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HOW DOES DIGITALIZATION IN THE ECONOMY AFFECT CHINA'S CO_2 EMISSIONS: A PANEL DATA ANALYSIS

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ABSTRACT

Climate change is one of the most serious concerns confronting humanity today and is threatening the sustainability of life on Earth. Human activities over the years are responsible for rapidly degrading environmental sustainability, which has created unprecedented challenges. China's economic growth and carbon emissions have risen sharply during the past four decades. As part of the Paris Agreement, China has pledged to reduce emissions to combat global warming. In recent years, China's economic growth is trending in the direction of digitalization as a result of the rapid expansion of the internet and the rising prevalence of digital technologies. This paper examines whether digitalization can affect CO_2 emissions and offers solutions for China's green economy. The cross-sectional autoregressive distributed lag (CS-ARDL) method is used to determine the impact of digitalization on CO_2 emissions. The data on variables for 30 Chinese provinces were collected from the China Statistical Yearbook and China's provincial statistics. Using the provincial data on China, we found that digitalization affects CO_2 emissions in stages. In the beginning, digital technologies increase energy needs, which can impair ecological sustainability. In subsequent phases, digital finance may lower the threshold for financial services, making it easier for enterprises to secure financing, which affects production, technological progress, CO_2 emissions, and the environment. Most of China's provinces are digitally modifying their economic structures and changing their company dynamics, which, in turn, affect the environment.

Contribution/Originality: This study contributes to existing literature by being the first to examine whether digitalization can affect CO_2 emissions and offering solutions for China's green economy.

1. INTRODUCTION

The continuous increase in industrial carbon emissions has resulted in severe climate problems, such as the rise in sea levels, floods, heatwaves and drought. China has not only witnessed tremendous economic expansion over the past 40 years, but it has also experienced a steep rise in the amount of energy consumed and the amount of CO_2 emissions produced. China's economy has grown at a rate that is considered to be medium-high, and it is expected that the country's GDP will exceed 10 trillion yuan by 2020 (Safi et al., 2021). At the same time, China's economic progress is being hampered by a number of issues that have been brought on by an excessive consumption of energy and the depletion of natural resources causing damage to the environment. China has overtaken the United States as the country that produces the most annual CO_2 emissions. More than one-third of the world's total CO_2 emissions will come from China in 2021, making the country the greatest CO_2 emitter in the world with 11.9 billion metric tons of CO_2 emissions (NASA, 2020). Figure 1 illustrates the average CO_2 emissions of the thirty Chinese provinces used in this study.

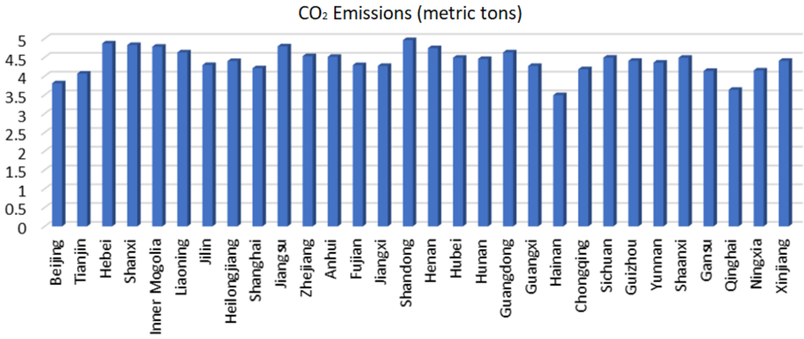

Figure 1. Average CO_2 emissions of 30 Chinese provinces from 2005–2020.

The remarkable economic growth that China has seen over the first two decades of the 21st century has been the most notable trend during this time period. The miracle of China's persistent economic growth is largely attributable to the country's process of industrialization and its rapid development of an industrial economy. In the ten years that have passed since the turn of the 21st century, there have been breakthroughs in artificial intelligence that have brought a dramatic shift in society and altered the way in which we lead our lives (Schwab, 2017). It has been easy to observe that the field of artificial intelligence (AI) has been on the cusp of a technological revolution. The world's revenue has multiplied many times over as a direct result of the adoption of cutting-edge technology across a variety of industries. Countries now have more riches than they have ever had. Digitalization has brought about significant improvements in the financial sector, similar to those brought about in other industries. Both the organizational structure and the operations of banks have been significantly affected as a result of new digital technologies, such as automation and artificial intelligence. In addition, the emergence of the digital economy brings both opportunities and problems to the process of transforming the industrial sector into a low-carbon sector (Bertani, Ponta, Raberto, Teglio, & Cincotti, 2021; Lange, Pohl, & Santarius, 2020).

Miller and Wilsdon (2001) described the digital economy as an important and decisive factor in the technological revolution. This factor has substantially assisted in transforming the value chain of virtually every type of industry. The duty of lowering overall energy usage rests with digital energy, regardless of whether it occurs on the consumption or production side. On the production side, the use of digital economy might change the pattern of human activities, which, in turn, enhances resource effectiveness and carbon neutrality. The contribution of the Chinese digital economy to the national income has drastically increased in recent years, showing a rise in associated economic development. As a result, gaining an understanding of the function that the digital economy plays in the reduction of CO_2 emissions is essential. China, in contrast to other countries in the region, has been encouraged to innovate as a result of higher levels of regional rivalry. China is able to distinguish itself from its rivals by way of innovative procedures. The economic efficiency and environmental performance of the transportation industry have increased due to the implementation of intelligent transportation systems. Through complicated calculations and careful planning, digital technologies have the potential to govern the transportation system. This will allow for more rational planning of traffic routes, which will, in turn, reduce congestion and eliminate idling. Also, the digital economy has the potential to change the level of CO_2 emissions by encouraging lifestyles that produce fewer CO_2 emissions, as well as stimulating the use of clean energy and public transportation. Because of this, policymakers need the assistance of empirical research to establish policies to overcome environmental problems.

The Chinese government has made a voluntary commitment to reduce emissions as part of the Paris Agreement and take an active role in combating the effects of global warming (Wang, Yu, Zhu, & Bao, 2021). China came up with the idea of a carbon neutrality target, which is to reach carbon neutrality by the year 2060. The transition to an economy with lower CO_2 emissions requires financial backing. China's economic growth is trending in the direction of digitalization as a result of the rapid expansion of the internet and the rising prevalence of digital technologies. The expansion of digital finance can have a significant impact on the growth of production and technological progress, which, in turn, can have an effect on CO_2 emissions. This can be accomplished by lowering the entry barrier for financial services. Hence, this study investigates whether or not the digital economy can have an effect on CO_2 emissions. The ultimate goal is to offer some suggestions for the growth of a green economy in China.

2. LITERATURE REVIEW

For a very long time, the reduction of CO_2 emissions has been the primary focus of research, and the findings related to this topic are substantial. The vast majority of research has looked at differences in CO_2 emissions across different regions (Ali, Maryam, & Rabbi, 2014; Buso & Stenger, 2018; Qin et al., 2021). According to the findings of a number of studies, the significant determinants include technical advancement, energy intensity and structure, gross domestic product, and industrial structure. Additionally, CO_2 emissions are partly caused by investment in R&D (Ali, Dogan, Chen, & Khan, 2021; Kirikkaleli, Adebayo, Khan, & Ali, 2021).

Due to the short time span of digital economy development, the amount of literature in this area is limited. The few available reports on the nexus between the digital economy and the environment are either hypothetical, personal, or ambiguous (Granell et al., 2016; Romm, 2000). In recent years, investigators have been looking into how digitalization affects CO_2 emissions (Afonasova, Panfilova, Galichkina, & Ślusarczyk, 2019; Bhattacharya, Paramati, Ozturk, & Bhattacharya, 2016; Bhujabal, Sethi, & Padhan, 2021; Chen & Zhang, 2021; Chen, 2022; Dubey et al., 2019; Fernández, López, & Blanco, 2018; Guo et al., 2020; Hao et al., 2022; Kovacikova, Janoskova, & Kovacikova, 2021; Ma, Tariq, Mahmood, & Khan, 2022; Omri & Hadj, 2020; Ren, Hao, Xu, Wu, & Ba, 2021; Tang, Xu, Hao, Wu, & Xue, 2021; Usman, Ozturk, Ullah, & Hassan, 2021; Wang et al., 2019; Xu, Gao, & Huo, 2021; Zhang, Liu, Wang, & Zhou, 2022). The research that has been done on the effects of information and communications technology (ICT) on the natural world typically makes a distinction between the various layers of digitalization. The majority of taxonomies contain first-order impacts, which involve the creation, use, and disposal of technologies; nevertheless, the entire impact of ICT incorporates numerous processes in addition to these (substitution, optimization, and rebound effects). The term "rebound effects" refers to the phenomenon that occurs when a rise in manufacturing efficiency results in lower prices for consumers. Because of this, there will be an increase in both economic activity and consumer demand (Zimnukhova, Zubkova, Morkovkin, Stroev, & Gibadullin, 2019). Different schools of thought have drawn divergent conclusions on the issue of how the digital economy affects CO_2 emissions (Hampton et al., 2013; Salahuddin & Alam, 2016; Thornton & Ferrone, 2001; Usman, Makhdum, & Kousar, 2021). Allam and Jones (2021) reached the conclusion that advances in digital technology shorten the research and development cycle for clean energy through the use of improved 3D modelling of geographical circumstances. On the basis of such effective models, researchers can precisely record projected climatic changes and assist the government in implementing price subsidies for energy supply regulation. In turn, this enhances the structural change of energy supply and energy consumption, which eventually controls CO_2 emissions and sustains the environment. However, according to Schauer (2003), paperless transactions will complement rather than replace traditional transactions. The disposal of digital equipment is one of the fastest rising waste streams. Usman et al. (2021) discovered that ICT makes it easier for companies to share their knowledge in order to lessen their influence on the environment. ICT was found to enhance ecological efficiency (Lange et al., 2020). The macro level has mostly been the focus of investigation in studies relating to the digital economy and carbon emissions (Khan, Ali, Jinyu, Shahbaz, & Siqun, 2020). Fichter (2017) conducted research on the effects of the internet economy on the environment, including the effects of the usage of information technology (IT), the World Wide Web, infrastructure, and rebound effects. In order to realize the goals of creating a sustainable society and cutting CO_2 emissions, it is recommended that a central government strategy be implemented to make it easier for people to adapt to digital economies. According to Xu, Zhou, and Liu (2022), the growth of the digital economy exhibits clear regional heterogeneity, and it was discovered that the growth of the digital economy in eastern China is helpful in reducing CO_2 emissions. Hurst (2001) investigated the effects of online business on the local ecosystem by looking at prior studies and conducting interviews with seven British companies. At the end, a recommendation was made that the businesses should consider environmental concerns such as energy, carbon trading, transportation, and the use of green goods.

This research investigates the impact of the digital economy, industrial pollution control investment (IPCI), renewable energy consumption (REC), and gross domestic product (GDP) on China's CO_2 emissions from 2005 to 2020. In the existing literature, trade, population, eco-innovation, energy demand, carbon tax, and GDP are considered important determinants of CO_2 emissions. However, the digital economy along with IPCI as a factor of CO_2 emissions have not been discussed before. Additionally, this study includes the squared term of the digital economy in the empirical model, which has been ignored in previous studies. Moreover, the role of IPCI in the nexus between the digital economy and CO_2 emissions is also ignored in previous literature. The findings of this study have significant implications for the development of public policy regarding innovation and financing.

3. METHODOLOGY

3.1. Theoretical Framework

There is a lot of information in the theoretical literature that explains how digitalization will affect CO_2 emissions. On the other hand, there are a variety of viewpoints concerning the effects that the digital economy will have on CO_2 emissions. It has been suggested that the optimization features of the digital economy could have an effect on CO_2 emissions. Through optimization, industrial processes and goods can be improved; operations can be made more efficient, and both mobility and CO_2 emissions can be reduced. For instance, the automation and optimization of energy consumption could lead to an increase in the energy efficiency of buildings. Likewise, the production and storage of equipment could become more efficient without sacrificing the level of comfort and quality parameters that are associated with the working environment. Digital technologies, such as sensors, networked devices, and data analytics, are already transforming how energy is produced, utilized, and consumed across the economy, and these changes are expected to continue. As the use of digital technology becomes more widespread, it paves the way for the creation of new options to improve energy production and consumption while simultaneously lowering CO_2 emissions.

An increasing number of individuals are adopting clean forms of energy instead of using fossil fuel companies, which generate significant amounts of pollution. The digital economy can be used to promote environmental protection and improve environmental quality, which has been a clear trend in recent years. The goal of industrial digitalization can be accomplished by the digital economy through the intelligent transformation of traditional industries and the empowerment of all components of the traditional industrial supply chain. That is, if the digital economy can realize industrial digitalization, it can be a great inspiration to further promote the industrialization of information technology and make new contributions to the field of green development. Tracking one's carbon footprint can be made easier with the help of digital technology, which, in turn, improves the skills of environmental regulation decision makers (Atkinson & Mckay, 2007; Feng, Hong, Zhang, Zhang, & Tan, 2017).

There is a strong association between the rising GDP per capita and the rising levels of environmental pollution in a given location (Grossman & Krueger, 1992). The combination of high energy demand and rising economic output leads to increased environmental stress in certain regions. A significant amount of the increased demand for energy caused by expanding economic activities is currently met by fossil fuels. Because of the growing demand for fossil fuels, which is not good for the environment and paves the way for a high rate of CO_2 emissions. Based on this premise, we have reason to believe that China's GDP will have a beneficial effect on the country's CO_2 emission levels.

It has been stated that industrial pollution control investment (IPCI) has a detrimental impact on CO_2 emissions. Any action that reduces or stops pollution at its source is considered an effective method of pollution prevention. As a consequence, one of the most common objectives of many investors is to direct investment capital toward businesses and prospects that are proactively striving to cut CO_2 emissions. As a result, we anticipate that IPCI will have a detrimental effect on the amount of carbon dioxide emissions produced in China. As a direct consequence of increased investments in research and development, the clean energy industry has undergone significant transformations while also experiencing cost reductions. In addition, as a direct result of these efforts, new technologies have emerged that make it possible to integrate renewable energy sources into the electrical grids that already exist. As a consequence of this, there was a detectable influence of renewable energy consumption (REC) on the amount of CO_2 emissions produced in China.

3.2. Model and Data Sources

Based on the above arguments, the empirical equation is modelled as:

$$CO2E_{it} = \lambda_0 + \lambda_1 DIGECO_{it} + \lambda_2 GDP_{it} + \lambda_3 IPCI_{it} + \lambda_4 REC_{it} + \eta_{it} \quad (1)$$

Where *CO2E* is the carbon dioxide emissions (per capita metric tons), *DIGECO* is the digital economy, *IPCI* is industrial pollution control investment, and *REC* is renewable energy consumption. The data for the variables were collected for 30 provinces in China from 2005 to 2020. The data for digital economy were collected from the China Statistical Yearbook, Enterprise Research Data – Digital Economy Industry Special Database. The data for CO_2 emissions, REC and IPCI were obtained from the China Statistical Yearbook on Environment. The GDP data is obtained from the China provincial statistical yearbooks.

3.3. Analytical Techniques

3.3.1. Data and Analytical Techniques

In recent years, greater emphasis has been placed on the use of econometric approaches that account for cross-sectional dependence (CD). This is especially significant given that the vast majority of conventional econometric panel techniques do not take CD into account. When dealing with long-term panel data sets, disregarding either of these two difficulties may lead to estimation results that are both inefficient and unreliable. Because of this, the first thing that we did was check for CD using the test developed by Pesaran (2004) and the slope heterogeneity test developed by Pesaran and Yamagata (2008). Because of the growing level of economic integration, the problem of CD has taken on greater significance. A great number of nations are not independent and are instead influenced by a variety of common shocks that have ripple effects. Similar to how different countries around the world have distinct economic systems and policies, assuming that all nations are similar might lead to false conclusions (Ali & Malik, 2021). In this initial stage, our primary objective is to determine whether or not cross-sectional dependence is present in a series. The critical series cross-sectional dependence is investigated before moving on to the panel unit root test.

The equation for the CD test is given as:

$$CD = \sqrt{\frac{2}{i(i-1)}} \sum_{k=1}^{i-1} \sum_{j=k+1}^{i} T^{k,j}\, \widehat{\rho^{k,j}} \sim N(0,1) \quad (2)$$

Similarly, the slope heterogeneity test equations are given below as:

$$\tilde{\Delta}_{,SH} = (N)^{\frac{1}{2}} (2k)^{-\frac{1}{2}} \left(\frac{1}{N}\tilde{S} - k\right) \quad (3)$$

$$\tilde{\Delta}_{Adjusted-SH} = (N)^{\frac{1}{2}} \left(\frac{2k(T-k-1}{T+1}\right)^{-\frac{1}{2}} \left(\frac{1}{N}\tilde{S} - 2k\right) \quad (4)$$

Here, $\tilde{\Delta}_{SH}$ is for delta_tilde and $\tilde{\Delta}_{ASH}$ is the adjusted version.

When applied to series that are cross-sectionally based, the contemporary unit root tests are ineffective. We focus on utilizing the CIPS unit root test, which is effective due to its power in dealing with cross-sectional dependence (Pesaran, 2007). The specified variables are put through this root unit test so that an evaluation may be performed to determine the order in which they should be joined.

In contrast to more conventional cointegration tests, such as the Kao and Pedroni tests, which do not take into account the problems of slope heterogeneity and CD, these tests take into account both of these aspects simultaneously. In the case of CD, a cointegration test was conducted according to Westerlund (2007) to determine whether or not the variables are cointegrated.

This study used an approach known as the CS-ARDL rather than more conventional methods. When compared to more conventional procedures in econometrics, this methodology is extremely reliable. The CS-ARDL addresses a variety of econometric issues and concerns. To begin, it is capable of producing effective outcomes, even when the order of integration is not consistent. Second, it is resistant to the challenges posed by both endogeneity and heterogeneity (Chudik & Pesaran, 2013a). Additionally, it is effective, even for CD, by introducing cross-section averages, which is a unique feature of this method. Following three main features, this study opts to use the CS-ARDL, and the general equation is given below as:

$$\Delta CO2E_{i,t} = \varphi_i + \sum_{l=1}^{p} \varphi_{il} \Delta CO2E_{i,t} + \sum_{l=0}^{p} \varphi'_{il} \bar{X}_{s,i,t-l} + \sum_{l=0}^{1} \varphi'_{il} \bar{A}_{i,t-l} + \varepsilon_{i,t} \quad (5)$$

In Equation 5, A represents the cross-section averages and is given as: $\bar{A}_{it} = (\Delta\overline{CO2E}_t, \bar{X}'_{s,t})'$, and X represents the independent variables.

4. RESULTS AND DISCUSSIONS

The results of the CD test, presented in Table 1, show that all variables are cross-sectionally dependent, which means that a shock in one variable in one of the Chinese provinces may have major implications for the other provinces. Since all variables are cross-sectionally dependent, the results of the CD test imply that this possibility exists.

Table 1. Slope heterogeneity and cross-sectional dependence.

Slope Heterogeneity Test	Statistics
$\tilde{\Delta}$	9.412***
$\tilde{\Delta}$Adjusted	11.427***
Cross-sectional Dependence	
Variable	**Statistics**
CO_2 emissions	32.53***
Digital economy	21.16***
GDP	42.72***
IPCI	46.91***
REC	27.72***

Note: *** denotes significance at the 1% level.
GDP = gross domestic product; IPCI = industrial pollution control investment; REC = renewable energy consumption.

For the purpose of determining whether or not a panel time-series process is stationary, this study applies the CIPS unit root test, which considers both slope heterogeneity and cross-sectional dependence. The findings of the CIPS test are presented in Table 2, and it can be seen that while CO_2 emissions and digital economy are both stationary at level, GDP, IPCI, and REC are stationary at first difference.

Table 2. Unit root (CIPS).

Variable	I(0)	I(1)
CO_2 emissions	-2.917**	-
Digital economy	-2.742**	-
GDP	-1.980	-3.852***
IPCI	-1.713	-3.592***
REC	-2.012	-3.928***

Note: *** and ** denote significance at the 1% and 5% levels, respectively.
GDP = gross domestic product; IPCI = industrial pollution control investment; REC = renewable energy consumption.

After that, the Westerlund cointegration test investigates the equilibrium between the CO_2 emissions and its determining elements, such as digital economy, digital economy^2, IPCI, GDP, and REC. According to the findings (see Table 3), the CO_2 emissions, digital economy, IPCI, GDP and REC variables are all in a state of stable equilibrium with one another over the long term.

Table 3. Cointegration test.

Statistic	Value
G_t	-7.81***
G_a	-18.76***
P_t	-20.62***
P_a	-18.26***

Note: *** denotes significance at the 1% level.

The CS-ARDL econometric approach was utilized in this study for the purpose of empirically analyzing the impact that digital economy, ICPI, GDP and REC have on CO_2 emissions. Table 4 presents the results of CS-ARDL. According to the findings, digital economy, ICPI, GDP and REC are all significant elements that contribute to CO_2 emissions in China. There is an inverse relationship between CO_2 emissions and every other variable, with the exception of the linear terms of digital economy and IPCI. Several intriguing conclusions can be drawn from our findings: First, the linear term "digital economy" is positively related to CO_2 emissions. Second, the squared term of digital economy is negative. This suggests that early stages of digitalization are detrimental to the long-term health of the environment, but that later stages of digitalization can reduce CO_2 emissions through the use of the digital economy. This suggests that the process of digitalization will progress through numerous stages of development, which could have varying effects on CO_2 emissions and their decrease. In the initial stages, the utilization of digital technologies results in a rise in the magnitude of the demand for energy, which has the potential to hinder ecological sustainability. However, in later stages, the development of digitalization makes it easier for businesses to obtain financing. It also has a significant effect on technological progress, which may, in turn, affect CO_2 emissions and the ecological environment. The improved environmental performance can be attributed to the increased flow of knowledge made possible by digital technologies. The findings indicate that there is a corrosive relationship between IPCI and REC and CO_2 emissions. The CO_2 emissions of Chinese provinces have been lowered thanks to a greater emphasis on investments in industrial pollution control and an increase in the proportion of energy derived from renewable sources.

Table 4. Long-run and short-run results.

Variable	Long-run Coefficients	Short-run Coefficients
Digital economy	0.155*** [0.076]	0.142*** [0.013]
Digital economy2	-0.094*** [0.013]	-0.084*** [0.011]
GDP	0.217*** [0.061]	0.516* [0.032]
IPCI	-0.115*** [0.031]	-0.171*** [0.024]
REC	-0.218*** [0.005]	-0.137 [0.474]
ECM	-	-0.516*** [0.008]

Note: *** stands for significance at the 1% level.

5. CONCLUSIONS AND POLICY IMPLICATIONS

China has not only witnessed tremendous economic expansion over the past four decades, but it has also experienced a steep rise in the amount of energy consumed and the amount of carbon emissions produced. The Chinese government has made a voluntary commitment to reduce emissions as part of the Paris Agreement in order to take an active role in combating the effects of global warming. The expansion of digital finance can have a significant impact on the growth of production scale and technological progress, which, in turn, can have an effect on CO_2 emissions and the ecological environment. Hence, the purpose of this article is to investigate whether or not the digital economy can have an effect on CO_2 emissions, with the ultimate goal of offering some suggestions for the growth of a green economy in China. This study includes the squared term of the digital economy in the empirical model, which has been ignored in previous studies. Using the CS-ARDL method, it was found that the digital economy goes through multiple stages of development in affecting CO_2 emissions. In the initial stages, the utilization of digital technologies results in a rise in demand for energy, which has the potential to hinder ecological sustainability. However, in the later stages, the development of digital finance may lower the threshold of financial services, make it easier for businesses to obtain financing, and have a significant impact on the expansion of production scale and technological progress, which may affect CO_2 emissions and the ecological environment.

China has not only witnessed tremendous economic expansion over the past four decades, but it has also experienced a steep rise in the amount of energy consumed and the amount of carbon emissions produced. The Chinese government has made a voluntary commitment to reduce emissions as part of the Paris Agreement in order to take an active role in combating the effects of global warming. The expansion of digital finance can have a significant impact on the growth of production scale and technological progress, which in turn can have an effect on CO2 emissions and the ecological environment. Hence, the purpose of this article is to investigate whether or not digital economy can have an effect on CO_2 emissions, with the ultimate goal of offering some suggestions for the growth of a green economy in China. This study includes the square term of digital economy in the empirical model, which has been ignored in previous studies. Using the CS-ARDL method, we find that a digital economy goes through multiple stages of development that affect CO_2 emissions. In the initial stages, the utilization of digital technologies results in a rise in the magnitude of the demands for energy, which has the potential to hinder ecological sustainability. However, in later stages, the development of digital finance may lower the threshold of financial services, make it easier for businesses to obtain financing, and have a significant impact on the expansion of production scale and technological progress, which may in turn affect CO2 emissions and the ecological environment. The vast majority of China's provinces are in the process of digitally altering their economic structures, which has resulted in a shift in their business dynamics. All of these institutional and structural shifts have repercussions for the environment and climate change.

The most important inference that can be drawn from this study is that the digital economy has a negative association with CO_2 emissions in the later stages. In the early stage, the development of digital economy hampers ecological sustainability. In a subsequent stage, digital economy may guarantee environmental sustainability. Participation in DE and ongoing education have to be at the top of the priority list for companies. They have a responsibility to ensure that their current and future workforces have access to cutting-edge technologies and the skills necessary to scale digital technologies and revolutionize business processes in high-emission industries. It is of the utmost importance to ensure that the digital transformations that speed up the transition to clean energy are also sustainable and inclusive. This is necessary so that the benefits can be enjoyed by the greatest number of people possible. In addition, in order to guarantee that the adoption of these digital technologies will have a net beneficial impact on our world, we will need to take measures to lessen the carbon footprint that they will leave behind. In light of the regional characteristics, we are of the opinion that Chinese provinces should pay attention to the development of green technology, make effective use of the advantages of green technologies, improve energy efficiency, and promote the development of emission reduction technologies. This is because eastern and non-resource-based provinces are key carbon emission regions with higher economic development levels. It has been observed that the world's focus has switched to the concept of sustainability due to mounting evidence that modern human activities are rapidly eroding the environmental sustainability of our planet. Nonetheless, humanity as a whole should engage in collective efforts to reduce carbon emissions by adopting a "green" lifestyle and secure a sustainable way of life by establishing efficient and productive practices.

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