

Research on the Evaluation of Core Competitiveness of Commercial Banks: Based on the Perspective of Digital Transformation

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Abstract: With the full arrival of the financial technology 3.0 era, commercial banks have realized the importance of using financial technology to accelerate their transformation and upgrading. Studying the influencing factors of commercial banks' digital transformation has important practical implications for commercial banks to improve their core competitiveness. In the respect of digital transformation, this paper uses principal component analysis method to evaluate the core competitiveness of some typical commercial banks in depth. Finally, it draws some conclusions that with the development of digital transformation, the scale, profitability and solvency of commercial banks become stronger. In this case, core competitiveness of banks becomes better. Driven by digital transformation, the scale, profitability and solvency of commercial banks show a clear positive relationship with the core competitiveness of commercial banks. According to the research conclusions, this paper shows that the development strategies of using digital transformation to improve core competitiveness should be different for banks of different sizes and degrees of development, but all commercial banks should pay attention to the advantages of what digital transformation can bring in improving core competitiveness.

Keywords: commercial bank, core competitiveness, digital transformation, principal component analysis

1. Introduction

Influenced by a variety of factors, the trend of domestic economic growth has slowed down, and the disadvantages of traditional business of commercial banks have been gradually exposed. Faced with multiple limitations such as customer loss, difficulty in developing lending business and frustration in transforming intermediary business, how commercial banks can improve their core competitiveness in the existing market has become the focus of attention in the financial industry.

Based on the 51st CNNIC Statistical Report in 2023, China's internet users reached 1.067 billion up to December 2022. The netizens in China have exceeded half of the population, and the Internet penetration rate has reached 75.6%. With the explosive development of the global Internet and the recombination of technologies and industries, more and more new technologies have become increasingly popular. The development of the Internet had a profound impact on the daily lives of the Chinese public, including changes in people's economic needs.

Obviously, the vigorous development of science and technology is changing the business model of the traditional financial industry, promoting transformation and upgrading, and realizing business innovation. This area has gradually become the focus of the traditional banking industry to enhance its core competitiveness. The concept of "Internet+" has gradually entered the financial industry and successfully transformed into "Internet +Finance", better known as fintech. With the maturity of this technology, Internet finance companies have flourished, and together with the traditional financial industry, they have formed a momentum of rapid development in various financial fields such as financial management, payment settlement, and financing.

In 2023, Premier Li Keqiang proposed in the government work report to strengthen digital development to build a digital China. Since then, the digital transformation of commercial banks has received strong policy support. Thanks to digital transformation, commercial banks have gradually developed their original traditional business and constantly improved their core competitiveness in the market. However, there are many problems to be solved in the process of digital transformation. For example, how do large commercial banks carry out strategic transformation, and whether they can have a clear understanding of the need for digital transformation, so as to actively change the business transformation of the bank's business model. How to establish an organizational management framework to realize the integration of digital transformation into the original banking business system, so as to improve the original business transaction volume? How does the digital transformation proposal affect and improve traditional business products? These issues have not been comprehensively reflected in previous research reports, and there are still some shortcomings in the selection of analytical variables.

Through the summary, collation and analysis of previous literature, it can be found that economists have long focused on the transformation and upgrading of commercial banks, and there are a large number of relevant studies and analyses, among them, some scholars have quantified and modelled the process of digital transformation of commercial banks. From the macro perspective, like causes, Lu collected the data of four types of commercial banks, compared and showed the results obtained, which were significant to the analysis, and effectively studied the causes through data analysis [1]. From the perspective of fintech, Sun accurately defined and explained fintech, took the application of digital technology in other fields as an experience, reasonably deduced the impact of fintech on improving the core competitiveness of commercial banks and proposed measures, and explained them by means of theoretical analysis [2].

There is a lot of literature on the impact of digital transformation on the internal of banks from a micro perspective through fintech, and digital transformation and risk taking of commercial banks is typical [3]. He collected the data of 227 commercial banks from 2010 to 2021 after screening as a basis, built a cubic model to remove the influence of quadratic terms, and finally obtained the inverted "U" relationship between the digitization of commercial banks and bank indicators. In the digital transformation strategy of commercial banks' credit business driven by fintech, Liu proposed a series of feasible strategies for the current situation of bank credit business, a single business [4]. What's more, Guo studied this field through SWOT analysis, and combined the transformation experience of foreign banks to finally obtain the transformation suggestions and strategies of Chinese commercial banks [5]. The innovation point in the hypothesis and empirical study of dynamic mechanism are different from the literature on the transformation of traditional fintech to commercial banks, and

introduced the perspective of consumer preference to study [6, 7]. The research group of the Development Research Department of Bank of Communications studied the transformation model according to the transformation steps and consumer preference, and finally obtained effective research conclusions. Thus, the research methods and perspectives of commercial banks' digital transformation have become more comprehensive, and the definition of commercial banks' transformation steps, factors and effects have become clearer [8, 9]. The research conclusions are also being improved, aiming at a multi-dimensional and multi-level comprehensive study of digital transformation.

In deepening the literature review, this paper finds that the existing research results have some shortcomings in the selection of analytical variables. For example, most of the literature focuses on the growth of profitability of commercial banks before and after transformation but ignores the success of transformation of commercial banks in the face of different liabilities.

In terms of research on the core competitiveness of commercial banks, scholars interpret and analyze the core competitiveness of commercial banks from different perspectives. Donna analyses the core competitiveness of commercial banks from the perspective of inclusive finance [10, 11]. Li innovated the competitiveness indicators of commercial banks using econometrics and draws corresponding conclusions [12]. Zhao proposed to improve the core competitiveness of commercial banks from the perspective of financial ethics [13]. The literature from multiple perspectives, multiple levels and multiple methods plays an important reference value for this paper from the perspective of digital transformation. With the continuous innovation of research perspectives, this paper finds that digital transformation is an industry trend in the banking industry, and there are not enough literatures to study from this perspective, which is innovative and of application value.

In the study of the core competitiveness of commercial banks, this paper chooses digital transformation as the research perspective, and defines the research object in more detail, in order to draw effective conclusions on the influencing factors of digital transformation of commercial banks and pursue the applicability of the conclusions. From the research perspective, the selection of index variables for digital transformation is more comprehensive, not only collecting variables related to the analysis of profitability, but also analyzing the overall situation of the bank, and quantifying the situation before and after the transformation more accurately, in order to obtain conclusions with wider applicability. In deepening the literature review, this paper finds that the existing research results have some shortcomings in the selection of analytical variables. For example, most of the literature focuses on the growth of profitability of commercial banks before and after transformation, but ignores different debts of different commercial banks.

2. Methods

2.1. Theoretical Analysis

2.1.1. Core Competitiveness and Digital Transformation of Commercial Banks

In 1990, Prahalad and Hamel first proposed the concept of core competitiveness, which is a unique capability that enables a company to deliver special benefits to customers. It is comprehensive feedback of a company's technology, product, management and other capabilities, and it is also the reason why the company has a high level of profitability compared to other companies. Core competitiveness is mainly reflected in three aspects: technical knowledge, process, and external relations, where external relations refer to strengthening the relationship with customers while adjusting to the latest policies and technologies to generate a connection with the times [14]. In addition, products and corporate culture also play an important role in core competitiveness [15].

Therefore, the core competitiveness of banks mainly includes product value, service capability, and market access capability (which helps banks to accurately identify customer needs) [16].

Improving the degree of digital transformation will have a direct influence on the core competitiveness of traditional banks. Since the explosive development of internet technology, traditional financial services have been unable to meet people's needs. On this basis, it has become an inevitable choice to change the service mode of the financial industry and carry out product upgrading and business innovation. The research group of Jiangsu Branch of Industrial and Commercial Bank of China pointed out in "Discussion on the Digital Transformation of Commercial Banks" that digital transformation has played an important role in measuring the core competitiveness of banks. Mascarenhas et al. also mentioned that core competitiveness includes external relations, which should be adjusted according to policies and technologies [14]. Nowadays, various industries have triggered a wave of digital transformation, and commercial banks are bound to carry out digital transformation to improve their core competitiveness. In other words, the degree of digital transformation has become one of the criteria to measure the core competitiveness of commercial banks.

In 2022, PricewaterhouseCoopers released the report "The Road to Regional Banks--2022 China Regional Banks High-quality Development Index", which pointed out that the focus of regional banks to improve their core competitiveness is to carry out digital transformation. Through digital transformation, commercial banks can reduce operating costs and improve profitability. Compared with traditional banks, commercial banks can use technological means such as big data and AI to innovate financial products, upgrade industries and optimize financial structure. While optimizing the allocation of resources, they can meet diversified financial needs, thereby reducing the probability of risk concentration and lowering the risk level. Therefore, digital transformation plays a positive role in the core competitiveness of commercial banks.

2.1.2. Profitability and Risk Levels and Digital Transformation

Digital transformation can improve the profitability of banks. It promotes the reform of the management system of commercial banks, improves the digitalization of service processes, and thus provides more efficient banking services. For example, the emergence of mobile banking APP greatly improves the service experience. Not only is it time-saving and convenient, but it can also be used to pay various life fees on the software and receive related customer service in a timely manner. By the end of 2020, the number of mobile banking customers of the six major banks will total more than 2 billion, with high customer viscosity, which improves profitability.

2.2. Research Design

2.2.1. Data Sources

This article selects the data of 24 highly digitized and representative banks in 2021, including 6 National Commercial Bank, 9 State-Owned Shareholding Commercial Banks and 9 Urban Commercial Banks. All the data used in this article mainly comes from the annual reports of banking companies.

2.2.2. Selection of Indicators

The aim of the digital transformation is to improve the core competitiveness of banks in the financial industry. Therefore, this essay selects eight indicators which are in the profitability and risk level two levels to analyze the factors affecting the core competitiveness of commercial banks, which is shown in Table 1 [17].

From the perspective of profitability, the average monthly active users of mobile banking (MAU), total assets (TA), net profit (NP), capital adequacy ratio (CAR) and core capital adequacy ratio (CCAR) are used as the indicators to measure the core competitiveness of commercial banks. In the level of risk, this essay selects the earnings per share (EPS), non performing loan ratio (NPLR) and provision coverage ratio (PCR) to measure the risk level of the banks.

Table 1: Descriptive statistical results.

Symbol	Minimum	Maximum	Average	SD	Median
TA	3294.950	347418.100	90324.729	103543.319	54117.245
NP	15.660	3502.160	777.794	996.652	353.585
EPS	0.260	4.610	1.380	1.045	1.090
CAR	11.560	18.020	14.549	1.858	14.065
CCAR	8.130	13.590	10.128	1.544	9.820
NPLR	0.770	1.790	1.287	0.298	1.325
PCR	140.660	525.520	265.163	107.984	232.085
MAU	8.840	10169.880	2388.330	3229.507	796.350

3. Results and Discussion

3.1. Relevance Analysis

In this essay, Pearson correlation coefficient is used to indicate the strength of the correlation. Table 2 shows that there is a strong correlation between some of the variables, such as the correlation between average monthly active users and net profit, net profit and total assets. However, the correlation coefficients between the average monthly active users and earnings per share, non-performing loan ratio, provision coverage ratio are not significant and close to 0. If all the variables above are analyzed directly, they may be affected by multivariate covariance, which may lead to wrong conclusions. Therefore, this essay utilizes principal component analysis to reduce the dimensionality of these variables to eliminate the influence of correlation between variables.

Table 2: Relevance matrixes.

	MAU	NP	EPS	CAR	CCAR	TA	NPLR	PCR
MAU	1							
NP	0.948	1						
EPS	0.036	-0.021	1					
CAR	0.773	0.784	0.209	1				
CCAR	0.749	0.758	0.184	0.884	1			
TA	0.932	0.985	-0.113	0.746	0.688	1		
NPLR	0.015	0.115	-0.493	-0.211	-0.155	0.157	1	
PCR	0.048	-0.091	0.568	0.269	0.224	-0.146	-0.881	1

3.2. Principal Component Applicability Test

A certain correlation between multi-dimensional indicators is a prerequisite for data to be amenable to principal component analysis. This paper is based on the KMO value and Bartlett's test to make a judgment.

Table 3: KMO and Bartlett Test.

KMO		0.704
Bartlett Test	Chi-squared approximation	225.329
	df	28
	p	0.000

To meet the prerequisite requirements, the quantity of KMO must be greater than 0.6. On the contrary, it indicates that it is not suitable for analysis. Another way to determine is Bartlett Test, whose value is greater than 0.5 implying the feasibility of data to be used.

From Table 3, it shows that the quantity of KMO is 0.704, which satisfies the requirements for principal component analysis. Meanwhile the data passed the Bartlett test which also verified the suitability of the data.

3.3. Kaiser-Harris Criterion

Principal component analysis is based on the correlation coefficient matrix or covariance matrix, whose eigenvalues can be used to calculate the proportion of variance contribution of each principal component. Therefore, in this essay, the number of principal components is determined by the eigenvalues and variance explained ratio. This essay utilizes the Kaiser-Harris criterion, which means that components with eigenvalues greater than 1 are retained as principal components. This judgment is more accurate when the variables are less than 30 and the cumulative variance kurtosis is greater than 70 [18]. The quantity of the cumulative variance explained rate of these components can reflect the ability of the extracted principal component factors to explain the original variables.

Table 4: Variance interpretation rate.

Number	Eigenvalue			Principal component extraction		
	Eigenvalue	Variance interpretation rate%	Accumulation %	Eigenvalue	Variance interpretation rate%	Accumulation %
1	4.319	53.982	53.982	4.319	53.982	53.982
2	2.458	30.731	84.712	2.458	30.731	84.712
3	0.576	7.200	91.913	-	-	-
4	0.359	4.487	96.400	-	-	-
5	0.127	1.593	97.993	-	-	-
6	0.109	1.359	99.353	-	-	-
7	0.045	0.560	99.912	-	-	-
8	0.007	0.088	100.000	-	-	-

As can be seen from Table 4, the eigenvalues of 2 principal components are 4.319 and 2.458. In corresponding, their weighted variance explanations are:

$$53.982 \div 84.712 = 63.72\% \quad (1)$$

$$30.731 \div 84.712 = 36.28\% \quad (2)$$

The variances explained by two principal components are 53.982% and 30.731% respectively and the cumulative variance explained is 84.712%. This means that the first principal component explains

53.982% of the information content of the eight indicators and the second principal component explains 30.731% of the information content.

3.4. Principal Component Score and Composite Score

Linear combination coefficients equal to loading matrix/Sqrt(eigen), which means the loading coefficients divided by the square root of the corresponding eigenvalues. According to the formula, the linear combination coefficient matrix can be calculated. Therefore, in Table 5 it shows that the coefficients of each principal component variable can be obtained.

Table 5: Linear combination coefficient matrix.

Symbol	Components	
TA	0.446	-0.181
NP	0.461	-0.136
EPS	0.052	0.474
CAR	0.439	0.123
CCAR	0.426	0.099
NPLR	-0.031	-0.581
PCR	0.056	0.598
MAU	0.456	-0.063

It can be found that the first principal component is related to total assets, net profit, capital adequacy ratio, core capital adequacy ratio and average monthly active users of mobile banking. The second principal component is related to earnings per share, return on non-performing loans and provision coverage ratio. Consequently, the first principal component represents the factors related to profitability and the second principal component represents the factors related to risk level. The coefficients of each variable of the first principal component have similar magnitude of impact. While the second principal component is more affected by the non-performing loan ratio and provision coverage ratio, comparing to the earnings per share.

In this essay, we can draw equations below:

$$F_1 = 0.446 \times TA + 0.461 \times NP + 0.052 \times EPS + \dots + 0.456 \times MAU \quad (3)$$

$$F_2 = -0.181 \times TA - 0.136 \times NP + 0.474 \times EPS + \dots - 0.063 \times MAU \quad (4)$$

$$\text{comprehensive score} = (53.982 \times F_1 + 30.731 \times F_2) \div 84.712 = 0.637F_1 + 0.363F_2 \quad (5)$$

It can be obtained from Table 6 that China Merchants Bank has the highest composite score which means that its digital transformation is progressing faster. Industrial and Commercial Bank of China, Construction Bank of China, Agricultural Bank of China, and Bank of China are followed. Among the top five in the overall ranking, 80% are state-owned banks, which have a higher degree of digital transformation compared to other types of banks.

Table 6: Commercial bank main component score, comprehensive score and ranking.

Banks	F1 Score	F2 Score	Comprehensive score	Ranking
CMB	2.447	3.631	2.877	1
ICBC	5.098	-1.322	2.769	2
CCB	4.616	-0.856	2.631	3
ABC	3.513	-0.870	1.923	4

Table 6: (continued).

BOC	2.566	-1.188	1.204	5
NBB	-0.380	3.547	1.044	6
PSBC	0.434	1.401	0.785	7
IB	-0.197	1.467	0.407	8
XMB	-0.465	1.501	0.248	9
NJB	-1.031	1.729	-0.030	10
Bank Comm	0.421	-1.016	-0.100	11
PAB	-1.094	0.668	-0.455	12
XAB	-0.677	-0.234	-0.516	13
CSB	-1.301	0.626	-0.602	14
JSB	-1.441	0.627	-0.691	15
BJB	-0.916	-0.556	-0.786	16
SPDB	-0.643	-1.237	-0.858	17
CCB	-0.965	-0.889	-0.938	18
CEB Bank	-1.121	-0.701	-0.969	19
SHB	-1.711	0.313	-0.976	20
CMBC	-1.186	-1.950	-1.463	21
HXB	-1.668	-1.580	-1.636	22
ZSB	-1.972	-1.339	-1.742	23
LZB	-2.328	-1.774	-2.127	24

4. Conclusion

After research, this essay ultimately acquires a few principal components that can describe the main part of the commercial bank. Firstly, the size of the bank will affect the degree of digital transformation, leading to higher core competencies. According to the experiment results, larger commercial banks occupy the front part of the table 6, while the regional commercial banks are slightly behind in the degree of digital transformation. Therefore, core competitiveness of large commercial banks in the financial industry will be greatly strengthened. From this, large banks are more competitive in the industry from a digital transformation perspective. What's more, strong bank profitability facilitates rapid digital transformation, leading to higher core competencies. High profits are the most important thing for commercial banks, which can bring high cash flow. In this case, high commercial bank profitability can provide a solid foundation for digital transformation investment by accelerating the speed of digital transformation degree through a large number of large transactions. Therefore, commercial banks take advantage of profitability to accelerate growth through the digital transformation, which makes them more competitive in the industry. Finally, strong bank solvency gives digital transformation a solid footing, leading to higher core competencies. Solvency plays a decisive role in the sustainable operation of commercial banks. Commercial banks with long-term operation strategies will also benefit greatly from digital transformation. Digital transformation of commercial banks can reduce the of risk of investment, getting the optimal investment programs. Meanwhile, commercial banks are more receptive to bad debts due to the digital transformation. Obviously, strong bank solvency lays the foundation for long-term bank operations. As digital transformation progresses, banks can improve their competitiveness.

Due to the rapid development of digital economy and emergence of fintech, it is important to have a good financial risk supervision system both internally and externally. The government should establish a fintech regulatory system to identify hidden risks and fraud factors. This can effectively avoid the spread and expansion of illegal and criminal behaviors through the tools of fintech.

Admitting that digital transformation plays a significant role in improving the core competitiveness of commercial banks. It effectively reduces the of risk that banks face now, but digital transformation is not the only way that all banks are worth trying. It is not recommended to invest in the digital transformation when all aspects of the bank are immature and the internal structure is chaotic. Digital transformation is preferred when a commercial bank already has a complete structure and wants to upgrade its strategy. However, focusing on the fundamentals such as restructuring, adjusting strategy is more necessary to small and medium-sized banks at the start-up stage.

Authors Contribution

All the authors contributed equally and their names were listed in alphabetical order.

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