

# Impact of Digital Finance on Regional Carbon Emissions

Subjects: Economics

Contributor: Qiutong Xue, Kairan Chen, Muchen Li, Sixian Feng

China is currently in the process of industrialization, and the excessive consumption of fossil energy results in a significant increase in carbon emissions. With the significant development of information technology and the digital economy, digital finance has gradually become a new model that affects human activities, motivating us to explore the relationship between digital finance and carbon emissions.

Keywords: digital finance ; carbon emissions ; low-carbon economy

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## 1. Introduction

Since the industrial revolution, production and business activities worldwide have increased air pollutant emissions, primarily of carbon dioxide, which can significantly negatively impact on human production and life. An increase in carbon emissions can lead to climate warming and environmental pollution. To reduce the impact of carbon emissions on the environment and climate, in September 2020, China proposed in the United Nations General Assembly to make carbon dioxide emissions peak by 2030 and strive to achieve the two stages of carbon emission reduction goals of carbon neutrality by 2060. As a major carbon-emitting and energy-consuming country, achieving carbon peaking and carbon neutrality goals is a way to ensure energy security and promote sustainable energy development and is the main driving force for high-quality economic development and ecological civilization construction.

Existing studies generally agree that developing a low-carbon economy in China is based on transformation-driven approach among industries <sup>[1]</sup>, particularly through the financial transformation pathway <sup>[2]</sup>. In recent years, the continuous progress of the Internet and digital technology based on big data, block chain, and artificial intelligence has been continuously applied to the financial industry. This brings new momentum to China's monetary development in terms of information networks, intelligent algorithms, and data resources <sup>[3]</sup>. Digital finance, as a modern financial industry, is widely used in developing various industries because of its low cost, convenience, and other advantages that can break through traditional spatiotemporal financial restrictions <sup>[4]</sup>. This promotes the financial structural change and efficiency <sup>[5]</sup> to meet the development needs of a low-carbon economy to the greatest extent, to promote China's sustainable development <sup>[6]</sup>.

Concerning financial development and carbon emissions, some researchers argue that the development of finance helps reduce transaction costs and promote investment and financing, thereby improving the ecological environment <sup>[7]</sup>. At the same time, some studies indicate financial development and carbon emissions are correlated in more complicated patterns, such as an inverted U-shape between financial development and environment pollution <sup>[8]</sup>. Recently, in order to explore how financial development affects the environment, a growing number of papers have incorporated financial development into the analysis of the relationship between finance and the environment. Bai et al. study the mechanism by which financial development affects environmental change <sup>[9]</sup>. Some studies empirically show that the development of inclusive finance reduces carbon emissions, where its thresholds vary with the level of financial development <sup>[10]</sup>. The relationship between digital finance and regional carbon emissions is discussed above.

The low-carbon economic effect of financial development has become the focus of academia. Some studies have found that digital finance has become the cornerstone for developing the global digital economy and that digital platforms can guide the green transformation of various industries through information dissemination, thus promoting carbon peaking and carbon neutrality goals. There is a dual mechanism (indirect mechanism and direct mechanism) for the impact of digital finance on regional carbon emissions as an important supporting force for the implementation of green and sustainable development. In the indirect mechanism, digital finance can give full play to the connotation that technology is the means and finance is the essence; promote technological innovation and industrial upgrading; reasonably solve the problems of corporate financing dilemmas and industrial lag; and enrich the green financial services content while giving

full play to the advantages of digital technology <sup>[11]</sup>. In the direct mechanism, digital finance uses mobile payment and Internet credit functions to build carbon trading channels on various mobile platforms, thereby reducing energy consumption and regional carbon emission intensity. Furthermore, a study argues that digital finance combines traditional finance with modern information science and technology, achieving online, paperless, and intelligent financial services. Digital finance reduces travel and paper usage, and promotes the development of green financial services such as green credit, green securities, and green investment, and it also guides people to pay attention to environmental protection in their lifestyle, thereby reducing carbon emissions <sup>[12]</sup>.

Compared with the extensive research of traditional financial development on carbon emissions, there is rarely work on the impact of digital finance on carbon emissions, particularly from the view of the low-carbon economy. Zhou et al. empirically find that achieving carbon reduction requires policy, technical, and financial support <sup>[13]</sup>. In addition, reducing regional carbon emissions, especially the tertiary industry carbon emissions, will enable digital finance to improve total factor productivity <sup>[14]</sup>. Some researchers introduce digitization into the Solow growth model as technical progress and find an inverted U-shaped relationship between regional carbon emissions and digitization, consistent with the EKC hypothesis <sup>[15]</sup>. The above research either conducts simple empirical tests based on a small amount of data or consists of theoretical research without empirical evidence.

## **2. Environment and Low-Carbon Economic Development**

Existing studies have shown that, in recent years, economic development and eco-environmental systems in China have been in the development trend of mutual coordination, the system coupling degree is generally at a high level, and the system coordination degree is also on the rise, but the overall coordination level of the system is low, and the development of each region varies significantly <sup>[16]</sup>. A good ecological environment can reduce damage to the environment, effectively reduce energy consumption <sup>[17]</sup>, and unify economic development and environmental development, which can further promote technological innovation and achieve good economic returns.

In recent years, China has raised the level of awareness, depth of practice, and promotion of eco-economy construction to an unprecedented level, and eco-economy construction has been placed in a more important strategic position. China has continuously raised its financial support for ecological environmental protection and environmental pollution control, and investment in environmental protection has continued to grow. At the same time, China has been focusing on strengthening ecological and environmental information construction, has vigorously been promoting the construction of environmental big data projects, and has made significant progress in the integration and application of data resources. China has been implementing regional ecological economy development strategies, focusing on comparative advantages, and promoting the construction of ecological economy on a larger scale to achieve effective results <sup>[18]</sup>.

Sustainable development of a low-carbon economy is the main model of current ecological economic development. Low-carbon economy is an economic model based on low energy consumption, low pollution, and low emissions, and is an inevitable choice to achieve a win-win situation for economic development and resource and environmental protection <sup>[19]</sup>. Under the dual pressure of China's international commitment to greenhouse gas emission reduction obligations and the reduction of resource and energy consumption led by heavy chemical industries, China must adjust its industrial structure, change its economic growth mode, implement policies related to energy conservation and emission reduction, and must seek a balance between low-carbon emissions and economic development. The development of a low-carbon economy is a long-term goal for China's economic development.

In early studies, the representative study on economic development and carbon emissions is the environmental Kuznets curve (EKC), which suggests that there is an inverted U-shaped relationship between economic development level and pollutant emissions, that is, the environmental pollution problem will become severe at the beginning of economic development. However, after crossing the inflection point, economic development will improve people's incomes and living standards, which will also alleviate carbon emissions and environmental pollution. Since the introduction of the EKC hypothesis, there has been a partially supportive attitude toward the conclusions of the literature. Selden and Song found an inverted U-shaped relationship between per capita air pollutant emissions and per capita GDP using cross-country data for various air pollutants <sup>[20]</sup>. Hu and Wang investigated the existence of the EKC for carbon emissions using provincial panel data in China. They found that the EKC for carbon emissions per capita existed in the national sample in the eastern and central regions <sup>[21]</sup>. However, some studies have questioned the EKC hypothesis. Regarding its establishment conditions, Harbaugh concluded that the EKC hypothesis is not robust, and its establishment conditions are affected by the type of pollutant <sup>[22]</sup>, location choice, and measurement method. Regarding its shape, some studies conclude that the relationship between economic growth and carbon emissions is not an inverted U-shaped, and some studies conclude that the EKC curve does not exist <sup>[23]</sup>.

In recent years, owing to the rapid rise of the global low-carbon economy and China's carbon peaking and carbon neutrality goals, many studies have begun to focus on developing a low-carbon economic transition. Frankel summarized the core meaning of a low-carbon economy as broad and narrow, and argued that from a narrow perspective, more emphasis is placed on the stage and coordination characteristics of the low-carbon economy. This sustainable development model considers economic development and environmental carrying capacity <sup>[24]</sup> and pays more attention to coordinating an energy–environment–economy (3E) system. Related studies have also conducted a comprehensive evaluation of regional low-carbon economy indicators. He and Zhang constructed a low-carbon economy indicator system based on the natural, industrial, and human ecosystems. They found that the region's comprehensive situation of low-carbon economy development level remained good with overall planning <sup>[25]</sup>. In low-carbon economic development, the contradiction between the sharp increase in energy demand and decrease in carbon emissions is an important factor affecting China's realization of carbon peaking and carbon neutrality goals. To achieve the goal as soon as possible, China needs to optimize the energy structure, improve emission reduction efficiency, and reduce production consumption of energy. Additionally, there is a need for local financial, monetary support, and industrial policy guidance to achieve the resource allocation green effect. In particular, regarding financial development, Shahbaz tested the conclusion that financial development in Malaysia reduces regional carbon emissions and leads to environmentally sustainable development <sup>[26]</sup>. Meanwhile, some studies have concluded that the higher the carbon price, the more significant the carbon reduction effect at the macro level. Comparing carbon tax and carbon trading policies shows that a reasonable carbon trading mechanism can mitigate the impact of the indirect carbon tax on China's energy sector and macro economy to a certain extent.

### **3. The Green Effect of Financial Digitization**

Finance is a key factor in the effective operation of a modern economy and is important for achieving rapid economic development <sup>[27]</sup>. Some studies have found that traditional finance is conducive to alleviating the financing constraints of some enterprises and improves resource allocation efficiency, which is an important way to achieve inclusive financial development. However, in the case of information asymmetry, traditional finance usually suffers from a high financing threshold and high offline network services cost. Some studies have begun to focus on the impact of digital technology on the quality and effectiveness of financial services to address this financial exclusion. With the rise of block chain technology, artificial intelligence, and big data technology, digital technology is being widely used in various fields, and digital finance is being developed. In the G20 High-Level Principles for Digital Financial Inclusion, digital finance broadly refers to all actions that promote financial inclusion through digital financial services <sup>[28]</sup>. Thus, digital finance provides efficient financial services, while the use of Internet technology is another means to meet society's needs and achieve sustainable economic development <sup>[29]</sup>. Many studies verify this, and the results all show that digital finance can expand the financial scale and optimize the financial structure by improving inclusiveness characteristics and information transparency, thus promoting high-quality economic development <sup>[30]</sup>.

In China's carbon peaking and neutrality goals, many studies have begun to examine digital finance as an influencing factor for energy consumption, green total factor productivity, climate change, green environmental development, and green finance. A study found that digital finance can effectively reduce energy consumption per unit of GDP in the real economy by promoting the development of technology-intensive manufacturing and other paths, and is a new engine for green development in China. Puschmann measured green total factor productivity (GTFP) using an SBM model that includes non-desired output and explored the relationship between digital finance and GTFP and the underlying mechanism <sup>[31]</sup>. Puschmann concluded that digital finance could improve GTFP through indirect mechanisms such as technological innovation and regional entrepreneurship. A study on developing digital finance in Switzerland concluded that the region's financial services industry is undergoing a major transformation. Supporting digital transformation and environmental sustainability is an important factor in improving the quality and effectiveness of green digital financial services and an effective means of mitigating local climate change. Some studies have also studied the green transformation of the industry using digital finance as a new financial development model in China and found that digital finance can significantly reduce the emissions of pollutants such as sulfur dioxide, industrial wastewater, and dust. However, its spatial heterogeneity is more obvious, showing the characteristics of 'high in the east and low in the west'. Dong and Cai discussed the impact of financial digitization on the development of green finance using data from Chinese industrial listed enterprises <sup>[32]</sup>. They found that financial digitization has a facilitating effect on green finance in general. The test results were consistent with breadth, depth, and degree of digitization as sub-dimensions. All the above studies show that digital finance can promote the construction of a green-friendly ecosystem and thus achieve sustainable development in China.

## 4. Financial Development and Regional Carbon Emissions

The relationship between financial development and carbon emissions is discussed in the literature. Conversely, it has been argued that financial development can effectively curb carbon emissions and produce green effects. Tamazian and Rao analyzed capital markets and financial openness data in BRICS countries. They found that economic and financial development are determinants of environmental quality in BRICS countries and that higher financial openness and liberalization are associated with lower carbon emissions <sup>[33]</sup>. Subsequent studies have also confirmed the reliability of the conclusion that financial development does not come at the expense of the environment but rather curbs regional carbon emissions and energy consumption. For the government, financial development can provide more environmentally friendly construction projects for market operations, reduce financial pressure and burden <sup>[34]</sup>, and achieve low-cost operations while reducing CO<sub>2</sub> emissions. Regarding impact mechanisms, financial development can mitigate carbon emissions by easing corporate financing constraints <sup>[35]</sup>, diversifying risks, promoting FDI flows, enhancing corporate social responsibility <sup>[36]</sup>, and promoting industrial upgrading. Additionally, some studies have found that to focus on climate change, pollution control, and development in energy conservation and emission reduction, China supports and promotes construction of a green financial system to achieve differentiated financial policies <sup>[37]</sup>. China also mobilizes capital gathering and forms green investments. This will also provide capital elements for green production.

In contrast, some studies believe that financial development reduces carbon emissions and induces other environmental problems. At the level of economic development, enterprises can expand their financing through financial channels <sup>[38]</sup>. However, they will gradually neglect environmental governance issues under mass production pressure, which will lead to more serious energy consumption and increased pollution. He found that China's natural resource-intensive industries have greater development advantages and profit margins <sup>[39]</sup> and have easy access to many financial resources. However, the natural resource-intensive industries generate greater pollution in their extraction and production, which is also detrimental to future green finance and sustainable development goals. Some studies have found that certain financial services for middle-class consumers expand domestic consumer demand. Among them, Sadorsky believes that financial development allows consumers to easily obtain loans to purchase large household appliances, which improves the consumption quality of the population but also increases the CO<sub>2</sub> emissions of their lives <sup>[40]</sup>.

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