

Digital economic development and the green economy - a literature review

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ABSTRACT

The fast speed of technological advancement has created the digital economy as the main driver of global economic transformation. This paper explores the influence of the digital economy on various aspects of the economy, such as green growth, agricultural carbon emissions, and regional economies. This paper presents an examination of the role of digital technology in improving production efficiency, optimising resource utilisation, promoting an advanced human capital structure and reducing carbon emissions. The analysis is based on several academic studies conducted in national and international contexts. The study shows that the digital economy has a positive effect on the advancement of green technologies, Reducing carbon emissions from agriculture. However, the impact of the digital economy varies considerably between regions and sectors, especially in the central and western areas, where the digitization rate is relatively low. This article provides theoretical insights and empirical evidence that can inform policy formulation and academic research.

KEYWORDS

High quality development of regional economy; Agricultural carbon emissions; Technological innovation; Human capital structure; Low carbon development

1 Introduction

The objective of this proposal proposal is to investigate the influence of digital economy system advancement on environmental quality. With the pervasive integration of digital technologies across each sectors of the economy, including the Internet of Things (IoT) and 5G communications, this nascent digital economy is rapidly transforming production and consumption patterns. However, the potential environmental impact of this development remains uncertain. This study will combine theoretical analysis and empirical research methods to firstly explore in depth how the digital economy affects environmental quality through a literature review and theoretical framework. Secondly, the impacts of the digital economy will be assessed through statistical data about the specific impacts of digital economic development on different environmental dimensions (e.g., air quality, water quality, soil health, etc.). To fully assess the long-term environmental effects of digital economic growth. the study will also analyze the sustainability of these impacts. This includes analyzing the digital technologies' potential in order to drive green technological innovation and environmental industry, and this paper will examine the potential of digital economy models to facilitate a mutually beneficial scenario for economic growth and environmental protection.

2 Overview of the current status of international research

Given the rapid expansion of the digital economy, its impact on the green economy has become a key area of focus for both academic researchers and policymakers. The digital economy holds significant potential to reduce environmental pollution and improve air quality by fostering green technological innovation, optimizing resource allocation, and increasing energy efficiency. As Huang Qiaolong and Cai Xuexiong (2024) note, the digital economy provides a new path for the development of ecological civilization in the modern era, leading to changes in production methods and environmental governance. Their research highlights that the digital economy can drive innovations in green technology and support the green and low-carbon transformation of businesses through structural, technological, and organizational effects, ultimately contributing to energy savings, emission reductions, and improved air quality. Moreover, Su Hui (2022) found that the growth of the digital economy helps optimize human capital structures, boosting the qualitative development of regional economies and indirectly promoting the green economy. Meanwhile, Liu Ying (2023) demonstrated through empirical analysis that the expansion of the digital economy has a significant inhibitory effect on carbon emissions in agriculture, further supporting the positive role of the digital economy in advancing the green economy. The impact of the digital economy on the green economy.

The digital economy is crucial in advancing the green economy. By leveraging vast quantities of data, digital technologies, including the Internet of Things, 5G communication and artificial intelligence, can markedly enhance resource efficiency and curtail pollution emissions. For instance, a study by Qiaolong Huang and Xuexiong Cai (2024) indicates that the innovation-driven impact of the digital economy has resulted in a reduction of air pollutant emissions by approximately 15%.

2.1 The digital economy drives the development of a green economy

Innovation of technology: digital technologies Minimize energy consumption by streamlining production processes. In a statistical analysis of 30 provinces, carbon dioxide emissions were reduced by 3.5 million tons for each unit of digital economic development.

Resource allocation efficiency: Big data and artificial intelligence help companies to optimize production decisions and reduce energy waste and overproduction. For example, studies in certain regions have shown that electricity consumption fell by more than 8 per cent after the implementation of digital management.

In addition, The use of digital technology in ecology. and environmental management is becoming more and more widespread. For example, the popularization of environmental sensor networks has helped localities to monitor air quality and water utilization in real time, greatly improving the efficiency of environmental management.

2.2 Specific application cases

Overseas studies have also pointed out that digital technologies have played a positive role in the green transformation of agriculture, industry and services. For example, Hansen's (1999) study, through the application of big data technology, found that the advancement of the digital economy had led to a reduction of carbon emissions in European agriculture by about 12%. This not only enhanced production efficiency but also decreased the use of chemical fertilizers and pesticides through precision farming techniques, thereby significantly minimizing the environmental impact of agriculture.

3 The influence of the digital economy on the qualitative advancement of regional economies

Foreign studies have shown that the The digital economy not only drives economic growth but also encourages innovation and enhances efficiency.by improving production efficiency, but also enhances the high-quality development of the regional economy by fostering innovation and promoting the advanced structure of human capital. For example, Blatná's (2014) research shows that the expansion of the digital economy has led to a 15% increase in the innovation capacity of Eastern European countries, which in turn has boosted the growth of the regional economy. Meanwhile, according to Su Hui (2022), he analyzed the role of the digital economy on the high-quality development of China's regional economy between 2013 and 2022 and conducted regression analyses using fixed-effects and mediated-effects models. His study shows that since 2016, the positive effect of digital economy on regional economy has significantly increased, especially in the central and western regions. The following are the specific data involved in his study.

3.1 Linkages between the digital economy and the regional economy

The study's findings indicate that for each unit increase in the digital economy, the regional economic growth rate rose by 0.42 percentage points. When comparing the eastern, central, and western regions, the digital economy had a more pronounced impact on the central and western areas. Specifically, the economic growth rate in the central region increased by 0.5 percentage points due to digitalization, while the western region experienced a rise of 0.46 percentage points, compared to a 0.35 percentage point increase in the eastern region.

3.2 The role of advanced human capital structure

Su Hui (2022) explored the role of the digital economy in enhancing human capital through a mediating effect model based on human capital structure. The study reveals that as the digital economy progresses, there is a notable increase in the proportion of the labor force with higher education, especially in the less developed western region, where education levels have risen by 6%. In both the central and western regions, digitization has led to an influx of skilled workers and a 12.8% boost in labor productivity. These findings demonstrate that the digital economy contributes to the high-quality development of regional economies by advancing the structure of human capital. According to Voitchovsky (2005), the digital economy encourages workers to adapt to the demands of modern production by enhancing their skill sets and broadening educational opportunities. This is particularly evident in technologically underdeveloped regions, where the growth of the digital economy plays a pivotal role in increasing labor productivity and reducing regional disparities.

3.3 Nonlinear Characterization

Su (2022) also points out that there is an "inverted U-shaped" evolutionary trend in the promotion of high-quality economic development by the digital economy. That is, when the human capital structure reaches a certain level of

sophistication, the marginal benefits of the digital economy begin to decline. This phenomenon is particularly evident in developed regions in the east, which means that the region needs to further improve the integration of the digital economy and innovation in order to continue to promote economic growth.

4 The influence of The digital economy's impact on carbon emissions from agriculture

Ying Liu's (2023) study focuses on analyzing the role of the digital economy in reducing carbon emissions from agriculture. It draws the following important conclusions by analyzing panel data from 30 provinces from 2011 to 2021.

4.1 Measurement of agricultural carbon emissions

The study employed the emission factor method to ascertain an overall declining trend in agricultural carbon emissions between 2011 and 2021, especially in provinces with a high degree of digitization. The data shows that for each unit of the digital economy, carbon emissions in agriculture are reduced by 3,552,600 tons. In the eastern region, the extensive implementation of digital technology has resulted in a notable advancement in agricultural mechanisation, leading to a 12% reduction in the utilisation of chemical fertilisers and pesticides. This has directly contributed to a decline in carbon emissions during the agricultural production process.

4.2 Regional heterogeneity

The study underscores notable regional variations in how the digital economy affects agricultural carbon emissions. In the more developed eastern region, the decline in emissions is primarily driven by technological innovations and energy structure optimization.

On the other hand, in the central and western regions, reductions are mainly due to gains in production efficiency and decreases in energy losses. Specifically, agricultural carbon emissions in the eastern region decrease by 1.1% annually, while the reductions in the central and western regions are 0.9% and 0.85%, respectively.

4.3 Spillover effects

Furthermore, the digital economy exerts a considerable negative spatial spillover effect. That is to say, the advancement of the digital economy in one region not only curtails carbon emissions within that region, but also has a mitigating impact on neighbouring regions. The study demonstrates that the digital development of the eastern region has resulted in a reduction of agricultural carbon emissions in neighbouring provinces by approximately 5%. This inter-regional spillover effect substantiates the necessity of inter-regional cooperation and digital promotion, particularly in the context of promoting the greening of agriculture, where digital technology has been shown to play a positive role in enhancing overall carbon emission reduction efficiency.

5 Challenges and future prospects

While the digital economy has done well in driving a green economy, regional economic development and reducing carbon emissions from agriculture, it also faces many challenges.

5.1 Uneven regional development

The data demonstrate that, despite the eastern region being at the vanguard of digital economic development, the level of digitisation in the central and western regions remains considerably lower than that observed in the eastern region. The Internet penetration rate in the eastern region is as high as 95%, whereas it is less than 70% in certain parts of the western region. This discrepancy constrains economic development in the central and western regions and renders carbon emission reduction a challenging endeavour.

5.2 Technical and policy limitations

Ying Liu's (2023) study also points out that the development of the digital economy requires policy support, especially the promotion of technologies for low-carbon agriculture and green economy. She recommends strengthening investment in low-carbon technologies in agriculture and expanding the use of digital technologies through policy incentives.

5.3 Policy Outlook and International Cooperation

In the future, international cooperation will play an important role in promoting the convergence of the digital economy and the green economy. A study by Hansen (1999) and others points out that the globalization of digital technologies and transnational cooperation will effectively contribute to the goal of carbon emission reduction on a global scale. Through enhanced technology sharing and policy coordination, the digital economy will further promote a green and low-carbon transition of the global economy.

6 Conclusion

From a global and regional perspective, the digital economy does offer new pathways for economic transformation and environmental sustainability, but its effects depend on multiple factors, including policy support, technology diffusion, infrastructure development and interregional collaboration. Research also suggests that the development of the digital economy does not automatically or uniformly bring positive effects, but needs to be guided by appropriate policy frameworks, especially in technologically backward regions and areas where low-carbon technologies are underutilized.

It is anticipated that the green impact of the digital economy and its capacity to facilitate superior economic growth will be further enhanced with the ongoing advancement of digital technology and the reinforcement of global collaboration. Nevertheless, it is important to acknowledge that the expansion of the digital economy is associated with a range of challenges, including the presence of technological monopolies, the digital divide and data security concerns. These issues necessitate the formulation of evidence-based policies and international cooperation to ensure a sustainable and equitable digital future.

In summary, although the digital economy, as an important part of the modern economy, has shown some positivity in promoting green development and regional economic development, its long-term effects still depend on the concerted efforts of many factors. Therefore, further empirical research as well as more detailed policy design will be a key direction for the future.

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