

Study on the pattern evolution and reasons of the coordination between digital economy and green development

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Abstract

The Recommendations on the Fourteenth Five-Year Plan and the Vision and Goals for 2035 suggest that the digital economy and green development have risen to the level of a national strategy, and that the study of their coupling and coordination and their spatial relevance can serve as a strong theoretical support for major national strategies. Based on the connotation of digital economy and green development, this study analyses the evolution of the temporal and spatial patterns of digital economy and green development by plotting the temporal change of the coupling coordination degree and the kernel density estimation of the whole country and each region, respectively. Finally, based on the findings of this study, policy recommendations are made for China's digital economy and green development and the synergistic development of the two.

Keywords

Digital economy, green development, spatial and temporal evolution.

1. Introduction

The 14th Five-Year Plan for the Development of Digital Economy proposes that China's digital economy will shift to a new stage of deepening application, standardised development and universal sharing. The report of the 19th National Congress emphasises that accelerating the improvement of a green and low-carbon economic system, and adhering to the concept of green development is the only way to achieve sustainable economic development. The report of the "19th National Congress" emphasised the importance of accelerating the development of a green and low-carbon economic system. Green development provides strategic guidance and broadens the development pattern of digital economy, while digital economy can reduce transaction costs and promote sustainable development, and the two promote each other. Therefore, in the context of tightening resource constraints and accelerated development of information technology, it is of great significance for economic and social development to study the coupled and coordinated relationship between digital economy and green development.

1.1. Theoretical significance

First, in the context of the new era of technological revolution and industrial transformation, as well as the tightening of strategic resources and the sharp contradiction between man and land, the study of the coordinated relationship between digital economy and green development and its spatial relevance is conducive to triggering more attention from the academic community to the digital economy and green development, and to broadening the perspective of the study and its horizons; second, it is to clarify the strategic value, influencing factors, and functioning mechanism of the coupling and coordination of digital economy and green development, which has certain theoretical value to Deepening the research in related fields and enriching

environmental economics has certain theoretical value; Third, according to the contents of the National People's Congress in 2022 and the Recommendations on the Fourteenth Five-Year Plan and the Visionary Goals for the 2035 Years, it can be seen that the digital economy and green development have been upgraded to a national strategy, and the study of the coupling and coordination relationship between the two and their spatial correlation can serve as a strong theoretical support for the major national strategies.

1.2. Practical significance

First, the establishment of the evaluation index system of digital economy and green development, and the study of the coupling and coordination of the two and their spatial relevance can provide a theoretical basis for the formulation of policies and programmes related to the digital economy and green development in various places; second, the study of the evolution of the spatial and temporal pattern of the coupling and coordination of the digital economy and green development and its reasons will help China to grasp the opportunities of the development of the scientific and technological revolution and industrial transformation of the new era, and to participate in the formulation of international rules and standards, and to enhance its participation in the field of digital development. international rules and standards, and enhance China's international competitiveness in the field of digital economy. At the same time, it is conducive to easing the contradiction between people and land, improving the resource utilisation rate, and promoting the green and sustainable development of the economy; thirdly, research on the coupling and coordination relationship between the digital economy and green development in the context of the times will help provide targeted policy recommendations for the current stage of the digital economy and green development, as well as for the problems that exist in the process of the synergistic development of the two.

2. Literature Review

The proposal and development of digital economy and green development have attracted extensive attention from scholars at home and abroad and have been discussed from different angles.

2.1. Research on digital economy:

Evaluation of development in specific spatial scope: Cheng Guangbin and Li Ying (2022) used entropy weight TOPSIS method and DEA network analysis to measure the input-output efficiency of the digital economy in China's provinces, and the results showed a spatial pattern of "higher in the east than in the west, higher in the south than in the north". Wang Juan et al. (2022) conducted a comparative study of the digital economy and trade in China, the United States and Europe, and found that China's digital economy and trade are in the state of "big but not excellent, fast but not first, surplus but not winning".

Analysis of the impact on the development of various industries: the digital economy can significantly promote the development of national and regional trade in services (Tao Aiping, Zhang Zhen, 2022), the vSport sports value chain and China Mobile Migu live broadcast of CBA events as an example, to analyse the digital economy to drive the high-quality development of the sports industry is of great significance (Shen Keyin et al., 2021), the digital economy empowers the transformation and upgrading of the manufacturing industry (Wang Guiduo et al., 2021). Upgrading (Wang Guiduo et al., 2021) can promote the high-quality development of regional economy, and digital economy and high-quality development present the characteristics of spatial agglomeration (Zhou Shaofu, Chen Yahui, 2022)

2.2. Research on green development:

Selection of the object of analysis: the current research objects on green development are mainly specific industries, provinces, economic zones, countries, the world and so on. Deer Chenyu et al. (2022) used the Spatial Durbin Model (SDM) and other methods to analyse the level of green development of China's industry in time and space, and the results show that the level of green development of China's industry is fluctuating and rising, and the space presents the development pattern of "East > West > Central". Xu Ye, Ouyang Wanhua (2022) analysed the dynamic measurement and spatial-temporal evolution of urban green development level in Jiangxi Province from 2011 to 2018. He Jian, Wang Xinai (2017) established a dynamic Malmquist model through SBM analysis to measure the green efficiency index of industries and the technological progress index of the Yangtze River Economic Belt. Rüstemoğlu Hasan et al. (2019) investigated Germany's ecological footprint by analysing ecological capacity and ecological footprint data.

The construction of the indicator system: based on reviewing the existing foreign literature on the theoretical research and analysis of policy recommendations on green economy, Tang Xiao (2014) summarised that the change of the indicator framework of green economy can be divided into three stages: single ecosystem target stage, economic-ecosystem target stage, economic-ecological Social three-dimensional composite system target stage. Satbyul Estella Kim et al. (2014) selected the OECD framework and 12 indicators for the cross-country comparison of green growth strategies. Bartelms' (1988) *The Theory and Practice of Environmental Accounting*, which comprehensively reflects the important achievements of the international income in environmental accounting, contains the theory and practice of integrated environmental and economic accounting, and the content of this book includes a comprehensive environmental and economic accounting. contains modelling theory and analytical applications of integrated environmental and economic accounting.

2.3. Research on the coupling and coordination relationship:

At this stage, the research on the coupled and coordinated development of the digital economy and green development is mostly a single impact study of the digital economy on green development, and most of them select a specific industry or region. Cai Ling and Wang Ping (2022) analysed the impact of the level of digital economy development on urban green total factor productivity and the mechanism of action, and the results present the conclusion that the development of the digital economy significantly promotes the green total factor productivity of Chinese cities. Liu Yi et al. (2022) studied the coupling effect and symbiotic path of the digital economy empowering the green development of traditional manufacturing industries in the Yangtze River Delta (YRD), and concluded that IT science and technology has a more significant impact on the coupled clusters of traditional manufacturing industries in the YRD green development.

From a comprehensive point of view, the current research in this field still has the following shortcomings: Existing literature mostly analyses the impact of the digital economy and green development on economic and social development, and lacks of research on the coupling and coordination of the two interactive relationship, and most of the literature only studies the unidirectional role of the digital economy on green development, ignoring the bidirectional role of the digital economy and green development mechanism; The existing literature mostly focuses on the construction and measurement of digital economy or green development indicators for specific provinces and cities in China, and there are few studies on the establishment of digital economy and green development indicator system from the national level as a whole; The qualitative research in the current literature is mostly qualitative, and the quantitative research level needs to be supplemented.

3. Connotation analysis

The digital economy is a product of the information age, through the direct or indirect digital presentation, selection and use of information, to achieve the advantageous reorganisation of resources, and to achieve the role of promoting economic quality and efficiency. The digital economy has swept the world at an unprecedented speed, not only achieving high-speed development in emerging industries through blockchain, big data, artificial intelligence and other technologies, but also penetrating into traditional industries, adopting such means as: Internet + agricultural planting supervision, Internet of Things + intelligent logistics, big data + precision marketing, etc., to promote the transformation and upgrading of traditional industries, and achieve economic and social benefits. The digital economy brings many opportunities and challenges, and has become an important growth point of the economy and a key force in the competition between countries.

Green development is a new model that inevitably arises from a certain stage of economic development, adding the consideration of ecological and environmental carrying capacity and resource sustainability to the traditional economic development model. In the context of increasingly severe global ecological and environmental problems, tightening resource constraints, and acute conflicts between people and land, green development has become a necessary path and a general trend for sustainable economic development. Existing research has a lot of extended thinking about the concept of green development, Hu Angang and Zhou Shaojie (2014) analysed the mechanism of the three systems of economy, society and ecology interacting with each other and working together; Qin Shusheng and Hu Nan (2017) launched a reflection on the relationship between green development and specific lifestyles, and proposed that ecological well-being be the ultimate value realization of green development. This paper argues that green development is a directional concept of development, and economic and social activities under the guidance of this concept can better achieve balance.

4. Evolution of spatio-temporal patterns

4.1. Temporal change

In order to further compare and analyse the trend of the coupling coordination level of the digital economy and green development in the country and regions in the time dimension, this paper draws a time-order change map of the coupling coordination degree of the country and regions, as shown in Figure 1. Overall, the national and regional digital economy and green development coupling coordination level shows a gradual increase. Among them, the coupling coordination level increased at a faster rate from 2011 to 2013, and the coupling coordination level increased at a slower rate from 2013 to 2019. Sub-regionally, the coupling and coordination degree of digital economy and green development shows a gradually decreasing development trend from east to west. Both the digital economy and green development in the eastern region are at a high level, which promotes the coupling coordination between the former and the latter in the eastern region. On the other hand, the central and western regions have a weaker foundation for the development of both, and although the development rate is impressive, the coupling and coordination of the two is still lower than the national average.

4.2. Spatial change

In this paper, four years, 2011, 2014, 2017 and 2019, are selected to depict the morphological distribution of the coupled coordination degree of digital economy and green development over time through kernel density estimation, and then analyse the dynamic distribution characteristics of the coupled coordination degree of digital economy and green development in China.

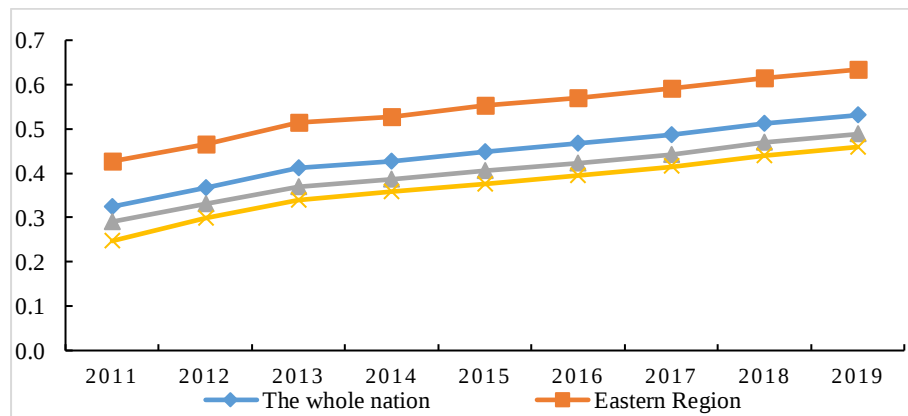


Figure. 1 Time series change of the coupling and coordination degree of digital economy and green development of the whole country and each region from 2011 to 2019.

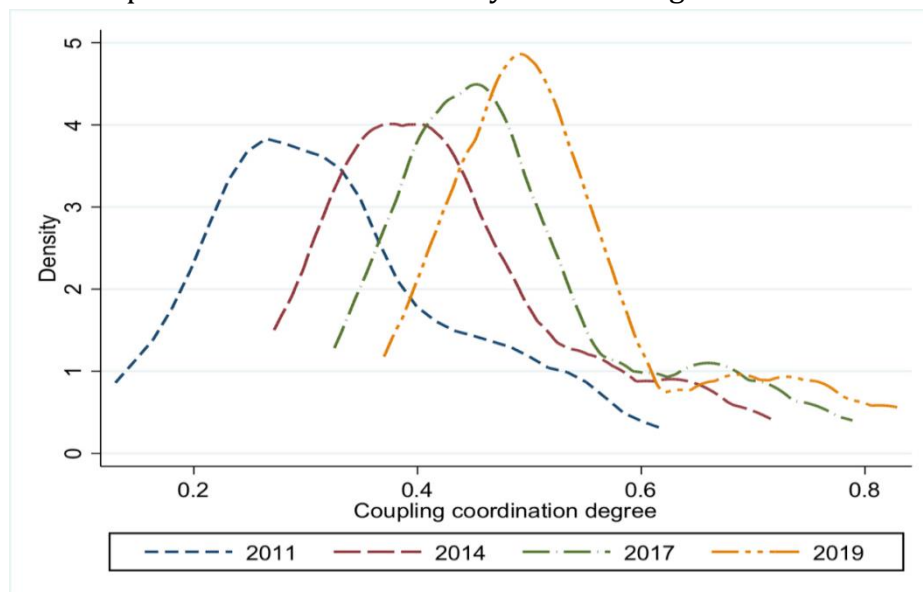


Figure. 2 Kernel density estimation of the coupling coordination degree of digital economy and green development

As shown in Figure 2, the right side of the curve of the degree of coordination of the coupling of digital economy and green development in the four years has a long trailing distance, reflecting the obvious differences between regions. In terms of time series, the coupling coordination curve of the four years gradually shifted to the right, and the height of the wave peak gradually increased and the opening became smaller, reflecting a steadily rising development trend, and the degree of concentration gradually increased, and the differences between provinces and municipalities were reduced. At the same time, the rightward shift of the curve of the coupling coordination degree of digital economy and green development between 2011 and 2014 is the largest, indicating that the level of coupling coordination between China's digital economy and green development increased the most between 2011 and 2014. In addition, after 2014, the coupling coordination degree curve changed from a single-peak pattern to a double-peak pattern, indicating that the coupling coordination degree of China's digital economy and green development showed polarisation, with some provinces and municipalities gradually concentrating on high coupling coordination levels.

5. Conclusions and recommendations

5.1. Conclusion

Based on the connotation of digital economy and green development, this study analyses the changes in the temporal and spatial patterns of digital economy and green development by plotting the temporal changes in the degree of coordination between digital economy and green development and kernel density estimation for the whole country and each region from 2011 to 2019. Finally, on the basis of the research results, policy recommendations are made for the digital economy and green development and the synergistic development of the two in China. The following conclusions are drawn: the level of digital economy and green development has increased significantly. The former is developing at a faster pace. The regional differences in the level of digital economy and green development are very significant, generally showing a decreasing trend from the southeast coast to the northwest inland; the overall degree of coordination between digital economy and green development shows a rising trend year by year, and the coordination level of some provinces and cities on the east coast is in the leading position in the country, while the northwest and northeast regions are relatively backward and the speed of improvement is slow.

5.2. Suggestions

Based on the study of the evolution of the temporal and spatial patterns of coordination between China's digital economy and green development, this paper puts forward the following recommendations.

Emphasis on improving regional coordinated development: The state and the region should uphold the concept of coordinated regional development, and carry out reasonable and effective macro-control in terms of strategic approaches, financial expenditures, and policy preferences. Give appropriate policy tilts to regions such as northwestern, southwestern, and central China that are lagging behind in terms of development level and coupled coordination level, look for more development driving points according to local conditions, improve the general environment for regional development, and encourage eastern provinces and municipalities with faster development to drive the lagging regions in terms of development through one-on-one key assistance and other forms.

Promote the deep integration of digital economy and green development: As the digital economy can bring a strong driving force for green development, green development of the digital economy to provide a fundamental direction guide, the coupling of the two coordinated development to help promote sustainable economic and social development. In the development process of the digital economy should fully implement the concept of green development, through the promotion of industrial agglomeration, integration of upstream and downstream industrial resources, the implementation of intensive production mode and other ways to play the effect of economies of scale, to achieve the efficient use of resources, reduce the emission of pollutants, and to promote the realisation of a sustainable model of circular economy development.

Improve the overall level of digital economy and green development: The study of the coupling and coordination level of digital economy and green development found that the level of digital economy or the level of green development in some regions is relatively backward, which restricts the improvement of the coupling and coordination level. In this regard, the country or region can take measures to promote the optimisation and upgrading of the digital economy by managing the marketing environment and the innovation environment, attaching importance to the cultivation of national talents related to the digital economy, and strengthening the inclination of policy preferences in the field of the digital economy. It can also inspire enterprises to enhance their sense of social responsibility by strengthening ideological

leadership, implementing material incentives and constructing demonstration zones, and take the concept of green development as a fundamental requirement for enterprise development, so as to help realise the green and sustainable development of the economy.

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References

- [1] L. Cai, P. Wang: Digital economy and urban green total factor productivity: influence mechanism and empirical evidence[J]. *Statistics and Decision Making*, (2022) No.09, p.11-16.
- [2] G.B. Cheng, Y. Li: Evaluation of regional differences and efficiency of digital economy development level based on input-output perspective[J]. *Statistics and Decision Making*, (2022) No.08, p.109-113.
- [3] J. He, X.A. Wang: Research on the green development of industries in the Yangtze River Economic Belt under the perspective of regional synergy[J]. *Science and technology progress and countermeasures*, (2017) No.11, p.41-46.
- [4] Y. Liu, X. Zhao, H.L. Bian: Research on the coupling effect measurement and symbiotic path of traditional manufacturing green development in the Yangtze River Delta empowered by digital economy[J]. *Journal of University of Electronic Science and Technology (Social Science Edition)*, (2022) No.02, p.78-85+112.
- [5] C.Y. Lu, W. Cheng, P. Huang, X.W. Liu, X.L. Tang: Comprehensive spatial and temporal measurement of China's industrial green development level and analysis of influencing factors[J]. *Ecological Economy*, (2022) No.03, p.54-61+69.
- [6] K.Y. Shen, Y.L. Zeng, Q.Q. Dong, L.L. Mou, W.G. Lv: Theoretical Explanation and Practical Path of High Quality Development of Sports Industry Driven by Digital Economy[J]. *Journal of Wuhan Institute of Physical Education and Sports*, (2021) No.10, p.5-12.
- [7] X. Tang: Review of the latest development of green economy theory[J]. *Foreign Theory Dynamics*, (2014) No.01, p.125-132.
- [8] A.P. Tao, Z. Zhang: The Impact of Digital Economy on the Development of Trade in Services--An Empirical Study Based on Country-Level Panel Data[J]. *East China Economic Management*, (2022) No.07, p.1-14.
- [9] G.D. Wang, L.S. Cui, J.F. Zheng, C.Z. Wang: Digital economy empowers the transformation and upgrading of manufacturing industry: heterogeneity influence mechanism and effect[J]. *Journal of Statistics*, (2021) No.05, p.9-23.
- [10] J. Wang, Y.J. Zhang, J. Song, P.W. Zhang: A comparative study of digital economy and trade between China, the United States and Europe[J]. *Journal of Xi'an Jiaotong University (Social Science Edition)*, (2022) No.03, p.1-15.
- [11] Y. Xu, W.H. Ouyang: Dynamic Measurement and Influence Mechanism of Urban Green Development Level in Jiangxi Province[J]. *Yangtze River Basin Resources and Environment*, (2022) No.07, p.1-17.
- [12] S.F. Zhou, Y.H. Chen: Research on the Impact of Digital Economy on the High Quality Development of Economy--Based on the Perspective of Structural Upgrading of Service Industry[J]. *Industrial Technology Economics*, (2022) No.05, p.111-121.