ESREIN
Economic and Social Research Institute

Journal of Economics, Law & Society

Advancing Ethical and Socially Responsible Finance

Vol. 2 - No. 2 - Dec 2025

Published by:
Economic and Social Research Institute (ESREIN)
Blagovac 192,
71320 Vogošća
Bosnia and Herzegovina
https://jels.esrein.org
jels@esrein.org

ISSN (Online): 3029-3189

JELS

JOURNAL OF ECONOMICS, LAW & SOCIETY

Advancing Ethical and Socially Responsible Finance

Volume 2 | Number 2 | December 2025

Published by

ESREIN
Economic and Social Research Institute

JOURNAL OF ECONOMICS, LAW AND SOCIETY

ABOUT THE JOURNAL

The Journal of Economics, Law, and Society (JELS) is a pioneering academic platform dedicated to the comprehensive exploration of economics, law, and society, with a distinct focus on Islamic economics, banking, and finance. Our mission is to foster interdisciplinary dialogue, cultivate a deep understanding of these interconnected disciplines, and promote the exchange of innovative research to advance both theoretical knowledge and practical applications.

CONTRIBUTIONS AND EDITORIAL CORRESPONDENCE

Comments, suggestions and requests to:
editor@esrein.org
jels@esrein.org

Online journal:
https://jels.esrein.org/

ISSN
ISSN (Online): 3029-3189

Published by:
Economic and Social Research Institute (ESREIN)
Blagovac 192,
71320 Vogošća
Bosnia and Herzegovina

Design & Layout by
Dr. Edib Smolo

Contents

JELS Journal of Economics, Law & Society

ESREIN Economic and Social Research Institute

Editorial

Two Years of Growth and the Move to Continuous Publication

As the *Journal of Economics, Law and Society (JELS)* (ISSN 3029 3189) publishes Volume 2, Issue 2, we mark the completion of our second year as an international, peer reviewed platform dedicated to the intricate relationships between economics, law, and society, with a particular emphasis on Islamic finance and related interdisciplinary themes. This milestone coincides with an important strategic shift in our publishing model. Beginning with Volume 3, JELS will adopt a continuous publication policy, under which articles will be published online as soon as they complete peer review and production, rather than waiting for compilation into a full issue. This change reflects our commitment to timely scholarly communication, enhanced visibility for our authors, and greater accessibility for our global readership.

Continuous publication has become an increasingly common model across academic journals because it reduces delays between acceptance and publication, allows research to be cited sooner, and supports a more dynamic flow of knowledge. For JELS, this model aligns closely with our mission to facilitate rapid, rigorous, and interdisciplinary dialogue among scholars, practitioners, and policymakers working at the intersection of law, economics, and society. While our archival structure of volumes and issues will remain, these will now be built progressively over time, as accepted articles are added in sequence. This evolution in our publishing practice is thus both operational and conceptual: it positions JELS as a responsive forum for emerging debates in areas that demand timely engagement, such as financial regulation, technological innovation, and institutional reform.

Themes and Contributions in Volume 2, Issue 2

The articles in this issue exemplify JELS's interdisciplinary scope, thematic diversity, and international character. They collectively address questions of financial crime and regulation, Islamic finance in new markets, banking sector stability, the long term impact of innovation, and the determinants of corporate resilience. Together, they highlight how legal frameworks, economic incentives, institutional design, and managerial choices interact in shaping outcomes for firms, financial systems, and societies.

Hazik Mohamed's article, "Decentralized Crime: Fraud, Cybercrime and Legal Enforcement," examines how the rapid expansion of Decentralized Finance (DeFi) and privacy enhancing cryptocurrencies

such as Monero and Zcash has opened new avenues for money laundering, ransomware, and fraud by reducing the role of traditional intermediaries and increasing transactional anonymity. By applying Strain Theory, Routine Activity Theory, and Rational Choice Theory to blockchain based ecosystems, the paper reinterprets established criminological models in light of decentralized architectures and global digital markets. It also evaluates the challenges that law enforcement agencies face—ranging from jurisdictional fragmentation to sophisticated privacy technologies—and surveys emerging responses, including blockchain analytics, AI based risk assessment, and cross border regulatory frameworks such as the FATF Travel Rule and the EU's Markets in Crypto Assets (MiCA) regulation. The article's recommendations for stronger international cooperation, improved forensic capacity, and ethically grounded regulation underscore JELS's interest in research that bridges legal theory, regulatory practice, and technological innovation.

In "Awareness and Attitudes of Customers Towards Islamic Banking Products in Non Muslim Country: The Case Study of Cameroon," Issa Hamadou, Luthfi Hamidi, Aimatul Yumna, and Aboubakar Mohamadou Soudi extend the frontier of Islamic finance research to a largely unexplored context. Using a mixed methods design that combines survey data from 300 potential customers with interviews of 10 Islamic finance experts, the authors document very low levels of awareness of Islamic banking products in Cameroon, especially with respect to operational principles and contractual structures. At the same time, respondents display a positive attitude toward Islamic banking and a willingness to patronize such services, anchored primarily in the broad understanding that Islamic banks operate without interest. The study, which the authors note is the first of its kind in Cameroon, fills a substantive gap in the literature and offers managerial and policy recommendations aimed at deepening financial inclusion and supporting the development of Islamic finance in a non Muslim, Sub Saharan African setting.

The macro financial dimension of this issue is represented by Ilinka Antova's "Banking Sector Concentration, Profitability and Non Performing Loans: Evidence from 93 Countries." Using an unbalanced panel of 93 countries from 2000 to 2020, the paper combines data on non performing loans (NPLs), banking sector concentration (measured by the asset share of the three largest banks), and post tax return on assets (ROA). Through a sequence of pooled regressions, fixed effects models, and interaction specifications, the study finds a robust negative association between profitability and NPL ratios, suggesting that higher bank profitability is systematically linked to better asset quality. In contrast, the relationship between concentration and NPLs is weaker and more nuanced: while simple pooled models show only limited association, within country increases in concentration over time are associated with moderately higher NPLs. The analysis further documents that advanced economies exhibit persistently lower NPLs than other countries even after controlling for these factors. These findings have clear policy implications for regulators and central banks concerned with financial stability, competition policy, and the design of prudential frameworks.

Two contributions from Bosnia and Herzegovina bring the discussion to the level of firm strategy and corporate resilience. Jasmina Džafić, Šeherzada Šakić, and Aida Zahirović Hadžić, in "The Lagged Financial Effects of R&D Investments on IT Company Performance in Bosnia and Herzegovina," analyze how R&D expenditure affects profitability, market value, and competitive positioning of leading IT companies over the period 2022–2024. Their study, relying on balanced firm level data, finds that R&D spending is positively and significantly correlated with key performance indicators such as return on assets (ROA), return on equity (ROE), and discounted cash flow (DCF) measures, with effects that strengthen over subsequent years. Regression models with lagged variables indicate that well planned and sustained R&D investments generate not only immediate but also delayed improvements in performance and market valuation, reinforcing the view of innovation as a driver of sustainable growth and strategic advantage.

Finally, Admir Mešković's article, "What Drives Corporate Financial Resilience? A Credit Analysis Approach with Management Efficiency Insights," foregrounds management quality as a central

determinant of a firm's ability to withstand financial stress. Drawing on 1,531 corporate loan cases from a commercial bank in Bosnia and Herzegovina, the paper integrates static financial ratios with dynamic year to year performance changes, and uses factor analysis and regression techniques to identify key predictors of resilience. The results highlight liquidity, self financing capacity, asset turnover, gross margin, and receivables collection time as relevant indicators, but underscore management efficiency as the most influential factor shaping corporate resilience. Companies with inefficient managerial practices exhibit markedly weaker resilience and greater vulnerability to financial deterioration. These findings invite credit institutions, investors, and regulators to incorporate management related metrics more systematically into risk assessment frameworks, thus moving beyond narrow ratio based models.

Looking Ahead with Continuous Publication

The breadth of topics, methods, and geographies covered in this issue reflects the mission of the Journal of Economics, Law and Society to foster interdisciplinary, internationally oriented research that speaks to both theory and practice. The adoption of a continuous publication policy from Volume 3 is a natural extension of that mission, enabling JELS to disseminate high quality work more rapidly and to remain closely attuned to fast evolving debates in areas such as digital assets, Islamic finance, financial stability, and corporate governance.

As we enter our third year, we aim to deepen our engagement with authors and readers across regions and disciplines, particularly those working on the intersections of law and economics in emerging markets, Islamic economic and financial systems, and socio legal transformations. We remain committed to upholding stringent double blind peer review, editorial rigor, and ethical standards, while offering a more flexible and responsive publication experience.

On behalf of the editorial team, I extend sincere thanks to our authors, reviewers, editorial board members, and readers for their continued trust and contributions. We look forward to building on the foundations laid in our first two years and to welcoming new submissions that advance understanding of the complex and evolving relationships between economics, law, and society.

Edib Smolo
The Co-Founder & Editor-in-Chief
Journal of Economics, Law & Society (JELS)

JELS Journal of Economics, Law & Society

ESREIN Economic and Social Research Institute

Decentralized Crime: Fraud, Cybercrime, and Legal Enforcement

Hazik Mohamed
Stellar Consulting Group, Singapore
ORCID ID: 0000-0001-8322-2714
Email: hazik@stellarcg.com

Abstract

The rapid rise of Decentralized Finance (DeFi) and anonymity-focused cryptocurrencies has transformed financial systems by eliminating intermediaries and enabling peer-to-peer transactions. While these innovations offer numerous benefits, they also present unprecedented challenges for crime prevention and regulatory enforcement. This paper examines how DeFi and privacy-enhanced cryptocurrencies, such as Monero and Zcash, facilitate financial crimes, including money laundering, ransomware attacks, and fraud. By applying criminological theories—Strain Theory, Routine Activity Theory, and Rational Choice Theory—this study reinterprets traditional crime models in the context of blockchain-based financial ecosystems. Law enforcement agencies face significant hurdles in investigating and prosecuting crypto-enabled financial crimes due to jurisdictional limitations, privacy-enhancing technologies, and decentralized governance. This paper explores how blockchain analytics, artificial intelligence-driven risk assessment, and cross-border regulatory collaborations, such as the Financial Action Task Force (FATF) Travel Rule and the EU's Markets in Crypto-Assets (MiCA) regulation, are being developed to counter these emerging threats. Additionally, it assesses the institutional limitations of law enforcement agencies, the role of DeFi governance communities in mitigating financial crimes, and the potential impact of central bank digital currencies (CBDCs) on reducing illicit transactions. To enhance regulatory effectiveness, this study recommends strengthening international cooperation, improving forensic capabilities for tracking illicit blockchain transactions, and implementing ethical frameworks that balance financial privacy with security. The findings contribute to criminology, financial regulation, and cybersecurity by offering insights into evolving digital crimes and proposing solutions to mitigate their risks. Future research should explore the role of artificial intelligence in DeFi crime detection and the impact of regulatory advancements on illicit financial flows in decentralized ecosystems.

Article History

Received: September 15, 2025
Accepted: November 26, 2025
Published: December 30, 2025

Keywords

blockchain forensics; criminal theory; cryptocurrency regulation; decentralized finance; financial crime.

JEL Codes

D81; G28; K42; O33;

How to Cite

Mohamed, H. (2025). Decentralized Crime: Fraud, Cybercrime, And Legal Enforcement. *Journal of Economics, Law and Society, 2(2)*, 5-22. https://doi.org/10.70009/jels.2025.2.2.1

1. Introduction

1.1. Background and Context

Decentralized Finance (DeFi) has emerged as a disruptive force in the financial industry, utilizing blockchain technology to build an open and permissionless financial ecosystem. DeFi uses smart contracts and decentralized applications (DApps) to replicate and improve traditional financial services including lending, borrowing, and trading without the need for centralized middlemen (Zreik, 2024). This paradigm shift has been paralleled by the emergence of anonymity-focused cryptocurrencies, sometimes known as privacy coins, which prioritize user secrecy by obscuring

transaction details. Cryptocurrencies like Monero and Zcash use advanced cryptographic algorithms to ensure that transaction data remains hidden, making them appealing to users wanting increased privacy (The CEO Views, 2024).

The advent of DeFi and privacy coins has caused considerable disruptions in traditional banking systems and established criminal prevention frameworks. Traditional financial institutions operate in regulated environments, using Know Your Customer (KYC) and Anti-Money Laundering (AML) standards to detect and prevent fraudulent activity. In contrast, DeFi services frequently operate without centralized oversight, allowing users to conduct financial transactions anonymously. This decentralization calls into question traditional regulatory paradigms, as the lack of middlemen makes compliance procedures more difficult to enforce (Bank of Canada, 2023).

Furthermore, the inclusion of privacy coins in DeFi platforms exacerbates these issues by giving users tools for conducting transactions that are resistant to traditional tracking and surveillance methods. The concealment of transaction details inhibits law enforcement authorities' capacity to trace funds, therefore creating a conducive environment for illicit financial activities (Europol, 2020).

The pseudonymous character of cryptocurrencies, along with the privacy features of certain digital assets, has resulted in their increased use in crimes and fraud schemes. Criminal groups use these technologies to assist money laundering, ransomware attacks, and the online sale of illegal goods and services. For example, the Financial Action Task Force (FATF) has documented an increase in cyber-enabled fraud schemes that trick victims into transferring funds using fraudulent cryptocurrency platforms (FATF, 2023).

High-profile incidents highlight the gravity of this problem. In February 2025, the cryptocurrency exchange Bybit was subjected to a sophisticated phishing attack that resulted in the theft of more than $1.4 billion in Ethereum tokens. The attackers used false interfaces to acquire illegal access to the exchange's wallet management system and then transferred the assets to unknown wallets. The Lazarus squad, a North Korean cyber squad, is suspected of orchestrating the crime and using innovative tactics to conceal the stolen assets (El País, 2025).

These changes underscore the critical need for a rethinking of old criminological theories and law enforcement techniques in the face of decentralized and privacy-enhancing financial technologies. As DeFi and anonymity-focused cryptocurrencies expand, it is critical to understand the implications for financial crime and establish robust risk mitigation procedures.

1.2. Research Questions and Objectives

The proliferation of Decentralized Finance (DeFi) platforms and anonymity-focused cryptocurrencies has introduced complexities that challenge existing frameworks in criminology and law enforcement. This study aims to address the following research questions:

i. How do DeFi and anonymity-focused cryptocurrencies challenge traditional criminological theories?
ii. What are the implications of decentralized financial crimes for law enforcement?
iii. How can existing and emerging forensic methods counter crypto-enabled crimes?

1.3. Significance of the Study

This research holds substantial significance across multiple domains:

i. Criminology: By examining how DeFi and anonymity-focused cryptocurrencies intersect with criminal behavior, this study contributes to the evolution of criminological theories in the digital age, addressing gaps in understanding related to cyber-enabled financial crimes.
ii. Cybersecurity: Insights from this research inform the development of security measures aimed at detecting and preventing the exploitation of decentralized financial systems by malicious actors, thereby enhancing the resilience of digital financial infrastructures.
iii. Financial Regulation: The findings provide valuable perspectives for regulators seeking to craft policies that balance innovation in financial technologies with the imperative to prevent and mitigate financial crimes, ensuring that regulatory frameworks remain effective in the face of evolving technologies.
iv. Law Enforcement: By identifying the challenges and proposing ideas related to investigating crimes involving DeFi and anonymity-focused cryptocurrencies, this study aids law enforcement agencies in adapting to the complexities of the modern financial crime landscape, promoting more effective investigative and prosecutorial practices.

This research endeavours to bridge the knowledge gap at the intersection of decentralized financial technologies and criminal activity, offering foundational insights for theory and policy considerations.

2. The Role of DeFi and Anonymity-Focused Cryptocurrencies in Financial Crime

2.1. Defining DeFi and Anonymity-Centric Cryptocurrencies

Decentralized Finance (DeFi) is a paradigm change in the financial industry that uses blockchain technology to provide financial services without traditional intermediaries. DeFi relies heavily on smart contracts, which are self-executing agreements written on blockchain platforms like as Ethereum. These contracts automate transactions when certain circumstances are met, decreasing the requirement for centralized oversight (Consensys, n.d.).

Decentralized exchanges (DEXs) are another key component of the DeFi ecosystem. Unlike centralized exchanges, DEXs allow users to trade digital assets directly between themselves, improving security and privacy by eliminating the need for a central authority (Chainlink, 2023). Additionally, DeFi has lending protocols that allow users to lend and borrow cryptocurrency in a decentralized manner. Platforms like Aave let users to earn interest or receive loans by dealing directly with smart contracts, bypassing traditional financial institutions (Amazon Web Services, n.d.).

Anonymity-centric cryptocurrencies, sometimes known as privacy coins, round out the DeFi environment. These digital currencies, which include Monero, Zcash, and Dash, are intended to increase transaction anonymity. Monero, for example, uses stealth addresses and ring signatures to obscure transaction details, keeping the sender, receiver, and transaction amount private (Merkle Science, 2023). Similarly, Zcash's zk-SNARK protocol provides optional privacy features that allow users to protect transaction information. Dash includes a function called PrivateSend, which mixes funds from multiple users to increase anonymity.

2.2. Criminal Exploitation of DeFi and Privacy Coins

While the revolutionary features of DeFi and privacy coins provide legal benefits, they have also been used illicitly. One major problem is money laundering on decentralized systems. DeFi's pseudonymous nature allows criminals to conceal the source of illicit payments by cycling them via numerous procedures, making detection and tracking difficult for authorities (Department of

Homeland Security, 2022).

DeFi platforms have also been subject to targeted attacks such as flash loan exploits and rug pulls. Flash loans, which are uncollateralized loans made in a single transaction, can be used to exploit flaws in DeFi protocols, resulting in significant financial losses. Rug pulls occur when developers withdraw liquidity from a project unexpectedly, deceiving investors (University Carlos III of Madrid, 2022).

To increase anonymity, criminals use privacy-enhancing wallets and mixers. Tornado Cash and Wasabi Wallet allow users to combine their cryptocurrency transactions with others, effectively obscuring the transaction trail. This approach hinders law enforcement's efforts to trace illicit financial transfers and has been linked to a variety of criminal activity.

The expansion of DeFi has coincided with an increase in criminal operations that use its infrastructure. Notable occurrences include sophisticated phishing assaults on cryptocurrency exchanges, which cause huge financial losses. For example, in February 2025, a prominent exchange was targeted by a phishing attack, resulting in the theft of nearly US$1.4 billion in Ethereum tokens (The Hacker News, 2025). Such occurrences illustrate DeFi platform vulnerabilities and the significant financial effect of these attacks.

Privacy coins have also been implicated in ransomware attacks and fraud cases. Their enhanced anonymity features make them attractive to cybercriminals seeking to evade detection. The use of privacy coins in illicit activities underscores the challenges faced by law enforcement in tracking and prosecuting offenders in the evolving landscape of financial crime (Merkle Science, 2023).

3. Rethinking Traditional Criminological Theories in the Context of DeFi

3.1. Strain Theory and Economic Crime in the Digital Era

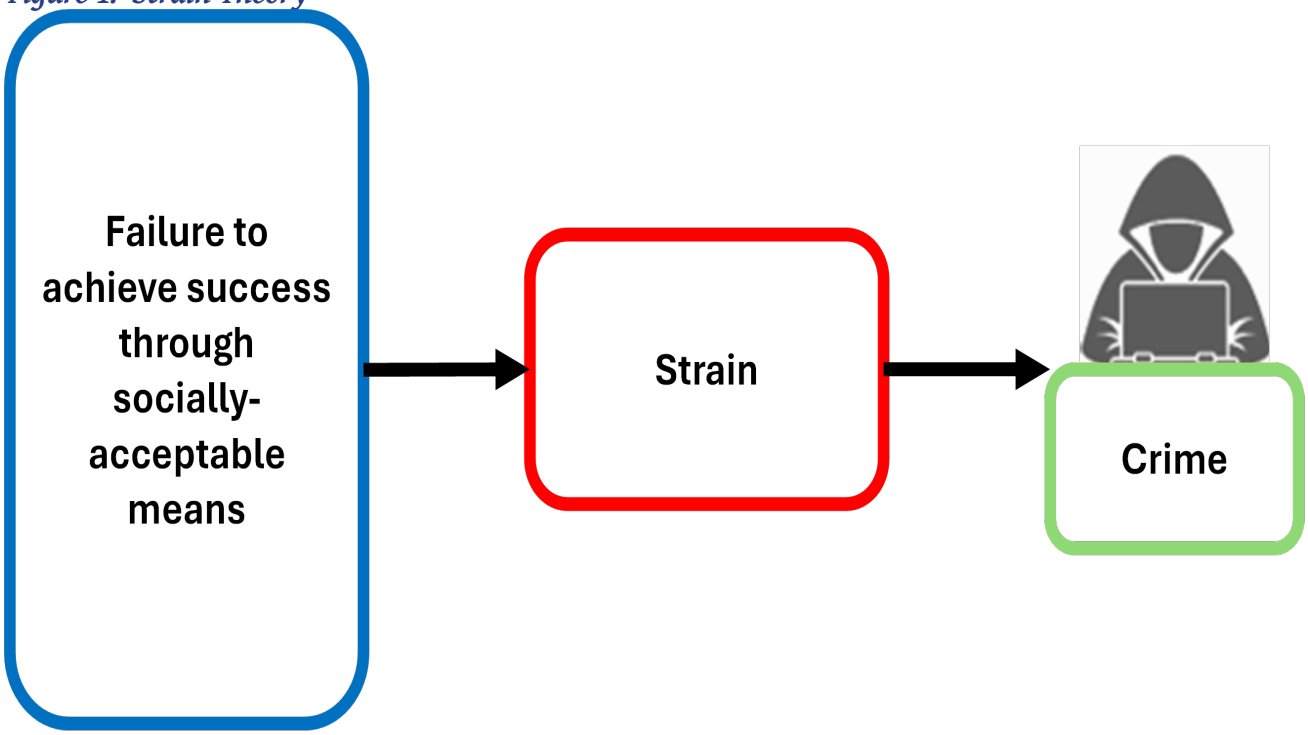
According to Strain Theory, societal pressures, such as the goal of financial success, might cause people to engage in criminal activity when lawful alternatives are unavailable. According to Merton, when people are unable to accomplish socially acceptable goals (such as financial achievement) through legitimate methods, they incur stress, which can lead to deviant behavior, including economic crimes. Strain theory's dynamics have transformed in the digital age, creating new obstacles and opportunities for economic crime. The pressure to achieve financial success has increased in the digital era due to the visibility of riches on social media and the ease with which one may compare oneself to others around the world. The digital divide—the difference between those who have access to digital technologies and those who do not—can intensify emotions of relative deprivation, which is an important component of strain theory. Individuals who feel themselves to be disadvantaged in the digital economy may experience increased stress, which increases the risk of engaging in economic crimes such as cyber fraud, identity theft, and online scams.

Decentralized Finance (DeFi) platforms have evolved as innovative financial systems that break down traditional boundaries and provide open access to financial services without the use of centralized intermediaries. While inclusion democratizes money, it also opens up new opportunities for economic criminality. The anonymous nature of DeFi transactions can attract persons looking to abuse these platforms for unlawful gain, considering them as low-risk opportunities due to the constraints they provide (Chainalysis, 2025).

These crimes are frequently helped by the anonymity and global accessibility of the internet, making them difficult to detect and punish. The digital ecosystem also opens up new chances for individuals to exploit vulnerabilities in systems and networks, complicating attempts to combat

economic crime.

Figure 1: Strain Theory



Source: Author's own.

Economic incentives are a major motivator of cybercriminal behavior in DeFi ecosystems. The considerable financial rewards associated with exploiting smart contract vulnerabilities or executing fraudulent schemes can incentivize people to commit cybercrimes. The quick appreciation of certain digital assets further enhances the possible rewards, motivating players to prioritize financial gain over ethical considerations (Chainalysis, 2025).

3.2. Routine Activity Theory and the Digital Crime Landscape

Routine Activity Theory (RAT), created by Lawrence Cohen and Marcus Felson (1979), has become a significant framework for explaining crime by emphasizing the convergence of three critical elements: a motivated criminal, an appropriate victim, and the lack of a skilled guardian. RAT, which was traditionally used to explain property crimes in physical surroundings, is now increasingly being used to explain digital crime, particularly in the context of decentralized technologies like blockchain, bitcoin, and Decentralized Finance (DeFi). As the digital world expands, criminal activities such as cyber fraud, hacking, money laundering, and ransomware have increased, aided in large part by the anonymity and decentralization provided by blockchain platforms. RAT provides vital insights into the mechanics of digital crime, as it helps explain how the interaction of these three components—motivated offenders, suitable targets, and weak or absent guardians—leads to an environment conducive to illicit behavior.

The first component, the motivated offender, is motivated by financial gain, anonymity, or a variety of other incentives arising from the decentralized nature of platforms such as cryptocurrency exchanges and DeFi protocols. Cybercriminals are particularly drawn to decentralized finance due to its promise of pseudonymity, reduced regulation, and the lack of a centralized authority (Zohar & Dahan, 2023). With the growing popularity of digital currencies like Bitcoin and privacy-focused coins like Monero and Zcash, criminals are finding new platforms to carry out fraudulent operations such as money laundering, ransomware attacks, and phishing schemes. The digital ecosystem,

with its worldwide reach and high liquidity, provides various chances for offenders motivated by profit and the perceived low risk of detection. (Binns, 2023).

Figure 2: Routine Activities Theory

Source: Author's own.

The second component of RAT, the suitable target, is widely available in the digital environment. Individuals and organizations who use digital platforms are frequently unaware of the risks associated with decentralized financial ecosystems. Many DeFi systems and cryptocurrency exchanges lack sufficient cybersecurity protections, leaving them open to exploitation (Choo, 2020). As a result, these platforms and their users are excellent targets for cybercriminals. Similarly, the massive amount of data and dollars passing through these platforms expands the pool of possible targets. Cryptocurrencies and digital wallets frequently contain enormous quantities of value, which attracts criminals looking to exploit flaws in transaction systems. Furthermore, decentralized networks often lack direct oversight, making it more difficult for users to detect and prevent dangers (Zohar & Dahan, 2023).

The third component of RAT, the lack of a skilled guardian, is especially important in the digital arena. In traditional crime prevention schemes, guardianship may include physical security measures, law enforcement, or regulatory entities that monitor and oversee illegal activity. In the digital arena, however, the lack of such guards poses a significant difficulty. The decentralized structure of blockchain and DeFi networks reduces the influence of central authorities, allowing criminal operations to thrive with little hindrance (Choo, 2020). Furthermore, the pseudonymous nature of blockchain transactions and privacy-enhancing technology like coin mixers and privacy coins impede law enforcement's capacity to trace unlawful activity, making it difficult to prevent and prosecute cybercrimes (Binns, 2023).

According to RAT, crime happens when a motivated perpetrator, an appropriate target, and the absence of a capable guardian intersect in time and space. In the case of DeFi, decentralized networks frequently lack standard monitoring systems, thereby eliminating skilled guardians who

dissuade illicit activity. This absence creates an atmosphere in which bad actors can operate with relative impunity, exploiting system weaknesses.

The DeFi ecosystem offers multiple options for the confluence of motivated offenders and vulnerable victims. Users, frequently motivated by the prospect of huge rewards, may engage with unverified platforms or smart contracts without fully appreciating the risks involved. This habit offers a pool of ideal candidates for cybercriminals that exploit these weaknesses via strategies like as phishing, rug pulls, or exploiting software bugs in smart contracts (Chainalysis, 2025).

RAT provides a framework for understanding how digital crime emerges and why decentralized systems are particularly vulnerable to exploitation. By considering how motivated offenders, suitable targets, and weak guardians converge in the digital landscape, it becomes evident that combating digital crime requires robust technological solutions, enhanced cybersecurity protocols, and international collaboration between regulators, law enforcement agencies, and DeFi developers. Strengthening the guardianship element in digital ecosystems, through both technological and regulatory advancements, is essential to reducing the risks posed by decentralized technologies.

3.3. Rational Choice Theory and the Evolution of Financial Crime

Rational choice theory (RCT), based on classical criminology, holds that people participate in illegal action after assessing the potential rewards against the risks and costs (Cornish & Clarke, 1986). This viewpoint assumes that offenders are rational individuals who make planned judgments to maximize personal advantage. In the context of financial crime, rational choice theory offers a valuable framework for understanding how individuals and organizations capitalize on possibilities in an ever-changing financial world, particularly in the digital age. As financial systems have grown more complicated and linked, the nature of financial crime has changed, posing new obstacles for prevention and enforcement.

Figure 3: Rational Choice Theory

Source: Author's own.

The digital revolution has profoundly changed the nature of financial crime, providing new opportunities for rational actors to exploit system and network vulnerabilities. For example, the rise of internet banking, cryptocurrency, and e-commerce platforms has broadened the scope of financial crime, allowing perpetrators to perpetrate fraud, money laundering, and identity theft on a massive scale. The internet's anonymity and global reach further minimize the perceived risks of detection and prosecution, making financial crime an appealing alternative for rational individuals looking to maximize profits with least effort.

One of the major pillars of RCT is the concept of "opportunity structures," which refers to the conditions that make specific crimes more feasible and appealing (Clarke & Felson, 1993). In the digital age, technological improvements have offered new opportunities for financial crime. For example, the widespread use of mobile payment systems and peer-to-peer lending platforms has created new opportunities for fraud and embezzlement. Similarly, while blockchain technology's decentralized structure provides benefits like as transparency and security, it has also been used by criminals for activities such as ransomware attacks and illicit transactions on the dark web (Yar & Steinmetz, 2019).

The rational choice perspective emphasizes the importance of situational conditions in shaping criminal behavior. In the context of financial crime, situational factors such as weak regulatory monitoring, inadequate cybersecurity measures, and a lack of international collaboration can create a climate conducive to illegal activity (Benson & Simpson, 2018). For example, the 2008 financial crisis revealed how lax regulation and oversight enabled rational actors within financial institutions to engage in risky and unethical practices, ultimately leading to widespread economic harm.

The anonymity and decentralization inherent in DeFi platforms and privacy-centric cryptocurrencies significantly alter this rational calculation of potential risks and rewards or cost-benefit analysis of RCT. The perceived low risk of detection and prosecution in decentralized networks lowers the threshold for engaging in illicit activities, as traditional law enforcement faces challenges in tracing and attributing transactions to specific individuals (Chainalysis, 2025).

Moreover, the use of self-executing smart contracts can automate illicit transactions, reducing the need for direct human involvement and thereby minimizing the risk of exposure. These contracts can be programmed to execute fraudulent schemes or launder money without manual intervention, further complicating detection and enforcement efforts (Chainalysis, 2025).

3.4. Cybercriminal Subcultures and Online Crime Communities

The rise of the internet has given rise to a new type of criminal activity: cybercriminal subcultures and online crime communities. These digital ecosystems enable individuals with common interests in illicit activities to collaborate, share knowledge, and build sophisticated criminal enterprises. Unlike traditional criminal networks, cybercriminals frequently operate in decentralized and anonymous online spaces such as dark web forums, encrypted messaging applications, and social media platforms (Holt & Bossler, 2014). These communities provide a sense of belonging while also providing technological support, tools, and resources for members to engage in activities such as hacking, fraud, and the sale of unlawful products and services.

One of the distinguishing characteristics of cybercriminal subcultures is a focus on talent sharing and mentorship. Experienced hackers and fraudsters frequently serve as educators, providing tutorials, instructions, and even one-on-one training to new members (Yar, 2005). This knowledge transfer not only lowers the entry barrier for aspiring hackers, but it also helps to drive the growth of more powerful and sophisticated attack methods. For example, forums dedicated to ransomware development or phishing techniques provide members with access to pre-built tools, exploit kits, and even customer service, allowing individuals to carry out crimes with no technical expertise (Hutchings & Holt, 2015).

A culture of trust and reputation shapes the social dynamics in these societies as well. Members frequently rely on feedback mechanisms like ratings and reviews to establish credibility and build confidence in the community (Motoyama et al., 2011). This reputation-based mechanism ensures that only trustworthy actors prosper, resulting in a self-regulating environment resembling legitimate internet marketplaces. However, this trust is fragile, and disagreements over payments, frauds, or failed cooperation are prevalent, frequently resulting in confrontations or the dissolution of partnerships.

Despite their illicit character, cybercriminal communities frequently share the ideals and practices of legitimate online communities, such as collaboration, innovation, and a common sense of purpose. This makes them especially durable and adaptable to law enforcement operations. The advent of DeFi coincides with the emergence of cybercriminal subcultures that use these technologies for fraudulent purposes. Individuals looking to take use of DeFi platforms can collaborate through online communities and forums. These networks enable the exchange of information, tools, and methods for committing crimes such as phishing attacks, Ponzi schemes, and smart contract exploitation (Chainalysis, 2025).

Anonymity in these digital places gives cybercriminals a sense of security, which encourages the establishment of unlawful cooperation that cross geographical boundaries. The anonymous nature of blockchain transactions and the adoption of privacy-enhancing techniques make it difficult for authorities to infiltrate these networks and identify culprits, hence enabling the persistence and growth of DeFi-driven fraud communities (Chainalysis, 2025).

4. Law Enforcement Challenges in Combating Decentralized Crime

4.1. Jurisdictional and Regulatory Barriers

Law enforcement organizations attempting to enforce laws throughout the Decentralized Finance (DeFi) ecosystem face considerable hurdles due to the decentralized structure of the platforms. Traditional financial systems have defined jurisdictional boundaries, which allows for the implementation of regional rules and oversight. DeFi platforms, on the other hand, run on blockchain networks that cross national borders, allowing users from anywhere to conduct financial transactions without centralized authority. This global accessibility affects law enforcement by making it more difficult to determine the appropriate jurisdiction and hold violators accountable. The anonymous character of transactions exacerbates this issue, as identifying individuals behind illegal activity requires advanced investigative tools and international cooperation (U.S. Department of the Treasury, 2023).

Furthermore, there is a fundamental tension between protecting privacy and executing efficient financial crime prevention methods. Privacy-centric cryptocurrencies, often known as privacy coins, are intended to increase user anonymity by obscuring transaction details. While these characteristics safeguard individual privacy, they also limit law enforcement's ability to monitor transactions and uncover illicit cash flows. Balancing the right to financial privacy with the need to combat money laundering, terrorism financing, and other financial crimes provides a difficult regulatory challenge. Regulatory authorities must manage these competing objectives in order to create frameworks that protect individual privacy while also allowing for effective oversight.

4.2. Investigative Challenges and Blockchain Forensics

Tracing transactions using privacy coins and DeFi protocols presents significant hurdles for investigators. Privacy coins, such as Monero and Zcash, use powerful cryptographic techniques to mask transaction data, making it harder to associate transactions with specific individuals or

institutions. DeFi protocols, which operate over decentralized and often pseudonymous networks, complicate tracking due to the lack of centralized management and oversight. The integration of cross-chain technologies enables the frictionless transfer of assets between different blockchain networks, allowing criminal actors to shift funds across multiple platforms while concealing their origins. This intricacy necessitates investigators to deploy advanced blockchain analytics tools capable of detecting cross-chain events and identifying trends indicative of illegal behavior (Merkle Science, 2025).

Individuals who want to hide the origins and destinations of their assets frequently use obfuscation tactics such as mixers and cross-chain swaps. Mixers combine numerous transactions to disguise the trail of funds, whereas cross-chain swaps allow assets to be exchanged between blockchains without a centralized intermediary. These approaches complicate the investigation by interfering with transaction traceability and making it difficult to track the movement of illicit monies. To address these issues, law enforcement agencies must use modern forensic tools and procedures that can analyze complicated transaction patterns and de-anonymize obfuscated activity (Elliptic, 2022).

4.3. Institutional Limitations and Capacity Gaps

The rapid evolution of DeFi and privacy-focused cryptocurrencies demands ongoing, specific training for law enforcement professionals. Traditional investigative procedures are frequently insufficient to solve crimes employing decentralized and pseudonymous systems. There is a critical need for better training programs focusing on crypto-forensics, providing investigators with the skills and expertise required to navigate the complexity of blockchain technologies, analyze transaction data, and successfully apply specialized analytical tools (Simply Forensic, 2025).

Securing cooperation from DeFi developers and governance communities poses additional problems. DeFi's decentralized ethos frequently means that there is no central authority to interact with, and developers may be distributed across multiple jurisdictions with different legal systems. This decentralization can lead to reluctance or refusal to assist law enforcement, particularly if participation is deemed to violate the ideals of user privacy and autonomy. In the fragmented financial landscape, successful law enforcement requires the establishment of collaborative relationships and structures that promote responsible innovation while guaranteeing compliance with legal and regulatory norms (U.S. Department of the Treasury, 2023).

5. Innovations in Crypto-Forensics and Legal Enforcement Strategies

5.1. Advances in Blockchain Analytics and DeFi Monitoring

The rapid rise of Decentralized Finance (DeFi) has forced the creation of sophisticated blockchain analytics and monitoring systems to detect and prevent fraudulent activity. Emerging forensic techniques may now track unlawful transactions within DeFi networks by examining both on-chain and off-chain data. These tools organize and evaluate transaction facts, including as timestamps, involved addresses, and linked services, to detect trends that indicate fraudulent activity.

Artificial intelligence (AI) has become critical to improving blockchain intelligence. AI-powered platforms can process massive volumes of blockchain data in real time, detecting anomalies and suspicious activity that traditional monitoring systems may miss. For example, AI-powered risk-scoring algorithms analyze the chance of transactions being related with unlawful activity, allowing for preventative interventions against possible dangers (AnChain.AI, n.d.).

5.2. Strengthening Cross-Border Law Enforcement Cooperation

Given cryptocurrencies' global character, international cooperation is critical in addressing crypto-enabled financial crimes. The Financial Action Task Force (FATF) has established the "Travel Rule," which requires Virtual Asset Service Providers (VASPs) to collect and transmit originator and beneficiary information during transactions in order to increase transparency and deter illicit activity (Sumsub, 2024). Similarly, the European Union's Markets in Crypto-Assets Regulation (MiCA) creates a standardized legal framework for crypto-assets, including consumer protection, asset classification, and licensing requirements (European Securities and Markets Authority, n.d.).

Multilateral measures strengthen efforts to tackle cryptocurrency-related financial crimes. These joint efforts promote the sharing of intelligence, harmonization of regulatory standards, and coordination of enforcement operations across jurisdictions, thus boosting the global response to illicit activity in the crypto realm (FATF, 2024).

5.3. Regulatory and Policy Responses to Emerging Crypto Threats

As the crypto ecosystem changes, regulatory authorities tighten compliance requirements for DeFi systems and privacy-enhanced cryptocurrencies. This involves establishing strong Know Your Customer (KYC) and Anti-Money Laundering (AML) measures to guarantee that organizations involved in crypto activity follow established financial regulations (Lukka, 2025).

Balancing privacy, innovation, and security raises ethical concerns for legislators. While privacy is a vital value, it must be balanced with the importance of combating financial crimes and maintaining market integrity. Regulatory frameworks strive to strike this balance by fostering openness and accountability while not limiting technological progress and the benefits that decentralized financial systems offer (Forbes, 2025).

6. Recommendations for Policy and Practice

Addressing the complexities of decentralized financial crimes, such as those facilitated by cryptocurrencies, dark web marketplaces, and peer-to-peer networks, requires a multifaceted approach that combines regulatory innovation, technological adaptation, and international cooperation. Policymakers and practitioners must recognize the unique challenges posed by these crimes, including their borderless nature, anonymity, and rapid evolution. To effectively address the complexities of decentralized financial crimes, a multidimensional approach is essential:

1. Strengthening Global Cooperation in DeFi Regulation: Given the transnational nature of DeFi platforms, international collaboration is crucial. Regulatory bodies should work towards harmonizing policies and sharing intelligence to create a cohesive framework that transcends national boundaries. Initiatives such as the Financial Action Task Force (FATF) Travel Rule and the European Union's Markets in Crypto-Assets (MiCA) regulation exemplify steps toward unified oversight (Financial Stability Board, 2025).
2. Enhancing Forensic Capabilities in Tracking Privacy-Focused Cryptocurrencies: Investing in advanced forensic tools and training programs is imperative for law enforcement agencies. The development and deployment of artificial intelligence-driven blockchain analytics can aid in tracing illicit transactions involving privacy coins and DeFi protocols, thereby improving the detection and prevention of financial crimes (Elliptic, 2025).

By adopting these recommendations, policymakers and practitioners can better address the challenges posed by decentralized financial crimes, ensuring a safer and more secure digital financial landscape.

Table 1: Summary of Challenges, Evolving Technological Innovations and Practical Policy Implementation

Section	*Focus Area*	*Key Points*
Law Enforcement Challenges in Combating Decentralized Crime	Jurisdictional & Regulatory Barriers	– DeFi operates across borders, complicating jurisdiction. – Privacy coins obscure transactions, limiting oversight. – Tension between financial privacy vs. crime prevention.
	Investigative Challenges	– Privacy coins (e.g., Monero, Zcash) mask data. – Cross-chain swaps and mixers complicate tracking. – Advanced blockchain forensics needed.
	Institutional Limitations	– Law enforcement lacks specialized training. – Limited cooperation from DeFi communities. – Decentralization reduces points of contact for investigations.
Innovations in Crypto-Forensics and Legal Enforcement Strategies	Blockchain Analytics & AI	– AI-driven tools detect anomalies and suspicious activity. – On-chain and off-chain data used for monitoring. – Risk scoring improves preventive intervention.
	Cross-Border Cooperation	– FATF Travel Rule mandates transaction data sharing. – EU's MiCA regulation creates standardized oversight. – Multilateral collaboration enhances enforcement.
	Regulatory & Policy Responses	– Stricter KYC/AML compliance for DeFi platforms. – Ethical tension: privacy vs. market integrity. – Efforts to balance innovation with security.
Recommendations for Policy and Practice	Global Cooperation	– Harmonize cross-border regulation. – Intelligence sharing and coordinated enforcement. – FATF and MiCA serve as models.
	Forensic Capabilities	– Invest in advanced blockchain forensics. – AI-based tools to trace illicit flows. – Training programs for investigators.
	Strategic Outlook	– Multi-pronged approach: regulation + tech + cooperation. – Balance innovation with oversight. – Focus on privacy coins and DeFi-related crimes.

Source: Author's ow.

7. Conclusion and Future Directions

The pseudonymous character of DeFi platforms and privacy-focused digital currencies has opened up new paths for criminal financial activity, challenging standard criminological ideas and law enforcement approaches. To properly handle the specific issues provided by digital financial crimes, established criminological frameworks must be reevaluated due to these technologies' decentralized and borderless nature.

Law enforcement organizations confront major challenges while addressing crimes in the DeFi ecosystem. The anonymity given via online platforms hinders the identification and apprehending of violators, while jurisdictional issues impede the enforcement of legislation across multiple legal systems. Despite these obstacles, advances in blockchain analytics and international regulatory activities are emerging as critical instruments in the battle against cryptocurrency-enabled financial crimes.

7.1. Areas for Further Research

The dynamic and evolving landscape of DeFi and cryptocurrencies presents several avenues for future research:

(a) ***The Impact of AI and Automation in DeFi Crime Detection:*** Exploring how artificial intelligence and machine learning algorithms can enhance the identification and mitigation of fraudulent activities within DeFi ecosystems is a promising area of study. Research should focus on developing models that can adapt to the rapidly changing tactics employed by cybercriminals (Elliptic, 2025).

(b) ***The Role of Central Bank Digital Currencies (CBDCs) in Reducing Crypto-Enabled Crime:*** Investigating whether the adoption of CBDCs can offer a regulated alternative to decentralized cryptocurrencies and potentially mitigate the prevalence of illicit activities is another critical research direction. Understanding the implications of CBDCs on financial crime dynamics will inform policymakers and law enforcement agencies in crafting effective strategies (U.S. Department of Homeland Security, 2024).

While DeFi and anonymity-centric cryptocurrencies provide new financial solutions, they also pose considerable risks in terms of criminal exploitation and regulatory supervision. A concerted effort comprising worldwide cooperation, technological innovation, and constant study is required for effectively combating and preventing decentralized financial crimes.

Declarations

The author has no relevant financial or non-financial interests to disclose. The data are available upon a reasonable request from the author.

References

Amazon Web Services. (n.d.). What is DeFi? - Decentralized Finance Explained. Retrieved from https://aws.amazon.com/web3/what-is-defi/

AnChain.AI. (n.d.). CISO: AI-powered Blockchain Analytic Tool. Retrieved from https://www.anchain.ai/ciso

Bank of Canada. (2023). Decentralized finance: Innovations and challenges. Retrieved from https://www.bankofcanada.ca/2023/10/staff-analytical-note-2023-15/

Benson, M. L., & Simpson, S. S. (2018). White-collar crime: An opportunity perspective. Routledge.

Binns, A. (2023). Decentralized finance and the rise of digital crime. *Journal of Financial Crime, 30*(1), 123-140. https://doi.org/10.1108/JFC-06-2022-0142

Bray, J. D. (2016). *Anonymity, cybercrime, and the connection to cryptocurrency.* Eastern Kentucky University. Retrieved from https://encompass.eku.edu/etd/418/

Chainalysis. (2021, December 9). Privacy Coins 101: Anonymity-Enhanced Cryptocurrencies. Retrieved from https://www.chainalysis.com/blog/privacy-coins-anonymity-enhanced-cryptocurrencies/

Chainlink. (2023, August 1). Analyzing the DeFi Ecosystem. Retrieved from https://chain.link/education-hub/defi-ecosystem

Choo, K. K. R. (2020). Cybercrime and digital forensic investigations: The role of decentralization in the digital crime ecosystem. *Journal of Digital Crime and Forensics, 8*(2), 203-217. https://doi.org/10.1080/JDCF-05-2020-0064

Clarke, R. V., & Felson, M. (1993). *Routine activity and rational choice*. Transaction Publishers.

Cohen, L. E., & Felson, M. (1979). Social change and crime rate trends: A routine activity approach. *American Sociological Review, 44*(4), 588-608. https://doi.org/10.2307/2094589

Consensys. (n.d.). Blockchain for Decentralized Finance (DeFi). Retrieved from https://consensys.io/blockchain-use-cases/decentralized-finance

Cornish, D. B., & Clarke, R. V. (1986). *The reasoning criminal: Rational choice perspectives on offending.* Springer-Verlag.

Department of Homeland Security. (2022, September). Combatting Illicit Activity Utilizing Financial Technologies and Cryptocurrencies. Retrieved from https://www.dhs.gov/sites/default/files/2023-09/08.%20Combatting%20Illicit%20Activity%20Phase%202_508_0.pdf

El País. (2025, February 25). Un sofisticado 'phishing' para el mayor robo de la historia cripto: 1.400 millones volaron de la cuenta de Bybit. Retrieved from https://cincodias.elpais.com/criptoactivos/2025-02-25/un-sofisticado-phishing-para-el-mayor-robo-de-la-historia-cripto-1400-millones-volaron-de-la-cuenta-de-bybit.html

Elliptic. (2022, June 9). Obfuscation on the blockchain: How to detect and mitigate the risks. Retrieved from https://www.elliptic.co/blog/obfuscation-on-the-blockchain-how-to-detect-and-mitigate-the-risks

European Securities and Markets Authority. (n.d.). Markets in Crypto-Assets Regulation (MiCA). Retrieved from https://www.esma.europa.eu/esmas-activities/digital-finance-and-innovation/markets-crypto-assets-regulation-mica

Europol. (2020). Cryptocurrencies: Tracing the evolution of criminal finances. Retrieved from https://www.europol.europa.eu/cms/sites/default/files/documents/Europol%20Spotlight%20-%20Cryptocurrencies%20-%20Tracing%20the%20evolution%20of%20criminal%20finances.pdf

Financial Action Task Force (FATF). (2023). Illicit financial flows from cyber-enabled fraud. Retrieved from https://www.fatf-gafi.org/content/dam/fatf-gafi/reports/Illicit-financial-flows-cyber-enabled-fraud.pdf

FATF. (2024). Virtual Assets: Targeted Update on Implementation of the FATF Standards. Retrieved from https://www.fatf-gafi.org/en/publications/Fatfrecommendations/targeted-update-virtual-assets-vasps-2024.html

Forbes. (2025, January 7). New EU Rules Could Threaten Your Security – What You Need To Know. Retrieved from https://www.forbes.com/sites/digital-assets/2025/01/07/new-eu-rules-threaten-your-security--what-you-need-to-know/

Holt, T. J., & Bossler, A. M. (2014). An assessment of the current state of cybercrime scholarship. *Deviant Behavior, 35*(1), 20-40. https://doi.org/10.1080/01639625.2013.822209

Hutchings, A., & Holt, T. J. (2015). A crime script analysis of the online stolen data market. British *Journal of Criminology, 55*(3), 596-614. https://doi.org/10.1093/bjc/azu106

Keller, P., Florian, M., & Böhme, R. (2020). Collaborative deanonymization. arXiv preprint arXiv:2005.03535. Retrieved from https://arxiv.org/abs/2005.03535

Levi, M. (2017). Fraud: Organization, motivation, and control. In M. Edelbacher, P. C. Kratcoski, & M. Theil (Eds.), *Financial crime and fraud in the digital age* (pp. 15-32). Springer.

Lukka. (2025). Explore Blockchain Analytics and Transaction Monitoring. Retrieved from https://lukka.tech/blockchain-analytics-and-transaction-monitoring/

Marko, K. (2022). Anonymity technology in virtual assets: Scope, limitations, and emerging strategies. Terrorism, Transnational Crime and Corruption Center. Retrieved from https://traccc.gmu.edu/wp-content/uploads/2022/06/Marko_Anonymity-Technology-in-Virtual-Assets-Scope-Limitations-and-Emerging-Strategies.pdf

Meiklejohn, S., Pomarole, M., Jordan, G., Levchenko, K., McCoy, D., Voelker, G. M., & Savage, S. (2016). A

fistful of bitcoins: Characterizing payments among men with no names. Proceedings of the 2013 Conference on Internet Measurement Conference, 127-140. https://doi.org/10.1145/2504730.2504747

Merkle Science. (2024, August 5). Crypto crime: How criminals are adapting and evolving. Retrieved from https://www.merklescience.com/blog/crypto-crime-how-criminals-are-adapting-and-evolving

Motoyama, M., McCoy, D., Levchenko, K., Savage, S., & Voelker, G. M. (2011). An analysis of underground forums. Proceedings of the 2011 ACM SIGCOMM Conference on Internet Measurement Conference, 71-80. https://doi.org/10.1145/2068816.2068824

Simply Forensic. (2025, August 1). Dark crypto: Essential forensic techniques for blockchain analysis. Retrieved from https://simplyforensic.com/dark-crypto-essential-forensic-techniques-for-blockchain-analysis/

Sumsub. (2024). Crypto Travel Rule 2024 - FATF Requirements. Retrieved from https://sumsub.com/blog/what-is-the-fatf-travel-rule/

The CEO Views. (2024, December 15). Privacy coins in decentralized finance – All you need to know. Retrieved from https://theceoviews.com/privacy-coins-in-decentralized-finance-all-you-need-to-know/

The Hacker News. (2025, February 24). THN Weekly Recap: From $1.5B Crypto Heist to AI Misuse & Apple's Data Dilemma. Retrieved from https://thehackernews.com/2025/02/thn-weekly-recap-from-15b-crypto-heist.html

University Carlos III of Madrid. (2022, August 30). On the Fragility of DeFi Lending. Retrieved from https://economics.uc3m.es/wp-content/uploads/2023/10/NewDefi_300823.pdf

U.S. Department of the Treasury. (2022, August 8). U.S. Treasury Sanctions Notorious Virtual Currency Mixer Tornado Cash. Retrieved from https://home.treasury.gov/news/press-releases/jy0916

Yar, M. (2005). The novelty of "cybercrime": An assessment in light of routine activity theory. *European Journal of Criminology, 2*(4), 407-427. https://doi.org/10.1177/147737080556056

Yar, M., & Steinmetz, K. F. (2019). *Cybercrime and society* (3rd ed.). Sage.

Zohar, A., & Dahan, T. (2023). Privacy coins and the role of anonymity in cryptocurrency crimes. *International Journal of Cyber Security, 25*(3), 101-118. https://doi.org/10.1007/JCS-05-2023-0032

Zreik, H. (2024, October 30). The rise of decentralised finance (DeFi): Opportunities and challenges. FinTech Futures. Retrieved from https://www.fintechfutures.com/2024/10/the-rise-of-decentralised-finance-defi-opportunities-and-challenges/

JELS Journal of Economics, Law & Society

ESREIN Economic and Social Research Institute

Awareness and Attitudes of Customers Towards Islamic Banking Products in a Non-Muslim Country: The Case Study of Cameroon

Issa Hamadou,[1*] Luthfi Hamidi,[1] Aimatul Yumna[1] & Aboubakar Mohamadou Soudi[2*]

[1] *Faculty of Economics and Business, Universitas Islam International Indonesia (UIII), Depok, Indonesia*

[2] *INCEIF University*

**Email: hamadouissa16@gmail.com*

Abstract

The objective of this study is to examine the level of potential customers' awareness and attitude towards Islamic banking products in Cameroon, a non-Muslim country. This research used a mixed-method approach. First, Primary data obtained from a structured questionnaire with 300 respondents are analyzed using appropriate tools to examine the customers' level of awareness and their attitude. Secondly, the study employed a qualitative approach, involving interviews with 10 experts in Islamic finance. The awareness of Islamic banking products among potential customers in Cameroon is very low. They know just the bare minimum about the difference between Islamic banking and conventional banks. Unfortunately, they are not aware of the principles and workings of Islamic banking products. Their understanding is limited to the fact that Islamic banks are interest-free, as opposed to conventional banks that charge interest. Although they have a low level of awareness, they have a positive attitude towards Islamic banking. Consequently, they are willing to patronize Islamic banking. The quantitative survey focused on respondents from Muslim-majority regions of Cameroon, while the qualitative interviews involved Islamic finance experts nationwide, targeting non-users of Islamic banking products. The results of this study fill the existing gap in the literature in Cameroon regarding Islamic banking, specifically in terms of customer awareness. It gives managerial implications to the levels of Islamic finance operators. In the meantime, this study offers certain policy suggestions that can assist in enhancing the growth of Islamic finance in Cameroon and financial inclusion. Based on the author's knowledge, there is no prior research about potential customers' awareness and attitude toward Islamic banking products in Cameroon. Therefore, this study remains the first of its kind to be conducted.

Article History

Received: September 10, 2025
Accepted: December 3, 2025
Published: December 30, 2025

Keywords

Islamic banking; customer awareness; customer attitude; financial inclusion; Cameroon

JEL Codes

G21; G41; Z12; O165;

How to Cite

Hamadou, I., Hamidi, L., Yumna, A. & Soudi, A. M. (2025). Awareness and Attitudes of Customers Towards Islamic Banking Products in a Non-Muslim Country: The Case Study of Cameroon. Journal of Economics, Law and Society, 2(2), 25-37. https://doi.org/10.70009/jels.2025.2.2.2

1. Introduction

In recent years, Islamic banking and finance have seen substantial expansion. Since 1970, one of the most important contributors to this rise has been the expansion of the oil industry in Arab countries, which has increased the availability of financial resources. During that historical period, the leaders of Muslim countries considered the possibility of establishing a new banking system that is in compliance with Islamic law (*Shari'ah*). After this, on September 11, 2001, terrorists attacked the United States of America, which prompted Middle Eastern investors to withdraw their money from Western institutions and repatriate it to their home countries in order to secure their assets (Gonne & Mohamadou, 2022). It is notable that the so-called subprime mortgage crisis, which occurred in 2008, motivated the evolution of Islamic financing in both developed and developing economies. Most banks in Europe and the United States were affected by the crisis, although Islamic banks

largely escaped its impact. Due to this trend, other non-Muslim countries such as France, the United Kingdom (UK), the United States of America (USA), and Germany have created Islamic windows in their conventional financial systems (Kaabachi, 2012).

Gait and Worthington (2015) noted that although Islamic finance has been around for some time, it has only modest market penetration, even among Muslim nations. The low level of awareness, comprehension, and demand for Islamic products is among the primary obstacles to the sector's development. For example, despite the fact that Indonesia is home to the biggest Muslim population in the world. Other hurdles include the smaller capital bases of Islamic banks, the limited product offerings of Islamic banks, the still-developing branch and E-banking networks, and the lack of experience by employees in Islamic banks (Islamic Financial Services Board (IFSB), 2022).

Yusoff (2021) observes that the lack of familiarity with Islamic financial system goods and services is the main factor contributing to the unwillingness of some Malaysians to engage with the system. An example is given of the misconception of consumers about the functioning of Islamic banks, and that most of them (primarily, non-Muslim clientele) do not understand how Islamic banks can earn profits without performing interest-based operations. This implies that the propensity to believe is not always a determining factor when deciding on which bank to choose. Moreover, it shows that Islamic banking segments in these countries lack a high degree of marketing initiatives that can help them reach a larger customer base and educate society about Islamic banking products. Moreover, some non-Muslim nations have shown a lack of awareness of Islamic banking by their customers in non-Muslim African nations, including South Africa (Cheteni, 2014), The Gambia (Sonko, 2020), Uganda (Bananuka et al., 2019), and Nigeria (Kewuyemi, 2015). They claimed that most of the population is unaware of Islamic banking products. This can be caused by the low level of literacy related to Islamic banking and the marketing strategies existing in those countries. Consequently, this lack of awareness constitutes the major obstacle to the development of Islamic banks in such countries. Although there is a lack of awareness about Islamic banking products, many studies have shown that Islamic banks are quite attractive in various countries with non-dominant Muslim populations. For instance, there is interest of non-Muslim consumers towards the Islamic finance industry in the United States, in New Zealand, and in South Korea (Junaidi et al., 2022). Consequently, it is essential to understand the driving factors behind customers' intentions to engage with Islamic banking products. In African countries, particularly those in North Africa (Tunisia, Libya, and Morocco), but also Tanzania, Nigeria, and Senegal, have demonstrated a significant interest in Islamic banking and are speeding up efforts to build this new financial system because of the benefits it will bring to each of their economies (Ngaha & Binam, 2019).

Why is the spread of Islamic finance in Cameroon relevant to us? As it was claimed by IMF Report (2022) and Tabash and Dhankar (2014), the introduction of the Islamic principles and tools of finance have numerous beneficial implications, such as enhancing financial stability and well-being, financial equity, fair distribution of gains, and economic growth (but the author does not neglect the limitations). Within the context of the fact that there is not always an effective solution to the issue of high interest rates that deny businesses and the owners of other projects access to loans and the lack of awareness of Islamic banking products in particular, such a type of intermediation would represent an opportunity not only to the financial sector but also to the economic landscape of Cameroon (Ngaha & Binam, 2019). This is largely because the Islamic banking system within Cameroon remains a young system. Currently, there are three conventional banks that have already established Islamic windows, and one is a fully established Islamic microfinance institution. However, to date, there is no fully established Islamic bank in operation in Cameroon. According to the current knowledge of the authors, the research conducted in the Cameroonian context related to the interaction between consumers and Islamic banks includes Ngaha and Binam (2019), Gonne and Mohamadou (2022), and the study by Mohammadou and Aissatou (2020). The key discoveries of their study indicated that

Islamic finance is a new phenomenon in Cameroon and people have a low level of knowledge on the same. Additionally, it is worth noting that Islamic banking is generally considered more beneficial than traditional banking; however, certain challenges hinder its growth, and clients are not always eager to adopt Islamic finance. Consequently, this study aims to address the gap in the literature regarding the development of Islamic banking in Cameroon by examining the level of awareness and attitudes of customers towards Islamic banking in the country. The study is regarded as a primary study on the customers' awareness and attitude towards Islamic banking in the country. This study has important implications for policymakers, practitioners in Islamic banks, as well as customers of the banks.

2. Literature Review

2.1. Islamic Banking in Cameroon

Of all the countries in central Africa, Cameroon has the most developed economy. By 2022, it is predicted that Cameroon will become the economic powerhouse in the entire Central African region, with a GDP per capita of $ 16,664 (World Bank Annual Report, 2022). The CEMAC region has the greatest number of financial institutions in Cameroon. The country hosts the headquarters of the Bank of the Central African States. Currently, there are 850 microfinance institutions in Cameroon, in addition to the 15 operational banks. The estimates of the International Monetary Fund (IMF) also indicate that the total assets of banks in Cameroon stand at CFA 5,300 billion (approximately $ 9 billion). This is a percentage greater than 27 percent of the GDP in Cameroon and above 40 percent of the total banking assets in CEMAC. The fact that the government has loosened part of the restrictions on liquidity since 2017 is why financial institutions continue to make a profit, and the environment of borrowing money has become more favourable.

This situation implies that a large portion of Cameroon's monetary system is governed by regional regulations, as the country is part of the CEMAC region. These regional laws are consequently responsible for the frequent stalling of court actions. The accounting rules have yet to be fully aligned with the International Financial Reporting Standards (IFRS). Conversely, country officials have recently stated that they intend to restructure the banking and financial sectors of the state to increase the scale of financial intermediation (Gonne & Mohammadou, 2022). Additionally, they plan to establish a central credit register, introduce new financial instruments to small and medium-sized enterprises, establish a court of law to resolve commercial disputes, and enhance the enforcement of contracts.

Traditional commercial banking infrastructure in Cameroon is limited, but access to microfinance institutions is better than the average across sub-Saharan African states (IMF Report, 2022). The reason behind this low level of financial inclusion is the limited number of commercial bank branches and ATM, whereby traditional banking services are only available to small and medium-sized enterprises (SMEs) as well as individuals. As shown in the table below, the number of branches per 100,000 adults (or per 1,000 km^2) has been increasing in recent years. Nevertheless, despite this increase, it remains quite low in comparison to the median indicator of Sub-Saharan Africa, which is 4.02 (or 1.28) as of the end of 2019.

Signs of access to microfinance institutions are fairly favorable, as the number of branches of microfinance institutions is equal to or greater than the average in Sub-Saharan Africa, with respect not only to the number of branches per 100,000 adults but also to the number of branches per 1,000 km2. However, the same situation is not true of Cameroon, which has not experienced any changes in access to microfinance since 2014, unlike other sub-Saharan African countries, where the average and median access have increased (IMF Report, 2022). Moreover, banks do not offer a wide range

of financial products: most loans are short-term in duration, although a middle-term loan is gaining popularity, and savings products turn out to be the most sought-after (demand, term deposits, and passbook savings accounts). Despite limited access to financial services, commercial banks and microfinance institutions are striving to expand their customer base by creating innovative products, launching digital banking products and services such as Mobile Money, and enhancing the infrastructure of financial service providers, including ATM machines and branches.

The IDB has been collaborating with government and business institutions in recent years to provide support for the country's growth and development. As an example, this is a syndicated agreement between the government of Cameroon and the International Islamic Trade Finance Corporation (ITFC), which is a member of the Islamic Development Bank (IDB) Group, and which has signed a deal with the government to provide financing to over 300,000 cotton farmers totaling to a sum of €100 million ($118 million). This agreement aims to provide financial support. As one of the releases states, this investment may be of help to Cameroon's cotton development company, SODECOTON, to enable it to purchase raw cotton produced by farmers, distribute fertilizer to them, and process the cotton for sale. This type of financial arrangement is referred to as a salam contract.

Moreover, the government of Cameroon just recently published a new version of the National Development Strategy of 2020-2030. The document illustrates the plans of the government to expand banking, microfinance and Islamic financial services to the whole nation. This consequently offers a great opportunity to the growth of the Islamic banking system in Cameroon

2.2. Awareness and attitudes towards Islamic banking

In general, being aware of anything results from having an understanding of that thing, whether it be a service, a product, or a person (Ahmad & Bashir, 2014). People are encouraged and motivated to act and make judgments based on the subject's advantages and drawbacks, as well as analysis or intuition, when they are aware of the subject's pros and cons. In other words, customer awareness reveals other aspects of the psychological side of customers, such as their understanding and knowledge of services and products, or whether the person would support a specific product or not. Specifically, these aspects are related to whether or not the person would support Islamic banks. Islamic banking services (IBS) are rapidly becoming one of the

The most frequent financial services in the world. Therefore, numerous studies on customer awareness of Islamic banking services have been done by many writers and academics in many countries. Therefore, we shall analyze those that were carried out in countries where Muslims constitute the majority before delving into countries where Muslims constitute a minority.

According to a study conducted in Bahrain, more than half of the respondents were familiar with Islamic banking and held a favorable opinion of the services offered by Islamic financial institutions (Buchari et al., 2015). Similarly, Gait and Worthington (2015) investigated the attitudes of retail clients in Libyan Islamic banks toward Islamic banking services. Based on the findings of their study, most respondents are familiar with some Islamic banking products, such as *Musharakah* (which refers to full-equity business partnerships) and *Qard Hassan* (which refers to interest-free benevolent loans), but they are less familiar with many other Islamic financial products. It creates an impression that the general population does not make very frequent use of Islamic banking. This directly leads to the situation where clients are unaware of other available options. Similarly, Jameel (2017) conducted a study in the city of Duhok, in the Kurdistan Region, to assess the level of knowledge among clients regarding Islamic banking services. In his opinion, the customers of Cihan Islamic Bank-Duhok and Kurdistan International Bank of Investment and Development lack a comprehensive understanding of the Islamic banking system. Again, in Quetta, Pakistan, Raja et al. (2020) found that women who owned their own businesses were unaware of the products and services offered by Islamic banks.

Furthermore, the results of Zouitene and Bensbahou (2020) in Morocco and Obeid and Kaabachi (2016) in Tunisia assumed that most Muslims are aware of the services provided by Islamic banks. When selecting a bank, Muslim clients are more concerned with efficiency, reduced bank fees, highly profitable and innovative products, rather than adhering to Islamic rules. Due to this, the use of these customs is very minimal. Most customers claim that Islamic banks are fully *Shari'ah*-compliant, which is why they are hesitant to consume products sold by these banks (Sonko, 2020).

Conversely, the study carried out in Russia found out that the level of awareness among the staff working in financial institutions was much below average. The responders did not know that *Riba*, *Maysir*, and *Gharar* are prohibited under the strictest form of the Islamic religion. Similarly, the respondents were unfamiliar with the numerous financial products offered, though they were conversant with the terminology of the different types of financing (Hidayat et al., 2020).

Islam and Rahman (2018) conducted a study to investigate the level of knowledge among Indian Muslims regarding Islamic banking services. They found that the majority of people are unaware of how Islamic banking operates; however, despite this, they are willing to transact with Islamic banking products. This conclusion was based on data gathered from 290 respondents in New Delhi. This implies that the level of communication methods offered by Islamic banks is inadequate, and Islamic financial literacy should also be incorporated into their education system. In the same spirit, Sheikh and Ahammad (2013) have researched the possibility or otherwise of having Islamic financial institutions in the United Kingdom. They had solid arguments that only a mere 45 percent of the Muslim population in Nottingham city know about the existence of Islamic banks. It appears to indicate and evidence that Islamic banks lack the right marketing strategy. Their products cannot access the majority of the Muslim population in the country, not to mention that these people are, theoretically, their main customers.

Again, Kaakeh et al. (2017) investigated the extent to which customers in Spain are aware of Islamic banking by collecting data from 154 respondents in the city of Barcelona. The study employed descriptive statistics and logit regression. Based on the findings of their study, the Muslim community in Spain lacks the knowledge of Islamic banking, and they lack adequate information on this topic, especially in the practical tenets of Islamic banks. Notwithstanding this, they will be willing to learn more and use Islamic financial services. It is insinuated that they are being driven by a religious cause, though they lack adequate knowledge of the concepts of Islamic banking.

In the Philippines, a recent study by Latif (2020) examined the level of awareness among customers regarding Islamic banking. They employed descriptive methods to analyze data collected from 233 individuals who have bank accounts with either conventional banks or Islamic banks. Based on the findings, the level of knowledge possessed by Muslim people is very low, but their stance towards Islamic banking is positive.

Moreover, some studies have demonstrated that the level of knowledge among clients with respect to Islamic banking is low in countries such as South Africa (Cheteni, 2014), The Gambia (Sonko, 2020), Uganda (Kasera and Nalukenge, 2019), and Nigeria (Kewuyemi, 2015). Based on the conclusion of their study, a significant proportion of customers are unfamiliar with the availability of Islamic banking products, including *Mudarabah*, *Musharakah*, and *Murabahah*. It creates the impression that the general population is characterized by a lack of financial awareness and employs inefficient marketing techniques. Due to this, it is advisable for Islamic banks to focus more on the distribution of their goods in order to target a wider range of consumers.

Lastly, Islamic banking products awareness is high in the Muslim countries, but the level of market penetration is low because of the marketing approaches, financial literacy, and *Shari'ah*-compliance issues. This was discovered in a study that correlated with the level of awareness among customers

of Islamic banking products. However, in countries where the number of Muslim minorities is minimal, there is a low level of awareness, but some of the clients are still willing to use Islamic banking products provided they are within the *Shari'ah* law.

3. Methodology

3.1. Data and sample description

The data collection employed online and convenience sampling. The convenience samples will provide the narration for the online samples. The overwhelming majority of the time, when conducting research on Islamic approaches to behavioural finance, this sampling method is utilized (Kaakeh et al., 2018). A section containing questions about the respondent's demographic characteristics is included at the beginning of the survey. In the second section of the questionnaire, respondents were asked about their knowledge of Islamic banking products, which were formulated based on previous literature (see Appendix A). Customers with accounts at conventional banks who are interested in utilizing Islamic banking products will constitute the population. This category will include all customers who utilize traditional banking services and have accounts at multiple financial institutions.

An evaluation of dependability was conducted. According to Hair et al. (2014), Cronbach's alpha for awareness and attitude are 0.82 and 0.87, respectively, which are greater than the minimum required. Therefore, we confirm the dependability of the items.

3.2. Exploratory Factor Analysis

An exploratory factor analysis is used to confirm the scale validity of the factors. ***Table 1*** below presents the results. All of the factors have an eigenvalue higher than 1. The KMO value is equal to 0.697, with a significant Bartlett's test of sphericity. Furthermore, the results in the table suggest that all the factors are valid, as their factor loadings are greater than the minimum required, which is 0.4 (Hair et al., 2014).

3.3. Qualitative Methods

To support the quantitative results, an interview was conducted with 10 respondents. These respondents are Islamic finance experts working in various conventional banks in Cameroon, including Afriland First Bank, CCA Bank, and UBA. There are also those who lecture at universities, and finally, those who are working in the private sector. All the respondents have at least a Master's degree holder. From the transcript of the interview, we came out with important themes related to the level of awareness of potential customers about Islamic banking in Cameroon and also their attitudes to deal with Islamic Banking Products.

4. Results and Discussion

4.1. Likert Scale Analysis of the Items

The initial analysis that we carry out is the Likert scale of the items. It presents the percentage of respondents in each scale, ranging from strongly disagreeing to strongly agreeing. It assists respondents in perceiving each factor (Obeid and Kaabachi, 2016). Each of the scales employs an average formula to capture the respondents' perception of the given factor. This is interpreted as follows by examining the average percentage for each scale. The mean scale of each factor is available in ***Table 2*** below.

Table 1: Factor Analysis Results

Construct	Items	Eigen Value	Loadings
Awareness		3.62	
	Awareness 1		.415
	Awareness 2		.680
	Awareness 3		.661
	Awareness 4		.540
	Awareness 5		.634
	Awareness 6		.605
	Awareness 7		.710
	Awareness 8		.843
Attitude		3.84	
	Attitude 1		.783
	Attitude 2		.598
	Attitude 3		.527
	Attitude 4		.630
	Attitude 5		.831
	Attitude 6		.471

Source: Results obtained from SPSS

Table 2: Interview Respondents Profile

Code	Category	Education	Institution	Position
R1	Client	Masters Holder	Election Cameroon	Head of the Branch
R2	Client	PhD holder	University of Maroua	Lecturer
R3	Expert	PhD holder	University of Tschang	Researcher
R4	Expert	Masters Holder	Savana Islamic Finance	Head of the Branch
R5	Academician	PhD holder	University of Garoua	Head of Department
R6	Expert	Masters Holder	Afriland First Bank	Head of Islamic Finance Branch
R7	Expert	Masters Holder	Savana Islamic Finance	Director
R8	Expert	Masters Holder	Afriland First Bank	Islamic Finance Expert
R9	Expert	Masters Holder	–	Islamic Finance Expert
R10	Expert	Masters Holder	United Bank of Africa	Resident Controller

Source: Elaborated by author based on interview results

In the case of item AWR4, one-third of the respondents say that they strongly or agree that the Islamic banking products and services are not the same as conventional banking. This means that 71 percent of customers are aware that Islamic banking differs from conventional banking. Consequently, they have been exposed to the basic principles of Islamic banking, such as the fact that Islamic banks do not charge or accept interest.

In the case of item AWR5, 26% agree and 19% strongly agree that they have been informed about the instruments contained in the financing products that Islamic banks offer. Although 12 percent respond negatively, 21 percent respond strongly negative and 20 percent respond neutral, this means that 45 percent of the customers have been informed of the instruments that are being used in the financing products that Islamic banks are offering. On the other hand, 33% of them have not been informed about the Islamic banking product.

In the case of item AWR6, 20% of the respondents confirm that they are aware of the fundamental principles of Islamic-based banking products, thus agreeing or strongly agreeing with the item. This

indicates that 38% of customers are familiar with the fundamental principles of Islamic banking products in detail. Although 43 percent of them are not aware of the fundamentals of the Islamic banking products. And 17% of them are neutral.

In the case of item AWR7, we find out that 24 per cent of the people who respond to the item that they agree with, and 18 per cent of those who strongly agree with the item that they are aware of the Islamic banking modes of financing that include *Murabahah*, *Mudarabah*, *Musharakah*, *Ijarah* and *Salam*, and 42 per cent of those who respond are not aware and 44 per cent are neutral. It means that most respondents are unaware of Islamic financing methods, such as *Mudarabah*, *Murabahah*, and *Musharakah*.

When we compute the percentage of items that depict the awareness variable, on average, we find that only 45% of the respondents are aware of Islamic products in Cameroon.

Finally, regarding attitudes, on average, 73% of customers have a positive attitude towards Islamic banking products. It implies that they are considering whether choosing Islamic banking is a wise and good idea for them.

Table 3: Likert Scale Analysis of the Items

Likert Scale	*Strongly Disagree*	*Disagree*	*Neutral*	*Agree*	*Strongly Agree*
Awareness					
AWR4	9%	5%	14%	30%	41%
AWR5	21%	12%	20%	26%	19%
AWR6	25%	18%	17%	20%	18%
AWR7	29%	15%	12%	24%	18%
Average	21%	13%	16%	25%	24%
Attitudes					
ATT1	7%	2%	12%	25%	52%
ATT2	5%	4%	11%	30%	48%
ATT3	7%	9%	25%	24%	32%
ATT4	3%	1%	16%	25%	53%
ATT5	5%	2%	14%	26%	52%
Average	5%	4%	16%	26%	47%

Source: Authors' own.

4.2. Discussion

4.2.1. Customer Awareness Level Quantitative Results Discussion.

The purpose of the research was to analyse the level of awareness and attitude of potential customers regarding Islamic banking products in Cameroon. Descriptive statistics indicate that 45% of respondents are knowledgeable about Islamic banking products, while 55% are unfamiliar with the system in its basic sense. This observation represents a crucial gap in the Cameroonian financial market and aligns with the first research objective of the study, which is to identify the level of awareness.

The awareness deficit manifests in two distinct dimensions. First, among the 45% who claim awareness, their knowledge is superficial and largely confined to understanding that Islamic banking

operates without *riba*, while conventional banks operate with *riba*. This surface-level comprehension falls short in extending to the operational mechanisms and specific products offered by Islamic banks. Second, respondents demonstrate particularly low awareness of Islamic financing modes, with only 42% recognizing products such as *Murabahah*, *Mudharabah*, *Musharakah*, *Ijarah*, and *Salam*. This limited product knowledge represents a significant barrier to market penetration, as customers cannot adopt products they do not understand

These findings are consistent with studies conducted in other Muslim-minority contexts. Islam and Rahman (2018) in India, Sheikh and Ahammad (2013) in the United Kingdom, Kaakeh et al. (2017) in Spain, and Latif (2020) in the Philippines. All reported similarly low awareness levels among Muslim populations in non-Muslim majority countries. The pattern suggests that the religious composition of a country has a significant influence on Islamic financial literacy levels. In African contexts, our results align with those of Cheteni (2014) in South Africa, Sonko (2020) in The Gambia, Bananuka et al. (2019) in Uganda, and Kewuyemi (2015) in Nigeria, where customers demonstrated a limited understanding of Islamic banking principles and products.

Nonetheless, our results differ from those carried out in Muslim-dominant nations. In Libya, Gait and Worthington (2015), Morocco, Zouitene and Bensbahou (2020), and Tunisia, Obeid and Kaabachi (2016), which indicated that the population awareness was higher. Such deviation can be explained by various situational factors, including the increased teaching of Islamic finance in schools, increased advertising by Islamic financial institutions, a greater concentration of Islamic banks, and more effective religious frameworks to promote financial literacy in Muslim-dominated countries.

Three major factors can be cited as the cause of the low awareness level in Cameroon. First, the nascent stage of Islamic banking development in the country, where only three conventional banks offer Islamic windows and one Islamic microfinance institution, restricts market exposure and customer awareness. Second, the lack of Islamic finance education in the formal curriculum implies that potential customers lack a structured way of acquiring knowledge about such products. Third, the modest promotional campaigns by current Islamic financial institutions do not reach the general population, resulting in a lack of information between providers and prospective customers.

4.2.2. Discussion of Quantitative Results: Customer Attitudes

Despite low awareness levels, the study reveals remarkably positive attitudes toward Islamic banking products, with 73% of respondents expressing favorable views. This finding directly addresses the study's second objective of examining customer attitudes and presents a significant opportunity for the development of Islamic banking in Cameroon.

The positive attitude-awareness paradox postulates that customers have a positive predisposition to Islamic banking, even though they have very little knowledge of its operational mechanisms. This circumstance can be projected on using a number of theoretical perspectives. First, even with the limited product knowledge, i.e., customers that have little or no product knowledge, religious compatibility becomes an issue; since Islamic banking is seen as part of religious value, an instinctive trust benefit is created. Second, customers who value fair financial services can relate to the ethical aspects of Islamic banking, specifically the profit-and-loss sharing principles and the prohibition of exploitative practices. Third, dissatisfaction with traditional banking habits, such as high interest rates and a perceived lack of transparency, creates latent demand for alternative banking models.

Since 79% of respondents believed that choosing Islamic banking is a wise idea, and 78% expressed interest in using Islamic banking products, this indicates strong market potential. Such a positive attitude is distributed in various dimensions: 80% believe Islamic banking can work in Cameroon, demonstrating confidence in the system's viability within the local context; 59% believe it is easier

to acquire business development loans through Islamic banking, suggesting perceived accessibility advantages; and 74% express explicit preference for choosing Islamic banking, indicating behavioral intention beyond mere attitude.

This positive attitude despite low awareness parallels findings from Islam and Rahman (2018) in India, where Muslim respondents expressed willingness to engage with Islamic banking despite limited understanding of its principles. Similarly, Kaakeh et al. (2017) in Spain found that Muslim populations were eager to acquire additional knowledge and utilize Islamic financial services, driven primarily by religious motivation rather than comprehensive understanding. These patterns suggest that positive attitudes can serve as a foundation for market development, provided that awareness-building initiatives are implemented to translate favorable dispositions into actual adoption.

4.2.3. Integration of Qualitative Findings: Understanding the Awareness-Attitude Relationship

The qualitative part of this study, which consisted of interviewing 10 Islamic finance experts and practitioners, is vital in providing insights that explain the quantitative results and help understand the processes behind customer awareness and attitudes. This triangulation will cover both the research objectives by bringing out the depth and nature of customer knowledge while explaining the sources of their attitudes.

4.2.3.1. Theme 1: Surface-Level Awareness - The Riba-Centric Understanding.

The interview data reveal that customer awareness is almost entirely concentrated on a single concept: the prohibition of *riba* (interest). This finding explains why quantitative results show 71% of respondents are aware that Islamic banking differs from conventional banking, yet only 38% understand basic Islamic banking principles in detail. The qualitative evidence suggests that most respondents equate "awareness" with knowing that Islamic banks do not charge interest, without fully understanding the alternative mechanisms Islamic banks employ.

The observation made by Expert R4 of the fact that "customers are simply limited to the only difference which is that the Islamic bank proscribes the interest rate" and the observation made by Expert R8 of the fact that "do not know the real differences except to say that the Islamic bank, there is no interest", directly supports the quantitative finding that while respondents claim awareness, their knowledge lacks depth. This *riba*-driven conception is based on the prevalence of religious education among the Muslim and Christian communities alike, which teaches about the forbiddance of interest, but does not extend to the practical operational models of Islamic banking.

It is important to explain the meaning of Expert R9 to put it into perspective: "According to a common approach, customers are aware of the existence of the Islamic bank as a bank that upholds the concepts of the Islamic religion... However, the traditional bank regarded the cost, i.e., the interest and usury. Simply stated, customers distinguish between Islamic banking and conventional banking, yet they do not fully understand it because the Bible also contains a few verses that prohibit interest, or usury." This observation suggests that awareness is more likely due to the broad-based religious principles employed by religions, rather than individual knowledge of Islamic finance processes.

The given theme directly holds the quantitative finding, according to which the levels of awareness seem to be moderate in the general case but fail in the case of evaluating specific product knowledge. It also helps explain why attitudes remain positive despite limited awareness; customers perceive Islamic banking as ethically superior based on the single principle they understand (no *riba*), without requiring detailed knowledge of alternative mechanisms.

4.2.3.2. Theme 2: Gap in product knowledge - Lack of Operational Knowledge.

Data from the interviews provide significant quantitative support for the outcome, which is that only 42 percent of the respondents have knowledge about Islamic modes of financing. Most importantly, there is qualitative evidence that even among individuals who claim to be conscious, there is a lack of awareness and understanding of products, at least in terms of a literal lack of awareness and understanding of products. This has been confirmed by Customer R2, who states: The reality is that I don't know. I believe this is because the Islamic banking system operates under the rate of interest, unlike the conventional banking system, which operates under the interest rate. Not more than that. It is an example of the average level of knowledge.

Multiple experts confirmed that customers often assume Islamic banking simply provides interest-free loans (*Qard Hasan*) without understanding that Islamic banks employ profit-sharing, cost-plus financing, and leasing arrangements. This misconception creates unrealistic expectations and may lead to disappointment when customers discover that Islamic banking involves costs and returns, albeit structured differently from conventional interest.

The lack of product knowledge is also a significant concern, as it is one of the obstacles to informed adoption. Even customers with positive attitudes cannot make apparently informed decisions about Islamic banking products without understanding how they work, the risks they present, and what is required to meet various financial requirements. This gap is the reason why quantitative data include high intentions to use Islamic banking (determined by positive attitudes) but comparatively low adoption rates in Cameroon.

4.2.3.3. Theme 3: Sources and Drivers of Positive Attitudes.

The qualitative data sheds light on the reasons why attitudes are positive despite a lack of awareness. Some of the drivers were identified by the experts: religious consonance, even without in-depth product familiarity, customers consider Islamic banking to be consistent with the religious commandments and this leads to the development of an inherent trust, ethical appeal, that is he prohibition of interest resonates with customers across religious backgrounds who view interest-based lending as exploitative; perceived fairness, also another reason is due to curiosity and openness, many respondents would be willing to learn more about Islamic banking, which means that the positive attitudes would lead to receptivity to future educational programs.

Expert R9's observation that both Muslim and Christian customers respond positively to Islamic banking's ethical foundations suggests that positive attitudes transcend religious boundaries in Cameroon. This finding has significant implications for market development strategy, indicating that Islamic banking can appeal to broader populations beyond Muslim communities by emphasizing ethical and fair finance principles rather than exclusively religious compliance.

4.2.4. Synthesis: The Awareness-Attitude Paradox and Its Implications.

The combination of quantitative and qualitative results gives rise to a paradox that characterizes the current situation in Islamic banking in Cameroon: customers have positive attitudes about a system that they barely know. This paradox is both an opportunity and a challenge to the development of Islamic banking.

On the opportunity side, positive attitudes create favorable conditions for entry and growth in the market. The receptive nature of customers and their readiness to interact with Islamic banking products act as a ready source of consumers for the educational and marketing campaigns. Ethical marketing of Islamic banking appeals has a religious transcendence, indicating wider potential in

the market than could be anticipated in a Muslim minority country. Initial adoption can be motivated by religious reasons, with or without detailed knowledge, which can open up the opportunities of experiential learning, as customers can use the products.

On the challenge side, surface-level awareness cannot sustain long-term adoption without a deeper understanding. Customers may become disillusioned if their expectations (particularly regarding "free" financing) do not match reality. The lack of product knowledge prevents customers from selecting suitable Islamic financial products that meet their needs. A limited understanding makes customers vulnerable to misconceptions and may reduce trust if they feel that products have been misrepresented.

The paradox also highlights a significant disparity between supply and demand. While latent demand exists (evidenced by positive attitudes), the supply side has failed to convert this demand into actual market penetration through effective awareness-building and education. The qualitative evidence suggests that this failure stems from inadequate marketing strategies, insufficient investment in customer education, limited branch networks and customer touchpoints, and the absence of Islamic finance literacy programs in formal and informal education systems.

4.2.5. Comparative Context Cameroon in Regional and Global Context.

Placing Cameroon's results in a comparative context reveals important patterns. Even in African countries such as Morocco and Tunisia, which are predominantly Muslim and are dominated by Muslims, the degree of awareness is associated with more developed Islamic banking, implying that the market evolves, and this, in turn, leads to a further rise in awareness, which provokes advancements in the market. In Muslim-minority African nations like South Africa, The Gambia, Uganda, and Nigeria, awareness levels comparable to Cameroon's exist, indicating that this is a regional rather than country-specific challenge.

These awareness shortfalls are also observed in the Asian cases of minority Muslim countries (India, Philippines), where similar awareness deficits persist, but some countries have implemented systematic literacy programs that Cameroon could emulate. In European markets (UK, Spain), though less popular, niche markets of Islamic banking have been established through more developed promotion and educational programs.

With the level of awareness indicating a low level and positive attitudes being high, Cameroon is in a good starting point compared to some similar countries. The problem lies in the fact that one must capitalize on this favorability before negative experiences or misconceptions have the opportunity to undermine positive attitudes. The three Islamic windows and one microfinance institution, which are currently -operational, are seeds that, with adequate nurturing through awareness building, will eventually form a large market segment.

4.2.6. Addressing the Religiosity Factor

The study findings support the research posit hypothesis, which states that the composition of religion affects the financial literacy of Islamic and developing countries. The qualitative data further show that though the diversity of Cameroon may relate to the religious dimension, and this is a challenge to the Islamic banking awareness, it also presents some unexpected opportunities. Interviewing experts, Christian respondents are not opposed to the concepts of Islamic banking; most of them are at least interested in the ethical foundation of Islamic banking, without being motivated by religious considerations to invest in such products.

It implies that Islamic banking development in Muslim-minority communities may need to transform the marketing narrative to focus more on broader ethics than religious compliance. Even the

name of the concept of Islamic banking as such could present some perceived obstacles to non-Muslim prospective clients. Other experts proposed that a stronger focus on so-called ethical banking, participatory finance, or profit-sharing banking, combined with Islamic branding, could be more attractive and at the same time keep the religious sincerity.

This rebranding should, however, be well-controlled to avoid diluting the Islamic identity that attracts religiously motivated customers. The dilemma is to appeal to both Muslim and non-Muslim customers who want *Shari'ah*-compliant products at the same time and to non-Muslim who want ethical substitute of conventional banking, yet not to lose the unique value proposition of Islamic banking.

5. Conclusion and Practical Implications

This study aimed to investigate the awareness of potential customers about Islamic banking in Cameroon. The results indicated that the awareness of potential customers about Islamic banking products is extremely low in Cameroon. The descriptive statistics revealed that 45 percent of the customers are aware of the availability of Islamic finance in Cameroon, while 55 percent are unaware of the existence of Islamic banking. However, there are customers who understand the fundamental differences between Islamic banking and conventional banks. Their knowledge is regrettable, as they do not understand the principles and operations of Islamic banking products, such as *Mudarabah*, *Musharakah*, and *Salam*. Their understanding of the matter is minimal to the fact that Islamic banks are interest-free, whereas their traditional counterparts are not. As a result, the level of awareness of the Cameroonian customers regarding Islamic banking is minimal. These findings were supported by numerous empirical studies. Nevertheless, there are studies that indicate that Islamic banking products are known to customers in Muslim countries. These conflicting findings are reflected in the level of religiosity among the countries under study. Studies conducted in the Muslim minority countries reveal low awareness, whereas studies that have been conducted in the Muslim majority countries reveal high awareness. It implies that there is a high degree of religious diversity in those countries, which is a significant factor in Islamic financial literacy and the construction of the Islamic banking system.

This study has tri-dimensional implications. To begin with, the findings of this research paper are significant to the literature, as they address the knowledge gap regarding awareness and adoption of Islamic banking products in the central economy of Africa, with a focus on Cameroon in particular.

Secondly, this research has a managerial implication for Islamic finance operators. The factors that influence customers' intentions towards Islamic banking products in the Cameroon islands should be considered. The attitude is positively relevant to the adoption of Islamic banking products. Islamic bank managers should aim to identify the factors that help customers develop a positive attitude, such as the disclosure of the benefits of their products, and consider the *Shari'ah*-compliance issues of their products to influence customers to have a positive attitude towards Islamic banking. They are also able to redesign their product development by providing new and appropriate products to their customers, making them more likely to patronize Islamic banking due to their positive attitude towards the system. They can also launch a major campaign promoting their Islamic banking products, aiming to raise awareness about the availability of Islamic financial products in the country. This is due to the ignorance of potential customers regarding the principles and operation of Islamic banking products. This plan should be achieved by conducting a substantial marketing campaign in the country. Furthermore, the operators of Islamic banking must fully disclose the benefits of Islamic finance to customers, as relative advantage is a notable predictor of intention to transact business with Islamic banking products. Lastly, all these strategies must be implemented by experts in Islamic finance; thus, Islamic banks must offer rigorous training and seminars to their

employees and recruit new professionals with proper knowledge of how Islamic banking works, which can help ease the interaction between the bank and its clients.

Thirdly, this study provides a few policy recommendations that can be used to enhance the growth of Islamic finance in Cameroon, thereby supporting financial inclusion. The evolution of the IF in Cameroon may only evolve through a great awareness of the banking product among the populace, the enhancement of the Islamic banking offer, the enhancement of the legal and tax framework customized to the specifics of the Islamic finance, the involvement of politics in the national level with the general vision and specific plans and plans of the evolution of the Islamic finance in Cameroon. Additionally, develop a national initiative focused on Islamic financial literacy. It may be a certification program, such as a Bachelor's and Master's Holder in Islamic finance. This can enlighten intellectuals in Islamic finance. Once again, build a holistic capacity-building program if the capacities of the different stakeholders, particularly in government bodies, are lacking. Moreover, full-fledged legislation and other compliance provisions must also be established to facilitate the regulation of Islamic financial institutions.

6. Limitations and Future Research

This research has some limitations. First, this research focused mainly on the Muslim zone; future research should provide a comparison between the Muslim and non-Muslim zones to understand the perceptions of customers living in the non-Muslim zone as well. Secondly, this study used only 300 respondents. Future studies could utilize a large number of samples to obtain a more generalized result. Finally, this study was focused only on potential customers. Therefore, we suggest that future research provide a comparative.

Declarations

The author has no relevant financial or non-financial interests to disclose. The data are available upon a reasonable request from the author.

References

Aaminou, M. W., & Aboulaich, R. (2017). Modeling Consumers' Behavior in New Dual Banking Markets: The Case of Morocco. Review of Pacific Basin Financial Markets and Policies 20(2), 1750009. https://doi.org/10.1142/s0219091517500096

Ahmad, A., & Bashir, R. (2014). An Investigation of Customer 's Awareness Level and Customer' Service Utilization Decision In Islamic Banking. *Pakistan Economic and Social Review, 52*(1), 59-74.

Alfarizi, M. A., & Sari, R. M. (2022). Indonesian Muslim Consumers' Perspectives and Behavior on Intentions to Use Islamic Financial Products Post-Covid-19. *EkBis Jurnal Ekonomi Dan Bisnis, 6*(1), 30–43. https://doi.org/10.14421/ekbis.2022.6.1.1549

Bananuka, J., Kaawaase, T. K., Kasera, M., & Nalukenge, I. (2019). Determinants of the intention to adopt Islamic banking in a non-Islamic developing country. *ISRA International Journal of Islamic Finance, 11*(2), 166–186. https://doi.org/10.1108/ijif-04-2018-0040

Cheteni, P. (2014). Awareness of Islamic Banking Products and Services among Consumers in South Africa. *Mediterranean Journal of Social Sciences, 5*(9), 96-103. https://doi.org/10.5901/mjss.2014.v5n9p96

Gait, A. H., & Worthington, A. C. (2015). Attitudes of Libyan retail consumers toward Islamic methods of finance. *International Journal of Islamic and Middle Eastern Finance and Management, 8*(4), 439–454. https://doi.org/10.1108/imefm-04-2013-0056

Hidayat, S. E., Rafiki, A., & Svyatoslav, S. (2020). Awareness of financial institutions' employees towards

Islamic finance principles in Russia. *PSU Research Review, 4*(1), 45–60. https://doi.org/10.1108/prr-08-2019-0026

IMF Report. (2022). Cameroon: 2021 Article IV Consultation and First Reviews Under the Extended Credit Facility and the Extended Fund Facility Arrangements and Requests for Waivers for Performance Criteria Applicability and Nonobservance and Modification Of Performance Criterion-Press Release; Staff Report; and Statement by the Executive Director for Cameroon. *IMF Country Report 2022*(075), 1-148. https://doi.org/10.5089/9798400203985.002

Islam, J. U., & Rahman, Z. (2017). Awareness and willingness towards Islamic banking among Muslims: An Indian perspective. *International Journal of Islamic and Middle Eastern Finance and Management, 10*(1), 92–101. https://doi.org/10.1108/imefm-01-2016-0017

Islamic Financial Services Board (IFSB). (2022). *Islamic Financial Services Industry Stability Report*.Islamic Financial Services Board (IFSB), Kuala Lumpur. https://www.ifsb.org

Jameel, S. A. (2017). Customer's Awareness Towards the Islamic Banking System: Case Study on Selected Banking in Duhok City- Kurdistan Region. *Humanities Journal of University of Zakho, 5*(1), 230–238. https://doi.org/10.26436/hjuoz.2017.5.1.305

Kaakeh, A., Hassan, M. K., & Van Hemmen Almazor, S. F. (2018). Attitude of Muslim minority in Spain towards Islamic finance. *International Journal of Islamic and Middle Eastern Finance and Management, 11*(2), 213–230. https://doi.org/10.1108/imefm-11-2017-0306

Kewuyemi, K. M. (2015). Customers' Awareness , Attitude and Patronage of Islamic Banking in Nigeria. *Islam and Civilisational Renewal, 6*(3), 388–408. https://doi.org/10.12816/0019195

Latif, S. D. H. (2020). Knowledge and attitudes towards Islamic banking in the Philippines. Journal of Islamic *Accounting and Business Research, 12*(2), 169–185. https://doi.org/10.1108/jiabr-05-2019-0092

Mindra, R., Bananuka, J., Kaawaase, T. K., Namaganda, R. H., & Teko, J. (2022). Attitude and Islamic banking adoption: moderating effects of pricing of conventional bank products and social influence. *Journal of Islamic Accounting and Business Research, 13*(3), 534–567. https://doi.org/10.1108/jiabr-02-2021-0068

Ngaha, R., & Binam, F. F. (2019). Déterminants de la réticence au marché de la finance islamique au Cameroun. Revue Congolaise De Gestion, *Numéro 28*(2), 41-85. https://doi.org/10.3917/rcg.028.0041

Obeid, H., & Kaabachi, S. (2016). Empirical Investigation Into Customer Adoption Of Islamic Banking Services In Tunisia. *Journal of Applied Business Research, 32*(4), 1243–1256. https://doi.org/10.19030/jabr.v32i4.9734

Raja, S., Ahmed, J., & Fatima, K. (2020). Awareness on Islamic Banking: An Investigation on Women Entrepreneurs in Quetta. *Journal of Business and Social Review in Emerging Economies, 6*(4), 1595–1609. https://doi.org/10.26710/jbsee.v6i4.1513

Sheikh, R., & Ahammad, M. F. (2013). The feasibility of establishing Islamic banks in the UK: the case of Nottingham. *International Journal of Social Entrepreneurship and Innovation, 2*(1), 67-82. https://doi.org/10.1504/IJSEI.2013.052762

Sonko, M. (2020). Customers' Perceptions on Islamic Banking: A Case Study in the Gambia. *Journal of Islamic Finance, 9*(1), 13–23. https://www.academia.edu/43266930/Customers_Perceptions_on_Islamic_Banking_A_Case_Study_in_the_Gambia

Tabash, M. I., & Dhankar, R. S. (2014). The Flow of Islamic Finance and Economic Growth: an Empirical Evidence of Middle East. *Journal of Finance and Accounting, 2*(1), 11-19. https://doi.org/10.11648/j.jfa.20140201.12

World Bank. (2022). *World Bank Annual Report 2022*. World Bank Group. https://www.worldbank.org/en/about/annual-report

Zouitene, I., & Bensbahou, A. (2020). La perception des instruments de financement participatifs par les dirigeants des TPE au Maroc. *Recherches Et Applications En Finance Islamique, 4*(1), 113–128. https://doi.org/10.48394/imist.prsm/rafi-v4i1.19170

JELS Journal of Economics, Law & Society

ESREIN Economic and Social Research Institute

Banking Sector Concentration, Profitability and Non-Performing Loans: Evidence from 93 Countries

Ilinka Antova[1*]

[1] *University of Sofia "St Kliment Ohridski", Sofia, Bulgaria*

**Email: ilinkaantova@yahoo.ca*

Abstract

This paper examines the determinants of bank non-performing loans (NPLs) using an unbalanced panel of 93 countries over the period 2000-2020. Combining annual banking sector indicators from the World Bank's Global Financial Development database with macroeconomic variables, the analysis focuses on the roles of bank profitability, balance sheet structure, market concentration and the macroeconomic environment in shaping banks' credit quality. The empirical strategy relies on pooled ordinary least squares regressions, country and year fixed-effects panel models, and pooled interaction specifications that distinguish between advanced and other economies.

In pooled regressions, there is a robust negative association between banking sector profitability and NPL ratios, which remains statistically and economically significant after controlling for an extensive set of bank-level and macroeconomic variables. Additional bank characteristics - such as the credit-to-deposit ratio, net interest margins, overheads and the Z-score - are also systematically related to NPLs in the pooled cross-country analysis. In the fixed-effects framework, however, the coefficient on profitability is no longer statistically significant, and real GDP growth emerges as the key driver of within-country NPL dynamics, indicating that the profitability-NPL relationship is largely cross-sectional. Advanced economies exhibit systematically lower NPL ratios than other economies, but the marginal effects of profitability, bank structure and macroeconomic conditions on NPLs are broadly similar across the two groups. These findings highlight the joint importance of bank-specific factors and macroeconomic conditions for understanding cross-country differences and time variation in bank asset quality, while emphasizing the dominant role of the business cycle in explaining NPL dynamics within countries over time.

Article History

Received: November 30, 2025
Accepted: December 25, 2025
Published: December 30, 2025

Keywords

bank non-performing loans; credit risk; banking sector concentration; return on assets

JEL Codes

G21; G41; Z12; O165;

How to Cite

Antova, I. (2025). Banking Sector Concentration, Profitability and Non-Performing Loans: Evidence from 93 Countries. Journal of Economics, Law and Society, 2(2), 39-57. https://doi.org/10.70009/jels.2025.2.2.3

The quality of banks' loan portfolios is central to financial stability and to the transmission of monetary and macroprudential policies. Episodes of sharply rising non-performing loans have featured prominently in many banking crises, often triggering credit contractions and large fiscal costs. Understanding how bank-specific characteristics and the macroeconomic environment shape the incidence of NPLs is therefore important for both prudential supervision and macroeconomic policy design. While a substantial literature has examined the determinants of NPLs in individual countries or specific regions, cross-country evidence that jointly considers bank profitability, market structure, balance sheet indicators and macroeconomic conditions over a long horizon remains relatively limited.

This paper contributes to this debate by studying the determinants of NPLs in a broad panel of 93 countries over the period 2000-2020. The empirical approach is designed to separate different

sources of variation in NPLs. Pooled ordinary least squares (OLS) regressions are used to characterize cross-sectional relationships between NPL ratios, profitability, concentration and other bank-level and macroeconomic variables. Country and year fixed-effects specifications then exploit within-country variation over time to isolate the role of macroeconomic conditions and changes in bank characteristics, controlling for time-invariant country heterogeneity and common shocks. Finally, pooled interaction models with an advanced-economy dummy allow for differences in both the average level of NPLs and the sensitivity of NPLs to bank-specific and macroeconomic factors across country groups.

By combining these elements in a single framework, the paper provides a coherent account of how bank profitability, market structure, balance sheet features and macroeconomic conditions are related to loan performance across a diverse set of banking systems. The results speak to ongoing discussions on the conditions under which higher profitability and particular balance sheet configurations are associated with improved asset quality, and on the extent to which findings from advanced economies generalize to other parts of the world.

2. LITERATURE REVIEW

This section reviews the main strands of research on non-performing loans, with a focus on macroeconomic and bank-specific determinants, the relationship between asset quality and profitability, the role of banking sector market structure, and differences between advanced and emerging economies. It then outlines how the present paper contributes to this literature.

2.1. Macroeconomic and bank-specific determinants of NPLs

A large empirical literature treats NPLs as a key indicator of banking sector fragility and macro-financial vulnerability. Cross-country and regional studies consistently find that NPLs are driven primarily by macroeconomic conditions, with bank-specific characteristics playing an important but secondary role.

For advanced economies, Nkusu (2011) documents that weaker real GDP growth, higher unemployment, increases in real interest rates and falls in asset prices are all associated with higher NPL ratios, and that adverse NPL dynamics can in turn amplify downturns. Klein (2013), focusing on Central, Eastern and South-Eastern Europe, reaches similar conclusions: macroeconomic conditions, especially growth, unemployment and exchange rates, are the main determinants of NPLs, while bank-level variables such as capital and profitability also matter but explain a smaller share of the variation.

Using a global sample, Jakubík and Piloiu (2013) show that real GDP growth is the single most important driver of NPLs, but that lending rates, equity prices and exchange rates also play a statistically and economically significant role. Beck et al. (2015) extend this analysis and confirm, for a broad set of countries, that NPLs rise when growth slows and interest rates increase, while stronger credit growth and higher asset prices are associated with lower NPL ratios. More recent work by Salas et al. (2024), combining bank-level and macroeconomic data for a large cross-country panel, reinforces the central role of cyclical conditions and financial variables while emphasizing that bank-specific factors - capitalization, cost efficiency and profitability - also significantly affect credit risk, especially in emerging markets.

At the bank level, micro-evidence typically combines macro variables with indicators of capital, liquidity, efficiency and management quality. Louzis et al. (2012), using Greek bank data, find that both macroeconomic conditions and bank-specific characteristics (capital, management efficiency, loan growth) are important determinants of NPLs across different loan categories. Messai and

Jouini (2013) reach similar conclusions for a panel of banks from Italy, Greece and Spain: weaker GDP growth and higher unemployment increase NPLs, while better capitalization and profitability are associated with lower NPL ratios. Taken together, this literature suggests that any empirical model of NPLs should control for both cyclical macroeconomic conditions and key bank-specific indicators.

2.2. Profitability and the NPL-performance nexus

A second strand of research examines the two-way relationship between asset quality and bank profitability. Theoretically, high NPLs reduce interest income, increase provisioning needs and erode capital, thereby weakening profitability; at the same time, chronically low profitability can incentivize banks to relax credit standards or shift towards riskier portfolios, raising future NPLs.

Empirically, many studies document a strong negative association between NPLs and profitability. Psaila et al. (2019) demonstrate that for listed Euro-Mediterranean commercial banks, higher NPL ratios are significantly associated with lower returns on assets and equity, even after controlling for solvency and liquidity ratios. Country-specific studies for a range of emerging economies also report that increases in NPLs tend to depress profitability indicators, while better-performing banks exhibit lower NPL ratios, consistent with both direct earnings effects and better risk management.

More recently, Ameur (2024) examines Tunisian banks and models NPLs as a function of both macroeconomic and bank-specific variables, including profitability. The results indicate that lower profitability is associated with higher NPL ratios, and that NPLs themselves feedback negatively into future profitability, pointing to a recursive link between loan quality and bank performance. Ozili (2019), in a global study of financial development and NPLs, similarly finds that low bank profitability is one of several financial sector characteristics associated with higher NPLs.

These findings motivate the inclusion of profitability as a central explanatory variable in NPL regressions. In particular, they suggest that system-wide measures such as aggregate return on assets can serve as useful summary indicators of the health and risk-return profile of banking systems.

2.3. Banking sector concentration, competition and credit risk

The role of banking sector market structure in shaping risk-taking and asset quality has been debated extensively in the banking and industrial organization literature. The "competition-fragility" view, associated with Keeley (1990), posits that more intense competition erodes banks' charter values and encourages greater risk-taking, especially in the presence of mispriced deposit insurance. By contrast, the "competition-stability" view, formalized by Boyd and De Nicolò (2005), argues that greater market power can lead banks to charge higher lending rates, inducing borrowers to take on riskier projects and raising default probabilities.

Empirical work on competition, concentration and bank risk generally finds mixed or context-dependent effects. Studies using bank-level risk measures, such as Z-scores or distance-to-default, often identify non-linearities in the competition-risk relationship and emphasize the importance of institutional and regulatory backgrounds. More recently, Yagli (2021) brings this debate closer to credit risk by examining NPLs and bank competition in a panel of 52 countries. Using both structural (Boone indicator, Lerner index) and non-structural (concentration ratios) measures, the paper finds that higher market power, as captured by pricing-based indicators, is associated with lower NPLs, whereas simple concentration ratios have limited explanatory power for NPLs once other factors are controlled for. Yagli also shows that the impact of competition and concentration on credit risk differs across country groups, suggesting that institutional context matters.

A key implication of this literature is that concentration and competition are conceptually distinct: concentration ratios describe the distribution of market shares, while competition relates

more directly to conduct and pricing. As a result, many empirical studies treat concentration as a control variable and focus on competition indices derived from prices or revenues. This leaves comparatively less systematic evidence on how simple, system-level measures of concentration, such as the asset share of the three largest banks, relate to aggregate NPL ratios in a broad cross-country setting.

2.4. Advanced versus emerging economies and cross-country heterogeneity

A further set of studies explicitly compares NPL determinants across advanced and emerging economies, or across country groups. Nkusu (2011), focusing on advanced economies, highlights the importance of macro-financial linkages and feedback effects from NPLs to the macroeconomy. Klein (2013) shows that in Central, Eastern and South-Eastern Europe, macroeconomic vulnerabilities and bank-specific weaknesses jointly explain high NPL ratios, with significant implications for growth.

Chaibi and Ftiti (2015) compare the determinants of credit risk in bank-based and market-based financial systems (Germany and France) and find that macroeconomic factors and bank-specific variables both play important roles, but that their relative importance differs across systems. Kuzucu and Kuzucu (2019) analyze the impact of emerging and advanced economies on non-performing loans (NPLs) before and after the global financial crisis, concluding that real GDP growth remains the primary driver of NPLs in both groups, while factors such as exchange rate movements and capital flows are relatively more significant in emerging markets.

Survey work by Ozili (2019, 2025) reviews this cross-country literature and notes that, while substantial progress has been made in identifying macro and bank-specific determinants of NPLs, less attention has been paid to the systematic role of structural banking characteristics, such as financial development, ownership structures or market concentration, and to how these characteristics interact with NPLs across different income and institutional groups. These reviews explicitly call for more cross-country studies that integrate structural banking variables with macro-financial determinants and that compare advanced and developing banking systems within a unified empirical framework.

The paper adds to existing research by providing a simple, transparent cross-country characterization of how banking sector concentration and profitability relate to NPLs, and how these relationships vary between advanced and other economies. This complements more granular bank-level studies and offers a system-wide perspective that is directly relevant for debates on consolidation, competition and financial stability.

3. Methodology

3.1. Data and variables

The empirical analysis is based on an unbalanced panel of annual observations for 93 countries over the period 2000-2020. The panel is defined at the country-year level and combines banking sector indicators from the World Bank Global Financial Development database (2025) and with macroeconomic variables from World Bank World Development Indicators (2025). All series are expressed at an annual frequency. The panel is unbalanced because data availability differs across countries and indicators; all regressions use all available observations with non-missing values for the variables included in the respective specification.

The main dependent variable is the ratio of bank non-performing loans to gross loans (NPL), expressed in percent. This indicator measures the share of loans that are past due or otherwise impaired and is widely used as a summary measure of banking sector credit quality.

The first explanatory variable of interest is banking sector concentration (CONC), measured as the percentage of total banking sector assets held by the three largest banks in each country. This variable proxies the degree of market concentration and the potential for market power in the banking system. The second key explanatory variable is the banking sector return on assets (ROA), defined as after-tax profits divided by total assets, expressed in percent. ROA is used as a bank-specific measure of profitability and, indirectly, of the underlying risk–return profile of the system.

To account for additional aspects of banks' balance sheet structure and risk, a set of bank-level control variables is included. These controls comprise the ratio of bank capital to total assets (CAP_TA), the cost-to-income ratio (COST_INC), the ratio of bank credit to bank deposits (CRED_DEP), the net interest margin (NIM), bank overhead costs to total assets (OVER_TA), the ratio of regulatory capital to risk-weighted assets (REG_CAP) and the bank Z-score (ZSCORE), which is an inverse measure of insolvency risk. All bank variables are constructed as sector-wide aggregates at the country level.

The macroeconomic environment is captured by real GDP growth (GDP_GROWTH), the interest rate spread between lending and deposit rates (INT_SPREAD), the real interest rate (REAL_INT) and the unemployment rate (UNEMP). These variables are introduced as additional controls to capture the influence of the business cycle and financial conditions on credit quality.

For the cross-country comparison between advanced and other economies, a categorical variable is constructed based on standard classifications of high-income and advanced economies. Countries commonly classified as high-income or advanced (Western European economies, North America, Japan, and a small number of Asian and European financial centres) are assigned to an "advanced" group, while all remaining countries are classified as "other" economies. A dummy variable ADVc is set equal to one for advanced economies and zero otherwise. This dummy is used both in the descriptive statistics and to allow for differential intercepts and slopes in the regression analysis.

3.2. Baseline pooled regressions

The econometric analysis proceeds in two main steps. The first step estimates a sequence of pooled ordinary least squares (OLS) models that relate the NPL ratio to measures of banking sector concentration and profitability, progressively adding bank-level and macroeconomic controls. In the pooled specifications, the panel is treated as a simple collection of cross-sectional country-year observations. Standard errors are computed using the conventional OLS formula.

The baseline pooled specification relates NPLs to banking sector concentration and profitability according to the following model:

$$NPL_{c,t} = \alpha + \beta_1 CONC_{c,t} + \beta_2 ROA_{c,t} + \varepsilon_{c,t} \quad (1)$$

where $NPL_{c,t}$ t denotes the non-performing loan ratio in country c and year *t*, $CONC_{c,t}$ is the banking sector concentration, $ROA_{c,t}$ is the return on assets, and $\varepsilon_{c,t}$ is an error term capturing all other influences. As a benchmark, a version of this model including only $CONC_{c,t}$ as regressor is also estimated in order to assess the unconditional relationship between market concentration and loan quality.

To account for additional bank-level characteristics and the macroeconomic environment, the baseline specification is extended by including the vectors of bank controls $B_{c,t}$ and macro controls $M_{c,t}$:

$$NPL_{c,t} = \alpha + \beta_1 CONC_{c,t} + \beta_2 ROA_{c,t} + \gamma B_{c,t} + \delta M_{c,t} + \varepsilon_{c,t} \quad (2)$$

In equation (2), $B_{c,t}$ collects the bank-level controls (CAP_TA, COST_INC, CRED_DEP, NIM, OVER_TA, REG_CAP, ZSCORE), and $M_{c,t}$ collects the macroeconomic variables (GDP_GROWTH, INT_SPREAD, REAL_INT, UNEMP). The coefficients γ and δ capture the marginal effects of bank structure and macroeconomic conditions on NPLs, conditional on concentration and profitability. All pooled regressions are estimated on the largest available sample, using all observations with non-missing values for the variables appearing in the specification.

3.3. Fixed-effects panel regressions

The pooled OLS models do not control for unobserved country-specific characteristics or for common shocks affecting many banking systems simultaneously. To address these issues, a fixed-effects panel specification with country dummies and year dummies is estimated. This model exploits only within-country variation over time in concentration, profitability and the control variables to explain changes in NPLs.

The fixed-effects specification takes the form

$$NPL_{c,t} = \alpha_c + \lambda_t + \beta_1 CONC_{c,t} + \beta_2 ROA_{c,t} + \gamma B_{c,t} + \delta M_{c,t} + u_{c,t} \quad (3)$$

where α_c denotes a full set of country-specific intercepts capturing time-invariant characteristics of each banking system (such as institutional quality, legal origin or long-run regulatory regimes), λ_t denotes a full set of year dummies capturing global or widespread shocks, and uc,t is an idiosyncratic error term. The coefficients β_1 and β_2 now measure the average within-country effect of changes in concentration and profitability on changes in NPLs, conditional on the controls and fixed effects. Equation (3) is estimated by OLS with country and year dummy variables explicitly included. Standard errors are adjusted for clustering at the country level to allow for arbitrary serial correlation and heteroskedasticity within countries over time.

3.4. Heterogeneity between advanced and other economies

To investigate whether the determinants of NPLs differ systematically between advanced and other economies, the pooled specification is augmented with the ADV dummy and interaction terms between ADV and the main explanatory variables. This allows both the intercept and the slopes of the NPL equation to vary across the two country groups.

The interaction model is specified as follows:

$$NPL_{c,t} = \alpha + \beta_1 CONC_{c,t} + \beta_2 ROA_{c,t} + \gamma B_{c,t} + \delta M_{c,t} + \theta ADV_c + ADV_c \times (\beta_3 CONC_{c,t} + \beta_2 ROA_{c,t} + \gamma_{ADV} B_{c,t} + \delta_{ADV} M_{c,t}) + + \varepsilon_{c,t} \quad (4)$$

In equation (4), ADV_c equals one for advanced economies and zero otherwise. The coefficient θ captures the difference in the conditional average level of NPLs between advanced and other economies, holding the explanatory variables constant. The interaction terms between ADV_c and the regressors allow the marginal effects of concentration, profitability, bank structure and macroeconomic conditions on NPLs to differ across country groups. For example, the marginal effect of ROA on NPLs is β_2 for other economies (ADVc = 0) and $\beta_2 + \beta_4$ for advanced economies (ADV_c = 1). The interaction model is estimated by pooled OLS on the full sample of country-year observations with non-missing values for all variables in the specification, using conventional standard errors.

3.5. Treatment of missing data, outliers and robustness

Throughout the empirical work, the panel is treated as unbalanced. For each specification, all available country-year observations with non-missing values for the variables appearing in that specification are retained. No additional transformations or winsorisation of the NPL series are applied, so the estimates reflect the full dispersion of NPL ratios, including episodes of severe banking distress. This choice preserves information on crisis dynamics at the cost of greater sensitivity to extreme observations. Robustness checks based on trimming or winsorising the most extreme NPL observations, as well as alternative sets of controls and lag structures, can be implemented as extensions to the baseline results without altering the structure of the empirical model.

4. ANALYSIS AND FINDINGS

4.1. Descriptive statistics

The empirical analysis is based on an unbalanced panel of 93 countries observed over the period 2000-2020. The panel is defined at the country-year level and combines annual banking sector indicators from the World Bank's Global Financial Development database with a set of macroeconomic variables and a country classification into advanced versus other economies.

The dependent variable is the ratio of bank non-performing loans to gross loans (NPL), expressed in percent. Bank-level explanatory variables include the after-tax return on assets (ROA), the ratio of bank capital to total assets (CAP_TA), the cost-to-income ratio (COST_INC), the ratio of bank credit to bank deposits (CRED_DEP), the net interest margin (NIM), bank overhead costs to total assets (OVER_TA), the ratio of regulatory capital to risk-weighted assets (REG_CAP) and the bank Z-score (ZSCORE). Macroeconomic controls comprise real GDP growth (GDP_GROWTH), the interest rate spread between lending and deposit rates (INT_SPREAD), the real interest rate (REAL_INT) and the unemployment rate (UNEMP).

Across all available observations, the mean NPL ratio is approximately 6.4%, with a median of 3.7% and a wide dispersion (interquartile range 2.0–8.3%, maximum around 74%). This confirms that the dataset covers both tranquil periods and episodes of severe banking distress. Average ROA is around 1.2%, with a pronounced left tail reflecting years of substantial losses in some banking systems. The average capital-to-assets ratio is close to 9.6%, and the average Z-score is about 16.3, pointing to substantial cross-country heterogeneity in bank solvency and stability.

The cross-country comparison reveals systematic differences between the two groups. The mean NPL ratio is about 3.8% in advanced economies and 8.0% in other economies, while the median NPL is just above 2% in advanced economies compared with around 5% in other economies. Thus, both the level and dispersion of NPLs are lower in the advanced group. Average ROA is lower in advanced economies (around 0.65%) than in other economies (around 1.46%), and net interest margins are narrower (roughly 1.9% versus 5.5%), consistent with more competitive and efficient banking systems. At the same time, credit-to-deposit ratios tend to be higher in advanced economies (around 122% compared with 96% in other economies), suggesting more extensive financial intermediation. Average capital-to-assets ratios are somewhat lower in advanced systems (about 7.3% versus 11.1%), which may reflect more diversified portfolios and lower underlying risk.

Table 1 presents descriptive statistics for the variables used in the empirical analysis. The table is divided into two panels.

Panel A of ***Table 1*** reports statistics for the full sample of country–year observations. For each variable, the panel shows the number of observations, mean, standard deviation, minimum, first

quartile, median, third quartile and maximum. The sample includes up to 1,950 country–year observations for 93 countries over the period 2000–2020, with the exact number of observations differing by variable due to missing data.

Table 1: Descriptive statistics

Panel A. Full sample

Variable	N	Mean	Std. Dev.	Min	P25	Median	P75	Max
NPL	1809	6.41	7.13	0.10	1.95	3.70	8.30	74.10
ROA	1883	1.18	1.94	-23.89	0.59	1.10	1.73	38.30
CAP_TA	1738	9.64	3.65	1.49	6.97	9.28	11.80	30.60
COST_INC	1875	57.39	14.02	5.03	49.33	57.08	64.37	237.05
CRED_DEP	1871	105.06	50.72	10.67	73.78	96.29	123.96	598.15
NIM	1866	4.24	2.88	0.15	2.15	3.45	5.87	21.36
OVER_TA	1882	3.41	3.36	0.05	1.54	2.49	4.58	84.34
REG_CAP	1823	16.48	4.66	1.75	13.30	15.91	18.40	48.60
ZSCORE	1898	16.32	9.71	-0.33	9.36	14.81	20.24	66.27
GDP_GROWTH	1905	3.24	3.94	-21.40	1.57	3.28	5.39	26.52
INT_SPREAD	1151	7.01	6.56	-3.60	3.23	5.34	8.43	55.80
REAL_INT	1265	6.20	8.79	-53.64	2.12	4.83	9.26	93.92
UNEMP	1908	8.03	5.95	0.25	3.97	6.21	10.03	37.32

Notes: Panel A reports descriptive statistics for the full sample of country–year observations

Panel B. Means by country group

Variable	N_ADV	Mean_ADV	Std_ADV	N_OTHER	Mean_OTHER	Std_OTHER
NPL	665	3.75	5.37	1144	7.96	7.56
ROA	660	0.65	1.96	1223	1.46	1.86
CAP_TA	652	7.29	2.57	1086	11.05	3.46
COST_INC	658	58.55	14.93	1217	56.76	13.46
CRED_DEP	640	121.97	59.01	1231	96.27	43.32
NIM	653	1.91	1.06	1213	5.50	2.76
OVER_TA	661	1.67	1.03	1221	4.35	3.78
REG_CAP	682	15.31	4.06	1141	17.19	4.85
ZSCORE	668	15.71	9.56	1230	16.65	9.78
GDP_GROWTH	672	2.20	3.55	1233	3.81	4.03
INT_SPREAD	188	2.95	1.52	963	7.80	6.86
REAL_INT	266	3.29	2.73	999	6.98	9.65
UNEMP	672	7.38	4.09	1236	8.37	6.73

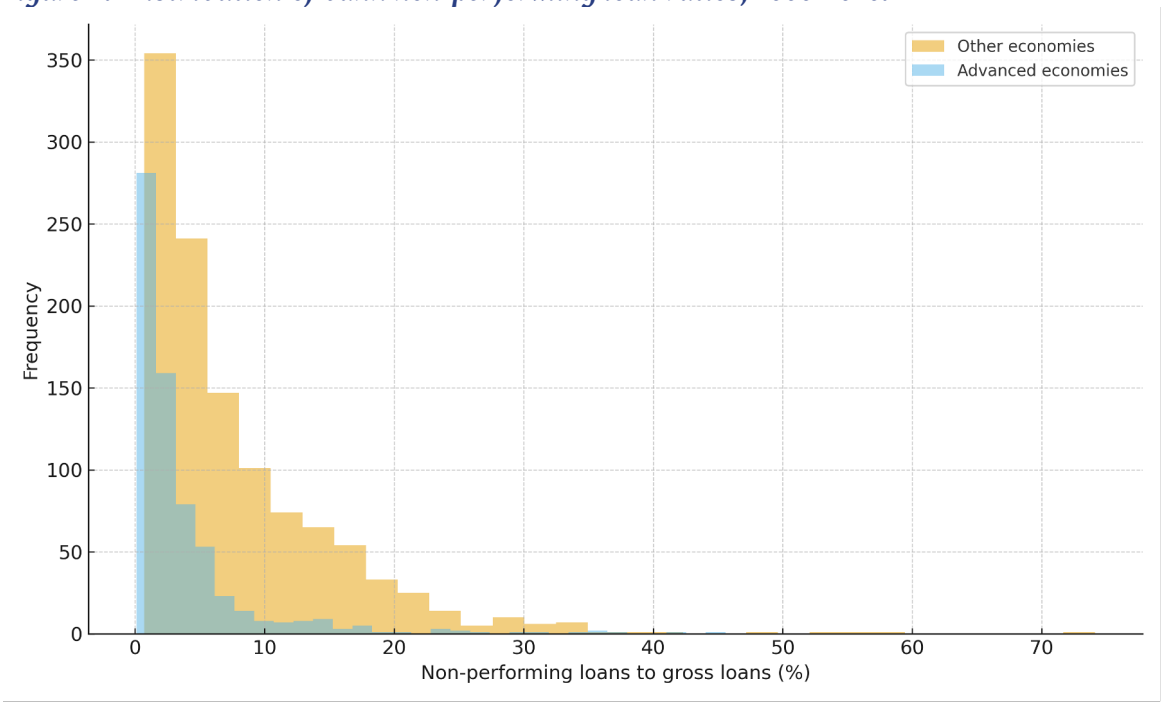
Notes: Panel B reports means and standard deviations separately for advanced and other economies
Source: Author's calculation

For the non-performing loan (NPL) ratio, the mean in Panel A is about 6.4%, with a median of 3.7% and a wide range extending from close to zero to more than 70%. Bank profitability (ROA) averages around 1.2%, with a left-skewed distribution reflecting episodes of large losses. Capitalization (CAP_TA) has an average of about 9.6%, while the credit-to-deposit ratio (CRED_DEP) averages around 105%, indicating that, on average, credit slightly exceeds the deposit base. Net interest margins (NIM) average roughly 4.2%, with substantial dispersion. Overheads-to-assets (OVER_TA) and regulatory capital-to-RWA (REG_CAP) also display wide variation across banking systems. The Z-score, used as an inverse measure of insolvency risk, has a mean of about 16.3. On the macro side, real GDP growth averages about 3.2%, real interest rates around 6.2% and unemployment about 8.0%, all with sizeable variability.

Panel B of ***Table 1*** compares mean values and standard deviations for advanced and other economies. For each variable, the panel reports separate sample sizes, means and standard deviations for the advanced group (ADV = 1) and the group of other economies (ADV = 0).

Panel B shows that NPL ratios are lower in advanced economies: the mean NPL is around 3.8% in advanced economies and 8.0% in other economies. Advanced economies also exhibit narrower net interest margins (around 1.9% versus 5.5% in other economies) and lower overheads-to-assets ratios (about 1.7% versus 4.4%). At the same time, banks in other economies have higher capital-to-assets and regulatory capital ratios, whereas banks in advanced economies tend to have higher credit-to-deposit ratios, consistent with more extensive financial intermediation. On the macro side, advanced economies are characterized by lower average real GDP growth but slightly lower unemployment. The differences in means reported in Panel B suggest that banking structures and macroeconomic environments differ systematically between the two groups, which motivates the use of the ADV dummy and interaction terms in the regression analysis.

Figure 1: Distribution of bank non-performing loan ratios, 2000-2020.



Source: Author's calculation

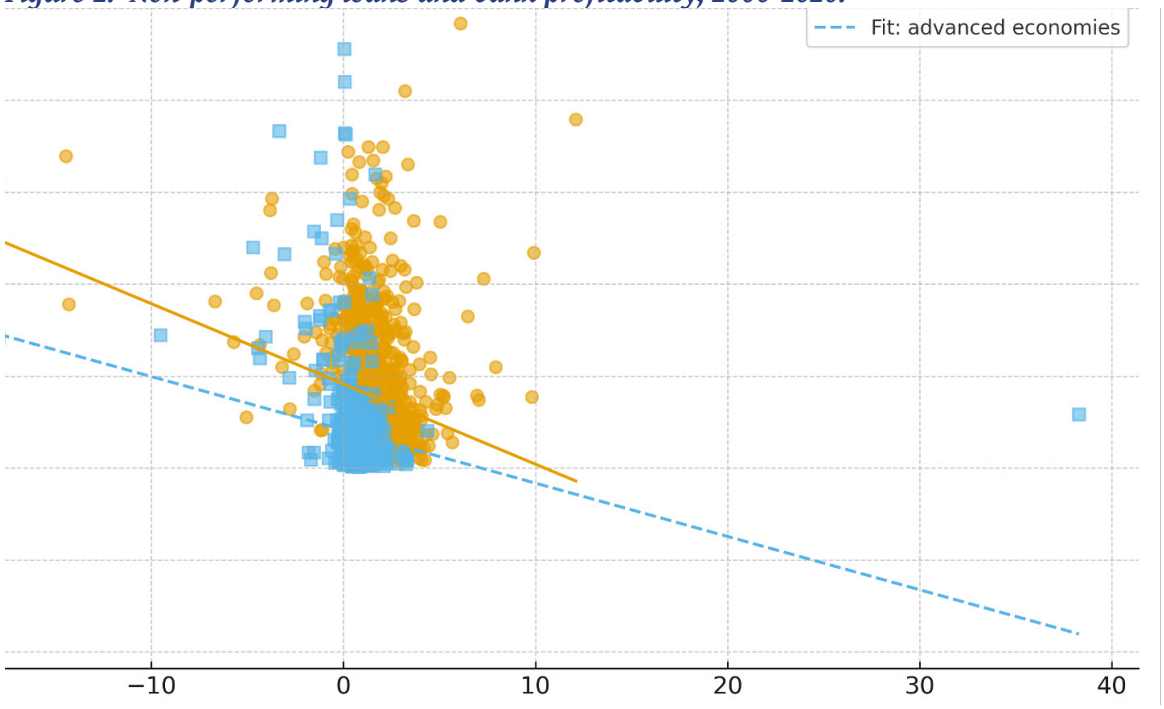
Figure 1 shows the distribution of bank non-performing loan (NPL) ratios over the period 2000-2020, separately for advanced and other economies. The histograms indicate that, in both groups, the distribution of NPLs is right-skewed, with most observations clustered at relatively low levels and a tail of higher values associated with episodes of banking stress.

The figure highlights clear differences between the two country groups. In advanced economies, the bulk of the distribution is concentrated at low NPL ratios, with most observations lying below 5% and relatively few cases above 10%. By contrast, in other economies the distribution is more dispersed and shifted to the right, with a larger share of observations in the 5-15% range and a sizeable tail extending to much higher NPL ratios. This visual evidence is consistent with the summary statistics in ***Table 1***, where mean and median NPL ratios are lower in advanced economies and the upper tail of the distribution is longer in the group of other economies.

Figure 2 plots the ratio of non-performing loans to gross loans against the banking sector return on assets for all country-year observations in the sample, distinguishing between advanced and

other economies. Each point represents a country-year pair, and separate fitted linear regression lines are shown for the two country groups.

Figure 2: Non-performing loans and bank profitability, 2000-2020.



Source: Author's calculation

The scatter suggests a clear negative association between profitability and NPLs in both groups. Observations with higher ROA tend to be associated with lower NPL ratios, while higher NPL ratios are more frequently observed when profitability is weak or negative. The fitted lines for advanced and other economies are both downward sloping and relatively similar in steepness, indicating that the marginal relationship between ROA and NPLs does not differ markedly across the two groups.

At the same time, the cloud of points for advanced economies is concentrated in a region with lower NPL ratios and somewhat lower ROA, whereas the cloud for other economies is more dispersed and extends to both higher NPLs and higher profitability. This pattern is consistent with the descriptive statistics from Table 1: advanced economies have, on average, cleaner loan portfolios but somewhat lower average profitability, while other economies exhibit a wider range of outcomes on both dimensions.

4.2. Baseline pooled regressions

The analysis starts from pooled ordinary least squares (OLS) models that relate NPLs to banking sector profitability and, progressively, to an expanded set of bank-specific and macroeconomic variables. The pooled regressions treat the panel as a simple cross-section of country-year observations and report conventional OLS standard errors. In each specification, the sample is restricted to observations with non-missing values for the variables included in that specification.

Table 2 reports pooled ordinary least squares estimates of the relationship between the ratio of non-performing loans to gross loans (NPL) and a set of banking sector and macroeconomic variables. The dependent variable in all columns is NPL. The table contains three specifications that progressively expand the set of regressors and illustrate how the inclusion of bank-level and macro controls affects the estimated relationship between profitability and credit quality.

Table 2: Pooled OLS regressions (dependent variable: NPL)

	(1)	(2)	(3)
ROA	-0.528***	-0.721***	-1.015***
	(0.084)	(0.106)	(0.179)
Capital to assets		0.088	-0.022
		(0.070)	(0.096)
Cost-to-income		-0.027*	-0.055***
		(0.014)	(0.018)
Credit-to-deposits		-0.025***	-0.040***
		(0.004)	(0.006)
Net interest margin		0.420***	0.502***
		(0.084)	(0.111)
Overheads to assets		0.106*	0.130**
		(0.061)	(0.065)
Reg. capital to RWA		-0.002	0.081
		(0.046)	(0.066)
Z-score		-0.123***	-0.128***
		(0.017)	(0.024)
GDP growth			0.002
			(0.059)
Interest rate spread			-0.036
			(0.051)
Real interest rate			0.022
			(0.036)
Unemployment			0.100***
			(0.034)
Observations	1748	1547	936
R-squared	0.022	0.123	0.151

Note(s): The table reports pooled ordinary least squares estimates of the relationship between the ratio of non-performing loans to gross loans (NPL) and banking sector characteristics and macroeconomic variables. Standard errors are in parentheses. *, ** and *** denote significance at the 10%, 5% and 1% levels, respectively.
Source: Author's calculation

In column (1), NPL is regressed only on the banking sector return on assets (ROA). The estimated coefficient on ROA is negative and statistically significant at the 1% level. In magnitude, the estimate implies that a one percentage point increase in ROA is associated with a reduction in the NPL ratio of roughly half a percentage point. The R-squared is relatively low, indicating that profitability alone explains only a small fraction of the cross-sectional and time-series variation in NPLs. Nevertheless, the sign and statistical significance of the coefficient provide initial evidence of an inverse association between profitability and the incidence of non-performing loans.

In column (2), the specification is extended to include the full set of bank-level controls (capital to assets, cost-to-income ratio, credit-to-deposits ratio, net interest margin, overheads-to-assets ratio, regulatory capital-to-RWA and the Z-score). Once these controls are added, the coefficient on ROA becomes more negative and remains statistically significant at conventional levels. This suggests that the negative association between profitability and NPLs is not driven by omitted variation in other observable bank characteristics. Several of the bank controls themselves display significant coefficients. The credit-to-deposits ratio enters with a negative coefficient, indicating that banking systems with higher credit relative to deposits tend to record lower NPL ratios, conditional on other factors. The net interest margin is positively associated with NPLs, consistent with higher margins being correlated with higher credit risk or lower competition. The Z-score is negatively related to NPLs, indicating that more stable banking systems, as measured by this summary indicator, tend to exhibit lower non-performing loan ratios. Overheads-to-assets enter with a positive coefficient,

suggesting that higher operating costs relative to assets are associated with worse loan performance. The inclusion of these bank-level regressors increases the explanatory power of the model, as reflected in a higher R-squared.

In column (3), the set of regressors is further augmented with macroeconomic variables: real GDP growth, the interest rate spread, the real interest rate and the unemployment rate. The sample size in this specification is smaller because macro variables, in particular interest rate indicators, are not available for all country-year observations. In this enlarged model, the coefficient on ROA remains negative and statistically significant and tends to be somewhat larger in absolute value than in column (2), indicating that, conditional on both bank structure and macroeconomic conditions, higher profitability is associated with lower NPL ratios. The signs and significance of the main bank-level controls are broadly preserved. Among the macro variables, the unemployment rate is the most robust predictor of NPLs, with a positive and statistically significant coefficient: higher unemployment is associated with higher ratios of non-performing loans, conditional on bank characteristics. The coefficients on real GDP growth, the interest rate spread and the real interest rate are typically not statistically significant once bank-level indicators are included. Compared with column (2), the R-squared rises only modestly, suggesting that bank-specific factors account for a larger share of the variation in NPLs than the macro controls included here.

Taken together, the results in ***Table 2*** indicate that the negative association between banking sector profitability and NPLs is a robust feature of the data and is not driven by simple compositional differences in bank structure or macroeconomic conditions. The additional bank-level variables make a non-negligible contribution to explaining cross-country differences in NPLs, while the macroeconomic environment, in particular labor market conditions, plays a secondary but still visible role in the pooled regressions.

4.3. Panel fixed-effects regressions

The pooled specifications do not control for unobserved country-specific characteristics or for common shocks that affect many banking systems simultaneously. To address these issues, a panel-data model with country fixed effects and year dummies is estimated. The fixed-effects specification is given by:

$$NPL_{c,t} = \alpha_c + \lambda_t + \beta_{ROA} ROA_{c,t} + \gamma B_{c,t} + \delta M_{c,t} + u_{c,t} \quad (5)$$

where α_c denotes a full set of country-specific intercepts, λ_t is a full set of year dummies, and $u_{c,t}$ is an idiosyncratic error term. The slope coefficients are estimated by OLS with country and year dummy variables explicitly included, and standard errors are clustered at the country level to allow for arbitrary forms of serial correlation and heteroskedasticity within countries over time. The set of regressors $B_{c,t}$ and $M_{c,t}$ is the same as in the third pooled specification, and the estimation sample consists of 936 observations for the subset of countries and years with complete data.

Table 3 presents estimates from a fixed-effects panel regression of the ratio of non-performing loans to gross loans (NPL) on banking sector characteristics and macroeconomic variables. The specification includes country fixed effects and year fixed effects, so the coefficients are identified from within-country variation over time, after controlling for time-invariant country-specific factors and common shocks in each year. Standard errors are clustered at the country level to allow for arbitrary correlation of the residuals within countries over time.

The set of regressors in ***Table 3*** mirrors that of the most comprehensive pooled specification: banking sector profitability (ROA), the bank-level control variables (capital-to-assets, cost-to-income ratio, credit-to-deposits ratio, net interest margin, overheads-to-assets ratio, regulatory

capital-to-RWA and the Z-score) and the macroeconomic controls (real GDP growth, interest rate spread, real interest rate and unemployment).

Table 3: Fixed-effects panel regressions (dependent variable: NPL)

	(1)
ROA	-0.219 (0.245)
Capital to assets	-0.109 (0.200)
Cost-to-income	0.004 (0.028)
Credit-to-deposits	-0.059* (0.030)
Net interest margin	-0.143 (0.210)
Overheads to assets	0.072 (0.051)
Reg. capital to RWA	-0.188 (0.128)
Z-score	-0.078 (0.081)
GDP growth	0.341*** (0.094)
Interest rate spread	-0.036
Real interest rate	0.009
Unemployment	0.168
Observations	936
Number of countries	60
R-squared	0.641
Country fixed effects	Yes
Year fixed effects	Yes

Note(s): The table reports estimates from a country and year fixed-effects regression of the ratio of non-performing loans to gross loans (NPL) on banking sector characteristics and macroeconomic variables. The specification includes country dummies and year dummies (not reported). Standard errors clustered at the country level are in parentheses. *, ** and *** denote significance at the 10%, 5% and 1% levels, respectively.
Source: Author's calculation

A first result is that, once country and year fixed effects are included, the coefficient on ROA is no longer statistically significant. Its sign remains negative, but the magnitude is smaller than in the pooled regressions and the standard error is large relative to the point estimate. This suggests that the strong negative association between profitability and NPLs found in the pooled OLS models is mainly driven by persistent cross-country differences in average profitability and credit quality, rather than by systematic co-movement within countries over time.

Among the bank-level controls, only the credit-to-deposits ratio retains some explanatory power in the fixed-effects framework. Its coefficient is negative and weakly significant, indicating that, within a given country, increases in credit relative to deposits are associated with modest declines in NPLs, conditional on the other controls and fixed effects. The remaining bank variables (capital-to-assets, cost-to-income, net interest margin, overheads-to-assets, regulatory capital-to-RWA and the Z-score) typically have signs consistent with the pooled results but are not statistically significant at conventional levels in this specification. This pattern suggests that much of the variation in these bank characteristics is cross-sectional and is already absorbed by the country fixed effects.

By contrast, the macroeconomic environment emerges as a key driver of within-country NPL dynamics. The coefficient on real GDP growth is strongly negative and statistically significant, implying that higher output growth is associated with lower NPL ratios within countries over time. The magnitude of the estimated effect indicates that a one percentage point increase in real GDP growth is associated with a reduction in NPLs of roughly one-third of a percentage point, holding other factors constant. This result is consistent with the view that NPLs are strongly countercyclical and respond to the state of the business cycle. The coefficients on the unemployment rate, the interest rate spread and the real interest rate are not statistically significant once GDP growth, bank variables and fixed effects are included, suggesting that their incremental contribution over and above the growth rate is limited in this specification.

The overall R-squared in Table 3 is relatively high, reflecting the combined explanatory power of the fixed effects and the included regressors. The country and year dummies capture a large portion of the variation in NPLs, and the remaining variation is explained primarily by movements in real GDP growth and, to a lesser extent, by changes in the credit-to-deposits ratio. Taken together, the fixed-effects results indicate that business cycle conditions are the dominant determinant of NPL dynamics within countries, whereas the role of profitability and other bank structural indicators is mainly to explain cross-country differences in average NPL levels rather than short-run fluctuations.

4.4. Advanced versus other economies: interaction model

To examine whether the determinants of NPLs differ systematically between advanced and other economies, the pooled regression with bank and macro controls is augmented with a dummy variable for advanced economies (ADV) and interaction terms between this dummy and the explanatory variables. The resulting specification is:

$$NPLc,t = \alpha + \beta_{ROA}ROA_{c,t} + \gamma B_{c,t} + \delta M_{c,t} + \theta ADV_c + ADV_c \times (\theta_{ROA}ROA_{c,t} + \gamma_{ADV}B_{c,t} + \delta_{ADV}M_{c,t}) + + \varepsilon_{c,t} \quad (6)$$

where ADV_c equals one for advanced economies and zero otherwise. This specification allows both the intercept and the slopes with respect to the bank and macro variables to differ across country groups. Estimation is carried out by pooled OLS on the same sample of 936 observations used in the third specification of ***Table 2***, and conventional standard errors are reported.

Table 4 reports estimates from a pooled ordinary least squares regression of the ratio of non-performing loans to gross loans (NPL) on banking sector characteristics and macroeconomic variables, allowing the relationship to differ between advanced and other economies. The specification is based on the most comprehensive pooled model and adds an indicator for advanced economies (ADV) and interaction terms between ADV and all explanatory variables. ADV is defined as a dummy equal to one for countries classified as advanced and zero for all other countries.

The ADV dummy captures differences in the average level of NPLs between advanced and other economies, conditional on the explanatory variables. Its coefficient in ***Table 4*** is negative and statistically significant, indicating that, for given values of banking sector and macroeconomic variables, advanced economies tend to have lower NPL ratios than other economies. The magnitude of the point estimate implies that conditional NPL levels in advanced economies are lower by several percentage points on average, which is consistent with the descriptive evidence from ***Table 1***.

The main coefficient on ROA in ***Table 4*** measures the effect of profitability on NPLs for the group of other economies (ADV = 0). This coefficient is negative and statistically significant, implying that higher bank profitability is associated with lower NPL ratios in that group. The interaction

term between ADV and ROA captures the difference in the ROA-NPL relationship between advanced and other economies. In the estimates, this interaction term is not statistically significant, and its magnitude is small relative to the main effect. This indicates that the slope of the NPL equation with respect to ROA is broadly similar in advanced and other economies: in both groups, higher profitability is associated with lower NPL ratios, and the size of this effect does not differ in a statistically meaningful way.

Table 4: Pooled interaction regressions (dependent variable: NPL)

	(1)
ADV dummy	-12.166**
	(5.783)
ROA	-0.958***
	(0.179)
Capital to assets	-0.154
	(0.102)
Cost-to-income	-0.047*
	(0.025)
Credit-to-deposits	-0.041***
	(0.006)
Net interest margin	0.280**
	(0.116)
Overheads to assets	0.111*
	(0.067)
Reg. capital to RWA	0.138**
	(0.069)
Z-score	-0.129***
	(0.025)
GDP growth	-0.032
	(0.060)
Interest rate spread	-0.057
	(0.051)
Real interest rate	0.019
	(0.035)
Unemployment	0.065*
	(0.034)
ADV × ROA	-0.117
	(1.558)
ADV × Capital to assets	0.255
	(0.466)
ADV × Cost-to-income	0.024
	(0.048)
ADV × Credit-to-deposits	0.034*
	(0.017)
ADV × Net interest margin	-0.249
	(0.909)
ADV × Overheads to assets	-0.290
	(1.113)
ADV × Reg. capital to RWA	-0.157
	(0.345)

ADV × Z-score	0.167* (0.087)
ADV × GDP growth	0.101 (0.240)
ADV × Interest rate spread	-0.352 (0.587)
ADV × Real interest rate	0.231 (0.267)
ADV × Unemployment	0.208 (0.431)
Observations	936
R-squared	0.203

Note(s): The table reports pooled ordinary least squares estimates of the relationship between the ratio of non-performing loans to gross loans (NPL) and banking sector characteristics and macroeconomic variables, allowing for differences between advanced and other economies. ADV is a dummy equal to one for advanced economies and zero otherwise. Interaction terms are defined as the product of ADV and the respective explanatory variable. Standard errors are in parentheses. *, ** and *** denote significance at the 10%, 5% and 1% levels, respectively.
Source: Author's calculation

A similar pattern emerges for the bank-level control variables. For other economies, the credit-to-deposits ratio enters with a negative and statistically significant coefficient, indicating that higher credit relative to deposits is associated with lower NPLs, conditional on the remaining controls. The net interest margin typically has a positive and significant coefficient, suggesting that higher margins are associated with higher NPL ratios, while the Z-score is negatively related to NPLs, indicating that more stable banking systems tend to exhibit lower NPL ratios. Interaction terms between ADV and these bank variables show how the corresponding slopes differ in advanced economies. In most cases, the interaction terms are not statistically significant at conventional levels, or are only weakly significant. The implied slopes for advanced economies, obtained by adding the interaction coefficients to the main effects, are often closer to zero but remain qualitatively similar. Overall, the results suggest that the direction of the marginal effects of key bank structure and risk indicators is the same in both groups, and that any differences in the strength of these effects are limited.

The macroeconomic controls behave in line with the pooled specification without interactions. For other economies, the unemployment rate tends to be positively associated with NPLs, indicating that weaker labor market conditions are correlated with higher NPL ratios, while the coefficients on real GDP growth, the interest rate spread and the real interest rate are generally less robust. The interaction terms between ADV and the macro variables are not statistically significant, implying that there is no strong evidence that the sensitivity of NPLs to macroeconomic conditions differs systematically between advanced and other economies in this pooled framework.

The summary statistics at the bottom of ***Table 4*** confirm that the interaction model uses the same sample as the fully controlled pooled regression and achieves a similar overall explanatory power, as measured by the R-squared. Taken together, the estimates in ***Table 4*** indicate that the main distinction between advanced and other economies lies in the average level of NPL ratios, rather than in the marginal effects of profitability, bank structure or macroeconomic conditions. Advanced economies tend to operate with systematically lower NPLs, but the underlying relationships between the regressors and NPLs appear broadly similar across the two groups.

5. CONCLUSION

This study has examined the determinants of banking sector non-performing loans (NPLs) using an unbalanced panel of 93 countries over the period 2000-2020. The analysis combined banking

sector indicators from the World Bank's Global Financial Development database with standard macroeconomic variables and distinguished between advanced and other economies. The empirical strategy relied on pooled OLS regressions, fixed-effects panel models with clustered standard errors, and a pooled interaction specification that allowed for differences in levels and slopes between country groups.

The pooled regressions indicate a robust negative association between banking sector profitability and NPL ratios. In all pooled specifications, higher ROA is associated with significantly lower NPLs, and this relationship remains statistically and economically significant after controlling for a wide set of bank-level and macroeconomic variables. Additional bank characteristics, such as the credit-to-deposits ratio, the net interest margin, overheads and the Z-score, also contribute to explaining cross-country differences in NPLs. In particular, higher credit-to-deposits ratios and higher Z-scores are associated with lower NPLs, while higher net interest margins and overheads are associated with higher NPLs. Macroeconomic variables, most notably the unemployment rate, add some explanatory power in the pooled setting, consistent with the view that weaker labor market conditions are associated with higher credit risk.

Once unobserved country-specific characteristics and common time shocks are controlled for using a fixed-effects specification with country and year dummies, the emphasis shifts towards the macroeconomic environment. In the fixed-effects regressions, real GDP growth emerges as the main systematic driver of within-country NPL dynamics: higher growth is associated with lower NPL ratios, underscoring the countercyclical nature of credit risk. By contrast, the coefficient on ROA ceases to be statistically significant, and most bank-level controls lose explanatory power within countries over time. This suggests that the strong profitability-NPL relationship observed in the pooled models primarily reflects persistent cross-country differences in average profitability and credit quality, rather than short-run co-movements within individual banking systems.

The interaction analysis between advanced and other economies shows that the principal difference across country groups lies in the level of NPL ratios rather than in the marginal effects of the explanatory variables. Conditional on bank and macro controls, advanced economies exhibit systematically lower NPL ratios, as reflected in a negative and significant coefficient on the advanced-economy dummy. However, the slopes of the NPL equation with respect to profitability, bank structure and macroeconomic conditions are broadly similar across the two groups, and interaction terms are rarely statistically significant. The evidence therefore points to a common set of underlying relationships between profitability, bank characteristics, macroeconomic conditions and credit quality in advanced and other banking systems, with advanced economies operating at a more favorable overall level of loan performance.

From a policy perspective, the results highlight the importance of both micro and macro dimensions. At the micro level, maintaining adequate profitability, a sound funding structure and strong solvency buffers is associated with lower NPL ratios across banking systems. At the macro level, the state of the business cycle, as captured by real GDP growth, plays a central role in shaping NPL dynamics within countries, implying that macroeconomic stabilization and growth-supporting policies can indirectly contribute to healthier bank balance sheets. The analysis also suggests that efforts to improve credit quality in other economies need to address not only bank-specific weaknesses but also broader macroeconomic vulnerabilities.

The study has several limitations that point to avenues for further research. First, the analysis is based on aggregate banking sector data and does not capture heterogeneity across individual banks within countries. Second, the regressions are largely reduced-form and do not address possible endogeneity between NPLs, profitability and macroeconomic conditions. Third, the focus is on contemporaneous relationships; the dynamic adjustment of NPLs with respect to past shocks is not

explored in detail. Future work could extend the analysis with bank-level data, dynamic panel methods, and explicit identification strategies to better disentangle causality and to examine the role of institutional and regulatory factors in shaping the link between bank behavior, macroeconomic conditions and credit quality.

Declarations

The author has no relevant financial or non-financial interests to disclose. The data are available upon a reasonable request from the author.

References

Ameur, I. (2024). Non-performing loans and banking profitability. *Financial Sciences, 29*(1), 1-12. https://dbc.wroc.pl/publication/168893

Beck, R., Jakubík, P., & Piloiu, A. (2015). Key determinants of non-performing loans: New evidence from a global sample. *Open Economies Review, 26*(3), 525-550. https://doi.org/10.1007/s11079-015-9358-8

Beck, R., Jakubík, P., & Piloiu, A. (2013). Non-performing loans: What matters in addition to the economic cycle? *ECB Working Paper No. 1515*.

Boyd, J. H., & De Nicolò, G. (2005). The theory of bank risk taking and competition revisited. *The Journal of Finance, 60*(3), 1329-1343. https://doi.org/10.1111/j.1540-6261.2005.00763.x

Chaibi, H., & Ftiti, Z. (2015). Credit risk determinants: Evidence from a cross-country study. *Research in International Business and Finance, 33*, 1-16. https://doi.org/10.1016/j.ribaf.2014.06.001.

Keeley, M. C. (1990). Deposit insurance, risk, and market power in banking. *American Economic Review, 80*(5), 1183-1200. https://www.jstor.org/stable/2006769

Klein, N. (2013). Non-performing loans in CESEE: Determinants and impact on macroeconomic performance. *IMF Working Paper 13/72*. https://doi.org/10.5089/9781484318522.001

Kuzucu, N., & Kuzucu, S. (2019). What drives non-performing loans? Evidence from emerging and advanced economies during pre- and post-global financial crisis. *Emerging Markets Finance and Trade, 55*(8), 1694-1708. https://doi.org/10.1080/1540496X.2018.1547877

Louzis, D. P., Vouldis, A. T., & Metaxas, V. L. (2012). Macroeconomic and bank-specific determinants of non-performing loans in Greece: A comparative study of mortgage, business and consumer loan portfolios. *Journal of Banking & Finance, 36*(4), 1012-1027. https://doi.org/10.1016/j.jbankfin.2011.10.012

Messai, A. S., & Jouini, F. (2013). Micro and macro determinants of non-performing loans. International *Journal of Economics and Financial Issues, 3*(4), 852-860.

Nkusu, M. (2011). Nonperforming loans and macrofinancial vulnerabilities in advanced economies. *IMF Working Paper 11/161*. https://doi.org/10.5089/9781455297740.001

Ozili, P. K. (2019). Non-performing loans and financial development: New evidence. *The Journal of Risk Finance, 20*(1), 59-81. https://doi.org/10.1108/JRF-07-2017-0112

Ozili, P. K. (2025). Bank non-performing loans research around the world. *Asian Journal of Economics and Banking, 9*(3), 437-462. https://doi.org/10.1108/AJEB-09-2024-0103

Psaila, A., Spiteri, J., & Grima, S. (2019). The impact of non-performing loans on the profitability of listed Euro-Mediterranean commercial banks. *International Journal of Economics & Business Administration, 7*(4), 166-196. https://doi.org/10.35808/IJEBA/338

Salas, M. B., Lamothe, P., Delgado, E., & Valcarce, L. (2024). Determinants of non-performing loans: A global data analysis. *Computational Economics, 64*, 2695-2716. https://doi.org/10.1007/

s10614-023-10543-8

Yagli, I. (2020). Bank competition, concentration and credit risk: Cross-country evidence. *Intellectual Economics, 14*(2), 17-35. https://doi.org/10.13165/IE-20-14-2-02

World Bank, DataBank, (2025). *Global Financial Development Database*. Global Financial DevelopmenDataBank (worldbank.org)

JELS Journal of Economics, Law & Society

ESREIN Economic and Social Research Institute

The Lagged Financial Effects of R&D Investments on IT Company Performance in Bosnia and Herzegovina

Jasmina Džafić,[1*] Šeherzada Šakić,[1] Aida Zahirovic Hadžić[2]

[1] *Faculty of Economics, University of Zenica, Zenica, Bosnia and Herzegovina*

[2] *ASA Banka d.d. Sarajevo, Sarajevo, Bosnia and Herzegovina*

**Email: jasmina.dzafic@unze.ba*

Abstract

Investments and allocations in research and development (R&D) represent a main driver of competitive advantage, innovation, and sustainable growth for the most reputable IT companies in Bosnia and Herzegovina. This study empirically examines the impact of R&D expenditures on corporate performance and market value over the period 2022–2024, using comprehensive and balanced data that ensures high analytical precision. Descriptive statistics indicate significant variability in the expected growth rate measured by the DCF method, while correlation analysis confirms positive and statistically significant relationships between R&D expenditures and key performance indicators (ROA, ROE, DCF), with stronger links observed in 2023 and 2024. Regression analyses, demonstrate that increased R&D allocations significantly enhance current and future profitability, market value growth, and competitive positioning, with variations depending on year and indicator. The results underscore the strategic importance of continuous and well-planned R&D investments for achieving sustainable growth, creating comparative advantages, and maximizing corporate value, providing empirical evidence and practical implications for managers and investors in the IT sector in Bosnia and Herzegovina.

Article History

Received: November 24, 2025
Accepted: December 25, 2025
Published: December 30, 2025

Keywords

R&D; DCF method; ROA; ROE; regression analysis; correlation analysis; lagged effects; IT sector of Bosnia and Herzegovina

JEL Codes

G31; G32; C10; C50; O30;

How to Cite

Džafić, J., Šakić, Š, & Zahirovic Hadžić, A. (2025). The Lagged Financial Effects of R&D Investments on IT Company Performance in Bosnia and Herzegovina. *Journal of Economics, Law and Society, 2(2)*, 59-72. https://doi.org/10.70009/jels.2025.2.2.4

1. Introduction

Investments in knowledge and innovation, i.e., research and development, play a significant role in the company's efforts to achieve the desired profit and realize long-term sustainable growth. In today's world, when companies are surrounded by strong competition and challenging market conditions, through the ability to innovate, create and produce new products, develop new production processes and technologies, and respond to the challenging and changing demands of customers, they can create and preserve a competitive advantage.

The importance of R&D has been widely documented in economic history, particularly in analyses of technological revolutions and long-term productivity growth (Solow, 1956, 1957; OECD, 2015). Neoclassical economic thought, based on Robert Solow's model from the 1950s, emphasizes the complex of technological changes as a key factor in economic growth. Solow's analysis showed that approximately 50% of historical growth in industrialized countries cannot be attributed solely to physical capital and labor, but to a third factor, namely, residual. This residual includes intangible factors such as the development of means of production, changes in education, research and

development, and organizational and production methods. Despite adopting the complexity of technological changes as a key driver of economic dynamics, neoclassical theory ignored the question of the source of these changes, presenting it as a key flaw. Also, neoclassical economists were not able to explain the variation of residuals

However, neoclassical considerations have nevertheless placed research and development activities as important drivers of economic growth. Most countries invest significant funds in research and development, recognizing it as a key factor for achieving progress in the technological sector and long-term economic profits (Sokolov-Mladenović et al., 2016).

Nowadays, research and development expenditures are very noticeable in fast-growing sectors of the economy, such as the technology sector. Development occurs through the digital revolution, also known as the third industrial revolution, when companies in the technological sector gradually take a leading position in modern economies. In an effort to maintain and improve this position, they resort to investments specifically related to research and development. Global companies spend billions of dollars annually to produce the latest and most sought-after products.

The growing importance of ITC systems over time requires long-term planning and implementation. The process of developing and implementing a new management system involves steps such as harmonizing the corporate strategy, defining the value creation system, establishing the control system, implementing continuous management processes, and enhancing external communication (Daum, 2003). R&D in these processes is of great importance, considering that the allocation in this domain is crucial for the creation of new systems.

Research focused on the impact of research and development expenditures on the performance and value of companies in the technology sector is very current and significant. A large number of international studies have been conducted to examine the impact of investment in research and development on company performance. However, domestic authors study these concepts very little or from a limited number of aspects. Most studies indicate a positive effect of research and development on a company's performance and value, but some results suggest a negative impact of these activities. The data obtained through these studies are important for understanding the position of BiH IT companies in comparison with global competitors.

At the national level, digital transformation is often associated with long-term economic modernization. However, the present study focuses on firm-level financial outcomes; therefore, macroeconomic aspects are referenced only to contextualize the growing relevance of the IT sector. The development of digital technologies should enable important structural changes in the economy of Bosnia and Herzegovina, strengthening the position of the IT industry as a leading source of growth and employment. In order to reach an adequate level of development, close to the most developed countries in Europe, according to projections, Bosnia and Herzegovina needs several decades, and if the growth strategy is based on innovations, the knowledge society and the IT sector, that period can be significantly shortened (Arnaut & Jerković, 2017).

Research and development activities represent an emerging concept that is essential for every company to succeed in a competitive and challenging environment. These activities greatly affect the company's performance and represent a means of improving it. Consequently, companies that invest more in research and development are expected to earn more than those that do not. The company's performance will exceed the costs of research and development, and after reaching equilibrium, they will be compensated by the benefits obtained.

Company performance is influenced by three key variables. First, the added value is influenced by the company's growth, specifically through its annual growth in total assets. Second, economic

value is expressed through profitability (the ratio of earnings before interest and taxes to total assets). Third, accounting-based earnings are expressed as return on assets (ROA), return on equity (ROE), and return on sales (ROS). In this paper, the focus will be on ROA and ROE as key indicators.

Based on these considerations, it is clear that research on the relationship between research and development activities and company performance remains an open question that requires additional theoretical and empirical clarifications. Various findings in the literature suggest that the nature of this relationship can be complex, influenced by both the company's internal characteristics and external market factors. Therefore, it is necessary to examine existing research to identify key patterns, as well as gaps that open up space for further analysis. In the next section, a review of the relevant literature will be presented, serving as a basis for developing research hypotheses.

2. LITERATURE REVIEW

Through their studies, numerous authors connect research and development (R&D) with the success of companies. Chao-Hung Wang (2011) emphasizes that organizations must manage their resources wisely in order to survive in the competitive market. He claims that companies with unique, non-imitable resources have an advantage in increasing performance. Investing in valuable resources, such as R&D, is crucial, despite the high costs. Although companies invest millions in research and development, the costs are justified by the internal ability to innovate and improve performance. Company performance depends on R&D resources, which become a key means of improvement in the age of technology. It is expected that companies with higher investments in research and development will generate higher revenues than those that do not (Wang, 2011; Cohen & Levinthal, 1990).

Sokolov Mladenović et al. (2016) statistically analyze the impact of investment in research and development on economic growth in the European Union, for the period 2002 to 2012. For the same purpose, a multiple regression model was constructed, in which the dependent variable was the real rate of economic growth, and the independent variable was the value issued for research and development as a percentage of GDP. In addition to the independent variable, a control variable was also introduced, which has a significant impact on the rate of real economic growth. Gross investments in fixed capital as a percentage of GDP, general government final consumption expenditures as a percentage of GDP, birth rate and financial crisis were used as control variables. Based on the obtained results, the authors conclude that investment in research and development has a positive impact on economic growth in the European Union. Similar results were presented in the research of Griliches (1979), who showed long-term positive effects of R&D investments on productivity and economic growth.

Ghaffar and Khan (2014) analyzed the impact of budget allocations for research and development on the performance of companies in the pharmaceutical industry. The performance of companies was measured through the ratios of return on assets, return on capital, and earnings per share. The results confirmed a positive correlation between dependent and independent variables. Thus, the research reveals that the performance of the company will increase if the research and development budget is increased (Ghaffar & Khan, 2014).

Park et al. (2019) focused their research on examining the impact of technology and market dynamics on the business performance of support services for small and medium-sized enterprises. Technology and market dynamics are introduced as moderating variables, while the degree of utilization that provides support to small and medium enterprises is presented as an independent variable. The degree of contribution to business performance, such as income, exports, and employment, is presented as a dependent variable. Upon completing the research, it is concluded that the support

services of small and medium-sized enterprises have a direct impact on business performance, and they also have an indirect impact on the business performance of SMEs through their degree of contribution to SME managers' decision-making. According to the above, technology and market dynamics have a mediating and moderating effect on the business performance of SMEs. A similar conclusion is drawn from the research of Deeds, DeCarolis & Coombs (2000), which highlights the importance of technological competence and knowledge management for the performance of small and medium-sized enterprises.

Abdel Razaq et al. (2017) conducted research on the impact of R&D expenditures on company performance. The purpose of this study is to investigate whether research and development (R&D) expenditures have an impact on the performance of Jordanian pharmaceutical companies listed on the Amman Stock Exchange in Jordan. During the research, a quantitative approach was employed to analyze data from a sample of six companies, spanning the period from 2006 to 2015. Empirical research was conducted using simple linear regression analysis to reveal the impact of research and development on company performance. Company performance was measured by return on assets (ROA), return on equity (ROE) and earnings per share (EPS) as proxies for measuring company performance, and for measuring R&D expenditure included the following items: research, experiments, studies and courses. This research showed that there is a significant impact of research and development expenditures on company performance (ROA, ROE and EPS), which is in line with the results for developed countries. Additionally, R&D expenditures in the current year yield future benefits, including a greater market share, a higher stock price, and a better reputation (Abdel Razaq et al., 2017).

Research by Chan, Lakonishok, & Sougiannis (2001) examines whether stock prices fully reflect the value of a firm's intangible assets, with a focus on research and development activities. For R&D companies, high R&D intensity has a characteristic effect on returns for two groups of stocks. Within a set of growth stocks, R&D-intensive stocks tend to outperform stocks with little or no R&D investment. Companies with high R&D expenditures relative to their market capitalization show strong signs of mispricing. Additionally, the intensity of research and development is positively correlated with the volatility of returns. Although most studies confirm the positive impact of R&D on performance, some studies indicate risks, such as increased variability of returns and misvaluation of capital. These contradictions justify conducting additional empirical analysis in the local context (Chan et al., 2001; Lev, 2001).

In their work, He and Estebanez (2023) examined the relationship between a company's investment in research and development and its operational performance. They collected data from 1,262 SMEs in the ICT service sector in China between 2011 and 2020. Research and development investment was selected as the independent variable, while financial performance (ROA, ROE, liquidity ratio, debt asset ratio, and interest coverage ratio) and market value (Tobin's Q) were selected as dependent variables. Multiple linear regressions were used to determine if there was a correlation between these variables. Primarily, R&D investment enhances current profitability and there is a one-period lag in these relationships. Second, R&D has a negative correlation with the short-term ability to pay debt, but is positively correlated with the long-term ability, and these effects persist for a certain period. Finally, R&D investment has a negative impact on the current state of market value, but R&D investment within two lagged periods still has a positive impact (He & Estébanez, 2023).

Also, the impact of R&D expenditures and advertising on creating comparative advantage and achieving profit in business was analyzed. By controlling for firm-specific unobserved factors and analyzing the feedback between discretionary spending and profitability, this study finds lower accounting and stock returns on R&D and advertising expenditures compared to earlier research. The results suggest that isolation mechanisms, which typically serve as a barrier to imitation, are insufficient for the aforementioned expenditures, as well as for advertising, to create a long-term

comparative advantage on average. These findings point to challenges in achieving profit through these key business aspects and encourage further research to better understand the dynamics between costs, profits and long-term competitive advantages (Erickson & Jacobson, 1992; Hall, 1993).

Based on previously analyzed theoretical and empirical research, it is clear that investments in research and development can significantly impact a company's performance, although the results are not always unambiguous. While most studies confirm the positive impact of R&D on the value and profitability of companies, some works suggest possible negative or contradictory effects, particularly in high-risk conditions or specific market circumstances. These variations in findings underscore the need for further empirical research in the technology sector of Bosnia and Herzegovina. Therefore, in the next chapter, the research hypotheses derived from the literature review will be defined and tested through the empirical analysis of the company's financial indicators.

Although previous studies consistently examine the effects of R&D on firm value and performance, the operationalization of these outcomes varies. In this study, firm value is measured through the expected growth rate obtained from a DCF-based estimate, while performance is assessed through ROA and ROE, following the approaches used by Freihat and Kanakriyah (2017), He and Estébanez (2023), and Razaq et al. (2017). These indicators align with the literature that treats profitability and market valuation as the primary channels through which R&D generates financial returns.

3. Methodology

The primary research goal of the work is to analyze, based on theoretical and empirical findings, whether there is an impact of investment in research and development on the value of companies in the technology sector, which operate in the territory of Bosnia and Herzegovina, to what extent the impact is present and what it is like. In addition to the primary goal, another objective is to assess the impact of these investments on the performance of companies in the IT sector in Bosnia and Herzegovina.

3.1. Sample data and variables

Due to the specific treatment of the term IT company and the complexity of the activity itself, for the purpose of conducting the analysis and construction of econometric models, the most significant companies that invest in research and development in Bosnia and Herzegovina were selected, which are members of the Bit Alliance association, whose activity code is 62.01 - computer programming, consulting and related activities. There is a total of 20 companies, members of the Bit Alliance association, registered under this activity code. Bit Alliance member firms represent the most R&D-active segment of the BiH IT industry, making the sample appropriate for examining firms where R&D intensity is economically meaningful. When collecting data, balance sheets for 14 companies, covering the period from 2022 to 2024 and available on the LRC database, were included in the sample.

According to Palepu, Healy, & Peek (1996), the most widely used method for valuing intangible assets, especially technological intangible assets, is DCF, and its essence is the discounting of predicted total cash flows. This approach involves making detailed, multi-year cash flow forecasts. For this reason, the value of the companies in the sample was measured using the DCF method.

To estimate firm value and derive the expected five-year growth rate (DCF%), a simplified discounted cash flow (DCF) approach was applied. The analysis was conducted for 14 IT companies that are members of the Bit Alliance, using financial statements from the LRC database for the period 2022–2024.

Future cash flows were projected by extrapolating revenues, operating costs, EBIT, depreciation, capital expenditures, and changes in working capital based on historical trends observed in the 2022–2024 financial statements. Free cash flow to the firm (FCFF) was calculated as:

$$FCFF = EBIT(1-t) + Depreciation - CAPEX - \Delta WC$$

The weighted averagecost of capital (WACC) was used as the discount rate. The cost of equity was estimated using the CAPM model with a risk-free rate from the Banking Agency of BiH, an equity risk premium for Bosnia and Herzegovina, and an industry beta obtained from Damodaran's database. The cost of debt was derived from average long-term interest rates published by the Central Bank of BiH.

Projected FCFFs for a five-year forward period were discounted to present value, and a terminal value was calculated using the perpetual growth formula:

$$TV = FCF_n (1+g) / (WACC - g)$$

The present value of projected cash flows and the terminal value were summed to obtain firm value. The expected growth rate (DCF%) used in this study represents the average annual growth implied by the DCF-based projections of net income and equity over the five-year forecast horizon. The measure should be interpreted cautiously due to simplified forecasting assumptions.

In addition to the above, the company's performance will also be used as a dependent variable. Looking back at previous research (Freihat and Kanakriyah, 2017; He and Estébanez, 2023) within the mentioned subject, it is evident that the authors measured company performance to the greatest extent by return on assets (ROA) and return on capital (ROE), which will be the case in this paper as well. The return on assets and return on capital from 2024 will be used as dependent variables, representing the performance of the companies in the sample.

R&D intensity was defined as the ratio of total annual R&D expenditures to total revenues. This measure is consistent with prior literature and captures the extent to which a firm allocates its resources to innovation-related activities. R&D expenditures were taken from the financial statement notes under the category 'intangible asset development costs' and, where not separately disclosed, from the item 'research and development expenses' reported in operating expenses. Only firms with explicitly reported R&D figures were included in the sample. Although three years of historical data were used to construct lagged R&D intensity variables, the regression analysis itself is cross-sectional, with N = 14 observations.

The ***Table 1*** presents a summary of the variables that will be used to model the research relationships.

Table 1: Model variables

Variable	*Name*	*Code*	*Calculation*
Dependent	Expected company growth rate measured by the DCF method for a five-year period	$DCF_{\%}$	DCF method
	Return on asset 2024	ROA_t	net profit/assets
	Return on capital 2024	ROE_t	net profit/capital
Independent	% expenditures on R&D in 2024	$expendituresR\&D_t$	$expendituresR\&D_t$/ $asset_t$
	% expenditures on R&D in 2023	$expendituresR\&D_{t-1}$	$expendituresR\&D_{t-1}$/ $asset_{t-1}$
	% expenditures on R&D in 2022	$expendituresR\&D_{t-2}$	$expendituresR\&D_{t-2}$/ $asset_{t-2}$

Source: Authors' own.

3.2. Hypotheses and research models

The central hypothesis is:

H1. There is a statistically significant positive relationship between investment in research and development and the value of enterprises in the technology sector.

Additional hypothesis:

H2. Higher investments in research and development are positively related to the return on assets of companies in the technology sector.

H3. Higher investments in research and development are positively related to the return on capital of companies in the technology sector

To verify and test the defined hypotheses, regression-correlation analysis will be employed, preceded by the calculation of descriptive statistics measures and testing the assumption of normality, a prerequisite for using regression analysis.

3.2.1. Main regression model

After the dependent and independent variables have been defined, and considering previous similar research and the specific characteristics and goals of this work, the basic regression model can be formulated.

$$DCF_{\%} = \beta_0 + \beta_1 expendituresR\&D_{t-m} + \varepsilon_t$$

Where are:

$DCF_{\%}$ – Expected company growth rate for a five-year period calculated using the DCF method

β_0 – model constant,

β – estimated regression parameter,

$expendituresR\&D_{t-m}$ – Share of research and development expenditures in assets for period *t* (t = 2024) minus *m* years $m \in (0,2)$.

For the purposes of testing auxiliary hypotheses, two more models were set up, due to the greater precision of the results themselves. The first auxiliary model is used to test the first auxiliary hypothesis, during which it will be clear whether research and development expenditures have a significant impact on the return on assets of IT companies in Bosnia and Herzegovina.

First additional outcome model

$$ROA_t = \beta_0 + \beta_1 expendituresR\&D_{t-m} + \varepsilon_t$$

ROA_t – returns on asset at time *t* (t = 2024), and the rest is as defined earlier.

For the purpose of testing the second auxiliary hypothesis, another model was established to determine the impact of research and development expenditures on return on capital in IT companies.

Second additional outcome model

$$ROE_t = \beta_0 + \beta_1 expendituresR\&D_{t-m} + \varepsilon_t$$

ROE_t – Rate of return on capital at year *t* (t = 2024), and the rest is as defined earlier.

3.3. Empirical research results

The first step before conducting regression analysis is to present the results of descriptive statistics for the dependent and independent variables of the model, as well as normality tests for the same variables.

Table 2: Results of descriptive statistics

Variable	Obs	Mean	Std. dev.	Min	Max
expendituresR&D 2022	14	0.2568	0.1990	0.0033	0.7111
expendituresR&D 2023	14	0.2386	0.1648	0.0036	0.5717
expendituresR&D 2024	14	0.2253	0.1557	0.0071	0.5707
$DCF_{\%}$	14	7.9850	17.5772	0.0001	50.4857
ROA 2024	14	0.3109	0.3164	0.0017	0.8383
ROE 2024	14	0.4820	0.4624	0.0017	1.5420

Source: Authors' calculation.

Based on ***Table 2***, data for both dependent and independent variables from all 14 technology companies in the sample were included, ensuring higher accuracy due to balanced data. Mean, standard deviation, minimum, and maximum values were calculated for each variable. The highest variability is observed in the expected growth rate, as measured by the DCF method, due to large differences between the highest and lowest projected growth rates. In contrast, other variables exhibit relatively low standard deviations. The relatively low variance in R&D intensity across firms indicates that differences in outcomes are not driven by extreme outliers, which increases the interpretability of regression coefficients. A normality check of the data distribution was also conducted.

To assess the distribution of the data, the Shapiro-Wilk test was employed, which is recommended for use with samples of 30 units or fewer (***Table 3***). After checking, it was determined that the dependent variable, the expected growth rate measured by the DCF method, does not meet the assumption of normality, and its transformation into a logarithmic value of the same variable was performed, which, according to the test results, meets this assumption.

Table 3: Results of the Shapiro-Wilk test for checking the data distribution

Variable	Obs	Prob>z	Assumption of normality
expendituresR&D 2022	14	0.19397	fulfilled
expendituresR&D 2023	14	0.33229	fulfilled
expendituresR&D 2024	14	0.37098	fulfilled
$lnDCF_{\%}$	14	0.17255	fulfilled after transformation to log
ROA 2024	14	0.05362	fulfilled
ROE 2024	14	0.09250	fulfilled

Source: Authors' calculation.

After the assumption of normality was satisfied for the selected variables of the model, a correlation analysis was performed, the results of which are presented below.

The correlation analysis in ***Table 4*** reveals that the dependent variable, the expected growth rate (logarithmic value, DCF method, 5-year period), exhibits a positive correlation with the independent variables, specifically the share of R&D expenditures in total assets for 2022, 2023, and 2024. The relationship is moderately strong for 2022 and 2023 (correlation coefficient 0.4–0.6) and strong for 2024 (0.6–0.8).

The dependent variable of the first auxiliary model (*Table 5*), ROA2024, has a positive and moderately strong relationship with the independent variables, with the highest impact on R&D expenditures in 2023.

Table 4: Results of correlation analysis of the variables of the main regression model

	lndcf	expendituresR&D 2022	expendituresR&D 2023	expendituresR&D 2024
$lnDCF_{\%}$	1.0000			
expendituresR&D 2022	0.5155***	1.0000		
expendituresR&D 2023	0.5737***	0.9864***	1.0000	
expendituresR&D 2024	0.6079***	0.8137***	0.9214***	1.000

Source: Authors' calculation. (*** p < 0,05)

The third correlation analysis conducted examines the relationship between the dependent variable of the second auxiliary model and the dependent variables. As in the previous case, the strongest connection is present with expenditures from 2023. The dependent variable of the second auxiliary model, ROE2024, has a positive but weak relationship with the independent variables (see *Table 6*).

Table 5: Results of correlation analysis of the variables of the first additional outcome model

	roa2024	expendituresR&D 2022	expendituresR&D 2023	expendituresR&D 2024
ROA2024	1.0000			
expendituresR&D 2022	0.5058***	1.0000		
expendituresR&D 2023	0.5582***	0.9864***	1.0000	
expendituresR&D 2024	0.4503***	0.8137***	0.9214***	1.000

Source: Authors' calculation. (*** p < 0,05)

Table 6: Results of correlation analysis of variables of the second additional outcome model

	roe2024	expendituresR&D 2022	expendituresR&D 2023	expendituresR&D 2024
ROE2024	1.0000			
expendituresR&D 2022	0.4417***	1.0000		
expendituresR&D 2023	0.4655***	0.9864***	1.0000	
expendituresR&D 2024	0.3047***	0.8137***	0.9214***	1.000

Source: Authors' calculation. (*** p < 0,05)

Table 7: Main regression model

Independent variable	Dependent variable – $lnDCF_{\%}$		
$\beta_1$expenditures R&D $_{2022}$	8.29399		
$\beta_1$expenditures R&D $_{2023}$		11.00095	
$\beta_1$expenditures R&D $_{2024}$			12.80082
P value (P > z)	0.0590	0.0320	0.0210
Const	-2.7809	-3.2599	-3.5189
R^2	0.2658	0.2733	0.3696
Prob > F	0.0592	0.0319	0.0211

Source: Authors' calculation.

The results of the basic model (*Table 7*) indicate that research and development (R&D) expenditures

have a positive impact on the company's expected growth, as measured by the DCF method, for the period 2022–2024. The strongest relationship is observed for R&D expenditures from 2024, while the weakest is for 2022. The statistical significance ranges from 0.05 to 0.10, and the coefficient of determination (R^2) for 2024 is 0.3696, indicating satisfactory explanatory power of the model.

Table 8: First additional outcome model

Independent variable	*Dependent variable – ROA* $_{2024}$		
$\beta_1$expendituresR&D $_{2022}$	0.7850		
$\beta_1$expendituresR&D $_{2023}$		1.0325	
$\beta_1$expendituresR&D $_{2024}$			0.9146
P value (P > z)	0.0650	0.0380	0.1060
Const	0.1078	0.0645	0.1049
R^2	0.2558	0.3116	0.2027
Prob > F	0.0592	0.0380	0.1062

Source: Authors' calculation.

In the first auxiliary model (***Table 8***), which examines the impact of R&D expenditures on return on assets (ROA), all independent variables show a positive correlation with the dependent variable. The strongest effect is recorded for R&D from 2023, while the 2022 expenditures are not statistically significant. The R^2 for 2023 is 31.16%, and in other periods it exceeds 0.2, indicating a moderate explanatory power of the model.

Table 9: Second additional outcome model

Independent variable	Dependent variable – ROE$_{2024}$		
$\beta_1$expendituresR&D $_{2022}$	1.0395		
$\beta_1$expendituresR&D $_{2023}$		1.3058	
$\beta_1$expendituresR&D $_{2024}$			0.9387
P value (P > z)	0.1140	0.0930	0.2890
Const	0.2130	0.1704	0.2705
R^2	0.1951	0.2167	0.0929
Prob > F	0.1139	0.0935	0.2894

Source: Authors' calculation.

The third model presented in ***Table 9***, analyzing return on equity (ROE), shows that R&D expenditures from 2023 have the strongest positive impact, while results for 2022 and 2024 are not statistically significant. The R^2 for 2023 is 21.67%, whereas in other years the explanatory power of the model is unsatisfactory. These results suggest a correlation between earlier R&D expenditures and 2024 outcomes.

3.4. Interpretation and discussion of results

The empirical analysis was conducted on a sample of 14 companies from the IT sector in Bosnia and Herzegovina, all registered under the same activity code. These companies were selected to include those with the most significant expenditures on research and development in the sector. Dependent and independent variables were defined in accordance with the main and additional research hypotheses, as well as the results of previous research in the relevant area, considering the specific characteristics of the observed sample. The first step of the analysis involved presenting the results of descriptive statistics, which were used to describe the data from the sample. Following this, data distribution testing and normality checks were conducted. The initial results indicated

that all independent variables, as well as dependent variables of the first and second additional outcome models, meet the assumption of normality, based on the Shapiro Wilk test, except for the dependent variable of the basic regression model of the expected growth rate of the company, measured by the DCF method, for which it was necessary to transform it into its logarithmic value. After that, all variables satisfied the assumption of normality, which is the basic assumption of regression analysis. Before conducting the regression analysis, a correlation analysis was conducted. The results obtained confirm that the dependent variables of all models positively correlate with the independent variables, indicating a moderate to strong positive relationship, which justifies the conduct of the regression analysis. Also, the correlation analysis determined that there is a very strong positive correlation between the independent variables and that using multiple regression, the results obtained would be unreliable due to the problem of multicollinearity, and a simple regression analysis was used.

The basic regression model confirmed that there is a positive and statistically significant relationship between the logarithmic value of the company's expected growth rate in the five-year period and research and development expenditures from the previous three periods (2022, 2023 and 2024), and that the intensity of this relationship weakens as we move towards older time periods. The statistical relationship is significant with a 5% error margin for 2024 and 2023, while for 2022, it is significant with a 10% error margin. Based on the described results, we can not reject the basic research hypothesis, which posits a statistically significant positive relationship between investment in research and development and the value of companies in the technology sector. These results are consistent with research by Hall and Oriani (2006) and O'Mahony and Vecchi (2009), who find that investments in research and development have a positive effect on firm value, especially in technology-intensive industries.

The results of the regression and correlation analysis confirm that there is a positive relationship between the rate of return on assets from 2024 and research and development expenditures from the previous three periods (2024, 2023 and 2022). The intensity of this connection is strongest with research and development expenditures from 2023, while it is weakest with research and development expenditures from 2024. This relationship is statistically significant at a 0.05 error level for the year 2023, while the relationship for 2022 is statistically significant at an error level of 0.10. The relationship between the dependent and independent variables from 2024 is not statistically significant. Based on the obtained results, we can say that research and development expenditures from the current year do not have a statistically significant impact on the rate of return on assets, while expenditures from earlier periods do, with a note that the highest impact of expenditures from period t-1 on the rate of return on assets is in period t. Considering all the obtained results, we cannot reject the first auxiliary research hypothesis, which is that higher investments in research and development are positively related to the return on assets of companies in the technology sector. The obtained findings are in accordance with Park et al. (2019), who emphasize that the effects of R&D investments often become visible only with a delay, which is also confirmed by our results where expenditures from the previous period have the greatest influence. Similarly, He and Estebanez (2024) show that R&D investments in the current year have a weaker or insignificant impact on ROA, whereas the effects of previous years manifest themselves more significantly.

The smallest correlation is present between the rate of return on capital from 2024 and research and development expenditures from the previous three periods (2024, 2023 and 2022). In this regression model, the relationship is statistically significant only with expenditures from period t-1, with an error level of 10%. Other years do not have a statistically significant impact on the rate of return on capital from 2024. Due to the above, it can be concluded that the second auxiliary hypothesis is rejected and we say that we cannot prove that higher investments in research and development are positively related to the return on capital of companies in the technology sector. These findings are partially consistent with Chan, Lakonishok and Sougiannis (2001), who state that R&D investments

can generate positive long-term effects, which may limit short-term profitability measured by return on capital. Similarly, Billings et al. (1994) point out that high R&D costs can lead to weaker financial results in the short term.

The main limitation of this study is the very small sample size (N = 14), which reduces statistical power and increases coefficient instability. In addition, the DCF measure relies on simplified assumptions regarding future cash flows. The models include only one explanatory variable, and no control variables could be added without overfitting. Given the small sample size, the findings should be interpreted as exploratory associations.

4. Conclusion

According to the conducted research, it can be concluded that there is a statistically significant positive relationship between investment in research and development and the value of companies in the technology sector. The most pronounced effect was recorded in year *t*, while in the earlier observed periods, a decrease in the intensity of this effect was observed. The obtained results indicate that the value of the company grows proportionally to the increase in research and development expenditures, which aligns with the findings of other authors who have examined this relationship in different markets.

The analyses suggest a positive association between R&D expenditures and firm value and performance indicators, although these results should be interpreted with caution due to methodological limitations. Expenditures from previous years had a stronger impact compared to allocations from the current year, confirming the importance of continuous and long-term investment in research and development.

On the other hand, the results did not show the same level of connection with return on capital. A statistically significant relationship was identified only for allocations from the previous period (*t-1*), so the positive impact of investment in research and development on the return on capital in the technology sector cannot be fully confirmed.

The business implications of these findings suggest that companies should pay particular attention to the development of long-term R&D strategies to enhance competitiveness and achieve sustainable financial results. However, the research has its limitations. The lack of a qualified workforce can reduce the company's capacity for innovation, while the limited availability of informative balance sheets makes precise and comprehensive analysis of financial performance difficult.

Recommendations for future research include a comparison with companies from the region and the member states of the European Union, which would facilitate a deeper understanding of the similarities and differences in the effects of R&D investments. Also, the research could be expanded by introducing additional independent variables, such as the number of new applications and software solutions, employment in R&D departments, or other indicators, as well as by analyzing long-term trends. In this way, it is possible to gain a more comprehensive understanding of the complex impact of investments in research and development on the value of companies in the technology sector.

Declarations

The author has no relevant financial or non-financial interests to disclose. The data are available upon a reasonable request from the author.

References

Abdel Razaq, A., Freihat, F., & Kanakriyah, R. (2017). The impact of R&D expenditure on firm performance: Evidence from Jordanian pharmaceutical companies. *International Journal of Economics and Finance, 9*(2), 45–57.

Arnaut, E., & Jerković, D. (2017). Utjecaj sektora informacionih tehnologija na ekonomski razvoj Bosne i Hercegovine. *Tranzicija, 19*(40), 64–81.

Billings, B. K., Buse, R., & White, M. A. (1994). The impact of R&D spending on firm performance: An empirical investigation. *Journal of Business Finance & Accounting, 21*(7), 971–989.

Chan, L. K. C., Lakonishok, J., & Sougiannis, T. (2001). The stock market valuation of R&D expenditures. *Journal of Finance, 56*(6), 2431–2456.

Cohen, W. M., & Levinthal, D. A. (1990). Absorptive capacity: A new perspective on learning and innovation. *Administrative Science Quarterly, 35*(1), 128–152.

Damodaran, A. (2024). *Industry Beta Estimates*. Stern School of Business.

Daum, J. H. (2003). *Intangible assets and value creation*. John Wiley & Sons, Ltd.

Erickson, G. M., & Jacobson, R. (1992). Gaining competitive advantage through R&D strategy. *Management Science, 38*(3), 357–374.

Freihat, F., & Kanakriyah, R. (2017). Impact of R&D expenditure on financial performance: Jordanian evidence. *European Journal of Business and Management, 9*(32), 73–83.

Ghaffar, A., & Khan, M. (2014). Effects of R&D investment on firm performance. *Pakistan Journal of Commerce and Social Sciences, 8*(1), 1–8.

Griliches, Z. (1979). Issues in assessing the contribution of R&D to productivity growth. *Bell Journal of Economics, 10*(1), 92–116.

Hall, B. H. (1993). R&D tax policy during the 1980s: Success or failure? In A. J. Auerbach & M. Feldstein (Eds.), *Handbook of public economics* (Vol. 3, pp. 313–356). Amsterdam: Elsevier.

Hall, B. H. (1993). The stock market's valuation of R&D investment during the 1980s. *American Economic Review, 83*(2), 259–264.

Hall, B. H., & Lerner, J. (2010). The financing of R&D and innovation. In B. H. Hall & N. Rosenberg (Eds.), *Handbook of the Economics of Innovation* (Vol. 1, pp. 609–639). Elsevier.

Hall, B. H., & Oriani, R. (2006). Does the market value R&D investment by European firms? Evidence from a panel of manufacturing firms in France, Germany, and Italy. *International Journal of Industrial Organization, 24*(5), 971–993. https://doi.org/10.1016/j.ijindorg.2005.12.001

He, X., & Estébanez, R. P. (2023). R&D investments and firm performance: Evidence from international technology companies. *Journal of Business Research, 158*, 113670. https://doi.org/10.1016/j.jbusres.2023.113670

Lev, B. (2001). *Intangibles: Management, measurement, and reporting*. Washington, DC: Brookings Institution Press.

O'Mahony, M., & Vecchi, M. (2009). R&D, knowledge spillovers and company productivity performance. *Research Policy, 38*(1), 35–44. https://doi.org/10.1016/j.respol.2008.09.003

OECD. (2015). Frascati Manual 2015: Guidelines for Collecting and Reporting Data on Research and Experimental Development. OECD Publishing.

Palepu, K. G., Healy, P. M., & Peek, E. (1996). *Business Analysis and Valuation: IFRS Edition* (6th ed.). Cengage Learning.

Park, S., Kim, H., & Lee, J. (2019). R&D investment and firm growth. *Technology Analysis & Strategic Management, 31*(6), 668–681.

Sokolov-Mladenović, S., Cvetanović, S., & Mladenović, I. (2016). R&D expenditure and economic

growth: EU28 evidence for the period 2002–2012. *Economic Research – Ekonomska istraživanja, 29*(1), 1005–1020.

Solow, R. M. (1957). Technical change and the aggregate production function. *The Review of Economics and Statistics, 39*(3), 312–320.

Wang, C.-H. (2011). The impact of resource-based factors on firm performance: Evidence from high-tech firms. *International Journal of Management, 28*(3), 1012–1027.

JELS Journal of Economics, Law & Society

ESREIN Economic and Social Research Institute

What Drives Corporate Financial Resilience? A Credit Analysis Approach with Management Efficiency Insights

Admir Meskovic,[1*]

[1] *Faculty of Business and Administration, International University of Sarajevo, Bosnia and Herzegovina*

Email: ameskovic@ius.edu.ba

Abstract

Building resilient companies capable of withstanding financial pressure is increasingly important for stakeholders, especially banks, investors, and suppliers operating in uncertain economic environments. Conventional credit assessment models often prioritize financial ratios while overlooking the strategic influence of managerial capability on a firm's capacity to withstand stress and maintain financial stability. This research places management efficiency at the forefront as a key driver of corporate resilience, examining how internal resource utilization, operational decisions, and financial management shape long-term sustainability. The analysis is based on 1,531 corporate loan cases from a commercial bank in Bosnia and Herzegovina over the period 2009–2015, incorporating balance sheet and income statement indicators available at loan approval, including both static financial ratios and year-to-year performance changes. Factor analysis and regression results reveal that liquidity, self-financing levels, asset turnover, gross margin, and accounts receivable collection time are relevant predictors of financial resilience. The results highlight the roles of liquidity, leverage, and profitability-related indicators as consistent correlates of loan non-repayment, while the management efficiency proxies (EUP/EFP) show weaker and specification-dependent effects. Firms with inefficient managerial practices demonstrate substantially lower resilience and higher vulnerability to financial deterioration. The findings highlight the strategic importance of integrating managerial effectiveness into risk evaluation frameworks and support the view that strong management is a foundation of corporate resilience in the financial sector.

Article History

Received: December 10, 2025
Accepted: January 28, 2026
Published: January 30, 2026

Keywords

company resilience; credit analysis; management efficiency; multivariate analysis; Bosnia and Herzegovina

JEL Codes

G21, G32, G33, C25

How to Cite

Meskovic, A. (2025). What Drives Corporate Financial Resilience? A Credit Analysis Approach with Management Efficiency Insights. *Journal of Economics, Law and Society, 2(2)*, 73-86. https://doi.org/10.70009/jels.2025.2.2.5

1. Introduction

Historically, arguably the most important work in the field of corporate financial resilience was published in 1968 by Edward I. Altman, which laid the foundation for modern ratio analysis for evaluating the financial health of a company. In this article, the author uses multiple discriminant analysis (MDA) as a statistical technique to find the five most important financial indicators combined from the financial statements, which best explain the possibility of bankruptcy of public companies. These factors are working capital/total assets, retained earnings/total assets, earnings before interest and taxes/total assets, market value of equity/book value of total debt, and sales/total assets.

Following Altman (1968), many authors have investigated corporate financial health for credit analysis, as this field is highly relevant to banking practice. Altman's pioneering model laid the foundation for later resilience-oriented financial diagnostics by demonstrating how accounting-based indicators can serve as early warning signals of distress. Lennox (1999) examines the causes of

bankruptcy for 949 companies listed in the UK between 1987 and 1994. According to the results of this research, the most important predictors of bankruptcy are corporate profitability, leverage, cash flow, company size, industry sector and business cycle.

Contrary to previous studies, Lennox (1999) argues that well-specified logit and probit models can more accurately identify failing companies than the discriminative analysis method. This work highlights that accurate failure prediction contributes to understanding how firms maintain financial resilience in unstable economic conditions. Nyathi et al. (2014) provide an overview of methods for predicting business failure and, as the most appropriate methods, cite linear probability and logit models. Their findings imply that robust prediction techniques are central to assessing a firm's vulnerability and future resilience capacity. Gurný and Gurný (2013) in their research estimate PD as a key parameter in credit scoring models, using linear discriminant analysis and regression models (logit and probit). The authors note that these models can be used for short-term (1-2 years) default prediction. Based on their results, the authors conclude that the logit model is most suitable for predicting bank failures. By focusing on default probability as a core metric, their study reinforces the importance of quantitative modelling for assessing resilience and sustainability in banking portfolios.

Vasilev (2014) also proposes using logit and probit to estimate the probability of bankruptcy. Such approaches strengthen predictive frameworks that help institutions anticipate shocks and build resilient credit decision processes.

Kollár et al. (2015) compare the Merton and KMV models for calculating companies' credit ratings. Mileris and Boguslauskas (2011) used 20 financial indicators from five-year financial statements in their study. Their research confirmed that discriminant analysis, logistic regression and artificial neural networks are relevant methods for classifying bank customers, and the highest classification accuracy (97%) was achieved by the logistic regression model. The percentages of the credit rating criteria proposed in this research are: profitability 50%, liquidity 25%, leverage 12.5%, and the individual default probability estimated by logistic regression 12.5%.

Altman and Sabato (2007) examine whether banks should distinguish between small and medium-sized enterprises (SMEs) and large corporations when designing credit risk assessment systems and strategies. In their study, the authors employ logit regression, supplemented by multiple discriminant analysis (MDA) for comparison. The findings indicate that SMEs differ substantially from large firms with respect to credit risk characteristics.

We have found that more recent literature has proposed various approaches, which are also used in bankruptcy prediction modeling. This includes the artificial neural networks used by Lee and Chen (2005). Bellotti and Crook (2009) also use support vector machines as an innovative approach in credit scoring modeling. More recently, Narvekar et al. (2021) applied tree-based ensemble methods, particularly XGBoost, to bankruptcy prediction during the COVID-19 recession and showed that these models achieve high out-of-sample accuracy compared with traditional techniques. Liu et al. (2021) further enhance gradient boosting models through tree-based embeddings. Those authors claim they demonstrated superior credit-scoring performance relative to standard GBDT specifications. Bhatore et al. (2020) compare a wide range of machine learning and deep learning algorithms for credit default prediction and find that random forest and boosting-type models largely dominate logistic regression in terms of accuracy and AUC.

Today's models rely on machine learning frameworks, but these approaches require more data, which is not feasible in countries such as Bosnia and Herzegovina. Matsumaru and Katagiri (2025) propose a two-stage machine learning framework with feature selection for Japanese listed firms. He shows that carefully selected features and ensemble models can significantly improve the robustness of bankruptcy prediction.

These newer approaches have disadvantages, including the need for large amounts of data, high computational demands, and issues with explainability and interpretability (Mešković and Mešković, 2023). These two concepts are important in lending decisions because the financial institutions must be able to explain why the client was not granted a loan.

In this study, we operationalize corporate financial resilience through the loan repayment outcome observed by the lending bank. Specifically, a non-repayment (default) event captures the point at which a firm's financial buffers, cash-flow generating capacity, and access to external financing prove insufficient to meet contractual debt service obligations. From a prudential and managerial perspective, default is a defensible resilience proxy because it represents the economically and legally salient threshold that triggers loss recognition, collections, and recovery procedures, and in many jurisdictions, regulatory provisioning. At the same time, we acknowledge that resilience can manifest (and deteriorate) before outright default. Earlier distress signals, such as arrears, covenant breaches, loan restructuring, maturity extensions, or temporary payment moratoria, may reflect partial loss-absorption capacity and renegotiation ability rather than complete failure. These indicators are not consistently available in our dataset in a standardized form across borrowers (or are recorded with heterogeneous definitions across loan officers and over time), which constrains the application of a multi-stage distress framework. We therefore focus on the most reliably observed and comparable outcome (non-repayment) and interpret the results as determinants of severe resilience breakdown, while noting that future work could extend the analysis to pre-default states when harmonized arrears and restructuring data are available.

2. Methodology

In the context of financial resilience, business failure is the point at which an enterprise's internal resources, cash flows, and management strategies are no longer sufficient to absorb financial shocks or sustain operations under adverse market conditions (Mešković, 2022). For the purposes of this article, we define business failure as the inability to repay loans granted by banks. The research questions are formulated as follows:

- Can multivariate analysis methods predict the failure of the businesses of legal entities that are clients of a domestic bank?
- Can the effectiveness of management be singled out as a factor that significantly contributes to the business failure/success of the company?

The following research hypotheses are formulated:

H1. Methods of multivariate analysis contribute to the explanation and prediction of the inability to repay loans given to legal entities.

H2. The inability to repay loans by legal entities is predominantly determined by factors from the financial statements.

H3. Management efficiency is a variable that significantly contributes to a company's business failure.

2.1. Data sources

For the purposes of this research, the internal database of one bank from BiH was used, for 1531 loans granted to legal entities in the period 2009-2015. The database contains data from clients' balance sheets and income statements, as well as data on the company's success in repaying the loan. For the purposes of this research, the inability to repay the loan was marked as a business failure. Observations with incomplete data for all ratios (missing values) were excluded from further analysis, leaving 1357 observations.

2.2. Methodology

In the above definition, the business failure of clients, as an observed variable, will be defined as the inability to repay the loan. It is generally accepted practice that predicting a corporation's bankruptcy/business failure is based on various financial indicators from the balance sheet and income statement. Based on previous research and literature, some basic (most commonly used) variables have been identified as indicators in financial statements with theoretical and practical value for predicting business failure. These 17 variables are listed in ***Table 1***.

We must emphasize that in this research, we are using exclusively internal financial data from companies. Several authors, such as Smolo and Mirakhor (2010) and Meskovic et al. (2023), have confirmed that external factors, such as crises and regulations, can have a significant impact on companies' and financial institutions' performance.

3. Data and the model

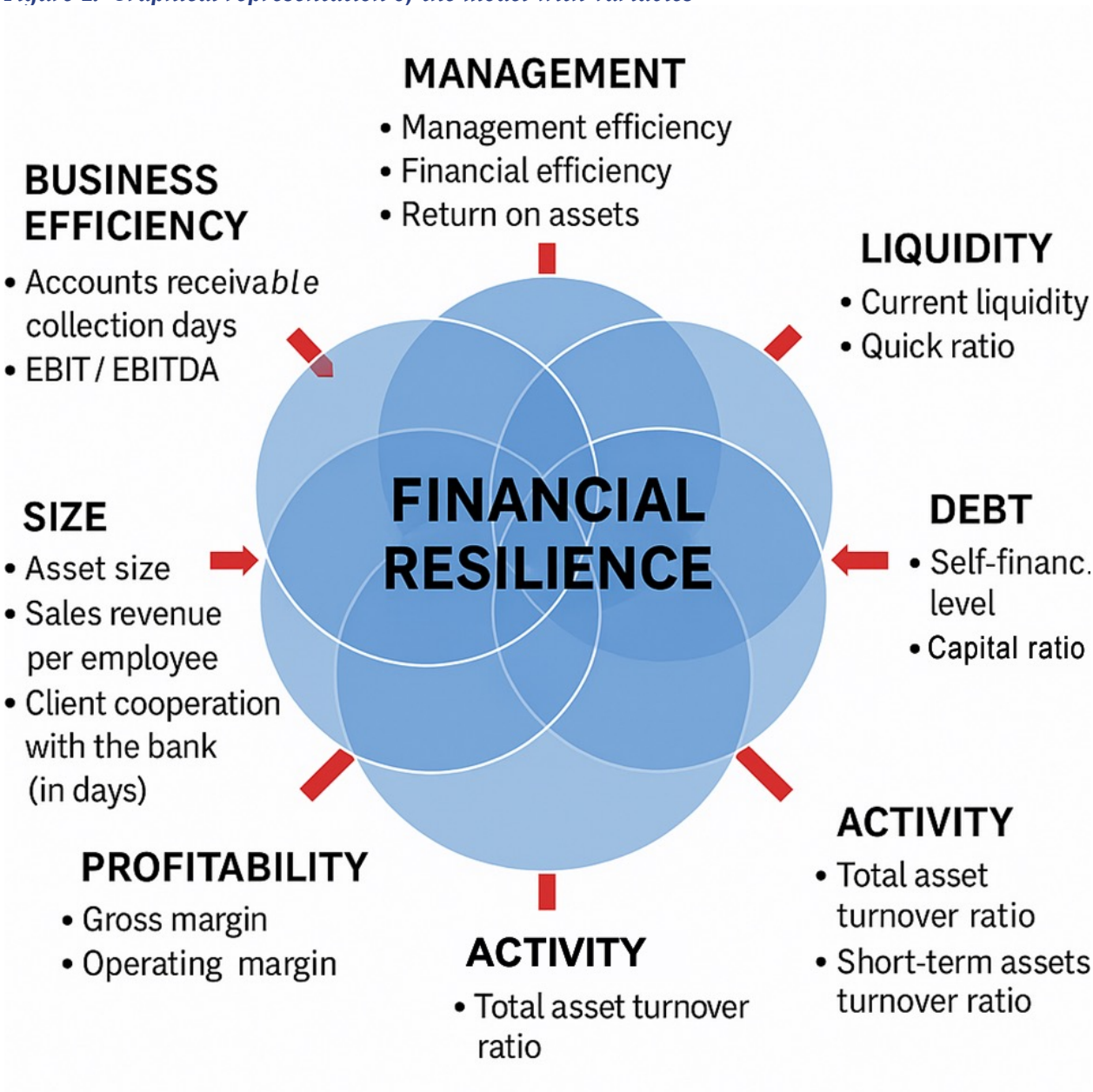
The data show considerable variation among firms across most financial indicators. Total Asset Turnover (KOUI) and Current Asset Turnover (KOKI) have moderate average values (1.36 and 2.95, respectively), but the relatively high standard deviations indicate substantial differences in how efficiently firms generate revenue from assets. The number of days to collect receivables (DNP) shows a very high mean (199 days) and an extremely large standard deviation, suggesting that receivables management practices differ widely and that a large portion of firms experience long collection cycles, potentially increasing liquidity risk. Sales revenue per employee (PPZ) also shows substantial dispersion, suggesting notable heterogeneity in workforce productivity across companies. Management efficiency (EUP) and effectiveness of financial activities (EFP) show relatively low means and low standard deviations, indicating more stable managerial performance than other variables. ***Table 1*** lists all variables initially examined in the research, and ***Figure 1*** graphically depicts them.

Table 1: Input variables

Variable	Definition	Arithmetic mean	Standard deviation
KOUI	Total Asset Turnover Ratio	1.3622	1.4887
KOKI	Current Assets Turnover Ratio	2.9499	3.5637
DNP	Number of days for collection of receivables	199.4825	3,062.3315
PPZ	Sales revenue per employee	245,210.8657	1,019,484.0751
EUP	Management Efficiency	1.0477	.3515
EFP	The effectiveness of financial activities	1.0564	.3592
TL	Current liquidity	1.6734	9.5121
BTL	Quick Liquidity Ratio	1.0973	9.4863
BM	Gross margin	.2018	.4086
OM	Operating margin	.0030	.3990
EBIT	EBIT / EBITDA	.2976	37.7102
ROA	Return on Property	.0378	.1004
SFIN	Level of self-financing	.3194	.2547
SKAP	Equity Ratio on Total Assets	.3174	.2328
ASSETS	Size of the property	11,589,348.18	33,042,731.630
PAKTIVA	Change in assets (% per year)	.5822	11.8449
DS	Duration of the client's cooperation with the bank (days)	2,261.79	922.196

Source: Author's own.

Figure 1: Graphical representation of the model with variables



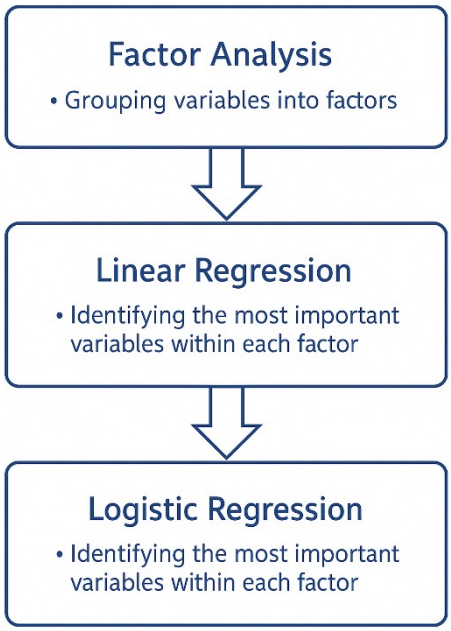
Source: Author's own.

Management quality is not directly observable in bank administrative data; accordingly, we approximate managerial efficiency through financial statement-based efficiency indicators. We construct two complementary proxies: (i) Expense Utilization Performance (EUP), defined as the ratio of operating income to operating expenses, and (ii) Expense-to-Financial Performance (EFP), defined as operating expenses relative to operating income (the inverse scaling of EUP). Higher EUP (or lower EFP) indicates that the firm converts a given expense base into higher revenue or operating earnings, consistent with more efficient planning, budgeting, procurement, and process control. Because income/expense ratios can also be influenced by sectoral business models, accounting policies, temporary shocks, or one-off items, we implement several safeguards. First, we compute the ratios using the same financial statement line items for all firms and apply winsorization at conventional cut-offs to reduce the influence of extreme values driven by unusual events. Second, we control for firm size, leverage and liquidity, which absorb mechanical scale effects and short-term funding constraints that may otherwise load onto the efficiency ratios. Third, we benchmark EUP/EFP against industry (sector) distributions by including sector fixed effects, so that efficiency is interpreted relative to peers facing similar cost structures. Finally, as an internal validity check, we

report that EUP/EFP correlate in the expected direction with standard profitability and operating performance measures (e.g., operating margin/ROA), suggesting that the proxies capture economically meaningful efficiency variation. These steps do not eliminate all measurement error, but they mitigate the most common sources of ratio distortion and align our managerial efficiency proxies with observable, decision-relevant performance signals in credit analysis.

Liquidity indicators Current liquidity (TL) and Quick liquidity (BTL) are high on average, but very high standard deviations suggest the presence of firms with both extremely strong and extremely weak liquidity positions, reflecting unequal resilience levels. Profitability indicators show low mean values: Gross margin (BM = 0.20) and Operating margin (OM ≈ 0.00) suggest that many firms operate with minimal operating profit margins, potentially affecting their financial resilience. The EBIT measure has an unusually high standard deviation, suggesting significant fluctuations in earnings performance across companies. ROA (0.0378) shows low average asset profitability with moderate dispersion. Capital structure indicators such as the self-financing level (SFIN) and equity ratio (SKAP) average around 0.32, indicating that roughly one-third of assets are financed with equity, suggesting moderate financial independence. Firm size (ASSETS) exhibits a very high standard deviation, suggesting a dataset that includes both small and very large firms. Annual asset growth (PAKTIVA) has a mean near zero but large variability, signaling diverse growth trajectories within the sample. Finally, the duration of cooperation with the bank (DS) averages around 2,262 days (approx. 6.2 years) with moderate variability, indicating that most firms have a relatively long banking relationship, which may influence credit decision quality and resilience capacity. ***Figure 2*** illustrates the methodological approach of the research.

Figure 2: Methodological aspect of the research



Source: Author's own.

After determining the basic indicators of the financial statements using factor analysis, the number of principal components will be reduced for further analysis. That is, identify those factors that have a significant impact on the possibility of business failure.

We assessed the adequacy of the data for factor analysis. The KMO test confirmed the adequacy of the sample and the presence of multicollinearity among the variables, while the Bartlett test rejected the hypothesis of univariate normality and confirmed the appropriateness of using factor analysis for the established data set. ***Table 2*** presents the correlation matrix

Table 2: Correlation matrix

VAR	KOU1	KOK1	DNP	PPZ	EUP	EFP	TL	BTL	BM	OM	EBIT	ROA	SFIN	SKAP	ASSETS	PASSETS	DS
KOU1	1	0,548**	-0,041	0,262**	-0,008	-0,023	-0,029	-0,026	-0,101**	0,055*	0,017	0,267**	-0,093**	-0,099**	-0,087**	-0,012	-0,074**
KOK1		1	-0,036	0,108**	-0,026	-0,014	-0,047	-0,035	-0,031	0,044	-0,021	0,131**	0,003	0,012	-0,056*	0,041	-0,039
DNP			1	-0,01	-0,045	-0,039	-0,002	-0,002	0,035	-0,084**	0,001	-0,019	-0,008	-0,029	0,016	-0,003	0,013
PPZ				1	-0,001	0,04	0,003	0,008	-0,043	0,025	0,006	0,084**	0,046	0,062*	0,204**	-0,007	0,0177**
EUP					1	0,940**	0,031	0,028	0,115**	0,240**	0,031	0,472**	0,097**	0,140**	-0,007	-0,017	-0,177**
EFP						1	0,030	0,029	0,0217**	0,372**	0,005	0,434**	0,091**	0,128**	0,004	-0,027	-0,285**
TL							1	0,996**	0,041	-0,006	0,003	0,014	0,100**	0,115**	0,030	-0,005	0,022
BTL								1	0,056*	0,013	0,002	0,011	0,085**	0,095**	0,032	-0,003	0,22
BM									1	0,500**	-0,001	0,112**	0,052	0,045	0,005	-0,052	0,053
OM										1	0,003	0,250**	0,001	0,037	0,009	-0,041	-0,079**
EBIT											1	0,05	-0,008	0,038	0,007	0,001	0,017
ROA												1	0,162**	0,257	-0,022	-0,079**	-0,149**
SFIN													1	0,799**	0,101**	-0,040	-0,006
SKAP														1	0,130**	-0,047	0,013
ASSETS															1	-0,014	0,162**
PASSETS																1	-0,057*
DS																	1

Note(s): ** Statistically significant with an error of 1%; * Statistically significant error code of 5%
Source: Author's own.

4. Data analysis

According to the analysis, seven factors in the financial statements contributed to the inability to repay the loan. The first factor included dominant variables that can be summarized under the heading "Management". The current ratio and the quick ratio are two equal factors in the "Liquidity" group. The third factor is "Indebtedness", while the company's "Activity" is the fourth factor. The fifth factor is "Profitability," while the sixth is "Company Size" based on assets. The last factor is the "efficiency" of debt collection.

Table 3: Isolated factors

Variable/Factor	Factors						
	Management	Liquidity	Indebtedness	Activity	Profitability	Size	Efficiency
EUP	0.960	0.016	0.028	-0.071	0.047	-0.013	-0.011
EFP	0.934	0.014	0.016	-0.075	0.191	-0.004	-0.033
ROA	0.616	-0.004	0.237	0.344	0.114	-0.095	0.142
TL	0.014	0.997	0.060	-0.022	0.004	0.014	0.002
BTL	0.011	0.997	0.042	-0.013	0.024	0.017	-0.001
SFIN	0.044	0.044	0.937	-0.033	0.008	0.029	-0.008
SKAP	0.112	0.056	0.935	-0.015	0.013	0.065	0.019
KOUI	0.047	-0.003	-0.105	0.883	-0.042	-0.007	0.033
KOKI	-0.046	-0.030	0.035	0.792	0.036	-0.067	-0.071
BM	0.038	0.038	0.035	-0.090	0.876	0.017	0.053
OM	0.264	-0.013	-0.016	0.098	0.809	-0.011	-0.086
ASSETS	0.031	0.006	0.118	-0.103	-0.011	0.746	-0.064
PPZ	00.07	0.004	0.027	0.407	-0.071	0.615	-0.041
DS	-0.152	0.018	-0.055	-0.136	0.076	0.59	0.154
DNP	-0.056	0.002	-0.040	-0.074	-0.052	-0.015	0.562
EBIT_EBITDA	0.081	0.007	-0.006	0.023	-0.082	0.012	0.511
PAKTIVA	0.004	0.011	-0.069	-0.024	-0.155	-0.048	-0.516
Extraction Method: Main Component Method							
Rotation method: Varimax with Kaiser normalization							

Source: Author's own.

We conduct a set of robustness checks to address measurement and specification concerns. First, we re-estimate the models using alternative profitability and efficiency indicators (where available) to assess whether conclusions depend on the specific EUP/EFP construction. Second, we include

interaction terms (EUP/EFP × size; EUP/EFP × liquidity) to test whether managerial efficiency is more relevant for particular firm profiles. Third, to mitigate potential dependence across observations for firms with multiple loans, we compute robust standard errors that account for within-firm correlation and confirm that qualitative conclusions remain unchanged. Overall, the central findings for core financial drivers are stable, while management-efficiency effects are comparatively sensitive and are therefore interpreted with caution. ***Table 3*** presents the isolated factors that contributed the most to financial resilience.

In the second part of the study, a linear probability model was created, the basic form of which is:

$$Y=\alpha+\beta_1 \ln X_1+\beta_2 \ln X_2+\beta_3 \ln X_3+\beta_4 \ln X_4+\beta_5 \ln X_5+\beta_6 \ln X_6+\beta_7 \ln X_7+ \varepsilon$$

The dependent variable is binary (dummy) and is coded 0 and 1, where 0 indicates that the firm repaid the loan and 1 indicates that the firm failed to repay the loan, indicating business failure. The dependent variable captures loan non-repayment as recorded in the bank's internal credit database. A loan is coded as non-performing/non-repaid when it meets the bank's operational default definition (as used for monitoring and reporting), which is based on repayment delinquency and credit status classification at the observation date. While alternative manifestations of distress, such as restructuring or covenant violations, can also signal weakened resilience, these are not consistently available across borrowers and time in the present dataset. We therefore employ loan non-repayment/default as a transparent and policy-relevant proxy for a severe loss of resilience in a debt-servicing context.

In the independent variables, the model includes only those variables with the highest factor loadings for each factor. Another approach is to include all factors, weighted by their factor loadings, in the model; however, for simplicity, we have included only the most important factors. Variables are natural logarithms because they are indicators from financial statements.

Full management efficiency, which measures performance relative to invested funds, always has a positive effect on the company's performance, thereby reducing the likelihood of failure. Efficient managers allocate resources better, control costs more effectively, and respond quickly to market fluctuations - strengthening operational resilience and lowering the probability of financial distress. The higher the liquidity ratio, the greater the company's ability to repay its short-term liabilities. This means that a higher current ratio reduces the likelihood of loan non-repayment. Firms with more liquid assets maintain healthier cash buffers, enabling them to withstand temporary revenue drops or unexpected expenses without defaulting on their obligations. ***Table 4*** presents the variables in the model with their expected impact on loan repayment.

Table 4: Input variables in the model

No.	Variable	Model	The Expected Impact on Business Failure
1	Management Efficiency (EUP)	X_1	-
2	Current Liquidity (TL)	X_2	-
3	Self-Funded Level (SFIN)	X_3	-
4	Total Assets Turnover Ratio (KOUI)	X_4	-
5	Gross margin (BM)	X_5	-
6	Asset	X_6	-
7	Number of days for debt collection (DNP)	X_7	+

Source: Author's own.

The higher the level of self-financing, the greater the company's resilience and the lower the likelihood that it will not be able to meet its financial obligations. Equity-funded firms rely less

on external borrowing, thereby reducing leverage-related pressure and strengthening financial stability during crisis periods. A higher turnover ratio of total assets shows that the company is less likely to fail. Stronger asset utilization indicates more efficient resource use to generate revenue, supporting sustainable operations and enhancing the company's resilience against downturns. A higher gross margin means a lower risk of the company going bankrupt. Better margins allow a firm to absorb increases in production costs or sales declines more easily, providing a financial cushion that protects against insolvency. Larger company assets reduce the risk of bankruptcy, as the company may sell some of its assets to raise the cash needed to repay the loan. A strong asset base also improves collateral value, making banks more willing to restructure terms in distress. ***Table 5*** presents the estimated parameters of the linear probability of loan default model

Table 5: Estimated parameters of the linear probability of loan default model

Variable	Variable Name	Model parameters
C	Constant	0.244* (0.090)
$\ln X_1$	Management Efficiency (EUP)	-0.102 (0.086)
$\ln X_2$	Current Liquidity (TL)	0.013 (0.409)
$\ln X_3$	Self-Funded Level (SFIN)	-0.028* (0.010)
$\ln X_4$	Total Assets Turnover Ratio (KOUI)	-0.074* (0.014)
$\ln X_5$	Gross margin (BM)	-0.006 (0.011)
$\ln X_6$	Asset	-0.015* (0.006)
$\ln X_7$	Number of days for debt collection (DNP)	0.017 (0,009)

Note(s): Standard errors in parenthesis; * Statistically significant with an error of 1%; ** Statistically significant error code of 5%.
Source: Author's own.

On the other hand, a lower asset value may indicate that the company is a startup; in banking practice in Bosnia and Herzegovina, up to 98% of startups do not repay their loans on time. This highlights the vulnerability of newer firms with limited tangible assets, especially when cash flows are unstable and business models are still maturing. A greater number of days to collect receivables indicates inefficiency and increases the likelihood that the company will be unable to repay the loan. Delayed collection indicates potential liquidity problems and increased customer credit risk, reducing working capital and increasing the likelihood of financial distress.

The abstract initially emphasized management efficiency as a dominant determinant of resilience. However, in the baseline specifications reported in the main regression tables, the estimated coefficients on EUP/EFP are not statistically significant at conventional levels. To maintain consistency and credibility, we refine the interpretation in two ways. First, we rephrase the abstract and conclusions to reflect the empirical hierarchy of determinants, highlighting variables that are robustly significant across specifications (e.g., leverage, liquidity, firm size, or other financial statement indicators), while characterizing management efficiency as suggestive rather than definitive evidence in our sample. Second, we probe whether the impact of managerial efficiency is conditional rather than average. In additional specifications, we test interaction terms (e.g., EUP/EFP multiplied by firm size and liquidity), sector-by-sector estimations, and alternative model forms (including parsimonious specifications and models excluding highly collinear controls). If management efficiency becomes significant only for certain borrower segments (for example, smaller firms

or firms with tighter liquidity), this heterogeneity reconciles the narrative with the tables and offers a more nuanced contribution. If the effect remains statistically weak across robustness checks, we interpret this as an important null finding: efficiency ratios may be less informative for default prediction than commonly assumed once core balance-sheet risk drivers are controlled for, or the proxy may contain noise due to accounting and one-off effects. Either way, aligning the abstract with the empirical results strengthens the manuscript and clarifies the boundary conditions of the management-efficiency argument.

Although the model is significant, with a classification rate of 84.59%, in the next phase of our analysis, we aim to further test the hypotheses and apply logistic regression to the observed dataset.

The model has a general form, for taking the value 0:

$$p = \frac{e^{b_0 + b_1 \cdot x_1 + b_2 x_2 + \cdots + b_n \cdot x_n}}{1 + e^{b_0 + b_1 \cdot x_1 + b_2 x_2 + \cdots + b_n \cdot x_n}}$$

While the probability that the dependent variable takes a value of 1:

$$1 - p = \frac{1}{1 + e^{b_0 + b_1 \cdot x_1 + b_2 x_2 + \cdots + b_n \cdot x_n}}$$

As independent variables, the same variables are used as in the previous model: linear probability.

The parameters of the model are given in ***Table 6***:

Table 6: Evaluated parameters of the logistic regression model - inability to repay the loan

Variable	Variable Name	Model parameters	95% confidence interval Lower limit	Upper limit
C	Constant	0.972 (0.818)	-0.631	2.576
$\ln X_1$	Management Efficiency (EUP)	-0.450 (0.668)	-1.760	0.859
$\ln X_2$	Current Liquidity (TL)	0.073 (0.136)	-0.195	0.340
$\ln X_3$	Self-Funded Level (SFIN)	-0.195** (0.082)	-0.355	-0.035
$\ln X_4$	Total Assets Turnover Ratio (KOUI)	-0.537* (0.116)	-0.764	-0.310
$\ln X_5$	Gross margin (BM)	-0.037 (0.089)	-0.211	0.137
$\ln X_6$	Asset	-0.132* (0.051)	-0.231	-0.032
$\ln X_7$	Number of days for debt collection (DNP)	0.150 (0.080)	-0.006	0.306
	Classification rate	85.1		

Note(s): Standard errors in parenthesis; * Statistically significant with an error of 1%; ** Statistically significant error code of 5%.
Source: Author's own.

Both the linear and logistic regression models were significant and identified the same variables in predicting a company's business failure. The expected sign of influence corresponds to the sign of the estimated models. The classification rate for the logit model is slightly higher than that of the estimated linear probability model, at 85.10%.

Although the conceptual motivation suggests that managerial efficiency should matter for debt-servicing capacity, the estimated coefficients on the EUP/EFP proxies are not statistically significant in our baseline specifications. This does not necessarily imply that management is irrelevant; rather, it indicates that our chosen accounting-based proxies may be noisy and that the management effect can be conditional on firm characteristics or sector context. To reconcile the narrative with the evidence, we interpret the management-efficiency results as weaker and more specification-dependent than those for core financial predictors. In addition to specifications, we test (i) alternative efficiency and profitability measures available in the financial statements, and (ii) interaction terms between EUP/EFP and firm size or liquidity, given that managerial discretion and cost flexibility may differ across firms. These checks help assess whether managerial efficiency matters in particular segments rather than uniformly across the sample.

5. Implications

The findings show that firms with higher levels of self-financing, more efficient use of total assets and larger asset bases are significantly less likely to default on their bank loans. For companies, this means building a strong equity position, focusing on asset productivity, and gradually increasing scale are not only desirable from a profitability perspective but also essential for financial resilience. Managers should therefore treat capital structure and asset turnover as strategic variables rather than purely accounting outcomes. Actions such as retaining earnings, reducing unnecessary leverage, investing in productive assets and actively monitoring asset turnover can strengthen the firm's ability to withstand shocks and maintain access to external finance. The results also suggest that younger or smaller firms need to be particularly cautious, since their weaker internal capital base and limited collateral make them inherently more vulnerable to financial distress.

For banks, the model's classification accuracy of about 85 percent indicates that relatively simple financial indicators can provide a powerful basis for predicting loan repayment problems. The significant role of self-financing, total asset turnover and firm size implies that these indicators should receive explicit weight in internal credit scoring systems and early warning frameworks. In practical terms, credit analysts can use higher equity ratios, strong asset utilization and larger asset bases as positive signals when assessing new loan applications or reviewing existing exposures. Conversely, small, undercapitalized firms with weak turnover should trigger closer monitoring, stricter covenants or additional collateral requirements. By integrating these findings into their models, banks can allocate capital more efficiently, reduce non-performing loans and support a more resilient loan portfolio.

From a policy perspective, the results highlight the structural vulnerability of small, thinly capitalized firms, which are more prone to loan repayment problems. Policymakers in Bosnia and Herzegovina and similar economies may therefore consider measures that help firms strengthen their equity base and improve operational efficiency. Examples include tax incentives for profit retention, targeted support programs that encourage equity financing, guarantee schemes for viable but undercapitalized SMEs and training programs aimed at improving financial management and asset utilization. Regulatory bodies can also encourage banks to incorporate resilience-oriented indicators, such as self-financing and asset turnover, into their risk management frameworks. This would align supervisory expectations with evidence-based drivers of default risk and contribute to a more stable financial system.

At the societal level, each firm that avoids failure and remains able to service its debts contributes to employment, tax revenues and local economic stability. The factors identified in this study as protective against default are closely linked to sustainable business models that generate stable cash flows and maintain prudent balance sheets. Encouraging firms to build stronger equity, use assets efficiently and grow in a controlled way thus has broader social benefits. Fewer bankruptcies mean fewer job losses and less strain on social safety nets, while a healthier banking sector is better able to support productive investment in the real economy. In transition economies, where access to finance is often a key constraint on growth, improving financial resilience at the firm level can therefore translate into more inclusive and stable development.

6. Future research directions

The study also has implications for future research. While self-financing, total asset turnover and firm size emerged as key predictors in this sample, other theoretically relevant variables, such as management efficiency, liquidity or profitability measures, were not statistically significant at conventional levels. This opens space for more nuanced models that include interaction effects, non-linear relationships or dynamic indicators, such as cash flow volatility and changes in management quality over time. Future work could also combine quantitative financial data with qualitative information on governance, strategy or business environment to better capture the multidimensional nature of financial resilience. Comparative studies across countries or sectors would help to identify whether the same drivers of default hold in different institutional contexts, and longitudinal analyses could examine how these relationships evolve across economic cycles or crisis periods.

7. Conclusion

In this study, we investigated the possibility of using multivariate analysis to predict and explain the business failure of corporate clients of a domestic bank. In a sample of 1,531 observations, we identified financial statement variables with a theoretical basis for explaining the observed phenomena. Observations with missing data were excluded from our analysis. Of the 17 variables identified, seven factors were identified by factor analysis. One variable with the highest factor loading was selected as a representative of each factor to serve as an independent variable in further analysis to predict business failure.

The classification rate achieved with the logit model, slightly higher than that of the estimated linear probability model, is 85.10% and is satisfactory for the purposes of this research. Based on our research, we conclude that the null hypothesis cannot be rejected.

As alternatives to the applied methods, the probit model, discriminant analysis, and new methods such as artificial neural networks can be used.

7.1. Limitations

This study has limitations. The dependent variable captures a severe repayment outcome and therefore represents a narrow but policy-relevant dimension of resilience in a lending context; earlier distress signals such as arrears trajectories, covenant breaches, or restructurings may provide a richer picture but are not consistently available in the dataset. In addition, the accounting-based management proxies (EUP/EFP) are imperfect and may be influenced by one-off items or reporting practices, thereby attenuating the estimated effects. For these reasons, we present our results primarily as empirical associations that strengthen credit-risk understanding, while encouraging future work with richer event histories and more direct measures of managerial practices.

It should be noted that the use of data from financial statements is a limitation because not all factors that predict a company's success are presented in the financial statements. Soft factors in management's success are often more important than financial statement indicators. Another limitation in terms of data is the use of financial statements from a single year, except for some indicators, which use "change" indicators – the change in position from one year to the next. However, in such cases, trends should be monitored, based on data from the financial statements for at least 3 years.

Declarations

The author has no relevant financial or non-financial interests to disclose. The data are available upon a reasonable request from the author.

References

Altman, E. I. (1968). Financial ratios, discriminant analysis and the prediction of corporate bankruptcy. *The journal of finance, 23*(4), 589-609.

Altman, E. I., & Sabato, G. (2007). Modelling credit risk for SMEs: Evidence from the US market. *Abacus, 43*(3), 332-357. https://doi.org/10.1111/j.1467-6281.2007.00234.x

Basel Committee on Banking Supervision. (1999). *Credit risk modelling: Current practices and applications*. Bank for International Settlements.

Bellotti, T., & Crook, J. (2009). Support vector machines for credit scoring and discovery of significant features. *Expert Systems with Applications, 36*(2), 3302-3308.

Bhatore, S., Mohan, L., & Reddy, Y. R. (2020). Machine learning techniques for credit risk evaluation: a systematic literature review. *Journal of Banking and Financial Technology, 4*(1), 111-138. https://doi.org/10.1007/s42786-020-00020-3

Dimitras, A. I., Zanakis, S. H., & Zopounidis, C. (1996). A survey of business failures with an emphasis on prediction methods and industrial applications. *European Journal of Operational Research, 90*(3), 487-513.

Gurný, P., & Gurný, M. (2013). Comparison of Credit Scoring models on probability of default estimation for US Banks. *Prague economic papers, 2*, 163-181.

Kealhofer, S. (2003). Quantifying credit risk I: default prediction. *Financial Analysts Journal, 59*(1), 30-44. https://doi.org/10.2469/faj.v59.n1.2501

Klieštik, T., & Cúg, J. (2015). Comparison of selected models of credit risk. *Procedia Economics and Finance, 23*, 356-361. https://doi.org/10.1016/S2212-5671(15)00452-9

Kollár, B., Weissová, I., & Siekelová, A. (2015). Comparative analysis of theoretical aspects in credit risk models. *Procedia Economics and Finance, 24*, 331-338.

Lee, T. S., & Chen, I. F. (2005). A two-stage hybrid credit scoring model using artificial neural networks and multivariate adaptive regression splines. *Expert Systems with Applications, 28*(4), 743-752. https://doi.org/10.1016/j.eswa.2004.12.031

Lennox, C. (1999). Identifying failing companies: a re-evaluation of the logit, probit and DA approaches. *Journal of Economics and Business, 51*(4), 347-364. https://doi.org/10.1016/S0148-6195(99)00009-0

Liu, W., Fan, H., & Xia, M. (2021). Step-wise multi-grained augmented gradient boosting decision trees for credit scoring. *Engineering Applications of Artificial Intelligence, 97*, 104036. https://doi.org/10.1016/j.engappai.2020.104036

Lopez, J. A., & Saidenberg, M. R. (2000). Evaluating credit risk models. *Journal of Banking & Finance, 24*(1-2), 151-165. https://doi.org/10.1016/S0378-4266(99)00055-2

Matsumaru, M., & Katagiri, H. (2025). A Two-Stage Machine Learning Approach to Bankruptcy Prediction: Integrating Full-Feature Modeling and Optimized Feature Selection. *Journal of Risk and Financial Management, 18*(12), 662. https://doi.org/10.3390/jrfm18120662

Mešković, A. (2022). Kreditna analiza kompanija i odabir faktora koji predviđaju uspješnost otplate korporativnih kredita bankama. *Business Consultant/Poslovni Konsultant, 14*(117).

Meskovic, A., Avdukic, A., & Kozarevic, E. (2023). Assessing the impact of external determinants on the social performance of Islamic banks. *International Journal of Islamic and Middle Eastern Finance and Management, 17*(1), 124-145. https://doi.org/10.1108/IMEFM-08-2022-0335

Mešković, M. N., & Mešković, A. (2023). Upravljanje rizicima i uticaj na poslovne performanse i vrijednost preduzeća. *Business Consultant/Poslovni Konsultant, 14*(126).

Mileris, R., & Boguslauskas, V. (2011). Credit Risk Estimation Model Development Process: Main Steps and Model Improvement. *Engineering Economics, 22*(2), 126-133. http://dx.doi.org/10.5755/j01.ee.22.2.311

Narvekar, A., & Guha, D. (2021). Bankruptcy prediction using machine learning and an application to the case of the COVID-19 recession. *Data Science in Finance and Economics, 1*(2), 180-195. https://doi.org/10.3934/DSFE.2021010

Nuhić-Mešković, M., & Mešković, A. (2023). Risk Management Culture, Structure, and Process–Theoretical Insights and Empirical Evidence. *International Business Research, 16*(10), 10-23. https://doi.org/10.5539/ibr.v16n10p10

Nuhić-Mešković, M., & Mešković, A. (2023). Transformacija upravljanja rizicima kroz standardizaciju: Komparacija tradicionalnih i integriranih pristupa. *Poslovni konsultant / Business Consultant*, 5/2025.

Nyathi, K. T., Ndlovu, S., Moyo, S., & Nyathi, T. (2014). Optimisation of the linear probability model for credit risk management. Unpublished manuscript.

Smolo, E., & Mirakhor, A. (2010). The global financial crisis and its implications for the Islamic financial industry. I*nternational Journal of Islamic and Middle Eastern Finance and Management, 3*(4), 372-385. https://doi.org/10.1108/17538391011093306

Spuchlakova, E., & Cug, J. (2015). Credit Risk and LGD Modelling. *Procedia Economics and Finance, 23*, 439-444. https://doi.org/10.1016/S2212-5671(15)00379-2

Vasilev, J. (2014). Calculating the probability of returning a loan with binary probability models. *Romanian Statistical Review, 62*(4), 55-71.

Published by:
Economic and Social Research Institute (ESREIN)
Blagovac 192,
71320 Vogošća
Bosnia and Herzegovina
https://jels.esrein.org
jels@esrein.org

ISSN (Online): 3029-3189