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Research on the Influence of Digital Finance on Green Credit of Commercial Banks

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Abstract

Based on the analysis and research of balanced panel data of 16 listed commercial banks from 2011 to 2018, this paper empirically analyzes the impact of digital finance on green credit of commercial banks by using the fixed effect model. The results show that: On the whole, the development of digital finance can promote the development of green credit in commercial banks, and the impact of each dimension is different. The impact of the coverage of digital finance is obvious, and the depth of the use of digital finance and the degree of digitalization have a time lag effect on the impact of green credit.

Keywords

Digital Finance ; Green Credit; Fixed Effect.

1. Introduction

Since the reform and opening, our country obtained the rapid development of national economy, but also has produced very serious environmental problems, such as pollution, resource shortages and problems such as damage to biodiversity, in order to make the sustainable healthy development of economy in our country, the environmental problems must be treated accordingly, relevant policy should also be put forward, improve and implement, Such as the 2012 China banking regulatory commission issued the "green credit guide", shows that green credit in our country has entered the phase of comprehensive development, so our country also entered the era of green economy, our country mainly indirect financing is given priority to, and it is difficult to change in a short time, although green credit is beneficial to commercial Banks to fulfill social responsibility, But its impact on commercial banks can not be underestimated. Because has the green business enterprise is mainly some light assets nature or from chemical and other heavy pollution enterprise transformation of the company, their common characteristic is the low return on capital investment and the cycle is long, and greatly influenced by policy uncertainty, that has made the implementation of green credit of commercial bank's initiative willingness is not high.

Commercial Banks to develop green credit problems in terms of risk control management, especially to apply for a loan of green enterprise is technology and capital-intensive enterprises, more reliance on with money is bigger, to borrow a long, there is also a lot of uncertainty to the credit risk, the risk of commercial Banks in the face of such bad both internal digestion is not good external share the bank's risk problem. At the same time, affected by information asymmetry, the information exchange and sharing mechanism of banks is not perfect, and the credit status of enterprises can only be judged by obtaining scattered information about environmental protection in the past, which is difficult to integrate and use. Therefore, banks need to establish a powerful credit investigation system, timely information sharing and exchange. At the same time, investment in green business technical professionals and technological innovation should be increased to improve the efficiency of commercial banks in developing green credit and green finance.

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With the development of digital financial, such as artificial intelligence, chain blocks, the rapid development of Internet and Internet of things, the traditional financial models no longer meet the development requirements of the digital age, commercial Banks should gradually transform development patterns, combined with the digital technology, meet the digital transformation, to seize the opportunity of the country's economic transformation. China has increased investment in science and technology and issued a series of policies to vigorously support the development of green finance. In 2020, Yi Gang, governor of the People's Bank of China, said in a video speech at the Fintech Festival in Singapore that China would continue to explore the combination of financial technology and green finance to promote sustainable economic and ecological development. Green enterprises and commercial banks can and should use financial support to increase r&d investment and promote their own development. Digital finance is of great significance for commercial banks to develop green credit. Commercial banks can use fintech to update their risk control and management system, alleviate problems caused by information asymmetry and financial exclusion, and timely and accurately obtain relevant credit information of green enterprises willing to lend. Therefore, the research on the influence of digital finance on green credit of commercial banks has certain theoretical and practical significance.

2. Literature Review

Green credit is a very important aspect of the green finance system, especially in China, where indirect financing is the main factor, green credit is an important way to develop green finance. At the same time, China is in the transition period, and the country vigorously advocates the development of digital financial technology. The combination of digital technology and finance can well solve the related problems faced by commercial banks in the transition period. This paper mainly combs through the following three aspects: first, relevant literature research on green credit of commercial banks; Second, literature research on the development of Digital finance in China; Third, literature research on the relationship between digital finance and green credit.

Research on green credit of commercial banks. Chuan-lin shao (2010) with the method of double difference model of green credit and risk bearing is studied between commercial Banks, the results found that commercial Banks to develop green credit will increase the risk of bankruptcy, and green credit impact on commercial bank risk bearing is a very obvious heterogeneity, compared to private Banks, the green credit of listed banks has a great impact on their risk taking. Mai Junhong et al. (2015) used the method of joint analysis model to study and analyze the enthusiasm of commercial banks in developing green credit, and found that many financial institutions mostly regarded the repayment ability of borrowing enterprises as the primary factor whether to issue loans. Jiang Xianling, Xu Helong et al. (2016) studied and analyzed the green credit support system of commercial banks for new energy enterprises and relevant measures of how commercial banks improve their own support system to promote the development of new energy enterprises by constructing a game model between commercial banks and new energy enterprises. Chen Kai (2017) believes that China should promote financial institutions to carry out green consumer credit business, encourage consumers to participate, and realize the integration of enterprises, government, financial institutions and consumers. Hao Shuai et al. (2017) believe that green credit is a very effective means to control environmental risks, and it is also a mainstream direction for the banking industry to develop green finance. Xue Chenhui and Wei Ping (2020) established a game model and found that increasing the effective supply of green credit can increase the added value of commercial banks and reduce the related costs of issuing green credit. Hong-mei sun, Yao Shuqi (2020) through the research on the panel data of commercial Banks, draw the conclusion: green credit

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in the short term will be a negative impact on performance of commercial Banks, but in the long run can be reduce the management risk to improve the performance of commercial Banks, so commercial Banks should actively develop innovative financial products and financing mode; Jeucken (2003) believes that the attitude of commercial banks towards green finance shows four stages, from initial resistance and avoidance to active and sustainable development. According to Chami et al. (2002), the implementation of green credit policies by commercial banks can not only improve their reputation, but also enhance their risk management ability.

Research on digital finance. Zhang Rui and Yu Jintao (2021) analyzed the relationship between digital finance and economic growth through empirical research, and found that the development of digital finance could well promote economic growth, but was also affected by different prefecture-level cities and geographical locations. Business environment was added into the study as a moderating effect. Found that digital finance can promote economic growth by improving the business environment; ZhuangXuDong, Wang Renzeng (2021) empirical research on the digital financial and product innovation, the relationship between the transformation of the study found that digital financial between different regions can indeed different levels of the transformation of product innovation, at the same time the main body of enterprise willingness and ability to innovate in the impact mechanism also play an intermediary effect; Duan Yongqin and He Lunzhi (2021) study digital finance and bank loan interest rate liberalization and find that digital finance can promote the marketization of bank loan interest rate, in which digital technology such as big data is the core driving force, Internet loan is the second driving force, and Internet financial management also plays an important role in boosting it. Nimo, Chen Yin (2021) in the empirical research on the traditional financial supply and the Numbers are complementary or alternative relationship between financial, found in traditional financial supply is adequate, digital financial development is rapid, including digital financial coverage and using depth is more significant, but also influenced by region and time effect of heterogeneity; Lian-fu ma, Du Shan heavy 2011-2018 (2021) studied the listed company, the results showed that the higher level of management and low policy uncertainty can promote positive relationship of digital financial and business risks, including coverage and using depth is relatively obvious, the influence of should strengthen the financial supervision, better play to the role of the digital financial.

Research on the relationship between digital finance and green credit. Costas Lapavitsas and Paulo L. Dos Santos (2008) studied the impact of technological progress on the continuous operation of banks, and believed that the rapid development of fintech could promote commercial banks to comprehensively understand their customers and reduce the risks of banks in terms of credit. Vives (2017) pointed out that digital financial technology can reduce intermediary costs, expand financing channels, and increase financial inclusion and inclusiveness. Max Bomer and Hannes Maxin (2018) studied the relevant data of Commerzbank in Germany and analyzed the reasons for the cooperation between fintech companies and commercial banks: First, technology companies can promote the innovation ability of commercial banks; Second, fintech companies also help increase the profits of commercial banks. Liu Wenwen and Zhang Chang (2020) believe that to break the current predicament of green finance in China, it is necessary to achieve synergistic development with consumer finance and inclusive finance. In particular, technology finance can make the financial industry more efficient, provide technical means for green finance, and improve the demand for green finance. Ma Jun, Meng Haibo et al. (2021) Synergistic development of green finance and inclusive finance can effectively promote the development of green agriculture; Xu Shilong (2021) believes that modern information technology should be used to drive the development of green finance, which can alleviate information asymmetry and reduce costs.

Through reviewing relevant literature, it can be seen that the research results of domestic and foreign scholars are of great theoretical and practical significance, but also have some

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shortcomings. Most domestic scholars mainly study green credit of commercial banks, and there are few studies combining digital finance and green credit, and there is also a lack of empirical research support. This article through to 16 listed commercial Banks in 2011-2018 panel data for empirical research, the possible contribution is as follows: (1) collected comprehensive and representative 16 the panel data of commercial Banks, combines digital financial and green credit for research, using fixed effect model empirical analysis for the influence of green credit, Enrich the theoretical research in this field, as well as digital financial developing green in the commercial bank credit in practical application, at the same time enhance the convincing conclusion (2) for digital financial respectively the influence of different dimensions of green credit of commercial bank, this paper carried out analysis can be concluded that digital financial channels for the major effect of the green credit.(3) The research results have important theoretical and practical significance for China's development of green economy and the sustainable development of China's national economic environment.

3. Study Design

3.1. Research Samples

This paper selects the balance panel data of 16 listed commercial banks from 2011 to 2018. Firstly, the second statistical year of digital finance is from 2011 to 2018, in order to maintain consistent caliber and data availability. Second, the fluctuation brought by the epidemic was avoided during this year, which can well ensure the authenticity of the conclusion and has research significance. The main reason for choosing these 16 listed commercial banks is that their data disclosure is relatively complete and easy to obtain. These banks are highly comprehensive, have a wide range of branches, have strong comprehensive competitive strength and are sensitive to national policies.

3.2. Theoretical Analysis and Hypothesis

The development of digital finance can alleviate the problem of information asymmetry (mainly manifested as adverse selection and moral hazard) in the development of green credit by commercial banks, which is conducive to the realization of risk sharing by commercial banks. The use of information technology and big data platform to optimize and upgrade the risk management mode of commercial banks and the use of decentralized blockchain technology can greatly reduce the information asymmetry, thus improving the transaction efficiency of banks, reducing the risk of green credit and promoting the development of green credit for commercial banks. Commercial Banks at the same time complementary cooperation with digital financial platform, can put off those credit business credit level is low, can not only reduce the commercial Banks to issue green credit risks and can reduce the cost of trading, establish effective risk sharing mechanism, so as to evade the green credit business in the information asymmetry problem.

Digital finance helps expand the coverage of green credit, and commercial banks can obtain more potential customers. Digital finance is mainly through the combination of Internet and information technology with traditional financial forms. The improvement of digital coverage is conducive to the disclosure and transmission of environmental information and the improvement of environmental information disclosure mechanism. Through online mode, we can reach previously unreachable customer groups (the long tail effect) and broaden the scope of financial services. For some green enterprises, they can submit materials for review through online mode, and then through information sharing platform and large database, commercial banks can conduct strict online review and issue corresponding loans to qualified applications. In this way, enterprises can save transaction costs and easily apply for required loans.

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Therefore, the development of digital finance can broaden the scope of services provided by commercial banks, thus alleviating the problem of financial exclusion.

The degree of digitalization of digital finance can promote the technological innovation of commercial banks. The increase of the depth of digitalization and the improvement of digital support are conducive to the integration and utilization of decentralized information by financial institutions, so as to develop more green credit financial products. There are various types of green credit business in foreign countries, such as: Car loans, credit CARDS, financing and so on all kinds of green products, but for our country, green credit development history is not long, green credit business is primarily a way of borrowing funds, small business for small and medium-sized enterprises, mainly with the bank's risk management, technology, and benefit aspects and so on, therefore, through digital financial intervention, Based on the above theoretical analysis, this paper proposes the following hypotheses:

H0: Digital finance is conducive to promoting commercial banks to develop green credit

H1: Different dimensions of digital finance have different effects

Variable sources and data selection

1, be explained variable, draw lessons from the existing literature research (such as zhang Lin, 2020) this paper select 16 listed Banks green credit than is (GCR) as explained variable to reflect on the situation of the green credit of commercial Banks, at the same time in the robustness test of the article, the green credit balance (GCB) as an alternative be explained variable robustness analysis.The data are mainly from the Guotai 'an database and the social responsibility reports of commercial banks. The sample period from 2011 to 2018 is the same as the sample period of digital finance.

Table 1. Selection of main variables

Explained variable	Green credit	gcr
Explanatory variables	Total Index of Digital financial inclusion	dfia
	coverage	bfi
	Use the depth	dfi
	Degree of digitization	dl
Control variables	Core capital adequacy ratio	ccar
	Non-performing loan ratio	npl
	Bank size	size
	LDR	ldr
	Economic uncertainty	epu
	Loan balance	lb

Explanatory variables: China digital Finance Index is used in this paper to represent the development degree of digital finance.The index is compiled by the Research Center for Digital Finance at Peking University (Guo Feng et al., 2020).Big data based on the ant gold clothing trading accounts detailed statistics, are quite representative, and the truth of it covers China's 31 provinces (autonomous regions and municipalities directly under the central government), 337 more than regional cities (regions, autonomous prefectures, au, etc.) and nearly more than 2800 counties (county, city, flag, municipal districts) of the data.At the same time, Peking University Digital Inclusive Finance Development Index has been widely used in the economic effects of digital finance development (Xie Et al.,2018;Li Xiao, Wu Yu et al., 2021) are highly authoritative in measuring the development level of digital finance.Therefore, the following four indicators are selected in this paper, among which the total digital finance development index represents the development degree of digital finance (DFIA), the coverage breadth index

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represents the development breadth of digital finance (BFI), and the depth index represents the development depth of digital finance (DFI). Digital technology represents the financial digitized (dl) which covers the breadth from alipay account coverage, using deep cover pay treasure payment, the monetary fund business, credit business, insurance business, investment and credit business six aspects, including mobile digital degree, affordable, XinYongHua and facilitation.

Control variables

Based on the existing literature, this paper selected the core capital adequacy ratio (CCAR), non-performing loan ratio (NPL), bank size (SIZE), loan-to-deposit ratio (LDR), loan balance (LB) and economic policy uncertainty (EPU) of 16 listed commercial banks as the control variables of this empirical study.

Model Setting:

$$\text{Model (1)} gcr_{i,t} = \alpha_1 dfia_{i,t} + \alpha_2 control_{i,t} + \varepsilon_{i,t}$$
$$\text{Model (2)} gcr_{i,t} = \beta_1 bfi_{i,t} + \beta_2 control_{i,t} + \epsilon_{i,t}$$
$$\text{Model (3)} gcr_{i,t} = \gamma_1 dfi_{i,t} + \gamma_2 control_{i,t} + \theta_{i,t}$$
$$\text{Model (4)} gcr_{i,t} = \delta_1 dl_{i,t} + \delta_2 control_{i,t} + \vartheta_{i,t}$$

i, for individual bank; T, for year; Control stands for control variable;$\varepsilon_{i,t}$, $\epsilon_{i,t}$The random error term of the ith bank individual in the t year.$\theta_{i,t}\vartheta_{i,t}$

4. The Empirical Analysis

4.1. Descriptive Statistical Analysis

Table 2. Descriptive statistics of main variables

Variable	Obs	Mean	Std.Dev.	Min	Max
gcr	128	5.743	0.99	2.2	7.97
gcb	128	6.442	1.862	1.62	9.42
dfia	128	6.223	0.135	5.91	6.35
bfi	128	6.194	0.145	5.87	6.34
dfi	128	6.225	0.118	5.95	6.34
dl	128	6.285	0.141	5.95	6.4
ldr	128	4.286	0.145	3.86	4.7
size	128	10.65	1.107	7.87	12.53
lb	128	9.911	1.216	6.94	11.95
epu	128	5.42	0.489	4.74	6.13
npl	128	4.728	0.384	3.64	5.48
ccar	128	2.266	0.139	2.06	2.63

It can be seen from Table 2 that the standard deviation of green credit ratio of the 16 listed commercial banks is large but less than 1, indicating that there is a large gap in the development of green credit among commercial banks, which is due to differences in capital utilization and strategies and tactics among banks.Most of the other variables are less than 1, but they are also large, that is to say, the gap between various commercial banks is still large, which may have a certain impact on the bank's green credit issuance, so it has certain research significance.

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4.2. Correlation Analysis

Table 3. Correlation analysis of main variables

variable	gcr	dfia	ldr	size	lb	epu	npl	ccar
gcr	1							
dfia	0.203* *	1						
ldr	0.072	0.338***	1					
size	0.448***	0.252***	0.286***	1				
lb	0.420***	0.230***	0.336***	0.995 **	1			
epu	0.116	0.433***	0.425***	0.187**	0.184**	1		
npl	0.234***	0.686***	0.487***	0.520***	0.517***	0.459***	1	
ccar	0.301***	0.09	0.025	0.470***	0.477***	0.128	0.225**	1

* P <0.1, ** P <0.05, *** P <0.001

It can be seen from Table 3 that the coefficient between digital finance and green credit of commercial banks is positively correlated, that is, the development of digital finance plays a positive role in promoting the development of green credit, but this is only a separate look at the relationship between the two, without adding control variables and other model methods.Overall, the correlation between the selected variables is significant.

4.3. Baseline Regression Analysis

Through The Hausenmann test, it is found that all the four models strongly reject the random effect, so this paper adopts the fixed-effect model for regression. Model (1) is the total number of financial index and the relationship between the green credit of commercial bank the regression results, can be seen from table 4 digital financial regression coefficient is positive and green credit were positively to close, and also passed the 10% significance level, number of financial development can promote the development of green credit of commercial bank. Model (2) is the digital financial coverage and the relationship between the green credit of commercial bank, it can be seen that the regression coefficient is positive both conforms to our hypothesis, digital financial to broaden the number of approving the environmental protection enterprise, so it can promote the development of the green credit of commercial Banks, and model (2) compared with the model (1) is more significant, Passed a significance level of 5%;Model (3) is to use digital financial depth regression results, the relationship between green credit of commercial bank through the explanation of variable lag is significant, with a 10% significance level, and the regression coefficient is positive, commercial Banks need to put the number of financial extend to all areas of the business, so it is need time, In other words, the depth of the use of digital finance by banks in the last period has promoted the development of green credit this year. Model (4) is the degree of digital technology for commercial Banks to the influence of green credit, we can see the first lag items with second order lag is significant, but the first-order lag of regression coefficient is negative, the reason is that due to the development of the digitized precipitation need a longer time, only lag one year though but does not have any substantive effect significantly, The second-order lag term is positive, so the degree of digitalization can promote the development of green credit in commercial banks, but it takes a longer time.

We can see that Model (2) is more significant among the four models. We can know that digital finance promotes the development of commercial banks mainly by expanding the coverage of digital finance and breaking the "80/20 Rule" of commercial banks.We can also see the size of the commercial Banks for the development of green credit is also has a great influence, through the bank scale lag issue can be seen that when the bank on the Banks of the larger can have the

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ability to develop green credit, at the same time the bigger Banks more advantages in development of digital technology, and to reduce the risk of profit.In this paper, robust standard errors are used to reduce heteroscedasticity interference.

Table 4. Baseline regression results

	Model 1	Model 2	Model 3	Model 4
variable	gcr	gcr	gcr	gcr
dfia	3.740*			
	(1.76)			
bfi		3.177**		
		(2.43)		
L.dfi			1.596*	
			(2.01)	
L.dl				1.380**
				(2.40)
L2.dl				1.003*
				2.05
ldr	0.756	0.832*	0.6	0.758
	(1.26)	(1.7)	(0.97)	(1.1)
L.size	2.006**	2.091***	2.066**	0.989*
	(2.32)	(3.73)	(2.4)	(1.76)
lb	2.708**	2.817***	2.616**	1.571**
	(2.83)	(4.01)	(2.83)	(2.26)
epu	0.164	0.169	0.236	0.389*
	(1.27)	(1.64)	(1.64)	(1.86)
npl	0.225	0.234	0.114	
	(0.89)	(1.26)	(0.59)	
ccar	0.231	0.278	0.128	0.509
	(0.43)	(0.58)	(0.24)	(1.11)
L.npl				0.296
				(0.88)
_cons	14.4	10.79**	2.901	10.70**
	(1.69)	(2.29)	(0.81)	(2.5)
N	112	112	112	96
Individual fixed	is	is	is	is
Control variables	is	is	is	is
Robust	r	r	r	r
R-sq	0.3401	0.3411	0.3356	0.3397

* P <0.1, ** P <0.05, *** P <0.001

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4.4. Robustness Test

Table 5. Robustness test

	Model 1	Model 2	Model 3	Model 4
variable	gcb	gcb	gcb	gcb
dfia	3.743*			
	(1.76)			
bfi		3.179**		
		(2.43)		
L.dfi			1.597*	
			(2.01)	
L.dl				1.358**
				(2.36)
L2.dl				0.991*
				(2.03)
ldr	0.764	0.840*	0.608	0.762
	(1.28)	(1.71)	(0.99)	(1.11)
L.size	2.026**	2.111***	2.085**	1.023*
	(2.33)	(3.77)	(2.41)	(1.81)
lb	1.737*	1.846**	1.645*	0.607
	(1.82)	(2.63)	(1.78)	(0.88)
epu	0.165	0.17	0.238	0.388*
	(1.28)	(1.65)	(1.65)	(1.85)
npl	0.223	0.233	0.112	
	(0.89)	(1.25)	(0.58)	
ccar	0.226	0.272	0.123	0.503
	(0.42)	(0.57)	(0.23)	(1.09)
L.npl				0.292
				(0.87)
_cons	23.61**	20.00***	12.10***	1.39
	(2.77)	(4.25)	(3.37)	(0.32)
N	112	112	112	96
Individual fixed	is	is	is	is
Control variables	is	is	is	is
Robust	r	r	r	r
R-sq	0.7368	0.7369	0.7347	0.7951

* P <0.1, ** P <0.05, *** P <0.001

In order to test whether the above four models are robust, the logarithm of green credit balance is introduced as a substitute variable of the explained variable.It can be seen from the regression results that the significance level of the regression coefficients of explanatory variables has been improved.The goodness of fit of the models has also been improved, so it

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can be seen that these four models are very robust, the overall credibility has been improved, and all of them have passed the robustness test.

5. Conclusions and Suggestions

Based on the empirical analysis of the balanced panel data of green credit and digital finance from 2011 to 2018, the following conclusions can be drawn. On the whole, the development of digital finance can promote the development of green credit in commercial banks.Points dimension to see digital financial through expansion customer range, namely digital financial coverage this layer Numbers of financial indicators of promote the development of green credit of commercial bank more apparent, use digital financial depth and digitized for the development of green credit of commercial bank has lag effect, both the technical extension degree is bigger, need to set aside enough time to reflect, Commercial banks need time effect to upgrade management system for technology application.

Based on the above conclusions, the following suggestions are put forward:

First, strengthen the supervision of financial technology digital, digital financial technology development of high-tech enterprises can from this layer of regulation, to develop more about regulation of digital financial technology, makes the regulatory departments and local governments to improve and perfect the relevant regulatory reporting mechanisms and regulatory measures, power and effective development of green credit and green finance. We can start from the following aspects: for example, establish a docking platform for green finance and green projects, realize information sharing and real-time monitoring, and provide one-stop green credit; To establish a green credit evaluation system, since information asymmetry is an important reason for financial risks of financial institutions, high-tech enterprises can integrate the information data of multiple government departments through big data platforms to establish the information of green credit system including all kinds of enterprises. By establishing an information statistical platform for green finance, high-tech enterprises can provide a more convenient channel for the government to encourage and evaluate financial institutions and green enterprises by integrating relevant information about green finance.

Second, financial institutions should speed up digital transformation, and fully apply digital technology to the development of green credit and green finance, so as to realize the coordinated development of digital economy and green economy.Commercial banks actively increase investment in digital technology to combine it with green business. Meanwhile, they also need to develop some green innovative products to balance the excessive proportion of green credit.Commercial banks should also establish specialized functional departments, introduce relevant talents, combine digital financial technology on the basis of active innovation, and achieve all-round, whole-process, whole-stage supervision and service of green business. Financial technology company under the trend of the third revolution of science and technology in recent years, grown up like mushrooms in China, behind a force to be reckoned with, so commercial Banks can start cooperation with these companies, on the one hand can promote their own digital transformation, on the other hand can also be good profits to reduce the risk, innovative products.

Third, the government should attach importance to the role of green economy in energy conservation and emission reduction, and encourage relevant financial institutions to use digital technology to empower green credit and green finance development.In the context of China's economic transition, the government needs to promote the development of green finance with digital technology, but at the same time, the government's policy direction is also very important. On the one hand, the government should increase the investment in digital finance, increase talent and financial support, improve relevant laws and regulations and infrastructure. On the other hand, the government also needs to increase the policy preference

for commercial banks to develop green finance. Through preferential policies such as tax subsidies, commercial banks are encouraged to actively develop digital finance so as to promote the development of green credit and green finance.

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