

# Research on the Influence of Inclusive Finance on Carbon Emissions

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**Abstract:** Digital inclusive finance, as an emerging force that can promote technological innovation and economic level, can provide new ideas for carbon emission reduction. Using the panel data of 30 provinces, autonomous regions and municipalities in China from 2011 to 2019, this paper explores how digital inclusive finance affects regional carbon emissions. It is found that digital inclusive finance can obviously restrain carbon dioxide emissions; The carbon emission reduction effect of digital inclusive finance is particularly significant in the central and western regions; Digital inclusive finance can improve the level of technological innovation, and its inhibition on carbon emissions is mainly through the transmission mechanism of promoting the level of technological innovation. In view of this, green-oriented digital inclusive finance should be developed; Strengthen the combination of digitalization and industrialization, and adjust and optimize the industrial layout; Formulate digital inclusive finance policy according to local conditions; Increase investment in technological innovation funds, and promote technological innovation with digital inclusive finance.

**Keywords:** Digital inclusive finance, Carbon emissions, Technological innovation, Influential effect.

## 1. Introduction and Literature Review

While the economy continues to grow, China's carbon dioxide emissions remain high. As the largest developing country in the world, China's manufacturing industry is still at the low end in the international industrial division of labor, coal consumption still accounts for more than half of the total energy consumption, and the annual carbon dioxide emissions into the atmosphere exceed 6 billion tons, which is precisely because China's long-term mechanism to deal with climate change is still not sound enough [1]. It can be seen that China is under unprecedented pressure in environmental pollution control and low-carbon emission reduction. Therefore, how to reduce carbon emissions has become the biggest problem that China needs to think about on the road of sustainable economic development. Earlier, General Secretary Xi Jinping emphasized the "double-carbon" goal to meet the global climate change challenge, and put forward higher standards for the development of low-carbon life in China. However, if it is difficult to achieve the goal of peak carbon dioxide emissions and carbon neutrality only by end treatment, the realization of green and low-carbon development will be in the foreseeable future.

With the advent of the digital economy era, digital inclusive finance has merged with traditional finance with the help of artificial intelligence, big data and other information technologies, which strongly impacted the development of traditional finance, and promoted the inclusiveness and convenience of financial services [2]. Digital inclusive finance is the product of the effective integration of traditional finance and information technology, and it still has the basic characteristics of traditional finance. Therefore, the related literature on the impact of traditional finance on carbon emissions can provide reference for the research of carbon emission reduction effect of digital inclusive finance. Most scholars discuss the impact of financial development on carbon emissions mainly around three aspects. First, financial development inhibits carbon emissions. And Chen Zhigang and Guo Shuai (2012)[3] think that financial development is

very important for the development of low-carbon economy in China. Chen Liang and Hu Wentao (2020)[4] discussed the impact of financial development on carbon emissions from the empirical aspect by using the construction of VAR model, emphasizing that the development of green finance can indeed bring energy saving and emission reduction. Second, financial development promotes carbon emissions. Zhang(2011)[5] theoretically discussed the impact of financial development on carbon dioxide emissions in China, and found that there is a positive correlation between financial development and carbon emissions, which mainly comes from the scale effect of financial intermediaries. Zhao Jun et al. (2020)[6] Using provincial panel data research, it is found that from the overall level of China, financial development has temporarily failed to restrain carbon emissions, but has promoted carbon emissions. Third, the relationship between financial development and carbon emissions is inverted "U". Yan Chengliang et al. (2016)[7] think that the impact of financial development on carbon emissions is not single. By constructing an endogenous growth model that includes financial development, innovation and carbon emissions, this paper empirically studies financial development and carbon emissions, and the results show that there is an inverted "U" relationship between them. Hu Yan and Wang Mengqing (2018)[8] also found that there is an inverted "U" relationship between them, which is promoted first and then inhibited. Zhu Dongbo et al. (2018)[9] found that financial development has both positive and negative impacts on carbon emissions, and the relative size of the two impacts determines the comprehensive impact.

With the rapid development of information technology era, digital inclusive finance has been endowed with comprehensive and innovative color. It has broken the limitations of traditional finance to small and micro enterprises and regions, and provided low-cost, high-efficiency and full-coverage financial services for all members of the economy [10]. Tang Yu et al. (2020)[11] pointed out that digital inclusive finance not only increased the coverage rate but also reduced the operating cost of

enterprises, which could alleviate the "resource mismatch" problem brought by traditional finance to a certain extent and give important support to the dredging of the "last mile" of financial services. Thanks to this, some scholars began to turn their attention to the environmental impact effect of digital inclusive finance. For example, Deng Rongrong and Zhang Aoxiang (2021)[12] found that digital inclusive finance can directly improve carbon emission performance on the one hand, and through three effects (technological innovation, economic growth and industrial structure) on the other. Yao Fenge et al. (2021)[13] mainly studied the relationship between digital inclusive finance and carbon emission efficiency, and believed that digital inclusive finance could positively influence carbon emission efficiency, and this influence was mainly realized by improving the level of innovation and entrepreneurship.

To sum up, at present, most studies mainly focus on the impact of traditional finance on carbon emissions, while the research on digital inclusive finance mostly focuses on the impact on economic growth, technological innovation of enterprises, tackling poverty and other aspects [14-16], while there are few studies on green environmental effects [17]. Few scholars discuss the impact of digital inclusive finance on regional carbon emission intensity. The issue of carbon emission is very important for China, which is a big country of carbon emission. This paper empirically analyzes the influence of digital inclusive finance on carbon emission intensity, and further analyzes the intermediary effect and heterogeneity. This study starts with digital inclusive finance, enriches the research on the impact of traditional finance on carbon emissions, and provides a useful decision-making reference for realizing the carbon emission reduction effect of digital inclusive finance and promoting the development of green economy to a new stage.

## **2. Theoretical Analysis and Research Hypothesis**

### **2.1. Analysis of the direct impact of digital inclusive finance on carbon emission reduction**

As one of the lifeblood of the financial national economy, improving the utilization efficiency of financial resources and energy will inevitably have a certain degree of effect on the reduction of carbon dioxide emissions, especially the digital inclusive finance which is concerned in the digital age. The wide application of Internet, cloud computing, big data and other technologies has promoted the rapid development of digital inclusive finance, and its appearance has provided new ideas and directions for China in the low-carbon and digital tide. Digital inclusive finance's reduction of energy consumption and direct suppression of carbon emissions are mainly manifested in the following two aspects. One is the level of individual consumers. Take Alipay as an example, Alipay users can greatly reduce the carbon emissions and transaction costs that may be generated by offline participation in these services through living payment, transportation, offline payment, daily walking, online ticket purchase, second-hand recycling and other behaviors; At the same time, these low-carbon behaviors will generate corresponding green energy in ANT FOREST. When Alipay users collect energy and accumulate it to a certain amount, they can plant the virtual tree species on the platform into the

real desert [18]. In this way, the environmental protection activities involved in carbon emission reduction are integrated and infiltrated into the public, and the ordinary people are guided to really participate in environmental protection, which provides a reasonable and effective path for achieving the goal of carbon emission reduction. The second is the enterprise level. Since the digital inclusive finance came into being, most small and medium-sized enterprises with financial needs can benefit from it. They can easily obtain lower-cost financial support by applying for loan services through online financial service platforms [19]. This not only reduces the time cost and transaction cost caused by offline transactions, but also reduces the carbon dioxide that may be generated on the way to and from financial institutions. Based on this, hypothesis 1 is put forward:

H1: Digital inclusive finance can promote carbon emission reduction to a certain extent.

### **2.2. Heterogeneity Analysis of Carbon Emissions by Digital inclusive finance**

Due to the imbalance of economic development, whether the digital inclusive finance can significantly affect the carbon dioxide emissions may be obviously different due to different regional developments. When studying the influence of digital inclusive finance on urban green total factor productivity, Hui Xianbo (2021)[17] pointed out that due to the differences in resource richness and urban construction in different regions, its driving role was mainly played in the central and western regions. Deepening the economic reform step by step leads to the distance between the financial and industrial levels of various provinces, which leads to the widening of the gap between the effects of inclusive finance on carbon emissions in different regions, especially in the underdeveloped areas in the west [20]. Therefore, hypothesis 2 is proposed:

H2: The effect of digital inclusive finance on carbon emissions is regional heterogeneity.

### **2.3. Analysis of the Action Mechanism of Digital inclusive finance on Carbon Emission Reduction**

Since China's economy has entered a new normal, all aspects of development increasingly depend on technological innovation. Technology innovation is the core driving force to reduce energy consumption and achieve carbon emission reduction [21]. Fundamentally speaking, to achieve carbon neutrality and peak carbon dioxide emissions, we must rely on green low-carbon technology. At present, most of the innovative companies in science and technology are small and medium-sized enterprises. These enterprises have the characteristics of uncertain prospects, high risk coefficient and new business model, which leads them to face a common problem-financing difficulty. However, the rapid development of digital inclusive finance in the digital age reduces the threshold and difficulty for science and technology enterprises to obtain financial support, making it easier for them to obtain the expenses for scientific research. Adequate financial support can significantly promote the further innovation of enterprise production technology, especially the green low-carbon technology, so as to improve energy utilization efficiency and reduce energy consumption [22]. The development of digital inclusive finance provides a more favorable choice to curb carbon emissions, and accelerates the development of green and low-carbon

economy. Based on this, hypothesis 3 is put forward:

H3: Digital inclusive finance can further suppress carbon emissions by improving the level of technological innovation.

### 3. Analysis of Action Mechanism

Digital inclusive finance is the key way to ease the financial constraints of small and medium-sized enterprises. It can provide financial services for enterprises' technology research and development, improve the level of technological innovation and then affect the carbon emission intensity. Therefore, in order to further study the transmission mechanism of digital inclusive finance to regional carbon emissions, the intermediary variable of technological innovation is adopted, and the intermediary effect model is used to make regression analysis and evaluate whether the mechanism is reasonable or not. Step-by-step regression method is used, and the regression results are shown in Table 7. In the benchmark model (8), the digital inclusive finance coefficient is -0.187, and the original assumption is rejected

at the level of 1%, that is, its effect of reducing carbon emissions is remarkable. Analysis (9) shows that the digital inclusive finance coefficient is 0.367, which is significant at the level of 1%, which indicates that the development of digital inclusive finance contributes to the improvement of technological innovation capability of each province. In model (10), two variables, digital inclusive finance and technological innovation, are included in the empirical regression, and the following results are obtained: technological innovation has obvious and inhibitory effects on carbon emission intensity, and digital inclusive finance can also significantly inhibit carbon dioxide emission, with its coefficient value of -0.0812, which is significantly lower than that of -0.187 in model (8). The above comprehensive analysis shows that the intermediary variable of technological innovation has passed the verification of intermediary effect, that is, the vigorous development of digital inclusive finance can help to optimize and upgrade the level of technological innovation, thus inhibiting carbon emissions to a certain extent.

**Table 1.** Estimated results of intermediary effect of technological innovation

Variable	Regression (1)	TE (2)	CI (3)	Variable	Regression (1)	TE (2)	CI (3)
DIF	-0.187***(0.0130)	0.367***(0.0342)	0.0812***(0.0093)	constant term	1.822***(0.1021)	1.320***(0.3164)	2.575***(0.3210)
TE			0.0594***(0.0145)	R2	0.8070	0.7590	0.7600
Control variable	YES	YES	YES	observed value	270	270	270

### 4. Conclusions and Policy Recommendations

With the continuous advancement of the digital age, China's initiative of "double carbon" will bring a historic turning point for carbon emission reduction, which urgently requires digital inclusive finance to gradually form a long-term mechanism for low-carbon emission reduction. On the one hand, digital inclusive finance takes digital technology as the carrier to combine finance with its high efficiency, breaking the time and geographical restrictions, reducing offline transaction costs and improving energy utilization efficiency. On the other hand, because technological innovation is the main force to achieve carbon emission reduction, digital inclusive finance can provide low-burden and high-efficiency financing services for groups with financial needs or small and medium-sized enterprises, and promote the reduction of carbon emission intensity by promoting the technological innovation level of enterprises. In this paper, the direct impact of digital inclusive finance on carbon emission intensity and its mechanism are analyzed, and the following conclusions are obtained by using the regression calculation of 30 provincial panel data from 2011 to 2019 in China:

First, at the national level, digital inclusive finance obviously inhibits carbon emission, and this conclusion is still valid even after many models are compared and endogenous problems are considered.

Secondly, the regional heterogeneity makes the impact of digital inclusive finance on carbon emission intensity also heterogeneous. The carbon emission reduction effects it brings to the eastern, central and western regions are all significantly negative, but its inhibition effect is more concentrated in the central and western regions.

Thirdly, the inhibition mechanism of digital inclusive finance on carbon dioxide mainly alleviates the financial constraints of small and medium-sized enterprises, and the increased R&D investment helps to enhance and optimize the technological innovation capability of enterprises, thus stimulating the improvement of production efficiency and further realizing the purpose of inhibiting carbon emissions.

According to the above analysis conclusion, combined with relevant policies and actual development, the following policy suggestions are put forward:

First, vigorously promote the green-oriented digital inclusive finance, give high-level play to the leading role of digital inclusive finance in China's low-carbon process, and infiltrate its positive influence into every procedure in the financial field. At the same time, we will strengthen the construction of big data, cloud computing, 5G communication technology and other infrastructure, cross the dilemma of digital divide, ensure the coordinated development of digital inclusive finance in various regions, and focus on accelerating the development of green low-carbon economy and realizing the "double carbon" goal.

Second, strengthen the effective combination of digitalization and industrialization, constantly adjust and optimize the industrial structure, improve the allocation rate and utilization rate of financial resources among the real economy, and rationally guide the flow of funds to high-tech enterprises and environment-friendly enterprises, thus providing a strong guarantee for the sustainable and green development of China's economy. High urbanization rate can promote the innovation and improvement of enterprises' low-carbon emission reduction technologies. Therefore, efforts should be made to promote the level of urbanization, and modernization should gradually drive enterprises' technological innovation to achieve carbon emission

reduction. Evaluate whether foreign investment introduced by opening to the outside world can improve the environment and innovative technologies, and mainly introduce foreign direct investment that is beneficial to China's core low-carbon technologies.

Third, formulate relevant policies according to local conditions. The imbalance of economic development, resource factors and geographical environment in various regions make the development of digital inclusive finance regional heterogeneity. Therefore, all regions should rationally plan the development layout and resource allocation in combination with local internal and external conditions, focus on supporting the development of digital inclusive finance in developing regions, give full play to the inclusiveness of digital inclusive finance, and ensure that the benefits brought by inclusive finance can also benefit the relatively backward regions. In addition, the government should also guide the high-tech in the eastern and central regions to gradually radiate to the western developing regions, so as to drive the development of green industries with innovation.

Fourthly, technological innovation is the main kinetic energy for the development of low-carbon economy. Relevant departments can increase the research funds of enterprises and encourage them to innovate independently, especially focusing on China's core technologies and making "real efforts" to develop and apply energy-saving and low-carbon technologies, so as to control environmental pollution and reduce carbon emissions at the source. At the same time, the government and enterprises should make use of the development of digital inclusive finance to enhance the technological innovation ability of enterprises, and then use advanced technology to promote the further development of digital inclusive finance, so as to form a harmonious development and benign interaction between them, and gradually realize a virtuous circle of ecological environment.

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