A Study of the Impact of Digital Transformation on the Risk Level of Commercial Banks

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Abstract: Preventing and mitigating commercial bank risks is an important part of promoting the high-quality development of the financial industry. Whether and how the digital transformation of banks mitigates their risk level has important research value. This paper takes the sample of commercial banks from 2011 to 2021 to study the impact of digital transformation on the risk level of commercial banks and the mechanism of its role. The results of the study show that, first, digital transformation can significantly reduce the risk level of commercial banks. Second, the mechanism test results show that the above effects are mainly realized through the two paths of improving information-seeking ability and profitability. Third, the heterogeneity study finds that the inhibitory effect of digital transformation on bank risk levels is stronger among large banks, state-owned banks, and rural commercial banks. The findings of this paper are conducive to promoting the digital transformation of commercial banks, which in turn improves their risk management capabilities.

Keywords: Commercial banks, Digital transformation, Risk level, Information-seeking ability, Profitability

1 INTRODUCTION

Nowadays, the digital economy is sweeping the world. Based on digital technology, it has reshaped the economic form of traditional economic activities and business models by means of digitization, networking and intelligence. As the digital economy continues to penetrate financial institutions, the banking industry has taken digital transformation as a strategic priority in order to adapt to changes in the market environment and improve competitiveness in the digital economy era [1].

Digital transformation is a double-edged sword for commercial banks. On the one hand, it can drive banks to upgrade their human resources [2], improve organizational effectiveness [3], and promote sustainable efficiency [4]. But it also poses risks of cyber-attacks, data breaches, over-reliance on algorithms leading to bad decisions, increased competition, and so on. The Central Economic Work Conference has repeatedly emphasized the prevention and resolution of financial risks, and "risk prevention" is a strategic and fundamental matter related to the overall situation of China's economic development. Therefore, it is of great significance to examine the relationship between

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digital transformation and banks' risk level, to better promote the process of banks' digital transformation, facilitate the reform of the financial supply side, and help the high-quality development of China's economy in the new period.

Scholars have expressed their views on the question of whether digital transformation can reduce bank risks. Some scholars believe that banks use digital technology to improve positive interaction with customers [5][6], which is conducive to sound operation [7]; digital transformation can mitigate information asymmetry [8], optimize the loan structure [9][10], reduce management costs [11], improve operational efficiency, and thus reduce the level of bank risk. However, some scholars hold the opposite view that financial technology brings challenges to bank risk prevention and resolution through channels such as market-oriented interest rates [12], bank income structure [13], bank competition [14], and financial disintermediation [15]. In addition, some scholars believe that financial technology and digital finance are not a simple linear relationship to bank risk, but an inverted "u" type relationship that rises first and then falls [5][16]. In summary, there is no unanimous conclusion on whether digital transformation can reduce the level of risk, so the in-depth study of the impact of digital transformation on the level of bank risk has an important theoretical and practical value.

Based on this, this paper selects commercial banks from 2011-2021 as a sample to systematically study the impact of digital transformation on the risk level of banks and their mechanism of action. The marginal contribution mainly lies in the following: first, few studies directly address the relationship between digital transformation and the level of bank risk, and most of the existing literature analyzes it from the perspectives of financial technology, digital finance, and so on. Bank digital transformation is fundamentally different from digital finance and financial technology. The latter focuses on the use of digital technology to innovate products and services. Digital transformation is a comprehensive and in-depth digital transformation of a bank's business model, strategic positioning, business operations, and management system.[17]. Second, most of the existing theoretical studies confuse the concepts of "bank risk-taking" and "bank risk". In practice, "risk-taking" favors the willingness to take risks ex-ante, while "risk" focuses on the results of risk-taking ex-post. Moreover, this conceptual confusion is especially obvious in empirical research, as most scholars usually use indicators such as non-performing loan ratio and z-value to measure the level of risk-taking, but these indicators are more suitable for measuring ex-post results rather than ex-ante willingness. This paper avoids the problem of conceptual confusion in the existing studies and adopts the z-value to measure the ex-post indicator of "bank risk", which more accurately reveals the impact of digital transformation on the risk level of banks. Third, while previous studies have mostly explored the impact of digitalization on bank risk from a single perspective, this paper attempts to construct a logical chain of "digital transformation - information-seeking capabilities/profitability - bank risk level" to deeply analyze the transmission mechanism of digital transformation in lowering the level of bank risk, which is a useful supplement to the existing literature and provides a theoretical framework for banks to develop a scientific digital transformation plan.

2 THEORETICAL ANALYSIS AND RESEARCH HYPOTHESES

2.1 Digital Transformation and Commercial Bank Risk Level

First, digital transformation can reduce individual bank risks. Traditional commercial banks are constrained by incomplete customer information and can only identify customer risks from limited dimensions such as financial status, industry attributes, and credit. This makes it difficult to dig deeper into multidimensional information and unable to comprehensively understand customer needs and credit status. As a result, there is a serious information asymmetry problem between banks and customers [18][19]. In contrast, through digital transformation, banks have improved their information-seeking capabilities and expanded their data dimensions [20]. Using digital technology, banks can extensively acquire and integrate customer data, including social media information, consumer behavior data, and other multidimensional information, thus forming a comprehensive and accurate dynamic customer portrait [21][22]. Moreover, digital transformation also enhances the information processing and interaction capabilities of banks, enabling them to respond to customer needs in a fast and real-time manner. It enhances communication and interaction with clients and further mitigates information asymmetries. This change not only enables banks to achieve accurate marketing and improve operational efficiency but also optimizes the effectiveness of credit risk control and reduces individual risks.

Second, digital transformation helps to curb systemic risk in banks. Issues such as financial system correlation and financial leverage can exacerbate risk propagation, thus triggering systemic risk [23]. However, digital transformation improves the financial performance of banks through accurate marketing, diversified income, etc., increases capital reserves, forms a "risk buffer", and reduces the contagion effect of risk [24]. For example, when a commercial bank is hit by an external shock, it usually sells its assets to meet the macro-prudential regulatory requirements of the central bank. Capital increase can reduce such behavior and effectively reduce the contagion loss caused by the deleveraging mechanism under the correlation effect, preventing the spread of systemic risk [25]. In addition, banks use digital technology to improve the information search and analysis ability and alleviate the information asymmetry problem. Under the role of signaling, effective constraints are formed on enterprises with malicious default tendencies or higher reputational risks. This reduces the risk of malfunctioning external businesses [26].

Based on the above analysis, this paper proposes the following hypotheses:

H1: digital transformation of commercial banks can effectively reduce the risk level of commercial banks.

2.2 Digital Transformation and Commercial Bank Risk Level: Information-Seeking Capability Pathway

Through digital transformation, commercial banks can improve their information-seeking capabilities. This ability is not only limited to the acquisition of information but

also includes the capture of the immediate value contained in the information. First of all, commercial banks can break through time and space limitations by utilizing digital technology [27], breaking the information silos, and obtaining multi-dimensional and replaceable information. At the same time, commercial banks can understand in real time the latest developments in the supply chain, such as transaction flow and capital flow, and grasp the flow and use of loaned funds. Secondly, commercial banks use digital technology to improve the efficiency of data processing and the ability to harden "soft information", realizing in-depth mining and analysis of customer behavior and other information. This enables a more accurate understanding of customer needs and the development of more precise business strategies [28]. Finally, by searching and analyzing data in real-time, digitalization is deeply integrated into the internal control mechanism of commercial banks, realizing the comprehensive supervision of the loan management process, and improving the bank's mastery of the creditworthiness of loan customers and risk information. It is not difficult to see that digital transformation effectively improves the information searching ability of commercial banks and alleviates the information asymmetry problem that naturally exists between the credit parties. It not only reduces the potential default risk before lending and the actual default risk after lending [29], but also reconfigures the logic of the bank lending business so that the bank can rely on data rather than collateral to identify the credit of the enterprise, to improve the bank's operational efficiency, and reduce operational risk [30].

Based on the above analysis, this paper proposes the following hypotheses:

H2: the digital transformation of commercial banks reduces the risk level of commercial banks by improving information-seeking ability.

2.3 Digital Transformation and Commercial Bank Risk Levels: The Path to Profitability

Commercial banks undergo digital transformation, which can improve bank profitability. On the one hand, digital transformation reduces banks' operating costs. Specifically, by building online platforms and mobile applications, banks achieve more business online, reducing the need for physical outlets and lowering operating costs; through accurate marketing and personalized services, banks reduce the cost of matching financial products; using distributed cloud computing technology, banks can optimize the use of existing equipment and improve system processing capacity, thus reducing procurement costs [31-32]. On the other hand, digital transformation has broadened banks' revenue space. Through digital technology, banks have included more small and medium-sized enterprises in the financial supply chain system, broken the traditional "law of two or eight", and included long-tailed customers in the scope of services, thus increasing the number of customers. At the same time, banks utilize big data, intelligent analysis, and other means to gain insight into customer needs and realize precise marketing, thus improving customer experience. A good sense of experience can please and activate the stock of customers and increase customer stickiness. Therefore, digital transformation can reduce the cost of banking operations, create room for revenue, and improve the profitability of banks. Increased profitability inevitably leads to capital accumulation, which enables banks to better bear short-term economic fluctuations and

market shocks, and improves their risk-resistant ability. At the same time, improved profitability reduces the bank's dependence on risky business and enhances the robustness of the bank's business strategy, thereby reducing bank risk [33]. Based on the above analysis, this study proposes the following hypotheses:

H3: the digital transformation of commercial banks effectively reduces the risk level of commercial banks by improving their profitability.

3 RESEARCH DESIGN

3.1 Sample Selection and Data Sources

This paper selects commercial banks from 2011 to 2021 as the research sample. First, institutions such as agricultural credit cooperatives, foreign commercial banks, and policy commercial banks are excluded to ensure the homogeneity of the sample. Second, to make the regression results more reliable, all continuous variables are shrink-tailed by 1%. At the same time, observations with missing variables are eliminated to finally obtain the annual panel data of 66 commercial banks. Among them, the data on the digital transformation of commercial banks come from the index released by the digital finance research center of Peking University; the micro indicators of commercial banks mainly come from the Cathay Pacific Database; and the macro indicators come from the officially disclosed data such as the China Statistical Yearbook.

3.2 Definition of Variables

Explained Variable: Commercial Bank Risk Level (Risk).

Z-score is mostly used to measure bank insolvency risk and takes into account the bank's leverage position and earnings stability, etc., which can reflect the operating conditions of commercial banks in a more comprehensive way. Therefore, this paper draws on the practice of Ming Lei et al [34] to choose a Z-score to measure the risk level of commercial banks, which is calculated as follows:

$$Z\text{-}score_{i,t} = \frac{(ROA)_{i,t}+(\frac{E}{A})_{i,t}}{\sigma(ROA)_{i,t}} \quad (1)$$

Where ROA is the return on assets of commercial banks, E/A is the ratio of equity capital and total assets, which reflects the level of leverage from the side. $\sigma(ROA)$ is the standard deviation of return. The larger the z-score is, the lower the risk of commercial banks. This paper takes the -ln(Z-score) as a proxy variable for the risk level of commercial banks. In the robustness test, this paper also adopts the capital adequacy ratio as a proxy indicator. The capital adequacy ratio reflects a bank's capital buffer capacity and is internationally recognized as one of the most important indicators of a bank's health.

Explanatory Variables: Level Of Digital Transformation Of Commercial Banks (di).

This paper draws on the research of Yu Minggui [2] et al. To adopt the bank digital transformation index published by Peking University's Digital Finance Research Center. The index is compiled based on the research of Xie Xunli [35] et al. The index system is constructed from the three levels of strategy, business, and management, to provide a comprehensive evaluation of the digital transformation situation and development trend of commercial banks.

Intermediary Variables.

First, information-seeking capabilities(isc). Improved information-seeking ability reduces the cost of bank loan pricing, which in turn reduces the bank loan interest rate and increases the number of loans. Improvement of commercial banks' information-seeking ability can explore more potential customers and include long-tail customers in the scope of services, thus increasing the scale of credit [36]. Therefore, this paper draws on the practice of Sun Li and Yu Jiahuan [37] to use the number of total loans (tl) to measure the information-seeking ability of commercial banks. To prevent the interference of outliers, this paper takes logarithmic values of it, and lntl is used as a proxy for the information-seeking ability (isc) of commercial banks, and the larger lntl indicates that the information-seeking ability is stronger.

Second, profitability (bp). This paper draws on the practice of scholars such as Guo Lihong and Zhu Keda [7], who chose net profit after operating income minus related expenses to measure profitability. To reduce the interference of outliers, this paper takes the logarithm and uses the logarithm of the net profit as a proxy variable for the profitability (bp) of commercial banks, and the larger the logarithm of the net profit indicates the stronger the profitability.

Control Variables

Drawing on existing research, this paper selects control variables from the micro and economic macro levels of commercial banks. The indicators at the micro level are liquidity level (ldr), which is expressed as the ratio of total loans to total deposits; cost-income ratio (cir), which is expressed as the ratio of total costs to total revenues; and operational efficiency (roa), which is expressed as the ratio of net profit to total assets. Indicators at the macro level of the economy are monetary policy, expressed as the annual growth rate of m2, m2 refers to the broad money supply, including the total amount of money in circulation plus demand deposits and time and savings deposits; the banking climate index (bci); and the level of inflation (cpi), expressed as the annual growth rate of the consumer price index (cpi). See Table 1 for details.

Table 1. Definition of variables.

Variable type	Variable name	Variable symbol	Variable definition

Explained variable	bank risk level	risk	Z-score
Explanatory variable	digital transformation of commercial banks	di	digital transformation index published by Peking University's Digital Finance Research Center
Intermediary variable	information-seeking ability	isc	total loans taken as logarithm
	profitability	bp	logarithmic net profit
Control variables	liquidity level	ldr	total loans/total deposits × 100
	cost-income ratio	cir	total cost/total revenue × 100
	operating efficiency	roa	net profit/total assets × 100
	monetary policy	m2	annual growth rate of m2
	banking sector prosperity index	bci	banking sector prosperity index
	inflation level	cpi	annual growth rate of consumer price index

3.3 Model Design

To test the impact of digital transformation on the level of bank risk, this paper constructs model (2) for validation and the expected sign is negative.

$$risk_{i,t} = \alpha_0 + \alpha_1 di_{i,t} + \beta contral_{i,t} + \mu_{i,t} + \varepsilon_{i,t} \quad (2)$$

Secondly, this paper constructs models (3), (4), (5), and (6) to test whether digital transformation reduces the level of bank risk by improving information-seeking ability and profitability.

$$isc_{i,t} = \alpha_0 + \alpha_1 di_{i,t} + \beta contral_{i,t} + \mu_{i,t} + \varepsilon_{i,t} \quad (3)$$

$$risk_{i,t} = \alpha_0 + \alpha_1 di_{i,t} + \alpha_2 isc_{i,t} + \beta contral_{i,t} + \mu_{i,t} + \epsilon_{i,t} \quad (4)$$

$$bp_{i,t} = \alpha_0 + \alpha_1 di_{i,t} + \beta contral_{i,t} + \mu_{i,t} + \varepsilon_{i,t} \quad (5)$$

$$risk_{i,t} = \alpha_0 + \alpha_1 di_{i,t} + \alpha_2 bp_{i,t} + \beta contral_{i,t} + \mu_{i,t} + \epsilon_{i,t} \quad (6)$$

Where subscript i represents individual commercial banks, t represents the sample period, risk represents the risk level of commercial banks, di represents the level of digital transformation of commercial banks, isc represents the information-seeking ability of commercial banks, bp represents the profitability of commercial banks, and control represents the group of control variables, μ represents the control of individual commercial banks, ϵ represents a random perturbation term.

4 EMPIRICAL RESULTS AND ANALYSIS

4.1 Descriptive Statistics

The results of descriptive statistics, as shown in Table 2, show that the maximum value of the absolute value of the risk level of commercial banks is 6.386, the minimum value is 1.336, and the average value is 2.488, indicating that there is a large gap in the risk level among commercial banks. In terms of digital transformation, the data also shows a clear imbalance. Analyzed from a time-series perspective, the level of digitalization has increased year by year. Regarding the nature of ownership, state-owned commercial banks have the highest level of digitization, followed by joint-stock commercial banks, and rural commercial banks and urban commercial banks are lower. This indicates that there is a large gap in the level of digital transformation among banks. There are no extreme outliers in the selection of control variables, indicating that their selection is relatively reasonable.

Table 2. Results of descriptive statistics

Variable type	Variable	Sample size	Mean	Variance	Minimum	Median	Maximum
Explained variable	risk	726	-2.488	1.007	-6.386	-2.556	1.336
Explanatory variable	di	726	70.52	42.22	0	65.66	197.1
Control variables	cpi	726	2.364	1.114	0.900	2.100	5.400
	bci	726	71.21	6.772	60.50	70.20	85.40
	ldr	726	69.86	13.50	24.14	69.94	118.9
	cir	726	32.64	6.565	16.18	31.95	75.70
	m2	726	11.07	2.238	8.100	11.30	13.80
	roa	726	0.946	0.364	0.0420	0.929	2.701
Intermediary variable	isc	726	26.12	1.686	22.90	25.76	30.66
	bp	726	22.068	1.718	18.007	21.723	26.582

4.2 Baseline Regression Analysis

Columns (1) and (2) of Table 3 demonstrate the results of the test against H1. From column (1), it can be seen that the estimated coefficient of digital transformation is -0.008 and significant at the 1% level. It indicates that for every unit increase in the level of digitization, the level of risk-taking decreases by 0.8% on average. Further, this paper conducts the Hausman test and based on the test results, this paper should use a fixed effect model to better control the potential influencing factors. Column (2) shows the regression results of the fixed effect model, and the estimated coefficient of digital transformation is -0.005, which is still significant at the 1% level. This indicates that the higher the degree of digital transformation of commercial banks, the lower the level of bank risk, all other things being equal, so H1 holds.

Table 3. Regression results of digital transformation of commercial banks affecting the level of bank risk and mediating mechanisms

	(1)	(2)	(3)	(4)	(5)	(6)
	risk	risk	isc	risk	bp	risk
di	0.008***	0.005***	0.004***	0.002***	0.003***	0.002***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
isc				-0.686***		
				(0.152)		
bp						0.830**
						(0.112)
Control variables	Yes	Yes	Yes	Yes	Yes	Yes
Fixed effect	No	Yes	Yes	Yes	Yes	Yes
N	726	726	726	726	726	726
r^2	0.238	0.231	0.873	0.254	0.626	0.212

4.3 Test of Mediating Mechanisms

Information-Seeking Ability.

Columns (3) and (4) of Table 3 report the results of the relevant tests of hypothesis H2. Column (3) shows that there is a significant positive relationship between digital transformation and information-seeking capability, which suggests that as the level of digitization of commercial banks increases, their information-seeking capability is enhanced accordingly. Further, we introduce information-seeking capability as an intermediary variable in the baseline regression model. The results in Column (4) show that the coefficient of information-seeking ability is significantly negative, indicating that the enhancement of information-seeking ability can suppress the level of bank risk. Meanwhile, the p-value of Sobel's test is much less than 0.01, a result that suggests that information-seeking capability does play a mediating role between digital transformation and bank risk level in commercial banks. In other words, digital transformation effectively reduces the risk level of commercial banks by improving information-seeking capability and then effectively reduces the risk level of commercial banks. Therefore H2 holds.

Profitability.

For hypothesis H3, column (5) and column (6) of Table 3 provide the corresponding test results. Column (5) shows a positive relationship between digital transformation and profitability, suggesting that digital transformation can indeed enhance banks' profitability. The result of column (6) shows that the estimated coefficient of profitability is significantly negative, indicating that increasing profitability can reduce the level of

bank risk. The p-value of Sobel's test is significantly less than 0.01, indicating the existence of a mediation effect. This implies that the digital transformation of commercial banks can reduce the level of bank risk by improving profitability and H3 holds.

4.4 Robustness Checks

Endogenous Treatment.

First, is the instrumental variable approach. To address possible endogenous issues, this paper draws on the study of Zhang Guosheng[38] et al. to conduct a two-stage least squares test using the annual-overall commercial banks' level of digital transformation (mdi) as an instrumental variable. The results of the Wald test validate the applicability of this instrumental variable. The regression results (table 4, column (1)) show that the estimated coefficient of the regression on the digitization level is negative at the 1% significance level, thus confirming the robustness of the benchmark regression results.

Second, consider the effect of lags. Given the possible time lag of digital transformation, this paper incorporates the explanatory variables one period lagged into the model. This step aims to capture the long-term impact of digital transformation on banks' risk levels. The results in column (2) of Table 4 show that even after accounting for this time lag, the effect of digital transformation on reducing the level of bank risk remains significant, further enhancing the credibility and policy implications of the study's findings.

Table 4. robustness regression results

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	risk	risk	car	risk	risk	risk	risk
di	0.009**		0.008***	0.008***			
	(0.004)		(0.003)	(0.003)			
l.di		0.003*					
		(0.002)					
bd					0.002*		
					(0,001)		
sd						0.002*	
						(0.001)	
md							0.001
							(0.002)
Control variables	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Fixed effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	726	660	726	726	726	726	726
R^2	0.237	0.267	0.159		0.226	0.237	0.222

Other Robustness Tests.

First, this paper uses the capital adequacy ratio (car) as a key variable to replace the risk level of commercial banks. An increase in car usually implies that a bank is more risk-resilient. As shown in column (3) of Table 4, the level of digital transformation is significantly positively related to car and statistically significant at the 1% significance level. It further supports the conclusion that digital transformation reduces the risk level of commercial banks.

Second, given that the traditional linear regression model may not apply to all data types, especially when the dependent variable violates the classical regression assumptions. Therefore, this study borrowed from Li Chuntao [39] et al. and switched to the Ols-Tobit model for analysis. Results are shown in column (4) of Table 4 that there is a significant negative correlation between digital transformation and bank risk level. This finding further validates the robustness of hypothesis H1.

Third, concerning the study of Jiang Hai. Et al [11], this paper further subdivided digital transformation into three dimensions, namely strategic digitalization (sd), business digitalization (bd), and managerial digitalization (md), and regressed each of these three dimensions separately. The results, as shown in columns (5), (6), and (7) of Table 4, show that strategic digitization and operational digitization are significantly effective in reducing bank risk, while the impact of management digitization is not significant. This suggests that in promoting digital transformation, commercial banks should pay more attention to their strategic and operational dimensions of digital transformation to better achieve the effect of reducing the level of risk-taking.

4.5 Heterogeneity Analysis

Scale Heterogeneity Analysis.

Digital transformation requires a lot of financial and resource support, especially talent resources. Large banks usually have strong capital and composite excellent talents, while small and medium-sized banks are unable to make large-scale investments in technology and talent acquisition due to their weak financial capacity. As a result, small and medium-sized banks are caught in the predicament of urgent transformation needs and incomplete transformation conditions. Therefore, compared with small and medium-sized banks, large banks have a higher level of digital transformation and better results. Moreover, digital transformation for large banks to bring the "empowerment" effect is better than for small and medium-sized banks. For example, through digital transformation, large banks continue to sink their customer structure and expand the customer base of small and medium-sized banks, thus squeezing the business of small and medium-sized banks. This adversely affects small and medium-sized banks. In summary, the impact of digital transformation on the risk level of large banks is more significant than that of small and medium-sized banks.

To test the heterogeneity of the impact of digital transformation on banks' risk level under different sizes, this paper draws on Liu, Mengfei et al. [40], and categorizes the sample banks into large small, and medium-sized commercial banks according to the

classification criteria of the People's Bank of China and the China Banking and Insurance Regulatory Commission. The two groups of banks are regressed separately, and the results are shown in column (1) and column (2) of Table 5. The regression results of both groups show that digital transformation is significantly negatively associated with the level of bank risk, but the estimated coefficients are larger for large banks. The Fisher test shows that the difference of such coefficients is significant, indicating that the digital transformation of large commercial banks has a more significant effect on risk reduction.

Table 5. heterogeneity analysis

	(1)	(2)	(3)	(4)	(5)	(6)
	large	small and medium-sized	agricultural and commercial banks	tate-owned banks	city banks	joint-stock banks
	risk	risk	risk	risk	risk	risk
di	0.023***	0.004**	-0.018***	0.023***	-0.003	-0.003
	(0.008)	(0.002)	(0.006)	(0.008)	(0.002)	(0.004)
Control variables	Yes	Yes	Yes	Yes	Yes	Yes
Fixed effect	Yes	Yes	Yes	Yes	Yes	Yes
N	55	671	66	55	495	110
R^2	0.406	0.239	0.389	0.406	0.249	0.236

Analysis Of Property Rights Heterogeneity.

Relying on their rich data resources, deep customer base and continuous government support, state-owned commercial banks have constructed a solid development cornerstone. Therefore, state-owned banks are uniquely positioned to have better digital transformation. The risks faced by agribusiness banks are more prominent, and thus digital transformation is more effective in managing risks. Agribusiness banks are geographically dispersed, with widely differing customers, imperfect customer credit information, and credit risk problems that need to be solved. Moreover, risk management in agribusiness banks is not only difficult but also backward in terms of capacity. Digital transformation can help agribusiness banks better integrate and manage customer and business data, and realize cross-geographical and cross-departmental information sharing and risk co-management, which greatly improves risk management capabilities. In contrast, city banks and joint-stock banks have neither the high level of digital transformation of state-owned banks nor the obvious risk governance effect of agribusiness banks. Therefore, in the process of digital transformation to reduce risks, state-owned commercial banks and rural commercial banks are more effective.

To test the heterogeneity of the impact of digital transformation on banks' risk level under different property rights nature, this study divides the sample commercial banks into rural commercial banks, state-owned commercial banks, urban commercial banks,

and joint-stock commercial banks, and conducts an exhaustive subgroup regression analysis. The results are shown in Columns (3), (4), (5) and (6) of Table 5, that digital transformation has a more significant risk-suppressing effect in rural commercial banks and state-owned commercial banks.

5 RESEARCH CONCLUSIONS POLICY RECOMMENDATIONS

5.1 Research Conclusion

Currently, digital transformation has become an imminent strategic task for commercial banks. However, its impact on bank risk levels has not yet been finalized. Given this, this study chooses Chinese commercial banks as a research sample from 2011 to 2021 and empirically examines whether and how digital transformation can mitigate the level of bank risk. The following conclusions were obtained: first, digital transformation can significantly reduce the risk level of commercial banks. The results still hold after a series of robustness tests. Second, the mediation mechanism analysis shows that digital transformation reduces the level of bank risk mainly through two paths: improving information-seeking capabilities and profitability. Third, the heterogeneity analysis finds that the inhibitory effect of digital transformation on bank risk level is more significant among large commercial banks, state-owned commercial banks, and rural commercial banks. The research in this paper expands the scope of research in the area of digital transformation and bank risk and provides a useful reference for subsequent related research.

5.2 Policy Recommendations

Based on the above conclusions, this paper puts forward the following three recommendations:

First, Commercial banks should actively promote digital transformation. By using digital technology and developing a digital mindset, they can make deep changes to existing business models and management methods and give them the power of data, thus making the digital economic organization more competitive. To successfully realize digital transformation, commercial banks should choose a transformation strategy based on an accurate assessment of the current situation and a scientific definition of market positioning, combine their digital transformation goals with their situation, and develop a digital ecosystem that suits their business characteristics and risk management approach, and strive to take the initiative in the wave of digital transformation to avoid being marginalized.

Second, the government should strongly support the digital transformation of commercial banks, formulate relevant policies and norms, clarify the direction and objectives of digital transformation, and provide guidance for banks. Banks that are disadvantaged in the process of digital transformation, such as small and medium-sized

banks, city banks, and joint-stock banks, should be given appropriate financial assistance to reduce the cost pressure of digital transformation. The government should also actively promote cooperation and sharing among banks, and promote the sharing of digital technology and data within the industry, to improve the quality of digital transformation of the whole industry.

Third, regulators should strengthen risk monitoring and assessment. Regulators should pay close attention to the risk changes in the process of digital transformation of commercial banks, establish a scientific monitoring and assessment system, strengthen supervision for new types of risks such as data leakage, information security, and other risks that may be brought about by digital transformation, and formulate corresponding risk prevention measures. At the same time, regulators should also assess the results of the digital transformation of banks to ensure that the digital transformation can truly reduce the level of bank risk and enhance the overall competitiveness of banks.

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