

Review on the Impact of Urban Resilience on Urban Green Total Productivity

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ABSTRACT

In the process of urbanization in recent years, the city as the main place where people live and live, the importance of its resilience is increasingly prominent. Enhancing urban resilience can not only reduce the negative impact of natural disasters on economic activities, but also significantly improve the ecological and economic benefits of cities by optimizing resource allocation and promoting technological innovation. This paper expounds the research results on the impact of urban resilience on green total productivity in the existing literature, and analyzes the urban resilience factors, including the impact of four sub-systems, namely, economic resilience, social resilience, ecological resilience and infrastructure resilience, on the green Total factor productivity. Finally, the possible complex interaction among these factors is analyzed, and the future research directions and suggestions are put forward.

KEYWORDS

Urban resilience; Green total factor productivity

1. INTRODUCTION

Urban resilience refers to the resilience and adaptability of a city system in the face of internal and external shocks. As the carrier of economic development, on the one hand, high-quality population and resource elements gather together to bring rapid development and social progress to the city, on the other hand, the resource consumption and environmental pollution caused by the rapid economic development are becoming more and more serious. The urban resilience has the ability to absorb external disturbances, reduce disaster losses, recover quickly and adjust dynamically, even break through the development, and become an important source of urban green development. Therefore, this paper summarizes the relevant literature on urban resilience and green Total factor productivity, combs the existing research results, and analyzes the mechanism and influencing factors of urban resilience and green Total factor productivity, the analysis and evaluation of urban resilience and green Total factor productivity can provide reference for effectively promoting green Total factor productivity and sustainable urban development, and enrich relevant theoretical knowledge and empirical experience.

2. REVIEW OF URBAN RESILIENCE RESEARCH

Urban resilience is a complex concept, mainly manifested in the multiple abilities transformation of urban resilience, the integration of multiple elements in urban environments, and the multiple temporal and spatial characteristics of urban resilience. Currently, most measurements of urban resilience use methods such as entropy, analytic hierarchy process, expert scoring to construct

indicators for measuring urban resilience and grey evaluation models to assess the degree of urban resilience. Regarding the indicator system of urban resilience, Qian et al. [1] constructed indicators for economic resilience, social resilience, ecological resilience, and infrastructure resilience from the perspective of urban system elements to study the impact of smart cities on urban resilience. Some scholars have selected 21 parameters from five dimensions including infrastructure, society, economy, institutions, and nature to study the resilience evaluation of the Chennai community in India (Joerin et al. [2]). Some scholars have identified adaptability, resistance, and recovery as important characteristic factors of urban resilience, proposing a resilience model. Research has found that the greater the intensity of disaster damage, the more severe the damage to urban system functions, and the earlier the peak intensity of disaster damage occurs, the faster the rate of damage to urban system functions (Changkun et al. [3]). Therefore, this article will elaborate on the economic resilience, ecological resilience, social resilience, and infrastructure resilience of urban resilience.

2.1. Urban Economic Resilience

In terms of urban economic resilience, Wolman et al. [4] believe that urban economic resilience refers to the ability of a city's economy to maintain or restore its original balance after being influenced by external factors, meaning the city's economy is either unaffected or can quickly recover from shocks. Ubago et al. [5] constructed a comprehensive index of regional economic resilience in Spain based on dimensions such as industrial structure, capital value, labor force, and economic development level. He Jiahui et al. [6] used the Chengdu-Chongqing Economic Circle as a spatial carrier, and analyzed the development level of urban resilience and technological innovation, the characteristics of gravity center changes, and the level of coupled and coordinated development of the Chengdu-Chongqing Economic Circle from 2005 to 2019 using methods such as entropy value method, gravity model, and modified coupling coordination degree model. The study found that the development levels of urban resilience and technological innovation have been steadily increasing, and the level of coupled and coordinated development between urban resilience and technological innovation is also steadily improving. Xiao Chunmei et al. [7] measured the level of digital economy and urban resilience using panel data from 285 prefecture-level and above cities, and found that the digital economy can enhance urban resilience by increasing entrepreneurial activity, technological innovation, and human capital levels in cities. Zhong Xuesi et al. [8] calculated the coupling coordination degree of digital economy and urban resilience in the city clusters of the 19th National Congress of the Communist Party of China, and found significant spatial heterogeneity in the coupling coordination degree of the TD system among city clusters, as well as spatial neighbor effects between city clusters.

2.2. Urban Ecological Resilience

In terms of urban ecological resilience, Wu and Loucks [9] believe that ecology in cities consists of nested patches that interact with each other, and through internal structures, they complement each other in the spatiotemporal evolution process to enhance urban ecological stability. Alberti and Marzluff [10] point out that urban ecosystems, as a result of human activities and natural habitats, exhibit resilience in terms of ensuring and controlling the operation scale of various social, economic, biological, and physical processes. Zhang Mingdou et al. [11] used spatial econometric models to study the influencing factors of urban ecological resilience in 54 cities at the prefecture level or above in the Yellow River Basin. The study found that urban ecological resilience shows significant spatial agglomeration and regional differentiation characteristics, with levels of openness, infrastructure construction, and government intervention exhibiting positive spillover effects, while the degree of environmental pollution shows negative spillover effects. Gao Lu et al. [12] used a combination of entropy weight and GIS to construct an evaluation index system for urban green and safe resilience, analyzing the influencing factors of internal resilience differences and their spatial differentiation characteristics within cities.

2.3. Urban Social Resilience

In terms of urban social resilience, Ribeiro et al. [13] believe that social economy, community capital, demographic characteristics, social risks, human capital, lifestyle, etc. are social factors that influence urban resilience. Saja et al. [14] summarized that the most widely used social resilience indicators include social demographic characteristics, social capital, community participation, social values, health services, and community capacity. Joshua et al. [15] believe that factors such as assets, flexibility, social organization, learning, social cognitive structure, and agency capacity can enhance social-ecological resilience. Ma Haonan et al. [16], using 16 prefecture-level cities in Anhui Province as the research objects, found that urban resilience is significantly positively correlated with the level of urbanization coordination. Yang Xiaodong et al. [17] constructed a city resilience grey evaluation model based on 31 provinces in China, analyzing the spatial relationship of resilience levels among provinces. The study found that the correlation of resilience levels among provinces is low, showing a random distribution but with local clustering. The development of economic resilience, infrastructure and social service resilience, ecological resilience, information resilience, and disaster prevention and control resilience is not coordinated.

2.4. Resilience of urban infrastructure

In terms of urban infrastructure resilience, Shi et al. [18] believe that urban infrastructure mainly includes urban buildings, transportation facilities, public infrastructure, and communication facilities. Urban buildings provide residential and work functions for urban populations. Pal and Bhatia [19] believe that reducing the vulnerability of buildings and improving safety performance are the primary guarantees for safeguarding people's lives and property. Zhang et al. [20] believe that transportation networks play an important role in disaster relief, and the better the performance of road transportation, the more conducive it is to rescue efforts. Public infrastructure and communication facilities provide convenience for urban residents in their daily lives and work, maintaining smooth information flow with the outside world, and supporting the development of urban resilience. Chen Suchao et al. [21] used configurational thinking and fsQCA method to study the synergistic linkage mechanism of influencing factors in 45 cities in China, with digital infrastructure, digital economy, digital society, digital government, and digital ecology as conditional variables, conducting configurational analysis to explore the path of enhancing urban resilience.

3. REVIEW OF GREEN TOTAL FACTOR PRODUCTIVITY RESEARCH

The calculation method of green total factor productivity has evolved from and continuously improved upon the calculation method of total factor productivity. By the end of the 20th century, the proposal of an environmental regulatory behavior analysis model based on directional distance functions laid the methodological foundation for the study of green total factor productivity. By incorporating environmental pollution as a negative externality and unexpected output into the analysis process, it provided a basic analytical framework for the study of green total factor productivity.

3.1. Macro Regions

From a macro-regional perspective, Chen et al. [22] used directional distance function to calculate the green total factor productivity of 63 countries from 1981 to 2005. Lindikaya et al. [23] analyzed the growth of agricultural total factor productivity (GATFP) in African countries using the GML index and compared it with TFP. They found that in most African countries, TFP exceeded GATFP, suggesting the need for specific policies to encourage sustainable growth in agricultural productivity. Wang Yujin and Yu Wei [24] used a spatial econometric model to calculate the inter-provincial green total factor productivity of China from 2001 to 2014 and conducted empirical analysis on its

convergence and divergence. They found that the inter-provincial green total factor productivity in China showed a slow growth trend, with green technological progress contributing more significantly than green efficiency growth. They also suggested that improving the inter-provincial coordination of total factor productivity under resource and environmental constraints depends on promoting urbanization and industrial upgrading in lagging regions. Xu Xiaohong and Wang Xia [25] used the Malmquist-Luenberger productivity index based on directional distance function to calculate the GTFP and its sources in 30 provinces of China, as well as in two, three, and four major regions, from 2000 to 2014, considering energy consumption and environmental pollution. The study found that the growth of China's GTFP mainly depends on green technological progress rather than the improvement of green technological efficiency, and regional green economic growth at different spatial scales shows significant heterogeneity characteristics under different selection criteria. Su Hua et al. [26] analyzed the spatiotemporal evolution characteristics and influencing factors of GTFP based on the urban data of 191 prefecture-level and above cities from 2011 to 2018. The study found that the level of economic development, environmental regulations, and human capital can effectively improve the level of GTFP.

3.2. Meso Industries

From the perspective of intermediate industries, Fuwei et al. [27] used a super-efficiency model to study the impact of agricultural credit investment on the green total factor productivity of agriculture. They found that agricultural credit investment can significantly promote the improvement of green total factor productivity in the local area, while hindering the green total factor productivity in adjacent areas. Li Ling and Tao Feng used the SBM directional distance function and Luenberger productivity index to measure the green total factor productivity of 19 pollution-intensive industries in the Chinese industrial sector from 2004 to 2008. Their research found that the scale structure and environmental regulation level of pollution-intensive industries play a driving role in improving green total factor productivity. Chen Yang and Tang Xiaohua [28] used data from 285 cities in China to empirically test the spatial spillover effects of manufacturing agglomeration on urban green total factor productivity. They found that considering the internal and external status of manufacturing, the effect of manufacturing agglomeration on urban green total factor productivity shows a trend of "first rising then falling".

3.3. Micro Enterprises

From the perspective of micro-enterprises, Li Ying and Xu Yuemeng [29] based on the data of listed manufacturing companies from 2007 to 2018, used the super-efficiency SBM model and GML index method to calculate the green total factor productivity of enterprises. They found that under the background of the transformation from business tax to value-added tax, service-oriented manufacturing enterprises showed a significant improvement in GTFP compared to other enterprises. Sun Lixiang et al. [30] used panel data matching urban and Chinese industrial enterprises from 2005 to 2013 to analyze the enabling effects and mechanisms of synergistic agglomeration of productive service industry and manufacturing industry on enterprise GTFP. They found that the synergistic agglomeration of productive service industry and manufacturing industry promoted the improvement of enterprise GTFP. Based on panel data of Chinese listed companies from 2008 to 2020, Hui Xianbo analyzed the impact of the construction of national-level new areas on the high-quality development of enterprises. The study found that the construction of national-level new areas incentivizes high-quality development of enterprises through "policy effects," "agglomeration effects," and "institutional effects."

3.4. Urban Development

In addition, there is also abundant research on the impact of urban development on the green total factor productivity. Xu Haicheng et al. [31] constructed a panel threshold model to analyze the nonlinear impact of transportation infrastructure on green total factor productivity, finding that the growth rate of green total factor productivity in China decreases in the order of east, central, and west regions, and that there is a single threshold effect of transportation infrastructure on green total factor productivity. Liu Bei, Huang Weidong [32] used a dynamic panel model to study the impact of new digital infrastructure on green total factor productivity, and found that new digital infrastructure mainly enhances green total factor productivity by promoting innovation in renewable energy technologies and optimizing industrial structure. In terms of smart city construction, some scholars believe that smart city construction can promote the improvement of green total factor productivity by enhancing regional technological innovation capabilities, environmental regulatory levels, and the level of industrial structure serviceization [33]. Over time, green total factor productivity has been increasing to varying degrees, with technological progress being the dominant factor driving urban green growth. However, as urban scale expands, the promoting effect on technological efficiency continues to weaken until it is no longer significant [34].

4. SUMMARY

In summary, the academic research on urban resilience and green total factor productivity has developed a relatively complete research framework in terms of relationship definition, research methods, and mechanisms, providing a solid theoretical basis and practical reference. It can mainly be summarized by the following characteristics: (1) The connotations of urban resilience and green total factor productivity continue to expand. With the evolution of history and policy changes, the concepts of urban resilience and green total factor productivity have gradually enriched, related indicators have dynamically changed, and measurement methods have also been continuously improved. (2) Research on the relationship between urban resilience and green total factor productivity continues to deepen. This is mainly manifested in the impact of certain variables of urban resilience on green total factor productivity, such as industrial structure, human capital, and labor force. (3) The research on green total factor productivity and related dimensions of urban resilience indicators is gradually expanding. With the high-quality development of the economy, scholars are delving deeper into the discussion of green total factor productivity, and research on related indicators is also becoming more extensive.

Although the existing literature is very rich, most of the previous studies are about the dimensions or indicators related to urban resilience and green Total factor productivity, there is a lack of holistic and systematic analysis of green Total factor productivity and urban resilience, and the analysis of urban resilience and green Total factor productivity needs to be explored. To study the mechanism of the impact of urban resilience on green Total factor productivity, to reveal its internal principles, and to explore the impact of urban resilience on green Total factor productivity from the perspective of realistic influencing factors, and the mechanism of its effect on green Total factor productivity was verified. In order to make up the shortage of the existing literature, expand the existing research results, to promote our urban green development to provide theoretical guidance and empirical interpretation.

REFERENCES

- [1] Qian Zhou, Mengke Zhu, Yurong Qiao, et al. Achieving resilience through smart cities? Evidence from China [J]. *Habitat International*, 2021, 111: 102348.
- [2] Jonas Joerin, Rajib Shaw, Yukiko Takeuchi, et al. Action-oriented resilience assessment of communities in Chennai, India [J]. *Informa Uk Limited*, 2012, 11(3): 226-241.

- [3] Changkun Chen, Lili Xu, Dongyue Zhao, et al. A new model for describing the urban resilience considering adaptability, resistance and recovery [J]. *Safety Science*, 2020, 128: 104756.
- [4] Harold Wolman, Howard Wial, Travis St. Clair, et al. Economic Shocks and Regional Economic Resilience [J]. *Urban and Regional Policy and Its Effects*, 2012, (4): 23-35.
- [5] Yolanda Ubago Martínez, Ignacio García-Lautre, Belén Iraizoz, et al. Why are some Spanish regions more resilient than others? [J]. *Papers in Regional Science*, 2019, 98(6): 2211-2231.
- [6] He Jiahui, Wu Yingmei, Li Chan. A study on the coupling and coordinated development of urban resilience and scientific and technological innovation -- a case study of the Shuangcheng District Economic Circle in Chengdu-chongqing region [J]. *Resource Development and marketing*, 2022, 38(1): 46-52.
- [7] Xiao Chunmei, Huang Guixin. Has the digital economy made cities more resilient? Empirical evidence from 285 Chinese cities [J]. *Regional Economic Review*, 2023, (4): 117-125.
- [8] Zhong xuesi, Zheng Rui, Jiang Kaiwen. Study on the coupling and coordination relationship between digital economy and urban resilience of urban agglomerations in China [J]. *Resource Development and marketing*: 1-19.
- [9] Jianguo Wu, Orié L. Loucks. From Balance of Nature to Hierarchical Patch Dynamics: A Paradigm Shift in Ecology [J]. *University of Chicago Press*, 1995, 70(4): 439-466.
- [10] Marina Alberti, John M. Marzluff. Ecological resilience in urban ecosystems: Linking urban patterns to human and ecological functions [J]. *Springer Science and Business Media Llc*, 2004, 7(3): 241-265.
- [11] Zhang Mingdou, Ren yenting, Zhou Liang. Spatio-temporal evolution characteristics and influencing factors of urban ecological resilience in the Yellow River basin [J]. *Dry Zone Geography*: 1-12.
- [12] Galu, Narin Mandola, Guo enliang, etc.. Study on urban resilience evaluation based on the concept of green and safety-taking the streets of Hohhot as an example [J]. *Disaster Science*: 1-9.
- [13] Ribeiro P.-J.-G., Gonçalves L. Urban resilience: A conceptual framework [J]. *Sustainable Cities and Society*, 2019, (50): 101625.
- [14] A.M. Aslam Saja, Ashantha Goonetilleke, Melissa Teo, et al. A critical review of social resilience assessment frameworks in disaster management [J]. *Elsevier Bv*, 2019, 35: 101096.
- [15] Joshua E. Cinner, Michele L. Barnes. Social Dimensions of Resilience in Social-Ecological Systems [J]. *One Earth*, 2019, 1(1): 51-56.
- [16] Ma Haonan, Chujin Long, Li Jiulin. A study on the coupling and coordination between urban resilience and urbanization level in Anhui Province [J]. *World of research*, 2023, (7): 28-37.
- [17] Yang Xiaodong, Li Ziwei, Zhang Jiayu, etc.. Spatio-temporal evaluation of urban resilience from the perspective of sustainable development [J]. *Urban issues*, 2021, (3): 29-37.
- [18] Yijun Shi, Guofang Zhai, Lihua Xu, et al. Assessment methods of urban system resilience: From the perspective of complex adaptive system theory [J]. *Elsevier Bv*, 2021, 112: 103141.
- [19] Indrajit Pal, Sanjaya Bhatia. Disaster risk governance and city resilience in Asia-Pacific region [Z]: *Elsevier*, 2018: 137-159.
- [20] Juan Zhang, Mingyuan Zhang, Gang Li. Multi-stage composition of urban resilience and the influence of pre-disaster urban functionality on urban resilience [J]. *Springer Science and Business Media Llc*, 2021, 107(1): 447-473.
- [21] Chen Suchao, Yan Xuxian, Fan Ling. Study on the path of Urban Resilience Improvement in Digital China: A qualitative comparative analysis based on fuzzy sets [j]. *Disaster Science*: 1-9.
- [22] Eugene Yu-Ying Lin, Ping-Yu Chen, Chi-Chung Chen. Measuring the environmental efficiency of countries: A directional distance function metafrontier approach [J]. *Elsevier Bv*, 2013, 119: 134-142.
- [23] Lindikaya W. Myeki, Nicolette Matthews, Yonas T. Bahta. Decomposition of Green Agriculture Productivity for Policy in Africa: An Application of Global Malmquist–Luenberger Index [J]. *Mdpi Ag*, 2023, 15(2): 1645.
- [24] Wang Yujin, Yu Wei. A spatial econometric study on green Total factor productivity convergence among provinces in our country [J]. *Nanjing Social Sciences*, 2016, (11): 31-38.
- [25] Xu Xiaohong, Wang Xia. Green Total factor productivity in China and its regional differences: an empirical analysis based on panel data from 30 provinces [J]. *Journal of Guizhou University of Finance and Economics*, 2016, (6): 91-98.
- [26] Su Hua, Yang Fan, Alex Chang. Spatial econometric analysis of green Total factor productivity in Chinese urban areas [J]. *Economic geography*, 2022, 42(9): 138-146.
- [27] Wang Fuwei, Du Lei, Tian Minghua. Does Agricultural Credit Input Promote Agricultural Green Total Factor Productivity? Evidence from Spatial Panel Data of 30 Provinces in China [J]. *MDPI AG*, (1): 529.
- [28] Chen Yang, Tang Xiaohua. Spillover effects of manufacturing agglomeration on urban green Total factor productivity: Based on the perspective of urban hierarchy [J]. *Finance and trade research*, 29(1): 1-15.

- [29] Li Ying, Xu Yue Meng. The impact of manufacturing services on green Total factor productivity in the context of business transformation [J]. *Soft Science*, 2021, 35(9): 117-123.
- [30] Sun Lixiang, Zhang Jianmin, Hūning. A study on the effect evaluation and mechanism of green Total factor productivity promotion of enterprises with “Diversified” industry synergy agglomeration [J]. *Exploring economic issues*, 2022, (10): 134-144.
- [31] Xu Haicheng, Xu Si, Zhang Beiqi. A study on the impact of transport infrastructure on green Total factor productivity from the perspective of threshold effect [J]. *Eco-economy*, 2020, 36(1): 69-73,85.
- [32] Liu Bei, Wong Wai-tung. Study on the green Total factor productivity effect of new digital infrastructure [J]. *Journal of seeking truth*, 2023, 50(1): 96-106.
- [33] Shen Yang, Guo Junhua, Zhu Yan. Impact of smart city construction on regional green Total factor productivity [J]. *Journal of Central South University Science (Social Sciences)*, 2021, 27(2): 140-152.
- [34] Mao Yuanlong, Jiang Guogang. An empirical test of the relationship between urban size and green growth of urban economy [J]. *Statistics and decision making*, 2023, 39(6): 155-160.