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The Impact of Digital Transformation on Rural Commercial Banks

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Abstract: The rapid development of financial technology has promoted the digital transformation of rural commercial banks, which is crucial to enhance competitiveness, support "agriculture, rural areas and farmers" as well as rural revitalization. Therefore, this paper attempts to explain the impact of digital transformation on rural commercial banks, and provides optimization measures. Based on the financial data of rural commercial banks from 2013 to 2023, this paper uses a multiple linear regression model to explore the impact of digital transformation on them. It is found that digitalization and cost-income ratio have negative effects on ROA in the short term, but in enterprises with good cost control, digitalization can improve profitability. Non-interest income has had a significant negative impact on ROA in recent years, and reliance on a single source of income may weaken earnings. The findings suggest to strengthen cost control, promote income diversification and government support, and provide guidance for the digital transformation of rural commercial banks.

Keywords: Digital transformation, Rural commercial banks, Financial technology, Profitability

1. Introduction

With the rapid development of financial technology, digital transformation has become a key strategy for financial institutions to enhance competitiveness and adapt to market changes. As the primary financial entity serving “agriculture, rural areas, and farmers” as well as small and micro enterprises, the digital transformation of rural commercial banks is pivotal not only for their own sustainable development but also for the prosperity of the rural economy and the effective implementation of the rural revitalization strategy. In recent years, the rapid development of financial technology has brought opportunities for digital transformation to traditional financial institutions, and also provided strong support for alleviating the contradiction between traditional inclusive financial services and business sustainability [1]. However, most of the existing literatures focus on the digital transformation strategy and practice of commercial banks [2] or the challenges faced by rural commercial banks in the process of digital transformation, and put forward targeted strategic suggestions [3]. While acknowledging the significance of digital transformation in rural commercial banks, it is observed that there exists a relatively limited body of empirical research on this subject. In particular, in the context of differentiated development of county economy, systematic research have not yet formed the path exploration of science and technology empowerment. To address this gap, this study focuses on Jiangsu Rural Commercial Bank to explore the comprehensive impact of digital

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transformation on it. This study adopts the empirical analysis method to collect relevant financial data and digital transformation indicators of rural commercial banks, and uses statistical analysis and regression model for verification. The research focuses on three core issues: current status and characteristics of digital transformation, influencing mechanism, and strategy optimization based on empirical analysis. The empirical analysis of rural commercial banks enriches the research on the digital transformation of financial institutions and its relationship, and provides a new empirical basis for related theories. Additionally, the research results can provide references for rural commercial banks to formulate digital transformation strategies and better serve rural economic and social development.

2. Current situation and characteristics of digital transformation of rural commercial banks

Currently, the upgrading of the second-generation core business system has been implemented in most rural commercial banks, and the equipment of online banking, wechat banking, and various self-service devices has been completed. Additionally, the service methods of micro-banking and remote banking have begun to innovate, opening the road of exploration of digital operation and management [3]. However, the key aspects of digital transformation—including foundational infrastructure, construction planning, and practical application—are still being refined [4]. The digital transformation of rural commercial banks is not only a simple upgrade of technology application but also a profound change of service model and business model. In terms of technology application and innovation, through the introduction of big data, artificial intelligence and blockchain technology, banks can achieve precision marketing, intelligent risk control and efficient operations, thereby reducing operating costs and improving service efficiency. In terms of business process optimization, digital transformation significantly improves the speed and accuracy of business processing and reduces labor costs by simplifying operational processes and reducing manual intervention. The customer experience is enhanced through convenient online service channels, personalized financial solutions and real-time customer service support.

In addition, digital transformation has exacerbated regional differences, with urban areas making rapid progress in digital transformation due to technological resources and talent advantages, while rural areas face the challenges of weak technological infrastructure and talent shortages. This gap leads to relatively low access and efficiency of financial services in rural areas.

However, through digital means, rural commercial banks can break through geographical restrictions, extend financial services to remote areas, narrow the gap between urban and rural financial services, and provide strong support for the economic development of rural areas. The transformation of this service model not only improves the social benefits of banks, but also opens up new profit space for banks. In the context of the huge potential of the rural financial market, digital transformation has become a key path for rural commercial banks to enhance competitiveness and profitability.

3. Impact mechanism of digital transformation on rural commercial banks

Digital transformation is the trend of the development of modern financial industry and a necessary means for various financial institutions to enhance their competitiveness and service level [5]. The impact mechanism of digital transformation on rural commercial banks is multi-dimensional and complex, mainly through cost effect, income effect, risk control, competition and market structure.

In terms of cost efficiency, digital transformation has significantly reduced the operating costs of banks by replacing traditional manual operations with automated and online services. By introducing intelligent customer service and automated processing systems, banks can reduce manual

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intervention, reduce labor costs, and improve service efficiency and accuracy. In terms of revenue diversification, digital transformation has expanded the bank's revenue sources by launching diversified digital products and services. Products such as mobile payment and online wealth management not only meet the needs of customers, but also bring new revenue growth points for banks. In terms of risk control, digital transformation has significantly reduced the risk level of banks through the introduction of big data risk control models and intelligent monitoring systems. Big data technology can monitor customers' credit status and trading behavior in real time, so as to detect and prevent potential risks in a timely manner. In terms of market competitiveness, digital transformation has significantly increased the market share of banks by optimizing business processes and enhancing customer coverage capabilities.

These mechanisms collectively underscore the profound impact of digital transformation on rural commercial banks, driving efficiency, growth, and long-term sustainability.

4. Empirical analysis and strategy optimization

4.1. Data source and variable selection

The data used in this paper are from the wind database, annual reports of rural commercial banks and related industry reports, with a time span from 2013 to 2023. The data covers key metrics such as return on assets (ROA), total digital index, and cost-to-income ratio. Among them, the Digitalization Total Index calculates the comprehensive score of the bank in the aspects of strategic digitalization, business digitalization and management digitalization based on the bank's annual report and third-party data [6], and acts as a proxy variable for the degree of digital transformation.

The variables include:

Return on Assets (ROA) : A measure of a bank's profitability.

Total Digital Index: Reflects the degree of digital transformation of banks.

Cost-income ratio: reflects the cost control ability of the bank.

Proportion of non-interest income: reflects the degree of diversification of the bank's income.

Non-performing loan ratio: reflects the bank's risk control ability.

Total loans: reflects the bank's market share and market competitiveness.

4.2. Model construction and empirical results

This paper adopts multiple linear regression model to analyze the impact of digital transformation on the profitability of rural commercial banks. The model is set as follows:

$$ROA_{it} = \alpha+\beta_1 Digital_{it} + \beta_2 CostIncomeRatio_{it} + \beta_3 NonInterestIncome_{it} + \beta_4 MarketShare_{it}+ \beta_5 NPLRatio_{it}+\gamma_1(Digital_{it}\times CostIncomeRatio_{it})+\gamma_2(Digital_{it}\times NonInterestIncome_{it})+\epsilon_{it} \tag{1}$$

Among them:

- ROA_{it}: The return on assets of the i bank in year t.

-$Digital_{it}$: The total digital index of the i bank in year t.

-$CostIncomeRatio_{it}$: The cost-income ratio of bank i in year t.

-$NonInterestIncome_{it}$: The proportion of noninterest income of bank i in year t.

- $NPLRatio_{it}$: The non-performing loan ratio of the i bank in year t.

- $MarketShare_{it}$: Total loans of the i bank in year t (market share).

-Digital × CostIncomeRatio: An interaction that examines whether digital transformation has an impact on return on assets by reducing operating costs.

-Digital × NonInterestIncome: An interactive term that examines whether digital transformation has an impact on the return on assets by increasing non-interest income.

- ϵ_{it}: Random error term.

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4.2.1. Empirical analysis

(1) Correlation analysis

Table 1: Correlation analysis of bank performance indicators

(obs=230)						
	ROA	Digital	CostIn~o	NonInt~t	NPLRatio	Market~e
ROA	1.0000					
Digital	-0.1142	1.0000				
CostIncome~o	-0.4011	0.0462	1.0000			
NonInteres~t	-0.0556	-0.1973	0.3421	1.0000		
NPLRatio	-0.2372	-0.1827	0.3424	0.0708	1.0000	
MarketShare	-0.1605	0.5244	0.1315	-0.0123	0.0341	1.0000

It is obvious from Table 1 that the return on assets is inversely correlated with the degree of digitization, suggesting that companies with higher levels of digitization may face greater pressure on profitability. The cost-income ratio is positively correlated with non-interest income, indicating that enterprises with better cost control may rely more on non-interest income. However, the NPL ratio has a weak positive correlation with market share, indicating that enterprises with larger market share may face slightly higher credit risk.

(2) Segmented regression analysis

Table 2: Segmented regression analysis of factors affecting bank performance (2013 - 2018)

ROA	Coef.	Std.Err.	t	P>|t|	[958 Conf.Interval]	
Digital	-.0076511	.0017292	-4.42	0.000	-.0110696	-.0042326
CostIncomeRatio	-.0079503	.0017133	-4.64	0.000	-.0113374	-.0045633
NonInterestIncomeit	.0004	.0007875	0.51	0.612	-.0011568	.0019568
MarketShare	-8.00e-06	7.00e-06	-1.09	0.279	-.0000227	7.00e-06
NPLRatio	-.0125137	.0107874	-1.16	0.248	-.0338397	.0088124
Digital_CostIncomeRatio	.0000682	.0000238	2.86	0.005	.000021	.0001153
Digital_NonInterestIncome	.0000153	.0000155	0.99	0.325	-.0000153	.0000459
_cons	1.693073	.1262495	13.41	0.000	1.443487	1.94266

Table 3: Segmented regression analysis of factors affecting of bank performance (2019 - 2023)

ROA	Coef.	Std.Err.	t	P>|t|	[95%Conf.Interval]	
Digital	-.0094754	.0016756	-5.65	0.000	-.0128149	-.0061359
CostIncomeRatio	-.0036961	.0010872	-3.40	0.001	-.0058629	-.0015294
NonInterestIncomeit	-.0020164	.0009246	-2.18	0.032	-.0038591	-.0001737
MarketShare	-3.00e-06	6.00e-06	-0.61	0.542	-.0000149	8.00e-06
NPLRatio	-.0049291	.0083621	-0.59	0.557	-.0215947	.0117366
Digital_CostIncomeRatio	.0000763	.0000159	4.78	0.000	.0000445	.000108
Digital_NonInterestIncome	.000024	.0000135	1.78	0.080	-3.00e-06	.000051
_cons	1.341311	.0746992	17.96	0.000	1.192436	1.490186

Based on the staged regression analysis from different time periods in Tables 2 and 3, the results for 2013-2018 and 2019-2023 show some important trends and differences that reflect changes in the drivers of corporate profitability in different economic environments.

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Over the 2013-2018 period, the degree of digitization and the cost-to-income ratio had a significant negative impact on return on assets. This suggests that digital investment and higher cost-to-income ratios put pressure on profitability during this period, possibly due to high investment and poor cost control in the early phase of digitalization. However, the interaction between digitalization and cost-income ratio is significantly positive, indicating that digitalization can effectively improve ROA in enterprises with better cost control. The effect of non-interest income on ROA is not significant, indicating that traditional interest income is still the main source of profit.

Over the 2019-2023 period, the negative impact of digitization and the cost-to-income ratio remains significant. Notably, non-interest income was significantly negative during this period, suggesting that reliance on non-interest income could have an adverse effect on ROA.This may be due to the global outbreak of the novel coronavirus pandemic, which has limited rural economic activities and increased the survival pressure of small and micro enterprises, which has affected the loan demand, non-performing rate and non-interest income of rural commercial banks. The interaction term between digitalization and cost-income ratio is still significantly positive, further indicating the positive role of digitalization in enterprises with good cost control.

Overall, the impact of digitization and cost management on ROA is consistent, but the negative impact on non-interest income becomes more significant over the 2019-2023 period. The pandemic-induced disruptions to rural economic activities and financial market turbulence likely suppressed returns from wealth management and payment services, exacerbating the observed decline in non-interest income profitability. Enterprises need to pay more attention to the potential risks of non-interest income when advancing digitalization and optimizing cost management. In addition, synergies between digitization and cost management were significant in both periods, underscoring the importance of strengthening cost control in the digitalization process.

(3) Robustness test

Table 4: Heteroscedasticity Test Results

Test	Hypothesis(H0)	Variables	Statistic	df	P-value
Breusch-Pagan/Cook-Weisberg	Constant variance	Fitted values of ROA	0.11	1	0.7402

Table 5: Multicollinearity Test Results

Variable	VIF	1/VIF
Digital_Co~O	19.05	0.052490
CostIncome~O	10.51	0.095191
Digital	6.40	0.156232
Digital_No~e	6.11	0.163578
NonInteres~t	5.48	0.182380
MarketShare	1.55	0.645951
NPLRatio	1.31	0.764077
Mean VIF	7.20	

The robustness test results in Table 4 and Table 5 show that the model performs well in heteroscedasticity and multicollinearity.

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4.3. Strategy optimization and policy suggestions

4.3.1. Strengthen cost control and digital synergy

Although the degree of digitization and the cost-income ratio have a significant negative impact on the return on assets of rural commercial banks, in enterprises with better cost control, digitization can effectively improve ROA. Therefore, rural commercial banks should optimize business processes, reduce manual intervention and reduce operating costs by introducing technologies such as big data, artificial intelligence and blockchain [7]. At the same time, emphasis is placed on the synergies between digital investment and cost control to ensure that high investment in the early phase of digitalization translates into long-term profitable growth and enhances overall operational efficiency.

4.3.2. Promote revenue diversification and innovative product development

In a context of increased economic uncertainty and increased market competition, reliance on a single source of revenue may adversely affect profitability. Therefore, rural commercial banks should actively develop diversified digital products and services, such as mobile payment, online banking and intelligent investment advisory, to enhance the stability of non-interest income. By meeting the individual needs of customers, banks can expand their revenue sources, reduce their dependence on traditional interest income, and enhance their market competitiveness.

4.3.3. Government and regulatory support and guidance

Local governments should seize the policy opportunity period of national new infrastructure construction, accelerate the construction of digital financial infrastructure in counties, especially in rural areas, and build high-quality credit data platforms for county entities [8]. In rural areas, digital transformation is progressing relatively slowly due to weak technical infrastructure and talent shortages. Therefore, the government should provide policy support and financial subsidies, especially in rural areas with weak technical infrastructure, to help banks narrow the gap between urban and rural financial services. Regulators should develop a clear guidance framework for digital transformation, encourage technical cooperation and knowledge sharing among banks, and strengthen data security and customer privacy protection to ensure the steady progress of digital transformation. Through these measures, rural commercial banks can better cope with the challenges in digital transformation, enhance competitiveness, and provide strong support for the sustainable development of the rural economy.

5. Conclusion

This study reveals the complex impact of digital transformation on rural commercial banks through empirical analysis. The findings reveal that the degree of digitization and the cost-income ratio of return on assets have a significant negative impact in the short term, suggesting that high investment and poor cost control in the early phase of digitization may exert pressure on profitability. However, in enterprises with better cost control, digitization can effectively improve ROA, highlighting the importance of cost management and digital synergies. In addition, non-interest income has had a significant negative impact on ROA in recent years, especially in the context of increased economic uncertainty and increased market competition, and reliance on non-interest income may weaken profitability. This suggest that rural commercial banks need to pay more attention to income diversification and reduce their dependence on traditional interest income when promoting digital transformation.

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Optimization measures such as cost control, income diversification and government policy support should be strengthened to provide theoretical basis and practical guidance for the digital transformation of rural commercial banks. However, there are some limitations in this study. The sample data are mainly obtained from rural commercial banks, which limit the reliability of the research. Future studies could expand the sample scope to more rural commercial banks to enhance the universality of the conclusions. In addition, the study time span is reletively short, and could be further extended in the future to explore the long-term impact of digital transformation.

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