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A Study on the Impact of Commercial Banks' Digital Transformation on ESG Performance—Based on Empirical Evidence from Listed Banks in China

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Abstract: *ESG has become a crucial means for commercial banks to seamlessly integrate economic, social, and ecological benefits. With the rapid advancement of digital technology, studying the impact of bank digital transformation on ESG performance holds practical significance. This paper utilizes panel data from 26 listed Chinese banks spanning from 2010 to 2021, along with Bloomberg ESG Ratings and the China Commercial Bank Digital Transformation Index constructed by Peking University, to research the influence of commercial bank digital transformation on ESG performance. The study also explores the moderating effect of bank sentiment. Results indicate that digital transformation in commercial banks has a positive effect on ESG performance, while bank sentiment weakens this promotion effect. Based on these findings, the paper proposes relevant policy recommendations to drive bank digital transformation, enhance the ESG rating system, and leverage digitization for improved ESG performance.*

Keywords: *Commercial banks; Digital transformation; ESG; Bank sentiment*

1. Introduction

As the Chinese economy transitions from a high-speed growth phase to a high-quality development phase, there is an increasing emphasis from various sectors on the sustainable development and ESG principles of enterprises. ESG, as a new corporate development philosophy focusing on environmental, social, and governance performance, provides a comprehensive framework for the sustainable development of enterprises across three dimensions. It has become the mainstream evaluation system for non-financial performance of businesses[1]. With society entering the era of the digital economy, industries are systematically advancing digital transformation. Digital transformation is gradually becoming the engine for commercial banks to build a new development paradigm and promote high-quality development. Effectively leveraging the positive impact of digital transformation on the operations of commercial banks has become a key and challenging focus for banks in adapting to the development of the financial technology era. Against the backdrop of the new development philosophy guiding the construction of a modern economic system, studying how commercial banks can enhance their ESG performance and sustainable development capabilities through digital transformation is of practical importance for banks to achieve a "win-win" situation for social value and business development, and to drive high-quality economic development.

This paper makes several marginal contributions: Firstly, it enriches the research on factors influencing bank ESG performance. Existing literature primarily focuses on the economic consequences of ESG performance for banks, such as the impact of ESG on franchise value[2] and systemic risks in banks[3], with limited attention given to the factors influencing bank ESG performance. Secondly, from a banking perspective, this paper explores the impact of digital transformation on ESG performance, enriching research on the economic consequences of digital transformation for commercial banks. Existing literature mainly concentrates on the impact of digital transformation on ESG performance for listed companies[4][5], with scarce literature examining this issue from a banking perspective. Thirdly, this paper also explores the moderating effect of bank sentiment, enriching the mechanism analysis. Fourthly, ESG factors have become crucial considerations in the financial industry. Studying the impact of digital transformation on ESG can help banks better understand how to integrate sustainable financial principles in the digital era, aiding them in adapting to the future financial environment. This research contributes to achieving sustainability and social responsibility goals while enhancing profitability and competitiveness, promoting the exploration of the paths for digital transformation to support prudent bank operations and high-quality development.

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2. Literature Review and Research Hypotheses

2.1 Commercial Bank Digital Transformation

In recent years, with the rapid advancement of digital transformation in banks, scholars have increasingly focused on the profound impact of bank digital transformation on banking operations and even the real economy. Financial technology and digital transformation can facilitate the improvement of customer credit assessment, enhance the efficiency of credit business processing, reduce bank risks, and boost overall operational performance[6][7]. Xie Li and Wang Shihui found that digital transformation can enhance the profitability of banks' deposit and loan businesses, improve income acquisition efficiency, and drive the transformation of offline branch operations[8]. Jiang Hai et al. discovered that bank digital transformation significantly reduces bank management costs, enhances operational efficiency, and consequently reduces the motivation for banks to excessively undertake risks[9]. Some literature has also examined the negative impacts of bank digital transformation. Wang Daoping et al. analyzed that the process of banks applying and developing financial technology would tighten the liability-side connections between banks, thereby amplifying systemic risks[10]. The research by Yu Minggui et al. indicates that bank digital transformation can have a negative impact on labor demand in banks, with this employment disruption effect mainly observed in smaller banks and commercial banks operating in regions with higher levels of marketization and financial development[11].

2.2 ESG Performance

Most scholars believe that corporate ESG performance has a positive impact on businesses, such as improving corporate performance[12], increasing investment scale[13], and reducing corporate debt financing costs[14]. However, some scholars argue that only corporate governance investment in the ESG structure of banks can promote liquidity creation, while investments in environmental protection and social responsibility may have adverse effects on liquidity creation[15].

2.3 Bank Digital Transformation and ESG Performance

Digital transformation primarily promotes ESG performance by enhancing the level of a bank's social responsibility[16]. Firstly, digital transformation increases the transparency of a bank's information disclosure, prompting the bank to fulfill its social responsibilities effectively. When there is a high degree of information asymmetry between banks and external stakeholders, bank management tends to selectively disclose social responsibility information, such as exaggerating environmental achievements, to maximize reporting benefits. Digitalization brings banks closer to external stakeholders, allowing stakeholders to participate in the bank's decision-making process online, conveying user-centric value propositions to the bank, thereby strengthening the bank's strategic orientation towards social responsibility. Digitalization also makes the bank's decision-making process more transparent and traceable, increasing the cost of information falsification and compelling the bank to fulfill its social responsibility genuinely, ultimately achieving higher ESG ratings. Secondly, optimistic and positive sentiment leads banks to overestimate their and borrower enterprises' future profitability and debt-paying ability[17], causing banks to pursue short-term high returns and reduce their willingness to invest in long-term digital transformation. This, in turn, affects the positive impact of digital transformation on ESG performance.

In summary, this paper proposes the following hypotheses:

H1: Commercial bank digital transformation has a positive effect on ESG performance.

H2: Bank sentiment weakens the positive effect of bank digital transformation on ESG performance.

3. Research Design

3.1 Data Source

Bank-level data in this paper primarily comes from the WIND database and annual reports of various banks, manually collected and organized. Macro-level data mainly comes from the China Economic Information Network statistical database and the National Bureau of Statistics database. The China Commercial Bank Digital Transformation Index constructed by Peking University is chosen to represent the level of digital transformation in commercial banks, while the Bloomberg ESG rating system is used

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to measure bank ESG performance. The study sample covers the period from 2010 to 2021, consistent with the data range of the China Commercial Bank Digital Transformation Index. Interpolation is used to fill in missing values, and a winsorization process is applied to continuous variables at the 1% upper and lower levels to reduce the impact of extreme outliers on empirical results. The final dataset consists of unbalanced panel data from 26 listed banks.

3.2 Variable Definitions

3.2.1 ESG

Given the absence of a unified indicator for corporate ESG performance in existing research, and considering the increasing attention to ESG globally, various institutions have begun to rate and score corporate ESG performance, such as the HuaZheng ESG score and the Bloomberg ESG score. Considering data availability and comprehensiveness, this paper chooses the Bloomberg ESG score as the explanatory variable.

3.2.2 Commercial Bank Digital Transformation

The China Commercial Bank Digital Transformation Index constructed by Peking University ($Dindex$) is used as the core explanatory variable to represent the level of digital transformation in commercial banks. According to Xie Xuanli and Wang Shihui, this index is constructed using principal component analysis to assign weights to indicators, reflecting the dimensions of strategic digitalization, business digitalization, and management digitalization in commercial banks. The weights for the three sub-indices are 14.89%, 31.22%, and 53.88% respectively.

3.2.3 Moderating Variable

Referring to existing literature[12], this paper selects the macroeconomic heat index, monetary policy sentiment index, loan demand index, bank approval index, banking industry prosperity index, and banking industry profit index from the People's Bank of China's "Banker Survey Report" to measure the overall assessment and confidence of the banking industry on the economic situation, changes in monetary policy, credit supply and demand, and industry conditions. X-12 is used to seasonally adjust the selected indicators, and the HP filtering method is applied to remove the trend component. Finally, the principal component analysis is used to synthesize the banking sentiment index as the moderating variable in this paper. Since annual data is used in this paper, quarterly data for the banking sentiment index is averaged.

3.2.4 Control Variables

This paper selects the ratio of total assets of a bank to the total assets of the banking industry, return on equity, capital adequacy ratio, cost-to-income ratio, loan-to-deposit ratio, and liquidity ratio as bank-level control variables. Additionally, GDP growth rate and M2 growth rate are chosen as macro-level control variables. The specific variable definitions are presented in Table 1.

Table 1: Variables Definition

Type	Name	Symbol	Definition
Dependent Variable	Environmental, Social and Governance	ESG	Bloomberg ESG Disclosure Overall Score
Core Explanatory Variable	Level of Digital Transformation in Commercial Banks	$Dindex$	The China Commercial Bank Digital Transformation Index constructed by Peking University
Moderating Variable	Bank Sentiment	$Senti$	Constructed through principal component analysis
Control Variables	Macro Control Variables	GDP	Current Nominal GDP Growth Rate
		$M2$	Current Broad Money Supply Growth Rate
	Micro Control Variables	$Asset$	Bank Total Assets/Banking Industry Assets
		ROE	Net Profit/ Average Net Assets of the Enterprise
		CIR	Cost-to-Income Ratio
		LTD	Loan-to-Deposit Ratio
		LIQ	Liquidity Assets/Liquidity Liabilities

3.3 Model Construction

$$ESG_{it} = \alpha + \beta Dindex_{it} + \gamma_1 Controls_{it}^{Macro} + \gamma_2 Controls_{it}^{Micro} + \mu_i + \varepsilon_{it} \quad (1)$$

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In Equation (1), ESG_{it} represents the ESG rating of bank i in year t; $Dindex_{it}$ represents the level of digital transformation for bank i in year t; $Controls^{Macro}$ includes macro-level control variables, and $Controls^{Micro}$ includes micro-level control variables; due to the inclusion of time fixed effects that absorb the effects of macro-level control variables, there is an issue of collinearity. Therefore, this study only controls for individual fixed effects μ_i. α is the constant term; βis the coefficient for the core explanatory variable; γ_1 and γ_2 are the coefficients for macro and micro control variables, respectively; ε_{it} is the error term.

4. Empirical Results Analysis

4.1 Basic Regression

Table 2 reports the regression results of the impact of commercial bank digital transformation on bank ESG performance. Column (1) presents the regression results without including control variables and fixed effects. The coefficient of $Dindex$ is significantly positive at the 1% level, indicating that a higher level of digital transformation in commercial banks is associated with better ESG performance. Columns (2) and (3) add fixed effects and control variables in sequence. The coefficient of $Dindex$ remains significantly positive at the 1% and 5% levels, providing further evidence that digital transformation in banks significantly improves ESG performance, contributing to the enhancement of non-financial performance. This is mainly attributed to the increased transparency and compliance in bank operations due to digital transformation, prompting banks to fulfill their social responsibilities. Additionally, digital tools can be employed to streamline internal processes and governance, thereby enhancing operational efficiency. Hypothesis 1 is confirmed.

Table 2: Basic Regression Results

	(1)	(2)	(3)
VARIABLES	ESG	ESG	ESG
$Dindex$	0.294***	0.295***	0.091**
	(17.21)	(8.01)	(2.51)
$Constant$	2.281***	2.302***	3.033***
	(27.14)	(14.07)	(10.85)
$Controls$	NO	NO	YES
$Observations$	233	233	233
$R-squared$	0.586	0.586	0.738
$Fixed\ Effects$	NO	YES	YES

*** p<0.01, ** p<0.05, * p<0.1, sic passim

4.2 Endogeneity Test

Table 3: Instrumental Variable Method

VARIABLES	Phase 1	Phase 2
	(1) $Dindex$	(2) ESG
$Dindex$		0.187*** (3.06)
$Dindex_{t-1}$	0.515*** (7.39)	
$Constant$	2.158*** (4.42)	2.413*** (5.13)
$Controls$	YES	YES
$Fixed\ Effects$	YES	YES
$Observations$	183	208
$R-squared$	0.808	0.727

Endogeneity issues can arise due to factors such as reverse causality and omitted variables. In this study, we have partially addressed endogeneity concerns by using panel data, incorporating individual fixed effects, and including a range of control variables. However, we still aim to further mitigate endogeneity problems.

To achieve this, we introduce the lagged one-period digital transformation index of commercial banks as an instrumental variable into the regression model. The regression results are presented in Table 3. In the first-stage regression, the instrumental variable is significant at the 1% level, satisfying the requirement for relevance. The second-stage regression results indicate that the coefficient for digital transformation remains significantly positive at the 1% level, providing further validation for Hypothesis

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4.3 Robustness Test

This study conducts robustness test by replacing the Bloomberg ESG rating with the average index and comprehensive index from the Huazheng ESG rating. The average index assigns values from 1 to 9 based on the quarterly ESG ratings (C-AAA nine-level rating), and the average of the four quarterly ratings is taken for each year. Regression results of Table 4 indicate that digital transformation in commercial banks also significantly and positively influences the ESG performance, providing further confirmation for Hypothesis 1.

Table 4: Regression Results of Replacing the Explanatory Variable

	(1)	(2)
VARIABLES	ESG_Ave	ESG_Com
$Dindex$	0.048**	0.026***
	(2.41)	(4.18)
$Constant$	1.641***	4.327***
	(6.71)	(54.42)
$Controls$	YES	YES
$Observations$	239	239
$R-squared$	0.336	0.305
$Fixed\ Effects$	YES	YES

5. Further Analysis

To investigate the moderating effect of bank sentiment on the relationship between bank digital transformation and ESG performance, this study includes bank sentiment ($Senti$) and the interaction term between digital transformation index and bank sentiment ($Dindex \times Senti$) in the regression. Due to the potential for high collinearity between the interaction term and the independent and moderating variables, the interaction term is centered before regression. The empirical results are presented in Table 5.

Table 5: The Regression Results of Moderating Effect

	(1)
VARIABLES	ESG
$Senti$	-0.178*
	(-1.95)
$Dindex \times Senti$	-0.151***
	(-3.09)
$Constant$	2.792***
	(9.39)
$Observations$	233
$R-squared$	0.745
$Controls$	YES
$Fixed\ Effects$	YES

As shown in Table 5, the coefficient for the interaction term between the digital transformation index and bank sentiment ($Dindex \times Senti$) is -0.151, significantly negative at the 1% level. This indicates that the more optimistic the bank is, the stronger the negative impact will be exerted on the promoting effect of digital transformation on ESG. Under positive sentiment, banks may be more willing to take greater risks in pursuit of higher returns. This could lead them to focus more on short-term profits in digital transformation, neglecting the long-term sustainability of ESG factors and reducing their willingness for long-term investment in digital transformation. Hypothesis 2 is confirmed.

6. Conclusions and Policy Recommendations

This study, utilizing panel data from 26 Chinese listed banks spanning from 2010 to 2021, along with Bloomberg ESG Ratings and the China Commercial Bank Digital Transformation Index constructed by Peking University, delved into the impact of commercial bank digital transformation on bank Environmental, Social, and Governance (ESG) performance. The research yielded the following conclusions:(1) Commercial bank digital transformation has a positive impact on ESG performance. (2) Bank sentiment weakens the positive impact of digital transformation on ESG performance.

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Based on these findings, the following policy recommendations are proposed:

(1) Banks should establish clear goals and strategies for digital transformation, defining guiding principles and priority directions. Strengthening talent development, recruitment, and fostering an efficient team and organizational structure are crucial. Additionally, cultivating a digital culture and building a positive digital brand image are essential.

(2) Improvements to ESG rating systems and disclosure mechanisms are necessary. Governments should enact relevant policies, aligning with ESG practices in Chinese enterprises to enhance ESG rating systems. Banks should continually deepen their understanding of ESG principles, raise awareness and capabilities in ESG information disclosure, increase transparency, and thereby enhance overall ESG performance to alleviate financing constraints and improve corporate performance.

(3) Expand the breadth and depth of research in the field of digital transformation and ESG performance. In-depth exploration of the relationship between digital transformation and ESG performance, tailored digital transformation strategies considering the unique characteristics of banks, and leveraging digitalization for promoting ESG performance are essential. This will contribute to fostering steady banking operations and sustainable development.

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