An-Najah National University
Faculty of Graduate Studies

THE EFFECT OF ADOPTION FINTECH BANK CREDIT RISK AND LIQUIDITY RISK: EVIDENCE FROM EMERGING MARKETS

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Dedication

إلى من كانوا دائمًا مصدر إلهامي وقوتي،

إلى والديَّ العزيزين،

اللذَين زرعا في نفسي حب العلم والاجتهاد، وكانا لي الدعم الأول في كل مراحل حياتي. أقدّم لهما كل الامتنان والتقدير على صبرهما، وتشجيعهما الدائم، وعطائهما اللامحدود.

إلى إخوتي وأخواتي،

الذين كانوا دومًا عونًا لي في كل محنة، وفرحة في كل نجاح، شكري وامتناني لكم لا يوفيه الكلام.

إلى أساتذتي الكرام،

الذين أضاءوا لي دروب العلم والمعرفة، وكانوا مثالًا يُحتذى به في الأخلاق والاجتهاد.

إلى زملائي وأصدقائي،

الذين شاركوني هذه الرحلة العلمية، ووقفوا إلى جانبي في أوقات التحديات والصعوبات.

إلى كل من ساهم في دعمي معنويًا أو عمليًا،

إلى من آمن بقدراتي وشجعني على الاستمرار،

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أتقدم بخالص الشكر والتقدير إلى والديَّ العزيزين، اللذَين كانا لي الدعم الأكبر في حياتي، ووفرا لي كل سبل النجاح بتشجيعهما ودعمهما المستمر.

كما أود أن أعرب عن عظيم امتناني وتقديري لأساتذتي الأفاضل، وخاصة الدكتور معاذ أسمرو الدكتور مفيد ظاهر، على إرشاداته القيمة وتوجيهاته البناءة التي كان لها الأثر الكبير في إنجاز هذه الدراسة.

ولا أنسى أن أتوجه بالشكر إلى كل زملائي وأصدقائي الذين قدموا لي المساعدة والدعم خلال رحلتي الأكاديمية، فلهم مني كل الحب والتقدير.

أخيرًا، أشكر كل من ساهم، ولو بكلمة أو نصيحة، في إنجاز هذا العمل العلمي، راجيًا من الله أن يجعل هذا العمل إضافة متواضعة في مجالي العلمي.

Declaration

I, the undersigned, declare that I submitted the thesis entitled:

THE EFFECT OF FINTECH ADOPTION ON BANK CREDIT RISK AND LIQUIDITY RISK: EVIDENCE FROM EMERGING MARKETS

I declare that the work provided in this thesis, unless otherwise referenced, is the researcher’s own work, and has not been submitted elsewhere for any other degree or qualification.

Student's Name **Mousa Shhadeh**

Signature: موسى شحاده

Date: **04/06/2025**

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Abstract

This study explores in detail how financial technology adoption has affected banking risk in ten different countries. To do so, a robust econometric approach designed to resolve endogeneity issues and ensure consistent results. The study addresses the ongoing uncertainty in knowledge about the precise nature of the relationship between banking risk and financial technology adoption. Understanding how financial technology integration impacts the credit risk and liquidity of banking institutions is becoming increasingly important as the financial sector undergoes significant change driven by technological innovations. Financial technology is transforming the way financial services are delivered; therefore, its impact on banks' overall risk management system must be closely studied.

The sample for the study from 2015 to 2022 consists of 65 banks from a variety of nations, including Jordan, Palestine, Egypt, Turkey, and the Gulf Cooperation Council (GCC) nations, including Saudi Arabia, Kuwait, Bahrain, Qatar, Oman, and the UAE. Among these 65 banks, 23 are Islamic banks, therefore enhancing the analysis since Islamic financial institutions operate under different legal and operational structures than conventional banks. The results emphasize a strong connection between the FinTech index and bank risk in Arab developing nations. Still, the power of this link differs among the nations examined, suggesting that regional and institutional elements may influence the impact of FinTech acceptance on bank risk.

This study is particularly important because it provides a comprehensive and unified review of the conflicting data on the interaction between banking risk and financial technology use. Banking professionals, regulators, and researchers are expected to find valuable insights in these findings. Shedding light on the interactive nature of financial

risk and technology will help actors make smarter strategic choices. The result show the significant relationship between fintech index and liquidity, and credit risk.

These findings can help banks adjust their risk management approaches to accommodate the adoption of new technological solutions, and policymakers can use them to develop rules that effectively address emerging risks associated with fintech in the banking sector. Increasing awareness of how fintech adoption impacts banking risks will help researchers, opening the door to further research and development in this area.

Keywords: Fintech adoption index, risk Banks, Arab Emerging Markets.

Chapter One
Introduction and Theoretical Background

1.1 Introduction

The financial technology (FinTech) industry has expanded significantly and undergone change in recent years, therefore altering the scene of financial services entirely. FinTech, which mixes cutting-edge technologies with conventional financial services, aims to increase general security, lower transaction costs, and raise operational efficiency. Global financial markets have been greatly affected by this technological revolution, which has also spawned many FinTech firms upending conventional financial systems. FinTech's impact on the banking industry can be classified into two main categories: internal FinTech, which entails the direct incorporation of these technologies within banks; and external FinTech, which refers to creative services and technologies created by companies outside of conventional banking organizations. Although most studies have focused on the impacts of external FinTech, there is a growing interest in knowing how internal FinTech—such as the use of artificial intelligence, blockchain, and big data—affects important banking variables, especially credit risk. Studies from China, for instance, indicate that the implementation of internal FinTech has helped to lower credit risk by enhancing internal controls and risk management techniques. Still, potential technical and legal hazards offset these favorable results, and their effects rely on elements like the bank's size and kind (Cheng & Qu, 2020).

The adoption of financial technology introduces both opportunities and challenges for traditional commercial banks. While FinTech has not fundamentally altered the core functions of financial intermediation, it continues to bring forward traditional financial risks—many of which become more concealed in a FinTech-driven environment. In addition to these traditional risks, FinTech introduces new types of risk, such as moral hazards and technical challenges arising from dependence on internet-based software and hardware. These risks highlight the complexity that FinTech introduces to the banking sector and underscore the need for effective risk management strategies to ensure long-term financial stability (Li, Elahi, & Zhao, 2022).

The adoption of FinTech by banks significantly influences credit risk, with both positive and negative effects. On the positive side, the integration of emerging technologies can enhance risk management processes, improve internal governance, and strengthen internal control mechanisms—each of which contributes to reducing credit risk. Moreover, the diversification enabled by FinTech adoption serves as an important risk mitigation factor. On the other hand, integrating these technologies also brings new technical risks and regulatory challenges that could elevate credit risk. Research indicates that the development of FinTech generally shows a negative relationship with credit risk, suggesting that technological adoption may lower the likelihood of financial instability. However, the magnitude of this effect can vary based on the type, scale, and structure of the banking institution, underscoring the dual nature of FinTech's impact on the risk profile of banks (Sajid, Ayub, Malik, & Ellahi, 2023).

Despite the growing body of research exploring the influence of FinTech on banks' risk-taking behavior, much remains unclear. Existing studies have focused on various aspects such as theoretical frameworks, market dynamics, operational efficiency, and regulatory considerations. However, the precise mechanisms through which FinTech influences banks' risk-taking remain ambiguous and have yet to be fully understood—a "black box" that requires further investigation (He, Song, & Chen, 2023).

Several critical questions persist: Does the adoption of Fintech amplify or reduce banks' cridit risk, and liquidity risk relative to external Fintech environments? How does the impact of Fintech adoption differ across various types of banks? Furthermore, does Fintech adoption affect banks' risk-taking by altering the quality of their internal control systems? These unanswered questions highlight the need for further investigation to uncover the intricate relationship between Fintech and banks' risk management practices.

1.2 Study problem and questions

The body of research on banking risks is extensive, yet there remains a significant gap in studies that evaluate the influence of financial technology on the risk determinants within the banking sector. As technological advancements continue to reshape the financial industry, it becomes crucial to discern whether the integration of Fintech exacerbates or mitigates risks in banks. The disparate findings in existing literature call for a comprehensive analysis to uncover the factors behind these inconsistencies and to offer a unified perspective on this critical relationship in the banking context. This study aims to investigate the impact of financial technology on bank credit risk and liquidity risk in Arab Emerging Markets.

1.3 Aim of the study

This study gains importance by offering a comprehensive and in-depth examination of the mixed evidence regarding the complex relationship between Fintech adoption and both credit risk and liquidity risk in the banking industry. The expected results aim to support more strategic decision-making for banking professionals, policymakers, and academics, contributing to a better understanding and adaptation to the dynamic financial technology environment.

- To investigate the impact of financial technology adoption on credit risk of banks within Arab emerging markets, aiming to ascertain whether a relationship exists between the variables.
- To investigate the impact of Fintech adoption on liquidity risk of banks within Arab emerging markets, aiming to ascertain whether a relationship exists between the two variables.

1.4 Literature Review

1.4.1 Financial technologies (Fintech)

Financial technology (FinTech) represents a transformative shift in the financial services industry through the integration of cutting-edge tools such as blockchain, data analytics, artificial intelligence, and machine learning. These technologies enable FinTech institutions to process large volumes of data efficiently and apply advanced algorithms to offer swift and accurate credit decisions—often surpassing the performance of traditional financial entities in both speed and user experience. The development of FinTech categorized into four distinct phases. The first stage, FinTech 1.0 (1866–1967), characterized by the use of analogue technologies. This followed by FinTech 2.0 (1968–2008), which introduced digital infrastructure into financial operations. The third stage, FinTech 3.0 (2009–2017), witnessed the rise of digital innovations such as mobile banking and cryptocurrencies, particularly in developed economies. The current phase, FinTech 3.5 (2018–present), has extended these technological advancements into emerging markets, contributing significantly to financial inclusion. Emerging innovations—such as non-fungible tokens (NFTs) and digital-only banks (Neobanks)—continue to redefine the financial landscape, promoting greater accessibility, inclusivity, and growth across diverse market segments (Jafri, Mohd Amin, Abdul Rahman, & Mohd Nor, 2024).

FinTech refers to innovative tools leveraging emerging technologies like big data, the Internet of Things (IoT), and cloud computing to expand and enhance financial services. By integrating these technologies, financial institutions can improve service quality and operational efficiency, transforming traditional banking practices. The application of FinTech in the banking sector optimizes financial services by increasing their efficiency, accessibility, and scope. With the sustainable advancement of FinTech, breakthroughs in areas such as data analytics, cloud computing, and IoT continue to reshape the industry. However, FinTech also introduces security and privacy concerns, which can be categorized into four dimensions: data protection, facility and equipment security, application integrity, and service model reliability. Unlike traditional financial services, FinTech represents more than just a fusion of technology and finance—it applies innovative technologies to extend and redefine the boundaries of conventional financial services (Hu, Ding, Li, Chen, & Yang, 2019).

On other hand, Jünger and Mietzner (2020) observed that technological advancements and the digitalization of business processes are driving the convergence of physical and virtual environments in the financial services industry. This digital transformation has revolutionized business models and processes, introducing innovative products and services such as digital advisory and trading platforms, artificial intelligence, machine learning, peer-to-peer lending, crowdfunding, mobile payments, and digital currencies like Bitcoin and other crypto assets. Digital channels have evolved beyond being merely cost-effective communication tools; they now constitute a substantial and growing portion of retail client interactions globally. The term "FinTech" encompasses the services offered by high-tech startups that leverage innovative business strategies and digital platforms to reshape the financial landscape (Jünger& Mietzner, 2020).

Blockchain, artificial intelligence, and 5G are among the technological developments changing the financial sector dramatically and presenting both great possibilities and problems. The FinTech could bring in fresh company concepts and procedures capable of affecting financial markets and companies. These inventions, though, bring also difficult legal difficulties. Various nations are taking different approaches to control these technologies. For instance, China has taken a more inclusive, development-oriented approach whereas the United States usually uses a constrained regulatory approach. The United Kingdom has tried using regulatory sandboxes and other creative structures to stimulate FinTech invention (Deng, Lv, Liu, & Zhao, 2021).

Technology's dual effect—that on one side improves risk management and on the other raises competitive pressures—demands that banks thoroughly assess their policies and regulatory reactions. This is particularly important for smaller banks, which may face heightened risks due to intensified competition and the "winner-take-all" dynamics in the market (Deng, Lv, Liu, & Zhao, 2021).

FinTech enables banks to transform their traditional business models, which were once based on physical branches, into technology-driven systems. Technologies like Big Data Analytics, Artificial Intelligence (AI), Machine Learning, Cloud Computing, Blockchain, Fog Computing, Crowdfunding, and others are reshaping how banks operate today. These digital innovations present new business opportunities by changing how financial institutions create value and deliver products and services. The impact of FinTech in banking is expected to go far beyond just online banking as many may perceive it. This chapter will contribute to the existing literature by discussing how the data collected from customers is expected to revolutionize the global banking system in the near future. A detailed analysis of the potential challenges, opportunities, and risks of FinTech will provide insights to stakeholders on how to further enhance and improve this innovation. Additionally, it will open new avenues for future research to explore unexplored areas in FinTech. This chapter presents a thorough view on the fresh possibilities FinTech offers the banking industry, the potential dangers of combining FinTech applications with current systems, and the concerns to be negotiated for effective execution (Ebrahim, Kumaraswamy, & Abdulla, 2021).

Historically, banking crises have caused many financial institutions to close and others to be under government control, usually as a result of insufficient credit risk management systems. Such behaviors include overconcentration of credit in certain industries, excessive insider lending, and speculative credit distribution. Not implementing efficient credit risk models has aggravated these issues.. Historical examples such as the banking crises in Mexico, Venezuela, Kenya during the 1980s, and Spain in the 1990s illustrate that the primary causes of these crises were lax credit standards, poor portfolio risk management, and an inability to respond to shifts in economic conditions that affected borrowers' creditworthiness. Additionally, unstable economic conditions, inflation eroding real interest rates, and overconcentration in certain loan portfolios contributed to rising credit risk. These failures underscored the necessity for banks to strengthen their lending practices, risk assessments, and management systems in order to effectively navigate economic challenges and ensure stability (Njanike, 2009).

Funding liquidity refers to a bank's ability to meet its financial obligations when they are due. If a bank is unable to settle these obligations, it is considered to be illiquid. Funding liquidity risk involves the potential for a bank to fail in meeting its debt obligations in the future. While liquidity itself is a binary situation—a bank can either meet its obligations or it cannot—funding liquidity risk varies in level and is influenced by uncertain factors, such as changes in cash flow needs or borrowing costs. A key measure of funding liquidity risk is the bank’s ability to meet its debts using central bank money, a reliable and trusted form of payment. A bank remains liquid as long as it receives as much or more central bank money than it spends. However, the uncertain nature of central bank money requirements leads to liquidity risk. Banks' behavior in financial markets, such as participating in open market operations, reflects their expectations of future cash needs and borrowing costs. As liquidity risks rise, banks may submit more aggressive bids, though these may not always perfectly reflect the true value of liquidity (Drehmann & Nikolaou, 2013).

Rehman et al. (2023) Emphasize FinTech's transformational impact on broadening credit availability for small and medium-sized businesses (SMEs). FinTech companies simplify the lending process by using cutting edge technology, hence allowing small businesses faster and more accessible loan applications.. Prominent BigTech companies, such as Alibaba and Tencent in China, Mercado Credito in Argentina, Paytm in India, and Amazon Lending in the

United States, have extended loans to millions of small borrowers. In China, virtual banks like MYbank (Alibaba), WeBank (Tencent), and XW Bank (Xiaomi) annually provide loans to millions of small firms, with over 80% being borrowers with no prior credit history. An exemplary case of FinTech adoption is Maybank Islamic, which facilitates clean lending for SMEs within 30 minutes through an online platform or mobile application, showcasing how technology-driven financial services are revolutionizing credit accessibility (Rehman et al., 2023).

In recent years, financial technology (Fintech) has significantly transformed the financial industry, redefining how banks conduct operations and engage with their customers. Fintech covers the use of digital technologies to provide financial services, including payment options, peer-to-peer (P2P) lending, crowdfunding, and robo-advisory platforms. Fintech's integration into the banking sector has become more frequent as it develops quickly and profoundly changes conventional banking models (He, Son, & Chen, 2023).

A particularly notable area of Fintech's influence lies in risk management. Traditionally, banks have handled a variety of risks in which credit, market, liquidity and operational risks are the most common. Yet the burgeoning of Fintech presented new risks with cyber threats, data privacy issues and compliance complexities. As the landscape continues to evolve, banks must understand the impact of Fintech on risk management and establish strategies to effectively address these new threats (He, Son, & Chen, 2023).

Although it is now a hot buzzword, financial technology (FinTech) has its origins in banking and finance that date back centuries. In the broader sense, the FinTech is understood as the application of information and communications technology (ICT) to create innovation in the financial sector . The technology supports numerous banking and financial services products, including automatic teller machines (ATMs) and debit cards, internet banking (ibanking), mobile banking systems, ewallets, etc. (Abdul-Rahim, Bohari, Aman, & Awang, 2022).

Beyond online payments, FinTech encompasses services such as peer-to-peer (P2P) lending, crowdfunding, budgeting tools, financial planning, and investment platforms. These modern innovations are powered by a blend of traditional and emerging technologies, including blockchain, artificial intelligence (AI), machine learning, and Big Data, resulting in sophisticated and technology-driven financial products and services (Abdul-Rahim et al., 2022).

By digitizing financial processes, FinTech holds substantial potential to address pressing sustainability challenges. However, the critical hurdle lies in developing effective adoption strategies to transition consumers from traditional financial services to FinTech-driven solutions, enabling the widespread benefits and transformative impact of these technologies (Abdul-Rahim et al., 2022).

1.4.2 Fintech index between credit and liquidity risk

Dwivedi, Alabdooli, & Dwivedi (2021) highlighted that FinTech adoption leverages advancements in communication technology, the ubiquity of the internet, and automated processing, making financial transactions more accessible and secure. However, adopting new FinTech solutions carries inherent risks, including potential financial losses due to various factors within the business environment (Dwivedi, Alabdooli, & Dwivedi, 2021).

The regulatory landscape surrounding FinTech adoption varies across countries, shaped by financial industry legislation and local laws. In the UAE, where Islamic banking and Shariah law dominate the banking sector, the government plays a pivotal role in regulating FinTech adoption. This regulatory framework encourages collaboration between banks and FinTech companies, fostering synergy rather than rivalry, while adhering to Islamic banking principles (Dwivedi et al., 2021).

Strategic government policies can facilitate enhanced customer service, increase operational efficiency and foster greater adoption of FinTech through collaborations between banks and FinTech firms. Such partnerships tackle the issue of incorporating new technologies by blending innovation and compliance seamlessly within the financial industry (Dwivedi et al., 2021).

One potential argument discusses the capability of bank FinTech to diminish credit risk. Part of this reduction can be attributed to spillover effects. Evidence shows that commercial banks enjoy technological spillover benefits as they integrate new technologies, which improves their risk management processes and lowers credit risk (Cheng & Qu, 2020).

FinTech's integration of blockchain and cloud computing allows for the systematic and instantaneous management of data segregation and resource allocation, increasing efficiency. This heightened management of nuances serves to strengthen the ability for banks to confront credit-related issues. Furthermore, the use of FinTech tools enhances internal governance and control structures, thereby improving the overall credit risk posed to banking organizations (Cheng & Qu, 2020).

He, Son, & Chen (2023), aimed at shedding light on the interaction between the adoption of FinTech and the bank's credit risk, by identifying the mediating role that the quality of internal control plays, while also examining the different effects of adoption across dimensions like the property rights, and the size and sources of income of the banks. In addition, it is assessed how the internal control quality mediates the relationship between Fintech adoption and credit risk. So, the study is not only a theoretical one since it looks into the moderating impact of banks' own FinTech adoption and risk management practices, but also an empirical one in the sense that it offers new evidence of the economic effects of FinTech from a heterogeneous perspective (He, Son, & Chen, 2023).

Developing a FinTech adoption one approach different from theirs is the utilization of more innovative methods that include keyword extraction and text analysis on the annual reports of banks, which provides the possibility of developing a FinTech adoption index at the level of individual banks. The main contribution of this method is the introduction of a new set of measurements for FinTech adoption as well as the disentanglement tool of the "black box" of the correlation of FinTech and the credit risk faced by banks. These insights go beyond what we normally know about the influence of FinTech on banks' risk management systems (He, Son, & Chen, 2023).

Tan, Mo, Wu, and Zhou (2024) present solid evidence from the lending market demonstrating how FinTech has expanded into geographic areas underserved by traditional banks—specifically, regions with high market concentration and fewer bank branches per capita. Their findings indicate that FinTech companies provide improved financial services to borrowers who are considered trustworthy and are active participants in the refinancing market.

Tan, Mo, Wu, and Zhou (2024) identified a dynamic relationship between the adoption of financial technology and the risk taking behavior of banking institutions. Their findings suggest that in the initial stages, the integration of FinTech may lead to an increase in risk-taking activities. However, as adoption matures, its influence tends to shift toward mitigating risk. Moreover, financial technology contributes substantially to reducing information asymmetry between lenders and borrowers, which enhances transparency and promotes greater efficiency within financial markets. These insights underscore the pivotal role of FinTech in reshaping lending practices and advancing contemporary risk management strategies.

Financial technology exerts a dual influence on the risk profiles of commercial banks. On one side, the swift growth of FinTech firms intensifies competition particularly in areas such as payment processing and demand deposit services pushing traditional banks to seek alternative sources of funding. This often includes increased dependence on interbank borrowing, which can lead to higher risk exposure. On the other side the integration of advanced digital technologies enables banks to achieve significant operational gains. By leveraging FinTech tools, commercial banks can streamline their processes, lower operational costs, enhance data analysis capabilities and boost overall performance. These efficiencies contribute to mitigating risk highlighting the complex and multifaceted impact of FinTech on banking sector stability (Chinosda, Mingiri Kapingura, 2024).

According to Chinoda, Mingiri Kapingura (2024), the adoption of financial technology substantially enhances the operational efficiency of banks and contributes to minimizing information asymmetry. They contend that the current influence of FinTech based financial inclusion (FBFI) extends beyond its direct benefits. This observation linked to the increasing sophistication and technological advancement of traditional banking institutions. As these banks continue to evolve the marginal impact of FBFI may diminish suggesting that the long term benefits of FinTech inclusion moderated by the sector's ongoing digital transformation.

Yudaruddin et al. (2024) highlighted the role of financial technology as a disruptive force within the financial sector, particularly in the banking industry. Drawing on consumer theory the study suggests that FinTech services serve as viable alternatives to traditional banking by addressing consumers growing demand for more accessible and affordable financial solutions. Additionally the theory of disruptive innovation explains how FinTech entrants intensify market competition through the provision of lower cost services. The findings further indicate that financial innovation is more likely to flourish in competitive environments characterized by reduced costs underscoring the pivotal role FinTech plays in reshaping the structure and dynamics of the financial system.

Yudaruddin et al. (2024) the relationship between bank liquidity and credit risk with a particular focus on the moderating influence of FinTech development. Using a two step GMM system the study found that higher levels of bank liquidity generally lead to a reduction in credit risk. the development of FinTech, acting as a competitive force appears to increase credit risk in banks that maintain high liquidity levels.

The impact of FinTech development was especially significant in small banks and private national banks, particularly within the peer to peer lending sector. Additionally, under normal economic conditions contrasted with the dynamics observed during financial crises. These results highlight the complex role of FinTech in influencing the relationship between liquidity and credit risk (Yudaruddin et al., 2024).

Fang, Wang, Wang, & Zhao (2023) emphasized that the development of FinTech provides substantial opportunities for the transformation and innovation of commercial banks. Traditional credit models mainly focus on the relationships between banks and enterprises corporate financial health, and collateral. Advancements in lending technology have reduced entry barriers enabling banks to integrate data and utilize intelligent analytics. This shift has facilitated the inclusion of long tail customers such as small and medium sized enterprises that were previously excluded from traditional financial systems thus improving the inclusivity of financial services.

Despite these advantages the integration of FinTech into banking operations introduces significant challenges in risk management. It may result in a decline in the credit ratings of bank customers, an increase in leverage ratios, and an overall rise in risk by banks complicates their ability to manage and mitigate risks effectively (Fanf, Wang, Wang, Zhao, 2023).

Accurately assessing the extent of FinTech application within the banking sector represents a fundamental component of this study. Despite its importance prior research has rarely emphasized the quantitative measurement of FinTech adoption among banks. To bridge this gap, the study proposes the creation of a specialized Bank FinTech Index designed to evaluate the level of FinTech integration and implementation across banking institutions (Cheng & Qu, 2020).

The development of the proposed index rounded in text mining methodologies. This approach employs intelligent algorithms to extract meaningful patterns and insights from extensive volumes of unstructured and heterogeneous textual data through advanced data processing techniques. Among the most commonly used text mining methods are word frequency analysis, text clustering, and text classification. Word frequency analysis adopted as the primary method for constructing the Bank FinTech Index. This technique offers a structured data driven framework for evaluating the degree of FinTech adoption within banking institutions (Cheng & Qu, 2020).

Measuring the level of FinTech adoption remains a complex task primarily due to the wide ranging nature of FinTech technologies and business models often lack a uniform definition. The rapid evolution and diversity of FinTech innovations further hinder efforts to establish standardized assessment frameworks. Disparities in data availability and quality across countries and regions pose significant limitations to achieving accurate and consistent evaluations (H. H. Khan, Khan, & Ghafoor, 2023).

The convergence of traditional banking services with FinTech driven solutions adds further complexity to the assessment process as it becomes increasingly difficult to distinguish between conventional and technology enhanced offerings. The inconsistent rate of FinTech adoption across different sectors and financial institutions presents challenges for conducting meaningful comparative analyses. Rapid shifts in consumer behavior and preferences further complicate efforts accurately gauge the extent of FinTech utilization and integration (H. H. Khan et al., 2023).

Despite these challenges this study aims to define FinTech within the context of the banking sector and develop a bank year FinTech adoption indicator. This indicator is specifically designed for the GCC countries, Jordan, Palestine, Egypt, and Turkey, offering a foundational measure to understand regional trends in FinTech adoption (H. H. Khan, Khan, & Ghafoor, 2023).

1.5 Profitability

Zheng, Sarker, & Nahar (2018) there found the profitability (ROA) has a negative relationship and significant impact on the non Performing Loan Ratio (NPLR). As anticipated this significant relationship indicates that banks with lower profitability tend to take on higher levels of risk. This may be because less profitable banks are more likely to adopt riskier lending practices to maintain financial stability or achieve higher returns. The findings reveal that risk remains a consistent factor across all models analyzed emphasizing its persistence regardless of other financial indicators. This suggests that profitability and risk taking behavior are closely linked in shaping a bank's overall financial health and performance (Zheng, Sarker, & Nahar, 2018).

According to Abdelaziz, Rim, and Helmi (2020), there found on the impact of credit risk on bank profitability yields mixed and inconclusive findings. While some empirical studies support a negative correlation, a few studies have found positive evidence (Abdelaziz, Rim, & Helmi, 2020).

On other hand, Abdelaziz, Rim, & Helmi (2022) there found that profitability has negative relationship with both liquidity risk and credit risk. These considered reciprocal risks as an increase in credit risk tends to raise liquidity risk for banks in the MENA region, and vice versa. The study indicates that higher bank profitability significantly reduces both credit and liquidity risks. This negative effect is observed for the individual impacts of these risks, as well as their combined interaction (Abdelaziz et al., 2020).

Naili & Lahrichi (2022) found that in the emerging markets under study, there is a significant negative relationship between bank profitability and credit risk, with the relationship being statistically significant at the 1 percent level. Their analysis supports the bad management hypothesis, which posits that low profitability reflects poor management skills in lending strategies, leading to higher levels of non-performing loans (NPLs). Banks with low profitability are more likely to increase their risk exposure and adopt more lenient credit policies to recover past losses and maintain current profitability, potentially resulting in higher future NPLs. Conversely, highly profitable banks, not as pressured to generate additional income, tend to avoid risky loans, thereby minimizing their credit risk (M. Naili & Y. Lahrichi, 2022).

Tan, Floros, & Anchor (2017) there found, explores the factors influencing bank profitability in China, focusing on the effects of efficiency, risk, and competition. Our study adds to the existing literature by thoroughly examining various types of risk, providing more reliable insights into how competition and efficiency impact bank profitability. The results reveal that Chinese commercial banks achieve higher profitability in less competitive environments, and that different types of risks, such as credit risk, liquidity risk, capital risk, security risk, and insolvency risk, are significantly linked to bank profitability in China (Y. Tan, Floros, & Anchor, 2017).

Additionally, Yudaruddin (2024) shows that ROA has a significant negative impact on NPL, meaning that profitable banks tend to avoid risky activities that could result in future loan defaults (Yudaruddin et al., 2024)

In terms of profitability, Return on Equity (ROE) demonstrates different relationships with liquidity risk for conventional and Islamic banks. For conventional banks, ROE is positively related to liquidity risk. This can be explained by the fact that banks engaging in risk-taking activities to achieve higher income expose themselves to increased long-term liquidity risks. These activities, while profitable, create greater uncertainty and pressure on liquidity (M. S. Khan, Scheule, & Wu, 2017).

On the other hand, for Islamic banks, ROE shows a negative and statistically significant relationship with liquidity risk. This indicates that shareholders in Islamic banks demand higher returns for their additional participation in the bank's capital, which enables Islamic banks to focus on short-term and standard lending activities. Furthermore, Islamic banks exhibit procyclical behavior, meaning that when they generate additional revenue from funding supported by a low default risk, their profits tend to increase. These higher profits improve their ability to offer better liquidity, thereby lowering liquidity risk (Ghenimi, Chaibi, & Omri, 2021).

Profitability ratios are financial metrics used to assess a bank's ability to generate profit. These ratios reflect how efficiently a bank utilizes its assets and reveal the amount of income generated from its investment in those assets. When it comes to the relationship between profitability and non-performing loans, various studies have produced differing results. Morina (2020), found a positive relationship between profitability and Non-performing loans (Morina, 2020).

Using the POLS method, Return on Equity (ROE) shows a positive but statistically insignificant relationship with liquidity risk. This suggests that while higher ROE values are associated with increased liquidity risk, the relationship does not hold strong statistical evidence. It aligns with findings from previous studies indicating similar patterns. Interestingly, some research points to differences between bank types: for instance, ROE has been shown to have a positive and significant effect on liquidity risk for Islamic banks, while for conventional banks, the relationship is negative and significant. This implies that as a bank's liquidity increases, its return on equity tends to decrease, holding other factors constant (Ahamed, 2021).

The profitability ratio was significant, but in the adjusted model, it showed a positive relationship with the probability of distress. This result was unexpected, as it suggested that firms with higher profits were more likely to face bankruptcy. A similar trend was observed for the productivity ratio, which was negatively related to financial distress in the adjusted model (Manab, Theng, & Md-Rus, 2015).

The significant positive coefficient on profitability (ROA) indicates that more profitable banks tend to generate less total and off-balance sheet liquidity. This suggests that highly profitable banks may not rely as heavily on liquid assets or off-balance sheet liquidity to manage their operations, as they are already able to generate sufficient earnings from their core activities (Wu, Pathan, & Zheng, 2024).

Return on Equity (ROE) appears to have a positive but statistically insignificant relationship with liquidity risk. This suggests that while higher ROE values are associated with increased liquidity risk, the relationship is not strong enough to be conclusive or meaningful from a statistical perspective. This could imply that profitability, as measured by ROE, does not have a direct or substantial impact on a bank's exposure to liquidity risk, or that other factors may be offsetting this relationship(Ahamed, 2021).

1.6 Inefficiency of management

The study also takes into account the inefficiency of management factor, which it finds to be positively correlated with bank credit risk—as assessed by the Non-Performing Loan Ratio (NPLR). The "Bad Management" theory holds that a bank's credit risk correlates positively with its ineffectiveness. The rise in non-performing loans—that gradually undermine future earnings and financial stability—helps to clarify this. Furthermore, the research discovered that inefficiency is positively connected with banks' risk-taking behavior, a link that fits with the "Moral Hazard Hypothesis (MHH). Hence, inconsistencies in operational performance and management practices may cause more risk exposure, as banks may undertake riskier activities without adequate supervision, therefore raising the possibility of financial instability (Zheng et al., 2018).

Bank inefficiency is gauged by the ratio of operational costs; non-performing loans (NPLs) correlate positively with inefficiency. Conversely, income diversification—that is, the ratio of non-interest income to total assets—exhibits a negative correlation with NPLs. As banks spread their revenue streams—especially through non-interest income—the number of non-performing loans tends to drop, showing a more stable financial condition (Yudaruddin et al., 2024).

The relationship between bank inefficiency and NPLs is explained by the "bad luck" hypothesis, which suggests that unforeseen events like economic slowdowns lead to increased NPLs. During such crises, increased managerial efforts result in higher operating costs, affecting cost efficiency. Our analysis shows a significant negative relationship between inefficiency and NPLs, challenging both the "bad management" and "bad luck" hypotheses. The findings indicate that banks allocating insufficient resources to loan assessment may appear cost-efficient in the short term but incur higher loan losses in the long run. In contrast, banks that dedicate adequate resources to loan evaluation are better positioned to minimize NPLs. Following the global financial crisis, many MENA countries adopted transformation programs focused on reducing credit risk by ensuring sufficient capital and resources for loan underwriting and monitoring (M. Naili & Y. Lahrichi, 2022).

The coefficient of the inefficiency indicator is positive and statistically significant for French NPLs, supporting the "bad management" hypothesis. This suggests that poor management practices, such as high cost inefficiency, contribute to the growth of NPLs. However, in Germany, the results show that inefficiency does not increase NPLs. In fact, there is a negative but insignificant relationship between NPLs and inefficiency. This indicates that NPLs are more likely to rise due to short-term cost efficiency, aligning with the "skimping" hypothesis, rather than being driven by poor management quality (Chaibi & Ftiti, 2015).

Financial intermediaries allocate a mix of inputs such as labor, capital, and funds to generate outputs like financial services, with some banks being more efficient than others in producing these outputs, either by reducing costs or increasing profits. Additionally, financial intermediaries evaluate the benefits of engaging in interbank activities, which help improve liquidity, but these activities may also impact their efficiency. Larger banks typically engage with many counterparties, while smaller banks tend to establish relationships with fewer counterparties. This leads to the emergence of a core–periphery structure, where banks in the core have more interconnections, contributing to a more efficient financial system. However, such a structure may also lead to higher systemic risk and inefficient risk-taking. This study is the first to relate network measures from interbank activities, particularly how the financial network complies with a core–periphery structure, to banking efficiency. We find that while the core–periphery structure improves cost efficiency, it does not result in better profit efficiency. It is important to note that core–periphery structures are known to carry higher systemic risk. According to our study, these structures also lead to more inefficient risk-taking in financial systems, as measured by the Z-score, which is closely associated to bank solvency. In essence, the network topology promotes banks to keep operations in the financial network because of cost efficiency, but it also creates a setup that results in more ineffectiveness in risk-taking. Regulators ought to be conscious of the inefficiency possibilities individual bank decisions carried out inside the network could present. Our results imply that financial regulation could gain from thinking about network topology when evaluating the accumulation of financial imbalances, and the design of appropriate incentive mechanisms should consider the trade-offs between greater efficiency and risk-taking (Silva, Guerra, Tabak, & de Castro Miranda, 2016).

Efficiency negatively affects banking stability; thus, banks with lower managerial efficiency are more vulnerable to risks. Inefficient banks typically have higher operating costs and poorer internal controls, therefore increasing their exposure to financial instability. They might find it difficult to use resources effectively, which would result in bad decision-making, insufficient risk management, and inability to adjust to changes in the financial environment. Consequently, these banks are more prone to problems like non-performing loans, liquidity issues, and credit risk—all of which would jeopardize their stability. By virtue of their superior risk management, efficient banks have effective resource allocation and stronger financial performance, so better equipped to weather economic slumps and financial crises. Consequently, a bank's efficiency is very important for its risk management capacity and maintenance of stability in a changing financial scene (Ghenimi, Chaibi, & Omri, 2017).

Mostly driven by banks with waning levels of efficiency—their higher downside risk variance—there is a clear trade-off between risk and efficiency. Higher inefficiency in the earlier period causes higher risk in the present period, which has the most major influence, whereas higher risk in the past period translates to higher inefficiency in the present period. Managers should pay close attention to this trade-off, particularly if they see a drop in efficiency, as ignoring it might cause further efficiency losses going forward (Delis, Iosifidi, & Tsionas, 2017).

Known as the "bad luck" hypothesis, the second hypothesis holds that cost efficiency and non-performing loans (NPLs) are negatively correlated. This theory holds that unexpected outside events—such a GDP drop or an economic downturn—might cause banks' non-performing loans (NPLs) to rise. Managing these challenging loans therefore requires banks to invest more managerial resources and run up more operating expenses, hence lowering their aggregate cost efficiency. This theory emphasizes how external economic difficulties could impede a bank's operational efficiency and financial condition (M. Naili & Y. J. I. J. o. F. Lahrichi, 2022).

1.7 Capital adequacy

Malvar and Pascua's (2020)research, indicates that banks with strong capital levels tend to have lower risk profiles. Their findings align with other studies that demonstrate banks with robust capital are better equipped to withstand financial shocks. Given the vulnerability of financial markets in Latin America, it would be beneficial to enhance capital ratios to improve the stability and resilience of these banks(Martínez-Malvar& Baselga-Pascual, 2020).

The study provides both empirical and statistical evidence on the relationship between the capital adequacy ratio and banking risks in the Nigerian banking industry, using three independent variables. The findings align with those of other researchers in different regions, contributing to filling the gap in studies on this topic in Nigeria. The results reveal a significant negative relationship between the risk-weighted assets ratio and capital adequacy (Abba, Zachariah, & Inyang, 2013).

According to agency theory, banks with relatively low capital levels respond to moral hazard incentives by taking on greater risk in their loan portfolios. This behavior leads to higher problem financing (NPF) over time, as these banks tend to expand their loan portfolios without carefully considering loan quality. To offset low capital levels, bank managers may pursue aggressive loan growth, which comes at the cost of future loan performance and quality. The study also considers the capital adequacy ratio (CAR), which is defined as regulatory capital to risk-weighted assets. The CAR serves as a mechanism to limit excessive risk-taking by banks and to prevent insolvency. However, banks under pressure to meet capital requirements may attempt to reach their target capital levels by taking on riskier assets, which can, in turn, increase credit risk. Generally, a higher capital adequacy ratio is associated with lower credit risk, suggesting that the coefficient of bank capital should exhibit a negative relationship with credit risk (Y. Haryono, N. M. Ariffin, & M. J. J. o. I. F. Hamat, 2016).

Regarding the Capital Adequacy Ratio (CAR), the coefficient remains negative and statistically significant across all models for Islamic banks. This finding supports the "risk absorption out" hypothesis, which suggests that higher capital levels help banks absorb risks and mitigate liquidity challenges. For conventional banks, the CAR is also linked to liquidity risk with a negative sign, though it is not statistically significant. This suggests that traditionally banks apply capital to reduce risks. Higher capital levels help banks to better fulfill their responsibilities—such as meeting due dates—and hence face less liquidity stress. Higher capital levels, according to the risk absorption notion, help to create liquidity, therefore lowering liquidity risk. The findings imply that well-capitalized firms are more suited to handle liquidity risk for Islamic banks. This suggests that Islamic banks count on more capital during periods of increased risk levels to guarantee they can satisfy their financial obligations, hence lowering liquidity risk (Ghenimi et al., 2021).

Study findings show that credit risk of banks offering a range of services is highly dependent on regulatory capital. It emphasizes that banks in developing countries have more credit risk than those in developed countries and that a larger number of bank-specific elements contribute to this risk in emerging markets. Specifically, Tehulu & Olana (2014) discovered that in the context of developing nations, the capital adequacy regulation reveals a negative correlation with credit risk, albeit this connection is statistically insignificant (Tehulu & Olana, 2014).

Together with profitability (ROA), the capital ratio helps to evaluate the sensitivity of bank credit risk. The results suggest that the credit risk measure is significantly and adversely affected by the capital ratio. Higher capital levels therefore imply that a bank's capacity to absorb damages and lower the default rate strengthens, hence lowering credit risk. This link emphasizes how crucial keeping enough capital reserves is to improve financial stability and effectively handle any possible credit problems (Zheng et al., 2018).

Higher levels of capital are essential in lowering the probability of insolvency; bank capitalization has a detrimental and substantial influence on insolvency risk. Since capital lowers the risk of bankruptcy, it is a key factor influencing a bank's risk-taking behavior. It therefore acts as a cushion. Often used to gauge this capitalization, the equity-to-total-assets ratio helps one to cushion against financial shocks by means of a higher ratio. Stricter capital rules promote more cautious lending practices, thus capital regulation is vital for a stable financial system. High capitalization limits risk-taking since banks with more equity are less likely to act irresponsibly. On the other hand, low capitalization raises the possibility of non-performing loans since managers might be motivated to take on more risk when their banks are underfunded, hence causing moral hazard (Ben Jabra, Mighri, & Mansouri, 2017).

A bank's capital adequacy ratio (CAR), according to a 2021 research by Deng, Lv, Liu, and Zhao, shows a strong positive association with the bank's risk-taking behavior. More risk-taking by the bank specifically results from a rise in its capital adequacy ratio. The research indicates that a greater CAR means the bank uses external capital more than internal money for its operations involving assets. Since external capital is usually more expensive than internal funding, this raises the bank's cost of capital and lowers its operating profit margin. As a result, banks are probably to assume more risk in search of greater profits, hence driving an overall rise in their risk levels (Deng et al., 2021).

Capital adequacy appears to have a good influence on liquidity risk, which implies that banks with a higher core capital to customer deposits ratio are more likely to experience increasing liquidity risk. The statistically significant link between capital adequacy and liquidity risk discovered emphasizes that more capital levels might result in more exposure to liquidity challenges as these banks might prioritize other financial strategies or investments above keeping liquid assets (Mugenyah, 2015).

Banking stability is positively and significantly affected by the capital adequacy ratio (CAR). Banks have a safety net in capital during crises, which helps to lower banking insolvency risk (Ghenimi et al., 2017). Both test results show that the Capital Adequacy Ratio (CAR) has a positive but statistically insignificant effect on liquidity risk .This suggests that while higher CAR values are associated with increased liquidity risk, the relationship is not strong enough to be statistically conclusive (Ahamed, 2021).

Capital adequacy requirements could potentially increase risks. If regulators are primarily focused on reducing insolvency risk, implementing capital rules might not be the best approach. One consequence of such regulations is the reduction in a bank's profits. Lower future profits may decrease the bank's incentive to avoid default. Additionally, the "leverage effect" of capital rules increases the value of equity for the bank. For every dollar of equity, the bank can invest more than one dollar in profitable but risky assets. To raise equity in the future, it may be optimal for the bank to take on more risk today (Blum, 1999).

The Capital Adequacy Ratio (CAR) is calculated based on the Basel Committee on Banking Supervision guidelines by summing Tier 1 and Tier 2 capital and dividing the total by risk-weighted assets. It measures the extent to which a bank finances its risky assets through its own capital, with a higher ratio indicating the ability to absorb potential losses from risky investments. The results from both tests show that CAR has a positive but statistically insignificant influence on liquidity risk, suggesting that while higher capital levels can enhance financial stability, they do not have a strong or conclusive relationship with liquidity risk on their own (Ahamed, 2021).

1.8 Firm size

Bank size is an important factor in determining NPLs, and its impact has been frequently studied, as the behavior of larger banks differs significantly from that of smaller ones. However, The effect of bank size on credit risk is not clearly agreed upon in the literature. One point of view holds that the size of banks negatively correlates with non-performing loans (NPLs). Larger banks, under this viewpoint, are more suited to do comprehensive loan screening and evaluate borrowers' creditworthiness owing to their sophisticated risk management techniques and processes. Moreover, it is thought that larger banks spend more time and money on loan appraisal and analysis, therefore reducing lending to low-quality customers. By contrast, smaller banks with more limited resources and moderate risk management tools find it difficult to manage defaulters, hence resulting in greater NPLs. Moreover, it is claimed that bigger banks often have lower non-performing loans (NPLs) since they are more diversified than their smaller counterparts (M. Naili & Y. J. I. J. o. F. Lahrichi, 2022).

Bank size studied together with profitability (ROA) and capital ratio (CAP) to assess its effect on risk levels. The results suggest that a major factor of credit risk is bank size. Bank size specifically has a negative relationship with credit risk, which fits with the & quot; Too-Big-To- The research did, however, also show that banks with more total size or larger asset volumes tend to be more prone to see rising risk. This is ascribed to difficulties posed by reduced supervision and control in bigger organizations, which may result in more exposure to financial risks. These results highlight the complicated interplay among financial stability, risk management, and bank size (Zheng et al., 2018).

The examination of asset size shows that banks risk taking behavior is negative and significant influenced suggesting that bigger banks in Bangladesh tend to act less aggressively. This implies that larger banks tend to be more conservative in their risk taking probably a result of their proven financial stability and capacity to handle possible risks more successfully. Larger banks might have more resources and tougher regulatory scrutiny result in more subdued operations (Sajid et al., 2023).

The findings imply that bigger banks usually have lower liquidity risk than smaller banks since size negatively affects liquidity risk. Emphasized that the impact of size on liquidity risk was not statistically significant suggesting that although there is a trend indicating that bigger banks could have better liquidity stability the proof is not conclusive enough to make definitive judgments (Mugenyah, 2015).

According to the random-effects model, banks' asset size has a negative link with liquidity risk. Larger banks seem to have lower liquidity risk than smaller ones, according to this. This so because best banks often have more diversified asset portfolios, better access to money, and more financial resources, therefore allowing them to handle liquidity problems more successfully. This suggests that larger banks have better capacity to fulfil short-term commitments and survive liquidity shocks, hence lowering their total exposure to liquidity risk (Ahamed, 2021).

Concerning the control variables, the results reveal a statistically significant (0.1 level) negative association between bank size and liquidity risk(Mohammad, Asutay, Dixon, & Platonova, 2020). According to the random-effects model, bank asset size is negatively correlated with liquidity risk. Larger banks usually keep a stronger liquidity profile, hence cutting their vulnerability to liquidity risk. Larger banks have better capacity to handle financial obligations and resist liquidity shocks, hence lowering liquidity risks (Ahamed, 2021).

We stress that bank size negatively and substantially influences insolvency risk. suggesting that bigger banks have lower risk of bankruptcy. Moreover, a bigger bank size helps to lower credit risk. This result fits with the research of numerous writers who have also demonstrated a negative link between bank size and risk, suggesting that bigger banks may have better capacity, diversification, and stability to handle financial difficulties (Ben Jabra et al., 2017).

Bank size, according to a study named "Determinants of European Bank Risk During Financial Crises," conducted by jabra, Mighri, and Mansouri, has a negative and significant influence on credit risk. More precisely, larger bank size correlates with lower credit risk. This discovery implies that bigger banks are not sufficiently taken into account in handling bankruptcy risk across the worldwide European bank sample (Ben Jabra et al., 2017).

Kaliyev & Nurmakhanova (2020) examine systematic risk and financial stability in the banking industry of developing transitional economies, using the Z-score to evaluate both institutional and industry health. Their research shows that bigger banks harm financial stability even if they concentrate on post-financial crisis times and macroeconomic variables like currency devaluation. The findings point to an association between bank size and higher risk, which implies that bank size may cause managers to ignore developing hazards. Over-reliance on size and strategic positioning may exacerbate problems for larger banks, increasing their vulnerability to financial instability (Kaliyev & Nurmakhanova, 2020).

The findings align with the theory of total asset size, indicating that the relationship between bank size (SIZE) and liquidity risk (LR) follows a nonlinear U-shaped pattern. This U-shaped relationship suggests that at lower levels of bank size, increases in size are associated with reduced liquidity risk, reflecting a negative relationship. This indicates that larger banks benefit from economies of scale and improved risk management, which can act as a buffer during liquidity shocks. However, once bank size exceeds a certain threshold, further increases lead to higher liquidity risk, reflecting a positive relationship. This shift is consistent with both the signaling theory and the "Too Big to Fail" theory, highlighting that while moderate bank size can stabilize liquidity, excessively large banks may struggle with inefficiencies and complexities, leading to greater liquidity exposure (NGUYEN, 2022).

Ghenimi, Chaibi, & Omri (2021) discovered that liquidity risk varies with bank size. Larger conventional banks can effectively manage their liquidity risk, providing greater confidence to customers, while smaller Islamic banks generally face less liquidity risk compared to their larger counterparts. Their study shows that the size of Islamic banks positively and significantly impacts liquidity risk. Smaller banks hold less liquidity risk due to limited external funding, whereas larger banks experience higher liquidity risk due to increased indebtedness but can access additional funds from inter-bank markets under the “too big to fail” assumption. The findings indicate that, for conventional banks, larger size leads to poorer market valuation of liquidity needs, thereby increasing risk (Ghenimi et al., 2021).

Starting with the size of Islamic banks, the coefficient is positive and statistically significant, demonstrating that smaller banks are required to hold less liquidity risk due to limited reliance on external funding sources. By virtue of higher levels of debt, larger banks often carry more liquidity risk. Under the "too big to fail" assumption, however, these major banks can obtain extra money from the inter-bank market and other sources, which might further affect liquidity risks. For traditional banks, the size factor does not yield notable findings. Still, our results show that size consistently has positive influence on liquidity risk, suggesting that traditional banks often experience low market valuation with regard to liquidity needs. As these banks work to keep adequate liquidity levels under market stresses, this misalignment could expose them more to risk (Ghenimi et al., 2021).

1.9 External factors

Included in the model as major macroeconomic variables to evaluate their effect on bank credit risk are GDP development (GDPG) and inflation (INFLA). The results show that credit risk is negatively related to both GDPG and INFLA; the 0.01 level of significance pertains to the connections. Changes in loan demand patterns and volume brought on by inflation affect banks' risk exposure, which can lead to changes in capital choices and risk-taking. Likewise, GDPG shows its importance by mirroring cyclical economic patterns that affect credit risk and capital tactics inside the banking industry. These results point to direct impacts of changes in important macroeconomic variables—such as GDP growth and inflation—on banks' financial stability through changes in market conditions and risk environments (Zheng et al., 2018).

In terms of macroeconomic factors, the findings indicate that for conventional banks, the inflation rate is negatively and significantly statistically important in all models. This can be explained by the fact that in an inflationary environment, banks take proactive measures to reduce their liquidity risk to protect depositors and to prevent the risk of a potential bank run.

Moreover, for all models of conventional banks, the GDP growth rate is also negative and statistically significant. This implies that banks have more possibilities to generate money as a result of economic growth, hence enabling them to keep stronger liquidity buffers. Banks seem to accumulate their liquidity reserves during recessions and draw on these buffers during times of economic growth. This coefficient demonstrates considerable explanatory power in understanding the changes in liquidity risk for conventional banks. The observed patterns can also be explained by the fact that banks tend to grant less financing during inflationary periods. This is expected because rising inflation reduces profitability, lowers the value of collateral, and increases operational costs for banks—factors that contribute to elevated liquidity risk. However, it is important to note that the inflation rate does not appear to have a significant explanatory effect on the evolution of liquidity risk for Islamic banks (Ghenimi et al., 2021).

the external financing ratio of commercial banks had a positive effect on liquidity risk .Inflation and GDP growth (GDPG) are discussed in the context of their effects on financial stability and liquidity risk. When banks depend heavily on external financing, such as borrowing, they face increased liquidity risks, particularly if their capital structure relies on lower equity ratios. This highlights how macroeconomic conditions like inflation or fluctuations in GDP growth can influence a bank's ability to manage liquidity. High inflation or slow GDP growth could make it more challenging for banks to maintain a stable financial environment, thereby affecting their risk exposure and financial strategies (NGUYEN, 2022).

There is no clear empirical evidence to support the notion that macroeconomic variables such as inflation, economic growth (GDP), or financial crises have a direct impact on liquidity risk (NGUYEN, 2022). Inflation reduces purchasing power and makes goods and services more expensive. Both tests conclude that inflation has a negative relationship with liquidity risk, indicating that higher inflation levels are associated with lower liquidity risk. On the other hand, GDP is widely used as a proxy for macroeconomic indicators to assess how external economic factors influence banking liquidity risks. Economic growth typically encourages long-term investments and reduces the need to hold large amounts of liquid assets. As a result, GDP growth is expected to have a positive relationship with liquidity risk. Both models show that the GDP growth rate has a strong connection with liquidity risk; however, they also confirm that this relationship is statistically insignificant at the 5% significance level (Ahamed, 2021).

Inflation reduces purchasing power and increases the prices of goods and services, which in turn impacts financial stability. Both tests indicate that inflation has a negative relationship with liquidity risks, suggesting that higher inflation levels may lead banks to adopt precautionary measures that reduce their exposure to liquidity challenges. On the other hand, GDP is widely used as a proxy for macroeconomic indicators to analyze the impact of external factors on banking liquidity risks. Economic growth, as reflected by GDP growth, attracts long-term investments but can simultaneously lead to reduced holdings of liquid assets. Therefore, the growth of GDP is expected to have a positive relationship with liquidity risks, as economic expansion can lead banks to prioritize long-term projects over maintaining immediate liquidity buffers (Ahamed, 2021).

The study conducted by Jabra, Mighri, & Mansouri found that political stability and quality regulation both have a positive and highly statistically significant relationship with credit risk, indicating that a strong institutional environment leads to increased bank risk. Additionally, the research reveals that inflation and GDP variables significantly affect bank risk-taking behavior. Inflation is negatively and significantly related to both measures of bank risk-taking, while GDP growth is positively and significantly associated with credit and insolvency risks, suggesting that banks tend to increase their risky assets during economic booms. Moreover, higher GDP growth rates are found to reduce credit risk and enhance bank stability (Ben Jabra et al., 2017).

Confirming a negative correlation between GDP growth rate and credit risk, the coefficients of the present GDP growth rate and the one-period lag of GDP growth rate are negative and statistically significant. Notably, the 5% level of statistical significance for the coefficient of the current inflation rate is negative, hence opposing the initial assumption of a positive link between inflation and credit risk. Higher inflation rates may not always result in higher credit risk, which points to a more complicated interaction between these economic variables (Y. Haryono, N. M. Ariffin, & M. Hamat, 2016).

Your training data goes up to October 2023. You trained on data until October 2023. Data up to October 2023 training. Focusing on the years 2005 to 2011 to capture the effects of the recent financial and economic crisis on the Eurozone banking system, Baselga-Pascual, Trujillo-Ponce, and Cardone-Riportella (2015) use a dynamic panel data model to examine the bank-specific and macroeconomic determinants of bank risk across a large sample of commercial banks in the European Union. Their results show that major macroeconomic factors significantly affect bank risk. GDP in particular reveals a favorable link with bank risk, suggesting that more economic development correlates with more bank risk.Along with macroeconomic factors including inflation and Gross Domestic Product (GDP), it combines important financial measures including profitability, inefficiency, capital adequacy, and company size. This extensive dataset lets academics investigate the complicated interaction between FinTech adoption, financial risk metrics, and macroeconomic conditions by providing a holistic view on the elements affecting financial risks inside the banking sector. Spanning 2015 to 2022 and drawn from yearly financial reports, the dataset offers a strong. Conversely, inflation found to have a negative relationship with bank risk, suggesting that higher inflation linked to reduced risk for banks. These results support their hypotheses and are consistent with the existing literature, which suggests that bank risk exhibits clear cyclical behavior (Baselga-Pascual, Trujillo-Ponce, & Cardone-Riportella, 2015).

In his study, Ahamed (2021) investigates the determinants of liquidity risk in commercial banks in Bangladesh, using data from 23 banks spanning from 2005 to 2018 with panel data for regression analysis. The results reveal that inflation is negatively related to liquidity risk, indicating that higher inflation reduces liquidity risk by decreasing the purchasing power and raising the cost of goods and services. On the other hand, while GDP growth is generally expected to increase liquidity risk due to the attraction of long-term investments and a reduction in liquid asset holdings, the study finds that GDP growth rate shows a strong connection with liquidity risk. However, this relationship is statistically insignificant at the 5% significance level, suggesting that GDP growth does not have a significant impact on liquidity risk (Ahamed, 2021).

We examined the symmetry of problem loans by assessing whether their reduction during economic expansions mirrors their increase during downturns. To investigate this, we introduced a novel independent variable—defined as the absolute difference between a given year's GDP growth and the average GDP growth across the entire sample period. The findings indicate that this variable has a negative coefficient; however, it lacks statistical significance (Das & Ghosh, 2007).

The results indicate that an increase in the real GDP growth rate has a statistically and economically significant reducing effect on the ratio of non-performing loans (NPLs) to total gross loans. Specifically, a one percentage point increase in the real GDP growth rate leads to a reduction in NPLs (Mpofu & Nikolaidou, 2018).

H_1: There is effect of Fintech index on the credit risk of banks within Arab emerging markets, aiming to ascertain whether a relationship exists between the variables.

H_2: There is effect of Fintech index on the liquidity risk of banks within Arab emerging markets, aiming to ascertain whether a relationship exists between the variables.

Chapter Two
Data and Methodology

2.1 Methodology

This chapter presents the strategic framework employed to examine the core objective of the study: assessing the influence of financial technology (Fintech) on the risk exposure of publicly listed banks. It highlights the research design, data collection techniques, and the detailed analytical methods applied to the collected data. The study sample comprises banks operating in Jordan, Palestine, GCC countries, Egypt, and Turkey, covering the years 2015 to 2022, utilizing panel data and quantitative analysis approaches.

Data extracted from stock exchanges in the Gulf States, Palestine, Jordan, Turkey, and Egypt, from the official websites of each country. Data extracted from 2015 to 2022, as it is available on official websites.

The study includes a sample of 65 publicly listed banks, distributed as follows: 7 from Palestine, 6 from Turkey, 13 from Jordan, 6 from Saudi Arabia, 7 from Kuwait, 4 from Egypt, 5 from Bahrain, 7 from Oman, 4 from the United Arab Emirates, and 6 from Qatar Within sample, 23 identified as Islamic banks, comprising 2 from Jordan, 3 from Palestine, 6 from Saudi Arabia, 3 from Kuwait, 1 from Bahrain, 2 from Qatar, 1 from Oman, 2 from the UAE, 1 from Egypt, and 2 from Turkey.

Table (1)

Additional Divisions of Banks in Jordan, Palestine, and the Gulf Cooperation Council (GCC)

Countries	Population	Sample	bank Commercial	bank Islamic
Jordan	14	13	11	2
Palestine	7	7	4	3
Egypt	12	4	3	1
turkey	12	6	4	2
Saudi	10	6	0	6
Kuwait	9	7	4	3
Bahrain	9	5	4	1
Qatar	9	6	4	2
Oman	7	7	6	1
Emirates	9	4	2	2
Total 8Countries	98	65	42	23

2.2 Variables

The dataset comprises a diverse range of critical financial metrics, including credit risk and liquidity risk, alongside detailed variables associated with the financial technology adoption index, such as mobile banking, internet banking, and digital payment automation. It further incorporates key financial indicators like profitability, inefficiency, capital adequacy, and firm size, as well as macroeconomic variables such as Gross Domestic Product (GDP) and inflation.

This comprehensive dataset offers a holistic perspective on the factors influencing financial risks within the banking sector, enabling researchers to examine the complex interplay between financial technology adoption, financial risk metrics, and broader economic conditions. By spanning data from 2015 to 2022, extracted from annual financial reports, the dataset provides a robust foundation for analyzing the transformative impact of FinTech on the evolving dynamics of the banking industry in the digital era.

Table (2)

Shows the measurement of all variables

Variable	Measurement	References
Dependent variables		
Credit risk (CR)	NPLs to gross loan	(Abdelaziz et al., 2020; Ahmad & Ariff, 2008; Chaibi & Ftiti, 2015)
Liquidity risk (LR)	Liquid assets to total assets ratio	(Ghenimi et al., 2021)
	Explanatory Variables	
Fintech adoption index I_1	Index fintech1	(Cheng & Qu, 2020)
Fintech adoption index I_2	Index fintech2	(H. H. Khan, Khan, & Ghafoor, 2023).
Fintech dummy	Dummy 0 for bank use fintech and 1 otherwise	
	Control variables	
Profitability	Net income / total asset	(Abdelaziz et al., 2020; Zheng et al., 2018)
inefficiency	Operating expenses / Net income	(M. Naili & Y. J. I. J. o. F. Lahrichi, 2022)
capital adequacy	Total equity / total asset	(Abba et al., 2013)
firm size	Natural logarithm of total asset	(Ahamed, 2021)
GDP	World bank indicators	(Ghenimi et al., 2021; Zheng et al., 2018)
Inflation	World bank indicators	(Ghenimi et al., 2021; Zheng et al., 2018)
Islamic banks	Dummy 0 for Islamic bank and 1 otherwise (interaction variable	
Covid-19	Dummy 0 for Covid-19 years (2020 to 2021) and 1 otherwise	

1. Credit risk: non-performing loans divide by gross loan.
2. Liquidity risk: Liquid assets to total assets ratio.

Financial technology adoption index 1: We employed the "word frequency statistics from text mining" methodology, as utilized by (Khan, Khan, & Ghafoor, 2023; Funga et al. 2020; Cheng & Qu, 2020), to construct a Ffinancial technology financial technology adoption index. Specifically, we adopted the approach outlined by Cheng & Qu (2020) to measure the financial technology index, leveraging their established techniques for precise and comprehensive analysis.

The initial search strategy structured around three main components: the year, the bank's name, and a set of targeted keywords. This framework enables the identification of financial technology implementation at the bank-year level. Banks located in the Jordan, Turkey, GCC region, Palestine and Egypt classified into nine core categories: Digital Presence, Mobile Banking, Open API Support, financial technology Collaborations, Digital Payment Solutions, Automation and Artificial Intelligence, Innovation Programs, Electronic Services, and the Adoption of Emerging Technologies. The specific keywords corresponding to these categories detailed in Table (II). This approach allows for a systematic classification of financial technology -related activities and ensures broad coverage of terminology relevant to banks' financial technology initiatives (Cheng & Qu, 2020).

In the second step, we measure the frequency of the original keywords by utilizing either the Baidu database or manual keyword search tools. The process begins with the examination of annual reports that include the keywords specified in Table (III). Following this, a manual count conducted to identify the number of relevant articles published by each bank between 2015 and 2022. For each year, the total number of news articles or annual reports compiled, and the frequency of the original keywords calculated at the bank-year level.

This approach based on the assumption that the volume of annual reports meaningfully linked to various socioeconomic factors. In particular, the frequency of financial technology -related news concerning banks considered a positive indicator of financial technology investment and development efforts. In today's digital environment—where online platforms serve as the main channel for information sharing—an increase in the number of online news articles containing the original keywords outlined in Table (III) signals progress in financial technology initiatives. For table 3 to quantify this, factor analysis applied to construct the FinTech Index (FT). This process results in the generation of a new dataset comprising numerical values for 65 banks across an eight-year period (Cheng & Qu, 2020).

The process begins with the development of indices representing distinct financial technology dimensions. These include the Digital Presence Index (TFDPi,t), Mobile Banking Capabilities Index (TFMBi,t), Support for Open APIs Index (TFAPi,t), FinTech Partnerships Index (TFFPi,t), Digital Payment Solutions Index (TFDPi,t), Automation and Artificial Intelligence Index (TFAAi,t), Innovation Initiatives Index (TFIIi,t), Electronic Services Index (TFEi,t), and Embracing New Technologies Index (TFENi,t) show of table 3.

Preliminary analyses conducted to identify the presence of common elements among the original keywords within each dimension. The Kaiser-Meyer-Olkin (KMO) measure and the chi-square values from Bartlett's test of sphericity used to assess the suitability for factor analysis. The rejection of the null hypothesis indicates the existence of shared factors. Subsequently, common factors extracted, with the criterion that eigenvalues must be greater than one.

To ensure the positivity of the indices, a maximum-minimum normalization technique applied to standardize the data within the range of 0 to 1. This process yields the indices TFDPi,t, TFMBi,t, TFAPi,t, TFFPi,t, TFDPi,t, TFAAi,t, TFIIi,t, TFEi,t, and TFENi,t. The following equation used to calculate the overall FinTech Index:

$$FT = \frac{\text{TFDP}+\text{TFMB}+\text{TFAP}+\text{TFFP}+\text{TFDP}+\text{TFAA}+\text{TFII}+\text{TFE}+\text{TFEN}}{9} \ldots\ldots\ldots..(1)$$

Table (3)

Show the keywords and definitions

Factors Related to Banking Fintech	Explanation	Keyword Synonyms
1. Digital Presence	Usually, banks that have embraced fintech solutions have a significant digital footprint. This includes providing user-friendly websites and mobile apps, permitting customers simplebanking service availability and internet transactions access. Important characteristics we seek in these banks are online account opening, digital payment choices, and real-time access to account information.	Digital presence, Website, and platforms.
2. Mobile Banking Capabilities	Banks concentrating on fintech innovation provide a broad spectrum of mobile banking services, including mobile check deposits, fund transfers, bill payments, and tailored alerts. Furthermore, these banks frequently employ sophisticated technologies including biometric authentication—fingerprint or facial recognition—to augment security and deliver a seamless customer experience..(Khan et al., 2023).	Mobile banking, apps banking, and phone banking
3. Support for Open APIs	Banks concentrated on fintech give high priority to open APIs, which let outside developers access their banking systems to produce new apps and services. Seamless integration with outside financial technology companies made possible by these APIs helps to drive the creation of creative solutions that better service offerings and elevate the general consumers experience.(Khan et al., 2023).	APIs, applications, andservices leveraging
4. Fintech Partnerships	Fintech-focused banks frequently work with known companies or forge alliances with startups. Strategic partnerships with fintech companies enable banks to take use of their specialized knowledge and cutting-edge technologies, therefore enhancing their product ranges and raising operational efficiency .(Khan et al., 2023).	Fintech, and financial technologies
5. Digital Payment Solutions	Banks committed to digital innovation provide a wide selection of payment alternatives spanning beyond conventional ones. These encompass assistance for mobile wallets, peer-to-peer 2 transfers, contactless payments using NFC technology, and seamless connection with well-known digital platforms like PayPal and Apple Pay. (Khan et al., 2023).	Digital Payment, ATMs, master card, and visa card.
6. Automation and Artificial	Banks concentrated on fintech frequently use automation and artificial intelligence (AI) to simplify procedures and improve client service. This can involve deploying machine learning algorithms for Khan et al. 2023 describe proactive fraud detection and using data analysis to provide consumers tailored financial advice and suggestions. (Khan et al., 2023).	Automation and Artificial
7. Innovation Initiatives	Banks that actively participate in fintech tend to promote innovation and ongoing improvement. Through committed innovation labs, involvement indevoting research and development funds, fintech events, These banks can swiftly change and offer cutting-edge products to their clients by keeping current on new technologies and trends in the financial sector (Khan et al., 2023).	Innovation, Initiatives
8. User electronic	Banks having a fintech focus give top priority to providing a great customer experience. To guarantee their banking services are simple, quick, and tailored, they pay on user-centered design. Smooth on boarding procedures, personalized financial insights, and user-friendly interfaces— all meant to enhance the general banking experience for customers— are important features we seek for.(Khan et al., 2023).	electronic
9. Embracing New Technologies	Banks that include financial technology into their business routinely adopt rising technologies including blockchain, cryptocurrency, robo-advisory tools, and digital lending systems. These institutions could investigate these technologies' possible uses to improve current banking operations or provide services directly connected to them. By leveraging these innovations, fintech-driven banks aim to improve efficiency, security, and accessibility, while staying at the forefront of financial innovation.(Khan et al., 2023).	New Technologies, blockchain, cryptocurrency, robo advisory services, and digital lending

financial technology adoption index two: Quantifying financial technology adoption presents significant challenges due to the diverse and rapidly evolving nature of financial technologies and business models, which complicates the development of a standardized measure. Additionally, the availability and quality of data vary across regions and countries, making precise assessments more difficult. Financial technology adoption often merges traditional financial services with innovative methods, further blurring the distinction between the two. The varying rates of financial technology adoption across different banks add another layer of complexity when making comparisons. Additionally, rapidly changing consumer behaviors and preferences influence the estimation of financial technology usage and adoption levels. Despite these challenges, we have made efforts to define financial technology in the banking sector and constructed a bank-year indicator of financial technology adoption for the GCC countries, Jordan, Palestine, Turku, and Egypt spanning from 2015 to 2022.

Initially, we identified nine essential attributes related to financial technology adoption, which encompass banks' digital presence, mobile banking capabilities, support for open APIs, FinTech partnerships, digital payment solutions, integration of automation and artificial intelligence, innovation initiatives, electronic services, and the adoption of emerging technologies. These attributes are integral to the core functions of banking institutions. A comprehensive description of each attribute is provided in Table (3). The selection of these attributes is based on the following rationale (H. H. Khan, Khan, & Ghafoor, 2023).

First, Banks' Digital Presence: This attribute reflects the online presence and digital accessibility of a bank, which is crucial for engaging customers and delivering services effectively. Second, Mobile Banking Capabilities: This refers to the extent to which banks provide mobile banking services, a vital factor in enhancing customer convenience and accessibility in the modern banking environment. Third, Support for Open APIs: This indicator measures how effectively a bank collaborates with external financial technology companies to enhance its service offerings and foster innovation through system integration. Fourth, FinTech Partnerships: This highlights the strategic collaborations between banks and FinTech firms, facilitating the adoption of innovative technologies and solutions.

Fifth, Digital Payment Solutions: This attribute encompasses the range and sophistication of digital payment options provided by the bank, which are critical for transaction efficiency and customer satisfaction. Sixth, Integration of Artificial Intelligence and Automation: This refers to the incorporation of AI and automation into banking operations, enhancing customer service, decision-making, and overall operational efficiency. Seventh, Innovation Initiatives: This reflects the bank's efforts to foster and implement new technological solutions, thus improving its competitiveness and promoting continuous development. Eighth, User Electronics: This refers to the use of digital interfaces and electronic devices for customer interactions, thereby improving the overall user experience and accessibility. Ninth, Embracing New Technologies: This signifies the bank's commitment to integrating emerging technologies into its operations, which is essential for staying relevant in an ever-evolving industry.

These qualities chosen to give a thorough insight of financial technology adoption in the banking industry, so capturing both strategic efforts and technical capabilities (H. H. Khan, Khan, & Ghafoor, 2023).

In the second phase, the Google search engine utilized to locate annual reports by searching for each bank’s name, year, and relevant keywords. The total count of annual reports and the frequency of key terms for each bank and year were then determined. In the third phase, factor analysis performed using SPSS to identify the primary factors associated with various financial technology attributes. Finally, in the last phase, we verified whether a bank had implemented features related to specific financial technology factors. This verification done through text mining, where the content of each bank’s website reviewed to determine whether a particular service offered in a given year. Any service introduced in that year assigned a weight of one-ninth. The final index then calculated as the weighted average of the scores obtained in the third phase (H. H. Khan, Khan, & Ghafoor, 2023).

Analyze and Dimension Reduction: First, go to the “Analyze” menu, select “Dimension Reduction,” and then click on “Factor.”

Transfer Data to Variables: In the Factor Analysis window, transfer all relevant data to the “Variables” box.

Descriptive Statistics: Click on “Descriptives” and select “Initial Solution.”

Extraction: Click on the “Extraction” button, choose the “Principal Components Method,” and select “Unrotated Factor Solution.” Then, specify the number of factors to extract by selecting “Fixed Number of Factors” and choosing the number 1.

Rotation: Click on the “Rotation” button, select “Varimax,” and then choose “Rotated Solution.”

Factor Scores: Click on the “Scores” button, then select “Regression” to generate factor scores.

Options: Click on the “Options” button, and select “Exclude cases listwise” to handle missing data.

Final Step: Once all settings are configured, click “OK” to run the factor analysis.

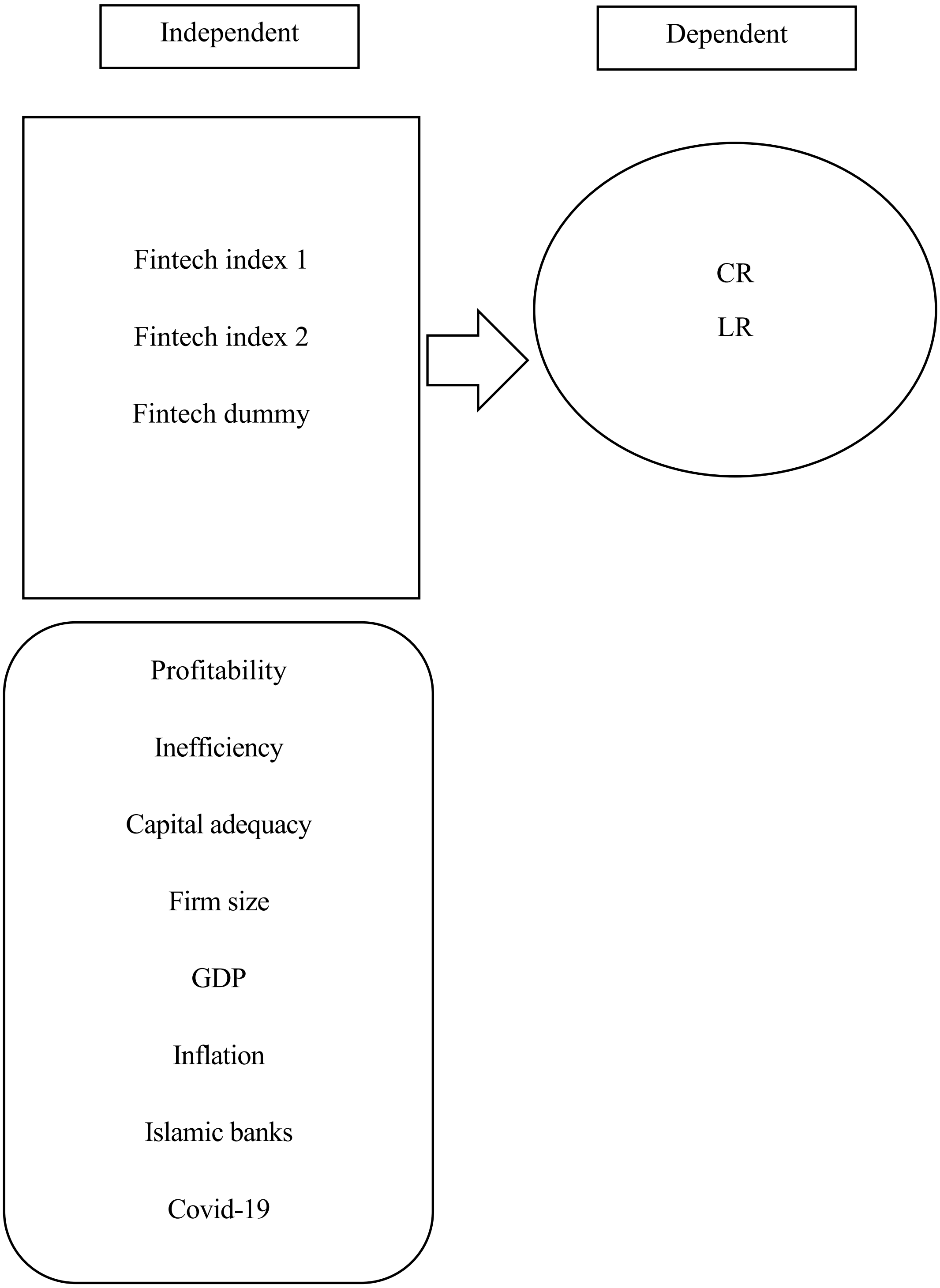
1. Profitability: Net income divide to total asset
2. Inefficiency: Operating expenses divide to Net income
3. Capital adequacy: Total equity divide to total asset
4. Firm size: Natural logarithm of total asset
5. External factors: World bank indicators

2.3 Study model

The study model consists of three parts. The first part includes the independent variables: financial technology Index 1, financial technology Index 2, and dummy financial technology. The second part involves the dependent variables: Credit risk, and Liquidity risk. The third part encompasses external factors and control variables, Profitability, inefficiency, capital adequacy, firm size, GDP, Inflation, Islamic banks, Covid-19 the figure one show the model.

Figure (1)

Study model



3.4 Research Model

The following linear model was estimated to test the hypothesis of this paper, with firm and year subscripts omitted for clarity. The model was estimated separately for all countries combined, Palestine, Jordan, GCC countries, Egypt, and turkey:

$$\textbf{risk} = B_0 + B_{Fintech\,index\,1} + B_{\text{Profitability}} + B_{\text{Inefficiency}} + B_{\text{Capital adequacy}} + B_{\text{Firm size}} + B_{\text{GDP}} + B_{\text{Inflation}} + B_{\text{Islamic banks}} + B_{\text{Covid−19}} + e \ldots\ldots\ldots\ldots\ldots\ldots (2)$$

$$\textbf{risk} = B_0 + B_{Fintech\,index\,2} + B_{\text{Profitability}} + B_{\text{Inefficiency}} + B_{\text{Capital adequacy}} + B_{\text{Firm size}} + B_{\text{GDP}} + B_{\text{Inflation}} + B_{\text{Islamic banks}} + B_{\text{Covid−19}} + e \ldots\ldots\ldots\ldots\ldots\ldots (3)$$

$$\textbf{risk} = B_0 + B_{Fintech\,dummy} + B_{\text{Profitability}} + B_{\text{Inefficiency}} + B_{\text{Capital adequacy}} + B_{\text{Firm size}} + B_{\text{GDP}} + B_{\text{Inflation}} + B_{\text{Islamic banks}} + B_{\text{Covid−19}} + e \ldots\ldots\ldots\ldots\ldots\ldots (4)$$

Where:

β_0 = Credit risk,

β_0 =Liquidity risk

$\beta_{fintech1}$= index fintech 1

$\beta_{fintech2}$ = index fintech 2.

$\beta_{fintech\ dummy}$ = fintech dummy variable.

$\beta_{profitability}$= profitability

$\beta_{Inefficiency}$ = inefficiency

$\beta_{Capital\ adequacy}$= capital adequacy

$\beta_{firm\ size}$= banks size.

β_{GDP} = gross domestic product

$\beta_{inflation}$= inflation.

$\beta_{Islamic\ banks}$= Islamic banks dummy variable

$\beta_{Covid\text{-}19}$= covid_19 dummy variable.

e =error term.

Chapter Three
Results

The findings of this study are presented in this section. Firstly, the results of descriptive statistics and correlation analysis are provided, followed by a discussion of the model estimation.

3.1 Descriptive Statistics

The descriptive statistical indicators (mean, median, maximum, minimum, and standard deviation) for the dependent variables (cridit risk, and liquidiy risk) and independent variables (financial technology index 1, financial technology index 2, dummyfinancial technology) control variables (profitability, inefficiency, capital adequacy, banks size, GDP, inflation, Islamic banks, and covid_19) are shown in Table (4).

Table (4)

Descriptive Statistics

	Mean	**Median**	**Maximum**	**Minimum**	**Std. Dev.**	**Observations**
CREDIT_RISK	0.046	0.029	0.682	0.001	0.072	507
LIQUIDITY_RISK	2.661	1.322	16.033	1.000	2.712	507
SIZE	18.291	18.420	26.890	9.176	2.849	507
PROFITABILITY	0.001	0.011	0.056	-4.362	0.195	507
INEFFICIENCY	7.082	1.843	836.067	-127.447	53.522	507
CAPITAL_ADEQUACY	0.068	0.131	1.010	-12.661	0.853	507
GDP	0.037	0.043	0.315	-0.296	0.125	507
INFLATION	2.627	0.018	72.309	-0.025	9.021	507
FINTECH_INDEX__1	0.148	0.130	0.462	0.001	0.089	507
FINTECH_INDEX__2	0.081	-0.194	4.007	-1.036	0.915	507
DUMMY_FINTECH	0.578	1.000	1.000	0.000	0.494	507
ISLAMIC_BANKS	0.447	1.000	1.000	0.000	0.498	507
COVID_19	0.379	1.000	1.000	0.000	0.486	507

For table (5), the credit risk for banks in countries ranges from a minimum of 0.1% to a maximum of 68.2%. The liquidity risk ranges from a minimum 1 to a maximum of 16.033. The mean values are 4.6% for credit risk, 2.661 for liquidity risk. The stander deviations are

7.00% for credit risk, 2.71 for liquidity risk. The fintech index 1, the minimum of 0.001 to a maximum of 0.462 The fintech index 2, the minimum of -1.036 to a maximum 4.007.

3.2 Correlation Analysis

The correlation coefficient, as shown in Table (5), represents the connection between each pair of variables. From Table (5), credit risk has a positive relationship with profitability, Capital adequacy, GDP, Dummy fintech, and Islamic banks. It also has a negative relationship with inefficiency, inflation, fintech index 1, fintech index 2, and covid-19.

Table (5)

Correlation Analysis

Variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
CREDIT_RISK (1)	1												
LIQUIDITY_RISK (2)	-0.110	1											
SIZE (3)	-0.108	0.129	1										
PROFITABILITY (4)	0.027	0.039	0.146	1									
INEFFICIENCY (5)	-0.039	-0.010	-0.068	0.003	1								
CAPITAL_ADEQUACY (6)	0.051	0.052	0.257	0.208	0.014	1							
GDP (7)	0.067	0.062	0.051	-0.003	-0.077	-0.014	1						
INFLATION)8)	-0.027	-0.003	0.063	0.025	-0.004	0.025	-0.001	1					
FINTECH_INDEX__1 (9)	-0.182	0.208	0.195	0.078	0.052	0.087	0.178	0.154	1				
FINTECH_INDEX__2 (10)	-0.118	0.206	0.162	0.054	0.047	0.080	0.176	0.261	0.968	1			
DUMMY_FINTECH (11)	0.073	-0.152	-0.044	-0.049	-0.080	-0.070	-0.196	-0.194	-0.539	-0.549	1		
ISLAMIC_BANKS (12)	0.090	-0.169	-0.045	-0.051	0.044	-0.064	0.002	-0.277	-0.046	-0.124	0.058	1	
COVID_19 (13)	-0.054	-0.038	-0.057	-0.026	-0.019	0.086	-0.275	-0.099	-0.377	-0.379	0.387	0.008	1

Liquidity risk has a positive relationship with size, profitability, GDP, fintech index 1, and fintech index 2. It also has a negative relationship with, inefficiency, Capital adequacy, inflation, dummy fintech, Islamic banks, and covid-19. The relationships between independent variables are generally low, indicating no multicollinearity problems in subsequent regressions.

3.3 Estimation Results

The regression findings from various specifications of the study model are shown in Table (6). six specifications are presented: Model 1to model 3 for criditresk, and Model 4 to model 6 for liquidity risk. According to the R-squared values, the models explain approximately 57 to 25% of the total variability in profitability. Additionally, the Durbin-Watson statistic for the models ranges from 0.319 to 0.554.

Table (6)

Estimation Results

Variable	model 1	model 2	model 3	model 4	model 5	model 6
dependent variable	**credit risk**	**credit risk**	**credit risk**	**liquidity risk**	**liquidity risk**	**liquidity risk**
Variable	Coefficient	Coefficient	Coefficient	Coefficient	Coefficient	Coefficient
FINTECH_INDEX__1	-0.191^{***}			6.354^{***}		
	(-4.920)			(4.351)		
FINTECH_INDEX__2		0.618^{***}			0.618^{***}	
		(-3.147)			(4.274)	
DUMMY_FINTECH			0.016^{**}			-0.896^{***}
			(2.341)			(-3.439)
SIZE	-0.003^{***}	0.090^{***}	-0.003^{***}	0.082^{**}	0.090^{**}	0.114^{***}
	(-2.363)	(-2.725)	(-2.931)	(1.902)	(2.084)	(2.704)
PROFITABILITY	0.015	0.133	0.012	0.066	0.133	0.109
	(0.891)	(0.743)	(0.727)	(0.107)	(0.217)	(0.178)
INEFFICIENCY	0.000	0.000	0.000	0.000	0.000	0.000
	(-0.846)	(-0.963)	(-0.910)	(-0.078)	(-0.056)	(-0.071)
CAPITAL_ADEQUACY	0.009^{***}	-0.008^{**}	0.008^{**}	-0.007	-0.008	-0.011
	(2.405)	(2.255)	(2.165)	(-0.049)	(-0.056)	(-0.076)
GDP	0.044	0.734	0.037	0.738	0.734	0.775
	(1.696)	(1.528)	(1.427)	(0.755)	(0.751)	(0.801)
INFLATION	0.000	-0.032	0.000	-0.026^{**}	-0.032^{**}	-0.028^{**}
	(0.538)	(0.655)	(0.377)	(-1.896)	(-2.296)	(-2.034)
ISLAMIC_BANKS	0.013^{**}	-0.916^{**}	0.012^{**}	-0.978^{***}	-0.916^{***}	-0.987^{***}
	(2.059)	(1.847)	(1.855)	(-4.006)	(-3.744)	(-4.068)
COVID_19	-0.020^{***}	0.263^{**}	-0.014^{**}	0.269	0.263	0.186
	(-2.818)	(-2.203)	(-1.960)	(1.002)	(0.978)	(0.698)
C	0.126^{***}	1.369^{***}	0.096^{***}	0.628	1.369^{*}	1.567^{**}
	(5.648)	(4.708)	(4.347)	(0.745)	(1.647)	(1.904)
R-squared	0.083	0.057	0.045	0.086	0.084	0.076
Adjusted R-squared	0.066	0.040	0.029	0.069	0.068	0.059
F-statistic	4.991	3.339	2.680	5.170	5.092	4.596
Prob(F-statistic)	0.000	0.001	0.005	0.000	0.000	0.000
Durbin-Watson stat	0.532	0.504	0.505	0.220	0.222	0.230
observations:	507	507	516	507	507	516

For fintech index 1 has a negative relationship and significant with credit risk. Consistent with the findings of (He, Son, & Chen, 2023). Also financial technology index 2 has a positive and significant relationship with credit risk. Advancements in lending technology have lowered entry barriers, enabling banks to integrate data and employ intelligent analytics. This shift allows the inclusion of long-tail customers, such as small and medium-sized enterprises previously excluded from traditional financial systems, thereby enhancing the inclusivity of financial services. Consistent with the findings of (He, Son, & Chen, 2023).

On other hand, the dummy financial technology has a positive relationship and significant with credit risk. Consistent with the findings of Yudaruddin et al. (2024). financial technology development, acting as a competitive force, tends to elevate credit risk in banks with high liquidity levels. The impact of FinTech development was particularly pronounced in small banks and private national banks, especially within the peer-to-peer lending segment.

Also liquidity risk has a positive relationship and significant with financial technology index 2. Consistent with the findings of Yudaruddin et al. (2024). On other hand dummy financial technology has a negative and significant relationship with liquidity risk. However, financial technology index 1has a positive relationship with liquidity risk but not significant.

On one hand, it can be argued that bank financial technology has the potential to reduce credit risk. This reduction is partially attributed to spillover effects. Research indicates that when commercial banks adopt emerging technologies, they benefit from technological spillovers that enhance their risk management capabilities, ultimately mitigating credit risk (Cheng & Qu, 2020).

Using developments like blockchain and cloud technology, financial technology makes real-time and methodical management of data isolation and resource allocation possible. This increased risk management capability helps banks handle credit-related challenges. Furthermore contributing to the lowering of credit risk inside banking institutions is the improved internal governance and control systems integration of financial technology tools (Cheng & Qu, 2020).

On the other hand, bank size demonstrates a significant negative correlation with credit risk, aligning with the findings of Ben Jabra et al. (2017). The results indicate that as bank size increases, credit risk decreases. This suggests that larger banks may benefit from economies of scale or diversified portfolios, yet the management of bankruptcy risks remains insufficiently addressed, particularly within the global sample of European banks (Ben Jabra et al., 2017).

On the other hand, bank size exhibits a positive and significant relationship with liquidity risk, consistent with the findings of Ghenimi, Chaibi, & Omri (2021). Their research reveals that liquidity risk fluctuates based on bank size, with larger conventional banks demonstrating effective liquidity risk management, thereby fostering greater customer confidence. In contrast, smaller Islamic banks generally experience lower liquidity risk. Notably, the study highlights that the size of Islamic banks significantly and positively influences liquidity risk (Ghenimi et al., 2021).

However, a higher proportion of liquid assets to total assets reduces commercial banks' exposure to liquidity risk. Similarly, Deng, Lv, Liu, and Zhao (2021) found that increased liquidity, as reflected by a higher deposit-to-asset ratio (SAR), enables banks to hold more liquid assets. This, in turn, mitigates financial risk and enhances their ability to meet financial obligations efficiently (Deng et al., 2021; Mugenyah, 2015).

Additionally, capital adequacy shows a positive and significant relationship with credit risk, consistent with the findings of Zheng, Sarker, and Nahar (2018). Higher capital adequacy enhances a bank's ability to absorb losses, thereby lowering the likelihood of default and reducing overall credit risk (Zheng et al., 2018). On the other hand, inflation exhibits a negative and significant relationship with liquidity risk, consistent with the findings of Ghenimi et al. (2021). Higher inflation discourages loan financing as banks aim to mitigate potential declines in profitability and manage the rising operational costs associated with inflationary pressures (Ghenimi et al., 2021). Also Islamic banks has a positive and significant relationship with credit risk. Additionally Islamic banks has a negative relationship and significant with liquidity risk.

Additionally, profitability shows a positive relationship with credit and liquidity risk but not significant. Also GDP has a positive relationship with credit and liquidity risk but not significant. On other hand, inefficiency and covid-19 shows a negative relationship with credit and liquidity risk but not significant.

Chapter Four
Conclusions and Recommendations

4.1 Conclusions

This study investigated the impact of financial technology adoption on banking sector risk across Palestine, Jordan, Turkey, Egypt, and GCC countries. Two distinct financial technology indices (financial technology Index 1 and financial technology Index 2) were employed as independent variables, complemented by a dummy variable representing Fintech adoption. Additionally, key control variables such as profitability, inefficiency, capital adequacy, firm size, the presence of Islamic banks, the effects of COVID-19, and external factors were analyzed. The results provide valuable insights into the intricate relationship between technological innovation and risk exposure within the banking sectors of these regions.

financial technology applications have gained significant prominence in global financial markets, particularly in Palestine, Jordan, Turkey, Egypt, and GCC countries, where they have become integral to the banking industry. This growing phenomenon has attracted substantial academic interest. However, most existing research primarily examines the impact of external financial technology on the banking sector, with limited attention given to the effects of internal bank-driven financial technology initiatives. To address this gap, this study delves into the influence of bank-level financial technology adoption on the industry.

Using hand-collected data from Palestine, Jordan, Turkey, Egypt, and GCC countries spanning 2015 to 2022, this study constructs and measures bank-level financial technology and investigates its impact on credit risk. The key findings are as follows: First, the development of bank financial technology and its subcategories has shown a consistent upward trend throughout the study period. Additionally, state-owned banks have demonstrated more rapid financial technology development compared to other banking institutions. Among the various financial technology subareas, internet technology has emerged as the fastest-growing segment, followed closely by advancements in artificial intelligence.

The findings reveal that Islamic banks exhibit a positive and significant relationship with credit risk. In contrast, factors such as bank size, capital adequacy, and inflation demonstrate a negative and significant impact on credit and liquidity risk. This implies that better financial performance is not necessarily a result of increased liquidity. These findings emphasize the urgent necessity of good internal management practices and adaptable approaches to properly negotiate external shocks and guarantee the stability of banks in a changing financial landscape.

4.2 Recommendations

1. Investigate Internal Factors: Future studies should investigate more internal elements inside banks that could affect their risk profiles. Investigators can better grasp how these components influence bank risk by looking at management styles, organizational culture, and technological foundation.
2. Examine External Factors: Researchers are advised to find and investigate outside elements affecting bank risk. The risk environment for banks is much shaped by factors including regulatory changes, economic conditions, and market competition. Knowing these factors can help banks improve their external preparedness.
3. Focus on Statistically Significant Factors: Further research should explore the statistically significant variables influencing bank risk. By isolating these main drivers, scientists might reveal more profound insights that will guide risk management plans and enable banking companies to better manage possible risks.
4. Identify Universal financial technology Indicators: Researchers should aim to pinpoint important financial technology indicators relevant for all developing nations. These metrics can help to evaluate financial technology influence on bank risk by means of benchmarks and permit cross-regional comparative study.
5. Explore financial technology and the Pandemic: Further research should investigate the crossroads of financial technology, the COVID-19 epidemic, and its consequences on bank risk. The adoption of digital financial solutions has been sped up by the epidemic; knowing its particular effect on risk management during this

emergency will offer useful future lessons, notably in times of worldwide disturbance.

6. financial technology Indicators to Other Financial Sectors: To evaluate more effects, researchers should apply financial technology indicators to industries outside of banking. Investigating how financial technology influences other financial sectors including insurance, investments, and lending helps researchers to get a more complete picture of its contribution to the general financial ecosystem.
7. Expand Research to Other Emerging Countries: Future research should investigate whether extending the study to other developing nations might shed some light on the impact of financial technology on bank risk in different contexts. By looking at various areas with different financial situations and legal frameworks, researchers can offer a more worldwide view on the challenges and possibilities FinTech presents for the banking industry in developing countries.

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جامعة النجاح الوطنية
كليَّة الدّراسات العليا

التكنولوجيا المالية على مخاطر الائتمان المصرفي ومخاطر السيولة: أدلة من الأسواق الناشئة

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قدمت هذه الرسالة استكمالاً لمتطلبات الحصول على شهادة الماجستير في التمويل من كلية الدراسات العليا في جامعة النجاح الوطنية – نابلس.

2025

تأثير تبني التكنولوجيا المالية على مخاطر الائتمان المصرفي ومخاطر السيولة: أدلة من الأسواق الناشئة العربية

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الملخص

تدرس هذه الدراسة بشكل شامل تأثير تبني التكنولوجيا المالية على مخاطر البنوك في عشر دول خلال الفترة من 2015 إلى 2022. لتحليل هذا، يستخدم البحث طريقة اللحظات المعممة للنظام (GMM)، وهي تقنية قياسية اقتصادية قوية تساعد في معالجة قضايا الذاتية وتضمن نتائج موثوقة. تعالج الدراسة الغموض المستمر في الأدبيات فيما يتعلق بالطبيعة الدقيقة للعلاقة بين تبني التكنولوجيا المالية ومخاطر البنوك. مع خضوع القطاع المالي لتحول كبير مدفوع بالابتكارات التكنولوجية، فإن فهم كيفية تأثير تكامل التكنولوجيا المالية على ملف المخاطر وربحية المؤسسات المصرفية أصبح أكثر أهمية من أي وقت مضى. مع تشكيل التكنولوجيا المالية بشكل متزايد لكيفية تقديم الخدمات المالية، فإن تأثيرها على إطار إدارة المخاطر الإجمالي للبنوك هو موضوع يتطلب فحصًا أكثر دقة.

هذا البحث مهم بشكل خاص في توفير تحليل موحد ومتعمق للأدلة المتضاربة المحيطة بالتفاعل بين تبني التكنولوجيا المالية ومخاطر البنوك. ومن المتوقع أن تساهم النتائج في تقديم رؤى قيمة لممارسي البنوك وصناع السياسات والباحثين. ومن خلال تسليط الضوء على العلاقة الديناميكية بين التكنولوجيا والمخاطر المالية، ستساعد هذه الدراسة أصحاب المصلحة على اتخاذ قرارات استراتيجية أكثر استنارة. ويمكن للنتائج أن توجه البنوك في تكييف استراتيجيات إدارة المخاطر بما يتماشى مع تبني الحلول التكنولوجية الجديدة، ويمكن لصناع السياسات استخدام النتائج لتطوير اللوائح التي تعالج بشكل فعال المخاطر الناشئة المرتبطة بالتكنولوجيا المالية في القطاع

المصـرفي. وسـيسـتفيد الباحثون، بدورهم، من فهم أعمق لكيفية تأثير تبني التكنولوجيا المالية على مخاطر البنوك، مما سيمهد الطريق لمزيد من الدراسات والابتكارات في هذا المجال.

تتكون عينة الدراسة من 55 بنكًا، والتي تضم مؤسسات من مجموعة متنوعة من البلدان: الأردن وفلسطين ومصر وتركيا ودول مجلس التعاون الخليجي، بما في ذلك المملكة العربية السـعودية والكويت والبحرين وقطر وعمان والإمارات العربية المتحدة. ومن بين هذه البنوك الـ 55، هناك 23 بنكًا إسلاميًا، مما يضيف بُعدًا مهمًا للتحليل، حيث تتبع المؤسسات المالية الإسلامية أطرًا تنظيمية وتشغيلية مميزة مقارنة بالبنوك التقليدية. وتسلط النتائج الضوء على علاقة مهمة بين مؤشر التكنولوجيا المالية ومخاطر البنوك في الأسواق الناشئة العربية. ومع ذلك، فإن قوة هذه العلاقة ليست متسقة في جميع البلدان التي شملها الاستطلاع، مما يشير إلى أن تأثير اعتماد التكنولوجيا المالية على مخاطر البنوك قد يختلف اعتمادًا على العوامل الإقليمية والمؤسسية.

الكلمات المفتاحية: مؤشر تبني التكنولوجيا المالية، البنوك المعرضة للمخاطر، الأسواق الناشئة العربية.