

# Research on the Impact of Digital Transformation of Commercial Banks on Profitability

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**Abstract.** Under the background of digital finance, this paper uses Stata to empirically study the impact of digital transformation on the profitability of commercial banks. This study examines how digital transformation affects the profitability of commercial banks by developing a fixed effect regression model using data from 16 Chinese listed commercial banks from 2012 to 2021 as research samples. Furthermore, the heterogeneity analysis is conducted to investigate the difference of the impact of digital transformation of different types of commercial banks on profitability. The research results show that digital transformation significantly increases the profitability of commercial banks. The digital transformation of large state-owned commercial banks cannot significantly improve their profitability, while the digital transformation of joint-stock commercial banks and urban commercial banks can significantly improve their profitability. Finally, based on the research results, suggestions are made for commercial banks and financial regulators.

## 1. Introduction

With the rapid development of digital technology, finance is constantly integrated with science and technology. Internet, cloud computing, artificial intelligence, blockchain, big data analysis and other technologies have been widely used in the financial field. Financial institutions use digital technology to provide financing, payment, investment and other financial services. As of December 2021, 904 million Chinese people used online payment services, making up 87.6% of all Internet users, according to CNNIC's Statistical Report on the Development of China's Internet Network. The trend of financial networking is obvious, and digital financial business has become an important business field in the financial service industry. In the environment of digital finance, many financial institutions, including commercial banks, are undergoing digital transformation. With a year-over-year increase of more than 12% in 2021, China's main state-owned commercial banks invested more than 100 billion yuan overall in science and technology, underscoring the banking sector's unparalleled investment in digital construction. China's urban commercial banks and joint-stock commercial banks have also increased their investment in science and technology to carry out digital transformation. As an important financial institution in China, commercial banks play an extremely crucial role in the economy. Therefore, it is significant to investigate how digital transformation of commercial banks affects profitability.

The impact of digital transformation on commercial banks has been widely studied by scholars around the world. Some scholars found that digital transformation has adverse effects on commercial banks. Sangita Dutta

Gupta et al. (2018) conducted an empirical analysis on IT expenditure and return on equity, and the research results showed that digital transformation could not bring a favorable impact on bank's profitability [1]. Wang Ke (2018) found that commercial banks' operations were greatly impacted by financial science and technology, which also increased their risk [2]. Yu Bo (2020) believed that the range of commercial banks' profits has been squeezed under the impact of digital finance [3]. Other scholars found that digital transformation has a beneficial impact on commercial banks. Dannenberg and Kellner (1998) believed that digital technology can enhance the competitiveness of commercial banks [4]. Liu Mengfei (2021) concluded through empirical research that financial technology has improved the profitability of commercial banks [5]. Zuo Lihua (2021) found that digital investment plays a big part in promoting the production efficiency of commercial banks [6].

The research sample for this paper involves data from 16 Chinese listed banks from 2012 to 2021. Using Stata to analyze the impact of digital transformation on the profitability of commercial banks. Furthermore, commercial banks are divided into three groups for heterogeneity analysis. This study enriches the research in related fields.

## 2. Theoretical analysis and research hypothesis

Digital transformation affects the profitability of commercial banks in terms of cost and revenue. In terms of cost, digital transformation can reduce operating costs

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of commercial banks, thereby improving the profitability. Firstly, commercial banks set up mobile banking, online banking and other digital platforms to provide customers with all-weather payment and settlement services, reducing costs and improving efficiency. Secondly, commercial banks introduced big data, cloud computing and artificial intelligence into credit business, thus easing the information asymmetry between banks and enterprises and reducing the cost of credit business [7]. Finally, commercial banks apply digital technology to internal office, realizing efficient communication and circulation, and reducing internal office costs. In terms of revenue, digital transformation can expand revenue channels, thereby improving the profitability of commercial banks. Firstly, commercial banks use digital technology to dynamically analyze market competition, develop personalized product adjustment strategies, and expand market boundaries through professional products and services [8]. Secondly, commercial banks can use big data and artificial intelligence to carry out precise marketing on the potential customers, so as to improve customer stickiness and contribution [9]. Finally, commercial banks can build an integrated financial service platform to effectively improve the profitability of commercial banks [10]. Therefore, hypothesis 1 is proposed:

H<sub>1</sub>: Digital transformation improves the profitability of commercial banks.

Whether the impact of digital transformation of commercial banks on profitability is heterogeneous remains to be further studied. On the one hand, large state-owned commercial banks in China have certain advantages over joint-stock commercial banks and urban commercial banks in terms of customer data resources, R&D funds, policy support, etc. Large state-owned commercial banks are also more likely to cooperate with large financial technology companies, so they have certain advantages in digital development. On the other hand, in the early development of digital finance, Alibaba and Tencent, as the representatives of Internet companies, had a certain impact on commercial banks. With the maturity of technology and the increase of external competitive pressure, more and more commercial banks have to carry out technological innovation and digital transformation. However, large state-owned commercial banks, due to their large size and government credit endorsement, have suffered less impact, so they lack innovation motivation. This gives joint-stock commercial banks and urban commercial banks a late mover advantage. These banks are likely to achieve curve overtaking of large state-owned commercial banks through digital transformation. Therefore, it is important to research the diversity of how the diversity of how the digital transformation affects commercial banks' profitability. As a result, this study puts forth proposition 2:

H<sub>2</sub>: The digital transformation of joint-stock banks and urban commercial banks can significantly improve profitability, while large state-owned banks cannot.

### 3. Research design

#### 3.1. Model setting

This paper establishes a fixed effect regression model to explore the impact of digital transformation on the profitability of commercial banks.

$$ROA_{i,t} = \alpha_0 + \alpha_1 DTI_{i,t} + \alpha_2 CAR_{i,t} + \alpha_3 LDR_{i,t} + \alpha_4 SIZE_{i,t} + \alpha_5 NPL_{i,t} + \alpha_6 M2_{i,t} + \alpha_7 GDP_{i,t} + \Sigma BANK + \Sigma YEAR + \mu_{i,t} \quad (1)$$

#### 3.2. Variable description

Table 1. Variable description.

Variable name	Variable symbol	Variable definition
Profitability	ROA	Net profit/ total assets×100%
Digital transformation Index	DTI	Digital technology application frequency/100
Capital adequacy ratio	CAR	Self-owned capital of commercial banks / Risk assets
Loan-deposit ratio	LDR	Total loans/ Total deposits
Asset size	SIZE	Ln(total bank assets)
Non-performing loan ratio	NPL	(Subordinated loans+doubtful loans+loss loans)/ Total loans ×100%
Money supply	M2	M2 growth rate
Gross domestic product	GDP	GDP growth rate

#### 3.3. Data sources and sample selection

In this study, the research sample is made up of data from 16 listed commercial banks in China between the years of 2012 and 2021. The financial data and digital transformation index of commercial banks are from CSMAR. Macroeconomic data are from the official websites of the National Bureau of Statistics of China and the People's Bank of China.

### 4. Empirical analysis

#### 4.1. Descriptive statistical analysis

The descriptive statistical findings for relevant variables are shown in Table 2. As can be observed, the standard deviation is 0.168 and the mean value of the commercial banks' digital transformation index (DTI) is 0.215. Commercial banks' return on total assets (ROA) averages 1.010%, with a standard deviation of 0.201. It indicates that the sample varies widely. Additionally, the samples are heterogeneous as evidenced by the significant difference between the maximum and minimum ROA values.

Table 2. Descriptive statistical analysis.

Variable	Obs	Mean	Std. Dev	Min	Max
ROA	160	1.010	0.201	0.500	1.470

DTI	160	0.215	0.168	0.000	0.810
CAR	160	0.133	0.018	0.100	0.180
LDR	160	0.794	0.134	0.470	1.110
SIZE	160	19.792	7.264	12.750	31.190
NPL	160	1.287	0.387	0.430	2.390
M2	160	10.820	2.198	8.100	13.800
GDP	160	6.716	1.583	2.300	8.100

### 4.2. Correlation analysis

Table 3 displays the correlation coefficients between the explanatory variables and the control variables. The result is that the majority of the correlation coefficients between variables are lower than 0.5. Therefore, there is no multicollinearity between variables.

**Table 3.** Correlation analysis.

	DTI	CAR	LDR	SIZE	NPL	M2	GDP
DTI	1.000						
CAR	0.429	1.000					
LDR	0.294	0.111	1.000				
SIZE	0.066	0.569	-0.108	1.000			
NPL	0.196	0.173	0.532	0.272	1.000		
M2	-0.489	-0.429	-0.542	-0.036	-0.446	1.000	
GDP	-0.404	-0.260	-0.288	-0.021	-0.283	0.272	1.000

### 4.3. Regression analysis

Before regression, it is necessary to determine whether the panel data is applicable to the fixed effect regression model. First of all, F test was conducted. The mixed effect model is not applicable because the original hypothesis was disproved at 1% level of significance. Secondly, Hausman test was conducted. At the 1% level of significance, the initial hypothesis was found to be unreliable, indicating that the fixed effect regression model should be used and the random effect model is not appropriate.

The outcomes of full the sample regression and the three component sample regression are displayed in Table 4. The first column is the full sample regression results. Commercial banks' digital transformation can significantly increase profitability, according to the coefficient of the digital transformation index (DTI), which is 0.186 and significantly positive at the level of 1%. Therefore, Hypothesis 1 is verified. The regression findings of the sample of significant Chinese state-owned commercial banks are shown in the second column. The digital transformation index (DTI) of commercial banks has a coefficient of 0.048, which is not statistically significant and suggests that the digital transformation of large state-owned commercial banks will not considerably increase their profitability. The third column is the sub sample regression results of China's joint-stock commercial banks. The joint-stock commercial banks' digital transformation can significantly improve profitability, according to the

coefficient of the digital transformation index (DTI) of commercial banks, which is 0.221 and significantly positive at the 5% level. The fourth column is the sub sample regression results of urban commercial banks in China. The coefficient of the digital transformation index (DTI) of commercial banks is 0.611, which is significantly positive at the level of 1%. So the digital transformation of urban commercial banks can considerably improve profitability. Hypothesis 2 is supported by the regression results of the three component samples, which demonstrate that the profitability of various commercial bank types is affected differently by digital transformation.

**Table 4.** Regression results.

Variable	(1)	(2)	(3)	(4)
DTI	0.186*** (3.38)	0.048 (1.27)	0.221** (2.31)	0.611*** (5.53)
CAR	-1.301* (-1.89)	-1.364* (-1.84)	0.110 (0.08)	1.517** (2.21)
LDR	-0.056 (-0.50)	0.536* (1.74)	-0.458** (-2.20)	-0.876 (-0.55)
SIZE	-0.164*** (-4.15)	-0.438*** (-5.67)	-0.167* (-1.90)	-0.272*** (-7.88)
NPL	-0.145*** (-5.70)	-0.077*** (-3.32)	-0.140*** (-3.53)	-0.131** (-2.13)
M2	0.019*** (3.66)	-0.015*** (3.78)	0.004 (0.36)	0.006 (1.06)
GDP	0.016*** (3.25)	0.008** (2.10)	0.013 (1.61)	0.020*** (3.47)
Constant	4.298*** (5.45)	14.108*** (6.41)	3.898*** (3.16)	4.48*** (8.60)
FE	YES			
R <sup>2</sup>	0.778	0.962	0.771	0.941
Observations	160	50	80	30

### 4.4. Robustness test

This work uses the technique of replacing variables to assess the robustness of the model in order to determine whether it is robust. In this study, ROE is used once more in place of ROA as the explanatory variable for regression. Table 5 displays the outcomes of the robustness test. The digital transformation index (DTI) of commercial banks has a coefficient of full sample regression of 0.026, which is significantly positive at the level of 1%. The findings are solid since the explanatory variable coefficients' significance and sign match those of the initial regression findings.

**Table 5.** Robustness test.

Variable	(1)
DTI	0.026*** (2.99)
Control variables	Control

Constant	0.948*** (7.73)
FE	YES
R <sup>2</sup>	0.909
Observations	160

## 5. Conclusions

### 5.1. Research Conclusions

This paper uses Stata to make empirical study to analysis the impact of digital transformation on the profitability of commercial banks. Research shows that digital transformation of commercial banks can increase profitability by reducing operating costs and expanding revenue channels. In addition, the impact of digital transformation of different types of commercial banks on profitability is heterogeneous. While joint-stock commercial banks and urban commercial banks can greatly increase their profitability, huge state-owned commercial banks have not seen a significant increase in their profitability as a result of digital transformation. The reason for the heterogeneity is that large state-owned commercial banks have a high degree of digitalization, and the decline of marginal efficiency leads to the fact that the continuous digitalization transformation has no obvious effect on the improvement of profitability. While joint-stock commercial banks and urban commercial banks have more innovation power, and digital transformation can significantly improve their profitability. Finally, the robustness test proves that the research results are robust.

### 5.2. Suggestions

For commercial banks, first of all, they should strengthen cooperation with leading financial technology enterprises and accelerate their digital transformation. Secondly, commercial banks should actively innovate financial products and services to improve the quality of service to customers. Thirdly, it is essential to support the development of scientific and technological expertise, because commercial banks' digital transformation is inextricably linked to the investment in such talent. Finally, commercial banks should attach importance to the construction of risk control system while improving their profitability.

For financial regulators, first of all, they should improve the construction of relevant legal systems, improve digital financial regulatory standards, and create specialized regulatory frameworks for the various business unites of financial institutions. Secondly, regulators should strengthen risk control and supervision of financial institutions to ensure that digital products and services do not violate the law, so as to prevent and resolve financial risks. Finally, regulators can also organize financial institutions, including commercial banks, to cooperate with technology-based companies to promote the development of a digital society.

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