmail.com.

Acknowledgments: We want to express our gratitude to the Journal of Risk and Financial Management for generously waiving the entire publication fee for our submission, taking into account Professor Maria Fekete-Farkas as a Topical Advisory Panel Member. Furthermore, we would like to extend our deep appreciation to Maria Fekete-Farkas for her outstanding assistance and her gracious act of covering the article processing fee. Additionally, we are sincerely thankful for the invaluable opportunity provided by the stipendium Hungaricum scholarship offered by Hungarian University of Agriculture and Life Sciences, specifically within the Doctoral School of Economic and Regional Sciences. This scholarship has played a pivotal role in facilitating our journey toward earning a Ph.D. Lastly, we offer our heartfelt thanks to the editorial board of the Journal of Risk and Financial Management and the anonymous reviewers for their insightful and constructive comments in ensuring the accessibility of our research to the wider financial community.

Conflicts of Interest: The authors declare no conflict of interest.

Appendix A Random Effect Model

<pre> . xtset ID Year panel variable: ID (strongly balanced) time variable: Year, 2010 to 2019 delta: 1 unit . xtreg NPL Banksize LoanGrowth Efficiency ROE CAD GDP INF INRate FORX, re </pre>						
Random-effects GLS regression			Number of obs		=	100
Group variable: ID			Number of groups		=	10
R-sq: within = 0.2206			Obs per group: min =			10
between = 0.7028			avg =			10.0
overall = 0.3278			max =			10
			Wald chi2(9)		=	43.89
corr(u_i, X) = 0 (assumed)			Prob > chi2		=	0.0000
NPL	Coef.	Std. Err.	z	P> z	[95% Conf. Interval]	
Banksize	.0068184	.0014018	4.86	0.000	.0040709	.0095658
LoanGrowth	-.0026202	.0049512	-0.53	0.597	-.0123244	.007084
Efficiency	.0273615	.008627	3.17	0.002	.0104529	.0442702
ROE	.0373939	.0172873	2.16	0.031	.0035115	.0712764
CAD	.1021323	.0426531	2.39	0.017	.0185337	.1857309
GDP	.0006348	.0009276	0.68	0.494	-.0011832	.0024529
INF	.000265	.0001102	2.41	0.016	.0000491	.0004809
INRate	.002212	.0033818	0.65	0.513	-.0044162	.0088402
FORX	-.0011658	.000665	-1.75	0.080	-.0024691	.0001375
_cons	-.1856424	.0485093	-3.83	0.000	-.2807188	-.090566
sigma_u	0					
sigma_e	.0076872					
rho	0	(fraction of variance due to u_i)				

Appendix B Fixed Effect Model

```
. xtreg NPL Banksize LoanGrowth Efficiency ROE CAD GDP INF INRate FORX, fe
```

Fixed-effects (within) regression

Group variable: ID

R-sq: within = 0.3445
between = 0.6117
overall = 0.2585

corr(u_i, Xb) = -0.9452

Number of obs = 100
Number of groups = 10
Obs per group: min = 10
avg = 10.0
max = 10

F(9,81) = 4.73
Prob > F = 0.0000

NPL	Coef.	Std. Err.	t	P> t	[95% Conf. Interval]
Banksize	.0212268	.0042206	5.03	0.000	.0128293 .0296244
LoanGrowth	-.012771	.0051516	-2.48	0.015	-.0230211 -.0025209
Efficiency	.0201238	.009523	2.11	0.038	.001176 .0390715
ROE	.0304869	.0175984	1.73	0.087	-.0045285 .0655023
CAD	.1681821	.0530439	3.17	0.002	.0626414 .2737228
GDP	.001261	.0008491	1.49	0.141	-.0004285 .0029505
INF	.0003825	.0001047	3.65	0.000	.0001742 .0005907
INRate	.0023177	.0031085	0.75	0.458	-.0038674 .0085027
FORX	-.002878	.0007689	-3.74	0.000	-.0044078 -.0013482
_cons	-.4969894	.0955677	-5.20	0.000	-.6871391 -.3068397
sigma_u	.01585008				
sigma_e	.0076872				
rho	.80957256	(fraction of variance due to u_i)			

F test that all u_i=0: F(9, 81) = 3.26 Prob > F = 0.0020

Appendix C Hausman Test to Select Random or Fixed Effect Model

```
hausman fe re
```

	Coefficients		(b-B) Difference	sqrt(diag(V_b-V_B)) S.E.
	(b) fe	(B) re		
Banksize	.0212268	.0068184	.0144085	.003981
LoanGrowth	-.012771	-.0026202	-.0101508	.0014228
Efficiency	.0201238	.0273615	-.0072378	.0040326
ROE	.0304869	.0373939	-.006907	.0032947
CAD	.1681821	.1021323	.0660498	.0315335
GDP	.001261	.0006348	.0006262	.
INF	.0003825	.000265	.0001175	.
INRate	.0023177	.002212	.0001057	.
FORX	-.002878	-.0011658	-.0017122	.000386

b = consistent under Ho and Ha; obtained from xtreg
B = inconsistent under Ha, efficient under Ho; obtained from xtreg

Test: Ho: difference in coefficients not systematic

```
chi2(9) = (b-B)'[(V_b-V_B)^(-1)](b-B)
          = 63.91
Prob>chi2 = 0.0000
(V_b-V_B is not positive definite)
```

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