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The Dynamics of Financial Technology Risk on Green Finance within the Modern Banking System

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Abstract

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This study aims to analyze the relationship between technology financial risk (FinTech risk) and green finance in the modern banking system. Through a literature review approach to the literature of the last five years, this study identifies the interaction between digital innovation, banking stability, and green finance in the context of financial sustainability. The study's results demonstrate that FinTech plays a crucial role in enhancing the efficiency, inclusivity, and transparency of the green financing process by digitizing transactions and leveraging smart data. However, technological developments also pose new risks such as liquidity disruptions, cyberattacks, algorithmic errors, and financial volatility that can affect the stability of the banking system. Financial stability is a key factor in ensuring the effectiveness and sustainability of green finance in the midst of rapid digital transformation. The research emphasizes the importance of adaptive risk governance, collaboration between regulators, industry, and financial institutions, and strengthening macroprudential policies to maintain a balance between innovation and sustainability. With proper risk management, FinTech can serve as a key catalyst in the transition to a green, inclusive, and globally competitive financial system.

1. Introduction

The development of financial technology (FinTech) has fundamentally changed the structure and function of the global financial system, including the banking sector which is the backbone of economic intermediation Financial digitalization is driving banks to transform towards faster, more efficient, and more inclusive systems, in line with global sustainability commitments. In this context, the concept of green finance is important because it serves as a strategy to balance economic growth and environmental sustainability through the distribution of funds to environmentally friendly and energy efficiency projects (Basmar, 2023). However, digitalization also brings consequences in the form of increasing technological financial risks, such as cyber risks, operational risks, and potential liquidity imbalances that can affect long-term financial stability.

Previous research has shown that FinTech has great potential in strengthening green financial infrastructure through transaction efficiency and financial data transparency, but at the same time it also poses complex risks for banking institutions (Wan et al., 2023). This risk is not only related to system security, but also to the capacity of institutions to manage changes in consumer behavior as well as regulatory pressures. Akomea-Frimpong et al. (2022) assert that most studies on green finance still focus on products and policies, rather than on the interaction between technological risk and financial sustainability in the banking sector. Thus, there is a research gap in understanding how FinTech risks interact with green financial performance and banking system stability.

The concept of green banking is now developing into a strategic dimension in achieving the Sustainable Development Goals, especially SDG 8 and SDG 13 which emphasize sustainable economic growth and climate action. Through a digital approach, banks are expected to utilize technology to support green lending practices, expand financial inclusion, and increase environmental accountability. However, as stated by Debrah et al. (2023), FinTech implementation in the context of sustainability is still faced with the limitations of risk evaluation models that are able to measure the systemic impact of digitalization on bank stability. This is relevant because fluctuations in financial flows due to the use of technology can shift the balance between short-term profitability and long-term sustainability.

Furthermore, Muganyi et al. (2021) show that although FinTech is accelerating capital flows towards the green sector, the integration of such technologies has not been fully balanced with effective risk mitigation policies. On the other hand, the Kwong et al. (2023) study identified that green FinTech innovation has great potential to create carbon efficiency and support the achievement of net-zero emissions, but requires strengthening banking risk governance. Therefore, it is important to take a deeper look at how technological financial risks affect the dynamics of green finance in the modern banking system, including its implications for financial cycles and economic stability.

This study seeks to answer this gap by analyzing the relationship between technological financial risks and the development of green finance in the banking sector through a literature review approach to the literature over the last five years. This approach is expected to provide a comprehensive perspective on how banks

can balance digital transformation and the financial sustainability agenda. As Zioło et al. (2021) affirm, financial sustainability is not only measured by economic growth, but also by the ability of financial institutions to effectively manage technological risks in fostering a green and inclusive financial system. Thus, this research is not only academically relevant, but also practical for the banking sector that is adapting to the dynamics of the digital economy and the demands of environmental sustainability.

2. Literature Review

2.1. FinTech Risk and Banking Stability

Financial technology (FinTech) is bringing a revolution in the banking ecosystem through transaction automation, decentralization of services, and increased access to digital financing. However, behind this potential, various new risks have emerged that affect the stability of the financial system. Basmar (2023) explains that banking digitalization has a double impact: on the one hand, it strengthens financial efficiency and inclusion, but on the other hand, it increases systemic risks due to the volatility of financial flows triggered by the velocity of money. In addition, technological risks such as cybersecurity, system failures, and regulatory gaps pose a threat to the reliability of the digital banking system.

Research by Wan et al. (2023) shows that FinTech can strengthen green finance if accompanied by good risk governance, as digital efficiency accelerates the distribution of green credit. However, without adequate risk management, FinTech can actually reduce the liquidity stability of banks and increase non-performing loan

ratios. Meanwhile, Zioło et al. (2021) emphasize that the sustainability of the financial system depends not only on technological innovation, but also on the integration of macroprudential policies that are able to offset operational risks. Therefore, in the context of modern banking, FinTech must be seen as a double-edged sword that requires adaptive supervision in order to support long-term stability and sustainability.

2.2. Green Finance and Sustainable Transformation in Banking

The concept of green finance emphasizes the importance of distributing funds to sectors that support environmental sustainability and energy efficiency. In the banking ecosystem, this includes green lending practices, sustainability-linked financing, and environmental risk-based credit policies. Akomea-Frimpong et al. (2022) suggest that most previous studies have only focused on green financial products without examining the technological risk aspects that affect the sustainability of the program. With the increasing integration of FinTech, green finance has the potential to expand financial inclusion for clean energy-oriented industries, but also open up vulnerabilities to digital risks.

According to Debrah et al. (2023), there is still a gap in understanding how FinTech innovations can be used to measure the environmental impact of bank financing decisions. On the other hand, Kwong et al. (2023) highlight that Green FinTech is the future direction of the financial system because it combines digital efficiency with a reduction in carbon footprint. Nevertheless, banking institutions still need an integrated risk evaluation model so that digitalization does not come at the expense of economic stability. Thus, the transformation towards green finance

in the banking sector demands a balance between digital innovation, environmental efficiency, and risk governance that is adaptive to technological change.

3. Methods

This study aims to analyze the relationship between technology financial risk (FinTech risk) and green finance in the modern banking system. Using a literature review approach to the literature over the past five years, this study examines the interaction between digital innovation, banking stability, and financial sustainability. The results of the study show that FinTech plays an important role in improving the efficiency, transparency, and inclusivity of green financing through the use of digital technology, big data analysis, and automation of financial transactions. Nonetheless, technological developments also bring new risks such as liquidity disruptions, cybersecurity, algorithmic errors, and market volatility that can affect the stability of the banking system as a whole.

This study confirms that financial stability is a fundamental element in ensuring the successful implementation of green finance in the digital era. Adaptive risk governance, responsive regulatory support, and strategic collaboration between regulators, industry, and financial institutions are needed to maintain a balance between innovation and sustainability. The results of this study make a theoretical contribution by strengthening the understanding of the cyclical relationship between FinTech risk and green financing, and practically serve as a reference for banks in designing digital transformation strategies that are safe, inclusive, and environmentally sustainability-oriented.

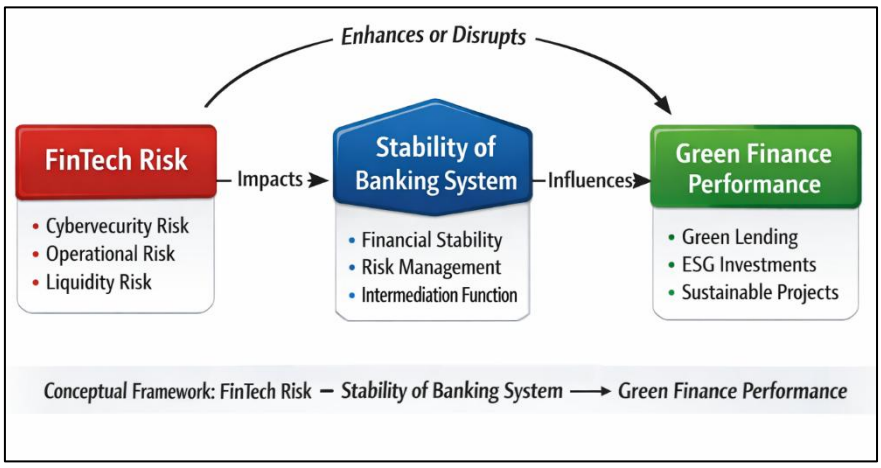

Figure.1 Conceptual Framework of Research

Figure 1 explains that technology financial risk is a variable that affects the stability of the banking system through operational, security, and liquidity mechanisms. Maintained banking stability will determine how effectively financial institutions can channel green financing and support environmental sustainability programs. In other words, the more mature FinTech risk management in a banking system, the higher the bank's ability to strengthen green finance. This relationship is dynamic and cyclical, as excessive digitalization without risk control can actually reduce stability and hinder the achievement of green finance goals.

4. Results

The results of this study are compiled based on a synthesis of findings from various literature relevant to the relationship between technology financial risk and green finance in the banking sector. In general, the findings show that financial

technology integration has significantly changed the way banks manage risk, distribute green credit, and maintain financial system stability. In the context of digital transformation, FinTech risks such as cyber risks, algorithm errors, and liquidity disruptions are the main elements that affect banks' ability to maintain the sustainability of their operations (Basmar, 2023). These risks not only impact the internal structure of banks, but also on market behavior and public confidence in the banking system as a whole.

The results of the study show that the relationship between FinTech and green finance is complex and depends on the readiness of banking infrastructure and regulations in each country. A study by Wan et al. (2023) found that the application of digital technology in banks can improve green credit efficiency through real-time data analysis systems, but also create new pressures on liquidity due to accelerated fund turnover. This phenomenon shows a dual relationship between efficiency and risk, where technology is able to accelerate the achievement of sustainability goals, while simultaneously increasing the sensitivity of the system to external shocks.

In line with this, Akomea-Frimpong et al. (2022) highlight that many financial institutions are still focused on the development of green products without in-depth review of the technological risk mitigation mechanisms that come with it. This gap has led to new challenges in the implementation of green finance, particularly in measuring the extent to which FinTech innovations can affect the effectiveness of sustainable finance. In certain cases, the adoption of digital technology can even widen the risk gap between banks, as institutions with strong digital infrastructure

tend to be better able to manage risk compared to conventional banks that are technologically lagging behind.

The results of the study also show that Debrah et al. (2023) identified a lack of literature that discusses the direct interaction between digital risk and the performance of the bank's environment. Their findings confirm that financial sustainability is not only determined by the volume of green investments, but also by the resilience of the system to technology-based risks. In this context, banks that integrate big data analytics and artificial intelligence to monitor green financing show a higher level of efficiency and transparency. However, the use of this technology also raises privacy risks and data misuse that need to be anticipated through strengthening regulations and ethical data governance.

Kwong et al.'s (2023) research reinforces this view by confirming that Green FinTech innovation plays a catalyst for a sustainable financial system. Through the digitization of financial transactions, banks can reduce the use of paper resources, accelerate environmental impact reporting, and support investment in green projects. However, the effectiveness of these innovations is highly dependent on the stability of the banking system and the ability of institutions to anticipate cyber risks. On the other hand, Zioło et al. (2021) emphasize the need for a balance between digital innovation and macroprudential policies so that the financial system does not experience excessive disruption due to uncontrolled adoption of technology.

The results of further analysis found that FinTech risks do not always have a negative impact on financial sustainability. In the short term, digital innovation can actually accelerate financial circulation and expand access to green financing, as

explained by Muganyi et al. (2021). They argue that FinTech contributes to improved fund disbursement efficiency and reduced transaction costs, which ultimately strengthens the competitiveness of green banks. However, in the long run, without strict supervision, increased transaction speed can lead to cash flow volatility and asset portfolio imbalances. This is an important challenge for financial authorities in formulating regulations that balance innovation and risk mitigation.

Meanwhile, Khan et al. (2023) show a non-linear relationship between digital financial inclusion and carbon neutrality. Their research results indicate that increased access to digital financial services can strengthen the financial sector's contribution to reducing carbon emissions when combined with strict green financing policies. Thus, the synergy between FinTech and green finance can be an effective strategy for banks in strengthening their contribution to sustainable development goals. However, the effectiveness of this strategy is highly dependent on the ability of financial institutions to manage complex environmental data and technological risks.

The analysis from Kong et al. (2022) adds that collaboration between digital finance and green innovation plays an important role in accelerating the renewable energy transition. Banks that integrate high-tech-based analytics systems in their investment portfolios are able to assess environmental impacts more accurately, thereby minimizing the risk of unsustainable project financing. However, the findings also warn that the high reliance on digital systems increases exposure to cyber threats and IT infrastructure failures. Therefore, there is a need for governance

that is adaptive to technological developments so that the stability of the financial system is maintained.

In addition, Zarifis and Cheng (2022) highlight the importance of the trust dimension in the FinTech ecosystem, as psychological factors and security perceptions greatly influence the success of digital banking implementation. Public trust in the digital system will determine the extent to which people are willing to participate in the use of technology-based green financial services. If this trust is low, then technological innovation can actually become an obstacle to financial inclusion and slow down the achievement of green finance targets. Therefore, the integration between cybersecurity, data transparency, and public education is an important element to strengthen the effectiveness of FinTech in supporting the sustainability agenda.

Furthermore, Akomea-Frimpong et al. (2022) and Basmar (2023) both emphasize that the interaction between technology financial risk and green finance must be understood in the context of dynamic financial cycles. The increased use of technology encourages the acceleration of financial flows that can strengthen economic growth, but at the same time create a potential liquidity imbalance in the banking sector. Under certain conditions, too fast money turnover can create systemic tensions that disrupt monetary stability. Therefore, this study emphasizes the importance of a cyclical approach in assessing the FinTech–green finance relationship so that its long-term impact on the financial system can be comprehensively understood.

The results of the study show that the relationship between FinTech risk, banking stability, and green finance performance is reciprocal. FinTech can strengthen efficiency, accelerate green financing, and increase transparency, but only if it is balanced with strong risk governance and regulation. Without adequate supervision, digital innovation has the potential to threaten the sustainability of the financial system through increased operational risks and decreased public trust. These findings confirm that the future of green finance in the banking sector will largely depend on the ability of financial institutions to balance digital transformation with comprehensive risk mitigation strategies.

5. Discussion

The results of the study show that the integration between FinTech and green finance presents opportunities as well as strategic challenges for the banking sector. In terms of opportunities, financial digitalization allows banks to improve the efficiency of green financing through a faster data analysis process, increased transparency, and optimized fund distribution for environmentally friendly projects. However, key challenges arise when technological risks such as cyberattacks, algorithm errors, or system disruptions affect public trust and financial system stability. In this context, the research findings reinforce the view of Wan et al. (2023) that digital technology can be a catalyst for green finance only if it is accompanied by strong risk governance and adaptive to technological change.

The banking sector must strike a balance between digital innovation and financial stability, as the two are interlinked. The Basmar study (2023) confirms that

technological financial risks are unavoidable, but can be controlled through risk analytics-based mitigation policies and building the capacity of banks' digital management. This is in line with the ideas of Zioło et al. (2021) who emphasize the importance of macroprudential policies to maintain the balance of the financial system amid the acceleration of digitalization. Thus, banks need to implement an approach that not only emphasizes technological innovation, but also pays attention to risk supervision structures and the readiness of human resources in operating complex digital systems.

In addition to the risk aspect, the results of the study show that public trust is a determining factor for the success of the implementation of FinTech in green financing. Zarifis and Cheng (2022) explained that the perception of digital security and the reliability of FinTech systems have a direct effect on public participation in the use of digital financial services. Without this trust, even the most sophisticated technological innovations will not be able to drive the expected financial inclusion. Therefore, banks need to strengthen data security systems and reporting transparency in order to maintain credibility in the eyes of users.

From a policy perspective, the research results of Akomea-Frimpong et al. (2022) and Debrah et al. (2023) show that there is a gap in the regulatory framework that governs the relationship between FinTech and green finance. Overly rigid regulations can stifle innovation, while policies that are too loose can increase systemic risks. Therefore, regulators need to adopt a principle-based approach that emphasizes a balance between consumer protection, innovation, and financial

stability. This approach is expected to create a secure, inclusive, and sustainable digital banking ecosystem.

Overall, these discussions affirmed that the successful integration of FinTech and green finance in the banking system depends on the synergy of three key elements: digital innovation, system stability, and risk governance. Without a balance between the three, digital transformation has the potential to create new vulnerabilities that can disrupt long-term economic sustainability. Therefore, banks, regulators, and industry players need to build strategic collaboration in strengthening digital infrastructure, developing adaptive policies, and ensuring that technological transformation truly supports sustainable development goals.

6. Conclusion

This study concludes that digital transformation through FinTech has a strategic role in strengthening the effectiveness and efficiency of green finance in the banking sector. Technological innovations enable banks to distribute green financing more quickly and transparently, while supporting the achievement of sustainable development goals. However, digitalization also poses new challenges in the form of increasing technological financial risks such as cyber threats, volatility in fund flows, and reliance on digital systems. Therefore, the balance between innovation and risk management is a determining factor for the success of green finance in the digital era.

Banks need to develop integrated risk governance, strengthen data security, and improve the competence of human resources in the face of dynamic

technological changes. Adaptive and collaborative regulation between financial authorities, banking institutions, and technology providers is an important prerequisite for maintaining financial system stability. This research confirms that the sustainability of the financial system does not only depend on technological innovation, but also on the ability of financial institutions to maintain stability and public trust. With proper risk management, FinTech can be a key driving force in accelerating the transition to competitive, inclusive, and sustainable green finance.

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