

The impact of digital transformation on systemic risk in the banking industry

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Abstract. In recent years, national strategies have accelerated digital transformation across various sectors, and for the banking industry, effectively managing risks in the digital era is essential for ensuring stable growth. This project aims to examine how digital transformation in banks influences systemic risk within the banking sector. It utilizes SRISK, based on the conditional mean method, as an indicator of systemic risk in banking, along with digital transformation indices derived from data collected by Peking University (2010-2021) and additional data from 2022 and 2023. The study investigates the effects and mechanisms through which banking digital transformation impacts systemic risk, focusing on both internal generation and contagion mechanisms. By analyzing the interactions between digital adoption and financial stability, the research sheds light on potential vulnerabilities that may arise from rapid technological advancements. It also provides policy recommendations for commercial banks and regulatory authorities to help mitigate systemic risks and enhance theoretical frameworks related to banking digital transformation.

1 Introduction

The report of the 20th National Congress of the Communist Party emphasized maintaining the baseline for systemic risk in banking. Deepening financial system reform and strengthening financial stability safeguards are crucial for ensuring the stable development of the banking sector. The State Council's "Guidance on Digital Transformation in Banking and Insurance Industries" stresses the importance of adhering to risk management standards and preventing systemic risks under digital conditions. Although there is extensive research on banking systemic risk and digital transformation, their direct interaction still requires investigation. This study employs Python to scrape data related to digital transformation indices and builds on traditional moral hazard models, introducing less explored mechanisms like internal generation and contagion. The study targets agricultural banks, commercial banks, and others to measure systemic risk indices and provide recommendations for maintaining stability and preventing systemic risk in the context of digital transformation.

2 Literature review

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2.1 Research on digital transformation

Digital transformation has become a crucial strategic direction in technological change, significantly impacting various industries. Researchers have primarily focused on two aspects of the concept of digital transformation: technological support and organizational change [1]. Valdez-De-Leon argues that digital technologies facilitate the processing of information and data, with a theoretical focus on the role of these technologies in enterprises [2]. Li et al. view digital transformation as a planned digital shock caused by information technology changes to an operational system, agreeing that digital transformation is driven by IT changes [3]. Xiao, on the other hand, analyzes the driving factors, internal mechanisms, and management adaptability changes associated with cross-system digital transformation from an organizational change perspective [4].

Regarding the main approaches to digital transformation, researchers have explored three primary areas: digital technologies, digital products, and digital platforms. Digital technologies are defined as a combination of information, computing, communication, and connectivity technologies [5]. Zhang argues that digital transformation in commercial banks has become a crucial engine for economic growth and industrial upgrading, with rapid integration of digital platforms into the banking technology system, profoundly altering all aspects of bank management [6]. Wang and Xie constructed Logit and fixed-effects Poisson models, demonstrating that digital finance enhances the efficiency of traditional financial systems and fosters innovation in digital products [7]. Concerning the transformational dimensions of digital transformation, this project focuses on industry-level changes. Initially, in terms of business models, enterprises like banks rely heavily on big data analytics to gain valuable resources and enhance their competitiveness. However, relying solely on internal capabilities is insufficient; external resource integration is also needed. Companies should implement digital innovation in phases, starting with accumulating experience and skills, building confidence in digitalization and related technologies, and eventually achieving disruptive innovation in operational models [8].

2.2 Research on systemic risk in banking

Banking systemic risk refers to the potential threats that can arise from both internal and external factors within the banking system, which may disrupt the entire financial system. In recent years, this topic has gained significant attention in financial economic research. The primary aim of studying banking systemic risk is to identify its origins and develop suitable regulatory and risk management strategies to mitigate its effects on the stability of the financial system.

Yang and Dong have observed an annual increase in contagion risk due to various influencing factors [9]. Gang and Pan discovered that the risk of systemic issues rises when default risk and liquidity risk are considered together [10]. In their study on measuring systemic risk in banking, Fan et al. analyzed the systemic risk in China's banking sector from both temporal and cross-sectional angles, creating a contagion network for measurement [11]. Chen and Zhou evaluated different indicators of systemic financial risk and found that SRISK is more effective for assessing micro-level systemic financial risk in China [12]. Wang and Liang proposed new metrics—system vulnerability degree and systemic importance degree—by calculating joint risk probabilities to assess institutional vulnerability and systemic significance [13].

To monitor and predict banking systemic risk, Tang and Su studied Chinese banks and developed effective early-warning systems for extreme financial events, improving the accuracy of systemic risk monitoring in the banking sector [14]. Gao et al. found that spillover risk, internal risk levels, non-performing loan rates, and macroeconomic changes

significantly affect the prediction of banking systemic risk [15]. In terms of research methodology, Bao created a closed banking system contagion model, emphasizing the importance of trust crises in systemic risk [16]. Sui and Chi developed a comprehensive framework for assessing interbank default contagion and banking systemic risk, capable of simulating challenges in interbank networks and those with scale-free characteristics [17]. Finally, Yang and Wang established a quantile regression model to analyze the spillover effects of systemic risk in commercial banks, confirming the existence of such effects in listed commercial banks in China [18].

2.3 Research on the Impact of Digital Transformation on Banking Systemic Risk

Prior research indicates that digital transformation is a well-recognized field of study, and systemic risk in banking is a widely discussed subject among scholars. However, there is a scarcity of literature that specifically explores the relationship between digital transformation and systemic risk in the banking sector. Most studies on digital transformation have focused on its concepts, key strategies, and transformative elements, providing a general overview of the financial industry. Nevertheless, there is a notable lack of understanding regarding how digital transformation impacts banks and the ways to evaluate its effects. While domestic research on banking systemic risk is relatively developed, there are few direct studies examining the influence of digital transformation on this risk. Prior studies have typically employed techniques such as dynamic CoVaR, Logit and fixed-effects Poisson models, and dynamic factor Copula models, mainly focusing on publicly listed and large state-owned banks, which has resulted in mixed and sometimes conflicting findings. In conclusion, while there is extensive research on both banking systemic risk and digital transformation, the specific effects of the latter on the former are still not well understood, particularly regarding direct impacts. This study seeks to address this gap by using Python to gather data on digital transformation index keywords and applying traditional banking moral hazard models, while also considering less explored internal generation and contact contagion mechanisms. The emphasis will be on commercial banks, assessing banking systemic risk indices to offer recommendations for managing systemic risk and promoting stable development in the context of digital transformation.

3 The impact of digital transformation on systemic risk in banks

3.1 Positive impacts of digital transformation on systemic risk in banks

Previous studies have primarily examined the indirect impacts of digital transformation on systemic risk within banks. Firstly, concerning contagion channels, Gu and Bian identified that the financial disintermediation effect lessens the negative influence of banking competition, risk-taking, and loan concentration, which in turn increases systemic risk in banks [19]. Secondly, alterations in bank structure resulting from digital transformation or external shocks can affect systemic risk. Qiu and Huang found that advancements in financial technology changed the liability structure of banks, leading to a greater risk-taking inclination on the asset side [20]. Similarly, Zou and Wang noted that the rise of interconnected finance mainly influences the asset-liability structure of banks, which subsequently affects the cost-income ratio and systemic risk of commercial banks in China [21]. Fang and Huang observed that during negative shocks, microprudential fire sales, as a Nash equilibrium, result in heightened systemic risk, while a well-timed implementation of macroprudential policies can mitigate risk contagion [22]. Under digital transformation, the evolution of financial

technology also influences systemic risk. Liu determined that, in general, financial technology increases systemic risk within the banking industry, as its rapid expansion heightens the risk-taking tendencies of commercial banks, leading to greater systemic risk [23]. Wang and Liu discovered that improvements in micro-level banking financial technology significantly raise systemic risk levels, with these risk spillover effects showing both time lag and persistence [24]. Additionally, certain regulations play a role in the emergence of risk. Wang examined the impact of interest rate liberalization reform and the creation of a deposit insurance system on the likelihood of systemic banking crises, concluding that interest rate liberalization increases the risk of such crises [25]. Lin and Cao developed a network of various nodes to study the contagion process of systemic risk between commercial banks and shadow banking, finding that shadow banking exacerbates the systemic risk faced by commercial banks [26].

3.2 Negative impacts of digital transformation on systemic risk in banks

The adoption and advancement of digital strategies have negatively affected banks' risk-taking due to the rise of financial technology [27]. Gu and Bian provided a theoretical analysis of how bank competition influences systemic risk, considering factors like loans to struggling firms, interbank transactions, and private sector deposits [28]. They discovered that enhanced digital transformation efforts and the establishment of deposit insurance systems strengthen the ability of bank competition to mitigate systemic risk. However, increased uncertainty in economic policy can diminish this mitigating effect. Wu et al. examined the direct effects of digital transformation on systemic risk, building on the traditional bank moral hazard model [29]. They incorporated elements such as digital transformation, network connectivity, and external shocks, concluding that digital transformation effectively reduces network connectivity and, consequently, systemic risk. Additionally, Gu and Shi found that technologies like big data, blockchain, and artificial intelligence enhance the precision of financial risk management and help avert systemic financial risks [30]. Financial technology can also be utilized in regulatory practices [31], such as employing digital tools for improved supervision, which allows for real-time monitoring of commercial banks' digital offerings, thereby decreasing the likelihood of macro-financial systemic risk.

4 Countermeasures and suggestions

4.1 Enhancing digital risk management capabilities

4.1.1 Improve the digital risk governance system

Banks need to create a robust digital risk governance framework that clearly outlines the roles and responsibilities of various departments and positions to promote effective collaboration. Appointing a Chief Digital Officer (CDO) or Chief Information Security Officer (CISO) can help spearhead the creation of digital risk management strategies and policies, as well as conduct regular evaluations of risk situations. Furthermore, banks should incorporate digital risk management into their overall risk management framework, merging it with conventional risk control practices.

4.1.2 Strengthen data security and privacy protection

As major holders of financial data, banks must prioritize data security and privacy protection. On one hand, banks should implement a robust data security management system that encompasses measures like data classification, access control, and encrypted storage to safeguard core data effectively. On the other hand, banks need to strictly adhere to data privacy regulations, establish robust customer information protection mechanisms, and safeguard customer privacy rights.

4.1.3 Enhance cybersecurity defense capabilities

With the increasing digitalization of banking operations, cybersecurity has become crucial. Banks should continuously improve their cybersecurity defenses, including deploying advanced security equipment, implementing strict user authentication, and establishing comprehensive security incident response mechanisms. Additionally, banks should regularly conduct cybersecurity testing and risk assessments to promptly identify and address vulnerabilities, thereby enhancing overall cybersecurity protection.

4.1.4 Raise employee awareness of digital risks

Digital transformation requires not only hardware and system upgrades but also changes in employee attitudes and skill enhancement. Banks should enhance digital risk management training for employees to boost their awareness and capacity to prevent digital risks, ensuring comprehensive involvement in digital risk management. Moreover, banks should recruit or develop talent with specialized knowledge and skills in digital risk management to provide strong human resources support for digital transformation.

4.2 Strengthen interbank cooperation and coordination

4.2.1 Establish an interbank information sharing mechanism

In the digital environment, the sources of risk banks face are often complex and intertwined, making it difficult for individual banks to address them independently. Therefore, banks need to establish a closer information sharing mechanism to facilitate effective data and intelligence exchange. This will not only help in timely detection and early warning of systemic risks but also promote the sharing of risk management experiences among banks.

4.2.2 Enhance interbank coordination and response capabilities

When systemic risk events occur, banks need to quickly coordinate and take effective response measures. Banks can establish emergency response teams to manage and coordinate resources, develop emergency plans and response strategies, and conduct drills in key areas to improve their response capabilities.

4.2.3 Promote interbank business interconnection

Banks can enhance overall risk resilience through business interconnection. For example, establishing interbank backup and disaster recovery mechanisms in critical business processes can improve system reliability and resilience. Additionally, achieving business

collaboration in customer services, payment settlements, and other areas can enhance efficiency and reduce operational risks.

4.2.4 Explore interbank risk sharing mechanisms

Banks can create risk-sharing mechanisms to distribute and transfer systemic risks through product innovations and risk transfer methods. For instance, banks could establish mutual guarantee funds to jointly bear losses from certain risk events or develop cross-industry risk transfer financial instruments, such as systemic risk insurance, to provide risk hedging channels.

4.3 Optimize regulatory policies and systems

4.3.1 Improve the digital regulatory framework and systems

Regulatory authorities should adjust and optimize regulatory policies and regulations in response to digital transformation trends, ensuring that the regulatory framework is up-to-date. A dedicated digital financial regulatory department or agency could be established to develop digital regulatory standards and rules, and to enhance monitoring and early warning of digital risks in banks. Furthermore, regulators should encourage information sharing and collaboration among banks to enhance the overall risk resilience of the financial system.

4.3.2 Strengthen supervision of critical financial infrastructure

The digital transformation makes the safety and stability of financial infrastructure more crucial. Regulators should strengthen supervision of cross-industry and cross-border critical financial infrastructure (e.g., payment clearing systems, exchanges) to ensure their safe and reliable operation and prevent them from becoming conduits for systemic risks. Furthermore, regulators should urge relevant institutions to establish sound emergency plans and disaster recovery mechanisms to improve infrastructure's risk resilience.

4.3.3 Improve cross-departmental and cross-border regulatory coordination

In a digital environment, financial risks often cross departmental and national boundaries, making it difficult for any single department or country to address them alone. Regulators should enhance coordination with other regulatory bodies, establishing robust cross-departmental and cross-border regulatory coordination mechanisms. Through information sharing, joint regulation, and cross-border enforcement, overall regulatory effectiveness and coordination can be improved.

4.4.4 Encourage financial innovation and experimentation

Regulatory authorities should provide greater policy space and support for bank financial innovations while ensuring risk control. For instance, financial technology regulatory sandboxes can be established to allow banks to conduct innovation trials under a regulated environment, exploring new risk management models. Additionally, regulators can issue policies to support deep collaboration between banks and technology companies, jointly advancing digital transformation.

5 Conclusion

By examining the relevant background and literature of the project, we propose that the digital transformation of banks increases systemic risk within the banking industry. This research investigates the internal generation mechanisms, contagion mechanisms, and different types of banks to understand how digital transformation impacts systemic risk. We analyze the China Commercial Bank Digital Transformation Index from Peking University covering the years 2010 to 2021 and collect data on related keywords for 2022 and 2023 using Python. We use SRISK, which is based on conditional mean, as an indicator of systemic risk in banks. By exploring internal generation and contagion mechanisms and classifying commercial banks into categories such as state-owned, joint-stock, city, rural, foreign, and private banks, we aim to provide theoretical insights for reducing systemic risk in the context of digital transformation.

Digital transformation leads to financial disintermediation and increases banks' susceptibility to contagion risk, thereby elevating systemic risk in the banking sector. The extent of this increased systemic risk varies among different types of banks.

This study aims to identify effective strategies for mitigating systemic risk and offers policy suggestions for both commercial banks and regulatory bodies. It seeks to enhance theoretical frameworks and lessen the impact of digital transformation on systemic risk in the banking sector.

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