

Study on the "Quality Effect" of New Infrastructure Construction

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Abstract: In the context of the accelerated evolution of the new round of scientific and technological revolution and industrial change, and the high quality development becoming the distinctive feature of the new era of China's economy, the construction and application of new infrastructure become an important support for the high quality development of China's economy. On the basis of clarifying the connotation and development status of new infrastructure, the article analyzes the impact effects of new infrastructure on the quality of economic growth based on the five development concepts, and digs deeper into the mediating role of entrepreneurial activity, industrial structure upgrading and environmental optimization effects between the two, and finally puts forward relevant policy recommendations.

Keywords: New infrastructure, Quality of economic growth, Financing constraints, Digital technology.

1. Introduction

Since the reform and opening up for more than 40 years, traditional physical infrastructure such as transportation and energy supply has played an important role in the rapid development of China's economy. As China's economy shifts from the stage of high-speed growth to high-quality development, correspondingly new requirements for infrastructure construction have been put forward. The new infrastructure system formed by the continuous integration, superposition and iteration of new-generation information technologies such as big data, artificial intelligence, 5G, industrial Internet and Internet of Things has become a fundamental, strategic and leading industry to promote high-quality economic development in the era of digital economy. The 2018 Central Economic Work Conference clearly pointed out that the pace of 5G commercialization should be accelerated, and the construction of new infrastructure such as artificial intelligence, industrial Internet and Internet of Things should be strengthened. In October 2020, General Secretary Xi Jinping further emphasized at a symposium for scientists that it is necessary to seize the opportunity of digital economy development and accelerate the layout of new infrastructure. In October 2021, General Secretary Xi Jinping again emphasized the need to accelerate the construction of new infrastructure, strengthen the strategic layout, and accelerate the construction of high-speed pan In the, heaven and earth in one, cloud network integration, intelligent and agile, green, low-carbon, secure and controllable intelligent digital information infrastructure, open the information "artery" of economic and social development.

Since the essential attributes of new infrastructure are significantly different from those of traditional physical infrastructure, the mechanisms that affect the quality of economic development are also significantly different. From the perspective of development conditions, development process and development results, the new infrastructure promotes the high-quality development of China's economy mainly through three dimensions: kinetic energy transformation, structural optimization and efficiency

improvement. At the level of kinetic energy transformation, as the global economic development shifts from material production and material services to information production and information services, new production factors become a powerful kinetic energy to support the high-quality development of China's economy, and the new infrastructure takes this digital knowledge and information as its main object; at the level of structural optimization, the current new round of technological revolution and industrial change is profoundly At the level of structural optimization, the current new round of scientific and technological revolution and industrial change is profoundly changing the organization of various industries, and the transformation and upgrading of traditional industries and the cultivation and growth of new industries have become the main content of promoting the high-quality development of China's economy. As a part of the industrial chain, artificial intelligence, Internet of Things, industrial Internet and other new generation information technology itself belongs to the category of strategic emerging industries, and its growth and development can help improve the supply capacity of information industry and form new economic growth points; at the level of efficiency improvement, on the one hand, artificial intelligence technology can replace the traditional practice of relying on manual experience to independently select the optimal process parameters to improve product quality On the other hand, production equipment directly connected to the Internet of Things, industrial Internet and other new infrastructure cloud platform, can further enhance production efficiency by remote operation of production equipment, real-time monitoring of the production process to form a flexible production line. Therefore, in the context of the accelerated evolution of the new round of scientific and technological revolution and industrial change, high-quality development has become the distinctive feature of the Chinese economy in the new era, the construction and utilization of new infrastructure has become an important support for the high-quality development of China's economy.

2. Review of The Literature

On April 20, 2020, the National Development and Reform Commission (NDRC) made a relatively clear conceptual definition of "new infrastructure" at the press conference, that is, "new infrastructure is an infrastructure system that provides services such as digital transformation, intelligent upgrading, integration and innovation, led by new development concepts, driven by technological innovation, based on information networks, and facing the needs of high-quality development". Under the new development pattern, how to effectively play the "quality effect" of new infrastructure has attracted extensive attention from the theoretical and academic circles.

In view of relevant issues, relevant scholars at home and abroad have conducted extensive discussions and achieved certain results. However, the existing research mainly focuses on the economic effects of transport infrastructure. Many scholars, based on the empirical evidence of "high-speed rail opening" and "highway construction", have confirmed the positive role of transport infrastructure in stimulating urban economic vitality and promoting regional economic growth (Ahlfeldt&Feddersen, 2018; Tang Keyue, 2020), and this role is mainly reflected in export trade (Xu, 2017; Tang Yihong, etc., 2019) Technical innovation (Yu Yongze et al., 2019; Wang Chunyang et al., 2020), people's livelihood improvement (Bell&van Dillen, 2018; Wang Yuze et al., 2020), environmental protection (Li Jianming and Luo Nengsheng, 2020; Yang Siying and Lu Jingjing, 2020), industrial structure upgrading (Luo Nengsheng et al., 2020; Deng Huihui et al., 2020), etc. However, some scholars have also found that transportation infrastructure construction has no significant effect on urban economic growth (Wang Yaohe and Nianmeng, 2014), and even has an inhibitory effect (Faber, 2014).

With the continuous development of the digital economy, a group of scholars began to focus on new infrastructure represented by 5G, big data, artificial intelligence, industrial Internet, and the Internet of Things. However, there are relatively few relevant studies, and they mainly focus on network infrastructure. Most foreign studies believe that the improvement of network infrastructure can bring a positive promoting effect on economic development (Ho et al., 2008; Koutroumpis, 2009). Some also believe that this economic effect is not significant, and even has an inhibitory effect on economic development (Winston&Benjamin, 2005). Domestic scholars confirmed the role of network infrastructure in promoting economic growth through analysis (Cao Yuequn et al., 2020), and believed that this role was realized through the improvement of innovation ability (Xue Cheng et al., 2020) and the optimization of industrial structure (Shen Kunrong and Sun Zhan, 2021; Ma Qingshan et al., 2021).

After China's economy changed from high-speed growth to

high-quality development, the academic community carried out extensive research on the quality of economic growth. The existing literature mainly uses regional total factor productivity (Han Ying and Ma Liping, 2019; Liu Zhibiao and Ling Yonghui, 2020) or uses the comprehensive index method to build a multi-dimensional evaluation index system of high-quality economic development to describe the quality of economic growth (Li Jinchang et al., 2019; Yang Wenpu, 2021). Most studies believe that various institutional factors are important to promote high-quality economic development (Gao Peiyong, 2019), which confirms the construction of free trade zones (Li Zilian and Liu Dan, 2021), innovative cities (Chen Chen and Zhang Guangsheng, 2020), smart cities (Zhang Zhidong and Zhao Biwu, 2021), intellectual property protection (Wang Guimei, et al., 2021) The development of digital economy (Zhao Tao et al., 2020) will improve the level of high-quality development of regional economy. However, few literatures have studied the impact of new infrastructure construction on high-quality economic development. Only a few literatures have theoretically analyzed the role of a certain type of new infrastructure in high-quality economic development. For example, Li Hui (2019) elaborated the theoretical mechanism of big data promoting high-quality development from the perspective of efficiency improvement, industrial structure upgrading and business model innovation; Pu Xiaoye and Huang Xin (2021) found that AI has the attributes of innovation and technological progress. It can overcome physical constraints such as capital and labor, open up new sources of value and growth, lead the comprehensive transformation of the global economic development mode, and provide power support for China's high-quality economic development.

3. The Definition and Development Status of New Infrastructure

3.1. The Connotation of New Infrastructure

In the World Bank's classification standard, infrastructure includes social infrastructure and economic infrastructure, and new infrastructure belongs to economic infrastructure, which is an important support for regional economic development. The concept of new infrastructure was first proposed at the 2018 Central Economic Work Conference, which clearly pointed out that the pace of building new infrastructure such as artificial intelligence, industrial Internet and Internet of Things should be accelerated. New infrastructure is an infrastructure system based on information networks, which provides services such as digital transformation, intelligent upgrading and convergence and innovation, including three major areas of information infrastructure, convergence infrastructure and innovation infrastructure.

Table 1. Three types of new infrastructure

Scope	Main Content
Information Infrastructure	It mainly includes infrastructure generated based on the evolution of new generation information technology, such as communication network infrastructure represented by 5G, Internet of Things, industrial Internet, satellite Internet, new technology infrastructure represented by artificial intelligence, cloud computing, block chain, etc., and arithmetic infrastructure represented by data center and intelligent computing center.
Converged Infrastructure	It mainly includes the deep application of Internet, big data, artificial intelligence and other technologies to support the transformation and upgrading of traditional infrastructure, and thus the formation of convergence infrastructure, such as intelligent transportation infrastructure, intelligent energy infrastructure, etc.
Innovation Infrastructure	It mainly includes infrastructure with public welfare attributes that support scientific research, technology development, and product development, such as major science and technology infrastructure, science and education infrastructure, industrial technology innovation infrastructure, etc.

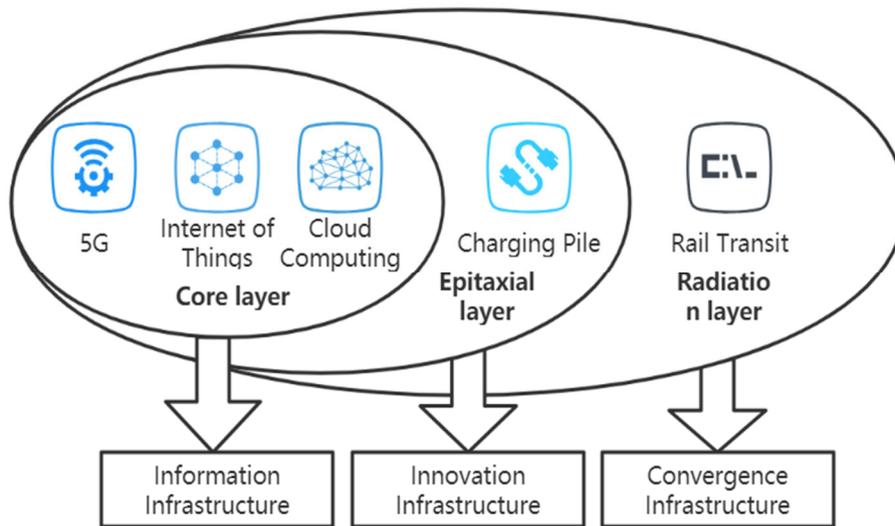


Figure 1. Three types of new infrastructure

3.2. Development Status of New Infrastructure

In recent years, new infrastructure has increasingly become an important force in promoting investment and stabilizing growth in China. General Secretary Xi Jinping first proposed at the 2018 Central Economic Work Conference to "accelerate the pace of 5G commercialization and strengthen the construction of new infrastructure such as artificial intelligence, industrial Internet, and Internet of Things". The Third, Fourth and Fifth Plenary Sessions of the 19th CPC Central Committee, the 14th Five-Year Plan, the 2021 Session of the National People's Congress and other relevant meetings of the Central Government have frequently mentioned "accelerating the construction of new infrastructure", further highlighting the important role of new infrastructure. Unlike in the past, the focus of this round of infrastructure investment is more focused on "new infrastructure" oriented to "fill the short board" based on traditional infrastructure projects such

as transportation and energy, and many places such as Guangdong, Zhejiang, Jiangsu, Shandong, etc. have explicitly stated in their investment plans that they will strengthen the development of new infrastructure in 5G. Guangdong, Zhejiang, Jiangsu, Shandong and other places in their investment plans clearly proposed to strengthen the layout of investment in 5G networks, data centers and other new infrastructure.

Infrastructure construction has played an important role in promoting investment and stabilizing growth in successive crises, and has also provided important support for long-term economic and social development. In particular, the current investment in new infrastructure construction for the new round of information technology revolution will drive significant value-added investment in applications upstream and downstream of the industry chain, laying the foundation for China to build core competitiveness in the global industrial revolution.

Table 2. Policy sequence for new infrastructure

Time	Post Source	New infrastructure construction related content
December 2018	Central Economic Work Conference	It is required to accelerate the pace of 5G commercialization and strengthen the construction of new infrastructure such as artificial intelligence, industrial Internet and Internet of things.
March 2019	Government Work Report	Requires increased investment in intercity transportation, logistics, municipal, disaster prevention and control, civil and strengthening the construction of a new generation of information infrastructure.
July 2019	Central Political Bureau Meeting	It is required to stabilize the investment in manufacturing industry, implement the renovation of old urban areas, urban parking lots, urban cold chain logistics facilities construction and other short board projects, and accelerate the construction of new infrastructure such as new networks.
December 2019	Central Economic Work Conference	It is required to strengthen the implementation of strategic, network-based infrastructure construction and other major projects, and steadily promote the construction of communication networks.
January 2020	State Council Executive Meeting	Requires the vigorous development of advanced manufacturing, the introduction of new infrastructure investment support policies such as information networks, and the promotion of intelligent, green manufacturing.
February 2020	The twelfth meeting of the Central Committee to deepen reform in all aspects	Requires the overall optimization, synergy and integration-oriented, integrated stock and incremental, traditional and new infrastructure development, to create an intensive and efficient, economical, intelligent, green, safe and reliable modern infrastructure system.
July 2020	Central Political Bureau Meeting	Accelerate the construction of new infrastructure, promote major regional development strategies, and accelerate the pace of implementation of major national strategic projects
October 2020	The Fifth Plenary Session of the Nineteenth Congress	On the one hand, strengthen the construction of traditional infrastructure to make up for the existing outstanding shortcomings; on the other hand, promote the construction of new infrastructure to provide strong support for the digital transformation of economic and social development.
December 2020	Central Economic Work Conference	To stimulate the vitality of investment in the whole society. We should vigorously develop the digital economy and increase investment in new infrastructure.
March 2021	Government Work Report	Strengthen the construction of new infrastructure, develop a new generation of information networks, expand 5G applications, build charging piles, promote new energy vehicles, stimulate new consumer demand, and help upgrade industries.
April 2022	Eleventh Meeting of the Central Finance and Economics Committee	To strengthen information, science and technology and other industrial upgrading infrastructure construction, layout and construction of a new generation of supercomputing, cloud computing, artificial intelligence platform, broadband infrastructure network and other facilities, and promote the layout and construction of major scientific and technological infrastructure

4. Analysis of The Effect of New Infrastructure on The Quality of Economic Growth

High-quality economic development is a development approach based on China's realistic development context, and the 19th Party Congress report points out that the core essence of high-quality development is higher quality, more efficient, more equitable and more sustainable development. Specifically, high-quality development embodies the new development concept and can well meet the growing needs of the people for a better life. Among them, innovation is the first driving force, coordination is the endogenous feature, green is the universal form, openness is the necessary path, and sharing is the fundamental purpose. As an expansionary fiscal measure of the government, the new infrastructure construction will continue to influence the accumulation level of regional physical and human capital under the multiplier effect of investment, which provides many facilities for high-quality economic development in five aspects: innovation, coordination, green, openness and sharing.

From the perspective of innovation development, new infrastructure is enough to break the spatial and temporal barriers to technological innovation, improve the mobility of knowledge elements, reduce the information asymmetry of the market, provide diversified information for carrying out technological innovation activities, and thus promote regional

innovation capacity (Czernich et al., 2011; Ke et al., 2017). Meanwhile, according to Metcalfe's law and the law of diminishing marginal cost of networks, the marginal cost of hardware inputs such as new infrastructure decreases year by year, and the marginal benefit shows an increasing trend, which will produce a more obvious economy of scale effect and help reduce R&D costs, enhance the speed of knowledge and technology absorption and reinvention, and accelerate R&D innovation (Zhang J. and Fu Kui, 2021). In terms of coordinated development, on the one hand, the sharing economy model brought about by new infrastructure development effectively improves resource allocation efficiency and enables more accurate matching of industrial supply and demand (Pisano et al., 2015), which promotes coordinated industrial development. On the other hand, the new infrastructure can reduce the information search cost of rural residents, improve the efficiency of agricultural markets while promoting innovation in marketing models, broaden the channels for farmers to increase their income, and help achieve coordinated urban-rural development (Chen Yang et al., 2022). From the perspective of green development, digital economy and strategic emerging industries with new infrastructure construction have lower energy consumption and less pollution emission compared with traditional industries, which are crucial for achieving carbon neutrality and carbon peaking. At the same time, the integration of traditional industries with emerging technologies such as big

data and artificial intelligence is accelerated, production costs are further reduced, production efficiency is significantly improved, and environmental awareness is gradually enhanced. From the perspective of open development, the construction and improvement of new infrastructure is conducive to the organization of trade links, the enhancement of competitive advantages and the acceleration of factor flows, thus promoting the upgrading of foreign trade through the technology diffusion effect (Cao Xiaojing et al., 2020). In addition, the improvement of new infrastructure can reduce the information asymmetry between exporting and importing countries and eliminate the "iceberg cost" in the trade process between the two countries, thus deepening the division of labor and collaboration in globalization and promoting the growth of export trade (Bojnec&Fertoe, 2009. Portugal-Perez&Wilson, 2012). From the perspective of shared development, first, the improvement of new infrastructure promotes the sharing of "data" as a factor of production in production activities; second, the improvement of new infrastructure promotes the sharing of knowledge and technology in R&D activities; third, the improvement of new infrastructure promotes the sharing of development fruits in people's daily life, which is conducive to the Third, the improvement of new infrastructure promotes the sharing of the fruits of development in people's daily life, which is conducive to the realization of common wealth.

5. Analysis of The Mechanism of New Infrastructure Affecting the Quality of Economic Growth

The core connotation of high quality development is the new development concept consisting of innovation, coordination, green, openness and sharing, which involves all socio-economic fields. In addition to directly affecting the high quality economic development, the new infrastructure construction can also have an indirect impact on the high quality economic development through three levels: entrepreneurial activity, industrial structure upgrading and environmental optimization effect.

5.1. Entrepreneurial Activity

New infrastructure construction mainly promotes entrepreneurial activity through three aspects: widening entrepreneurial space, reducing entrepreneurial costs and optimizing entrepreneurial environment. First of all, the new infrastructure construction can effectively broaden the entrepreneurial space for entrepreneurs. On the one hand, the development of new technologies such as big data and artificial intelligence can promote the growth of new industries such as Internet finance and sharing economy, optimize the production and operation methods of traditional industries, and create more new sub-sectors in terms of product forms, business processes, business models and organizational forms; on the other hand, the economy of scale effect of new infrastructure can stimulate diversified On the other hand, the economy of scale effect of new infrastructure can stimulate diversified demands, realize social relationship networking and community through the Internet's connectivity function, further stimulate the generation of new technologies, new products and new services, and stimulate industry entrepreneurship and self-innovation within the industry. Second, new infrastructure construction can effectively reduce the start-up costs of entrepreneurs. On the

one hand, the difficulty and high threshold of obtaining entrepreneurial capital has become one of the main factors limiting people's choice of entrepreneurship (Cai Qingfeng et al., 2017), along with the continuous improvement of new infrastructure, Internet finance and crowdfunding platforms represented by Ant Financial Services have been growing, breaking the time and space barriers of the traditional bank lending model and providing entrepreneurs with convenient channels to obtain entrepreneurial capital (Yu Wentao and Wu, Shiwei, 2019); on the other hand, digital technologies such as the Internet, big data and the Internet of Things can promote the marketization of the prices of elements needed for entrepreneurship and reduce the flow costs of entrepreneurial factors, including search costs, information costs and bargaining costs, which means that the construction of new infrastructure effectively reduces entrepreneurial transaction costs. Finally, the construction of digital infrastructure can also optimize the entrepreneurial environment. On the one hand, a perfect digital infrastructure provides a convenient information exchange platform, which greatly facilitates potential entrepreneurs to obtain valuable knowledge and information (Audretsch et al., 2015). On the other hand, new infrastructure construction can promote the cross-regional clustering and optimization of production factors, improve the objective environment for entrepreneurship by broadening the scope of applications in the digital economy, increasing R&D investment in digital technologies, and improving the scale and quality of digital technology talents.

Meanwhile, entrepreneurial activity is an endogenous driver of economic growth and has a significant contribution to industrial upgrading (Wang, Y. and Zhang, Y.), employment creation (Glaeser et al., 2013), and structural transformation (Noseleit, 2011), and its impact on high-quality economic development has been widely confirmed. For example, Wang, W.J. and Yao, Y.J. (2021) found, using a systematic GMM approach based on provincial panel data in China from 2001-2017, that entrepreneurship significantly contributes to high-quality economic development.

5.2. Industrial Structure Upgrading

New infrastructure construction can promote high-quality economic development by upgrading the industrial structure. On the one hand, the construction of new infrastructure helps to enlarge the tertiary industry and promote the transformation of industrial structure to advanced direction. First, the new infrastructure heralds the flourishing development of digital technology, paving the way for the arrival of an intelligent and digital society in the future, which will certainly breed a series of new industries and new business models, with the information industry bearing the brunt. Secondly, the construction of digital infrastructure with broadband as the core will help promote the embedding of new information technologies such as big data, cloud computing and Internet of Things into the manufacturing production value chain, promote the serviceization of manufacturing industry and move towards the high value-added fields at both ends of the "smile curve", and then promote the transformation and upgrading of the middle and high end of manufacturing industry (Li Xiaohua, 2021).. On the other hand, new infrastructure construction can help optimize resources. On the other hand, new infrastructure construction can help optimize resource allocation, improve production efficiency, and thus promote the rationalization of industrial structure. First, new information technologies such

as big data and artificial intelligence can help to replace and upgrade traditional production equipment, improve the operational efficiency of traditional industries by changing their organizational and management forms, and thus enhance the rationalization of urban industrial structure. Secondly, information infrastructure such as broadband can greatly improve the efficiency of information transmission and allocation of production factors by relying on information elements without location movement, and promote the reallocation of urban resources, thus promoting the rationalization of industrial structure.

At the same time, the current new round of scientific and technological revolution and industrial change is profoundly changing the organization of various industries, transforming and upgrading traditional industries, cultivating and growing new industries, and promoting industrial structure upgrading have become the main content to promote the high-quality development of China's economy. The upgrading of industrial structure has led to a more detailed division of labor and a higher degree of specialization and collaboration among industries and within industries, which in turn is conducive to saving production costs, improving production efficiency, achieving clean production and promoting high-quality economic development.

5.3. Environmental Optimization Effect

The new infrastructure construction can promote high-quality economic development through environmental optimization effects, specifically in the following aspects. First, the construction of new infrastructure can help improve the level of government services. On the one hand, emerging technologies such as cloud computing, 5G, blockchain and artificial intelligence bring strong momentum to the digital transformation of government. For example, Anhui Province has built an integrated government affairs platform called "Wanshitong" with the help of Internet technology, which provides professional services such as taxation, law and social insurance for enterprises and residents, especially in the post-epidemic era, which greatly facilitates the life of residents and production of enterprises. On the other hand, the improvement of new infrastructure promotes the improvement of government financial transparency, which helps the government accept public supervision and build an open, transparent, clean and efficient sunshine government. Second, the construction of new infrastructure helps optimize the production environment of enterprises. On the one hand, perfect digital infrastructure construction provides basic support for enterprise production, and production equipment can be directly connected to new infrastructure cloud platforms such as the Internet of Things and industrial Internet, which can form flexible production lines by remotely operating production equipment and monitoring production processes in real time. On the other hand, the government that attaches importance to the construction of digital infrastructure will also take the initiative to increase investment in innovation resources, use the dividends of new infrastructure construction to revitalize urban R&D and innovation activities, and provide policy support for enterprises to conduct basic R&D in such areas as intelligent terminal development and support platform construction. Finally, the improvement of new infrastructure is conducive to optimizing the network security environment. One of the key tasks of the new infrastructure construction is to promote network information security and emergency communication

security capacity construction, and continuously enhance the security control capacity of basic networks, core systems and key resources as well as emergency service capacity, so as to achieve controllable network security, manageable business security and reliable emergency security. The safer the network information, the lower the possibility of information leakage, the more the technical rights and interests of residents and enterprises are protected, which effectively raises the expectation of enterprises to invest in research and development, motivating them to venture into areas of higher technical difficulty and greater innovative breakthroughs, providing strong momentum for high-quality economic development.

Meanwhile, the positive incentive effect of environmental optimization effect on economic quality development has been confirmed. Zhujun Wang and Baoping Ren (2019) point out that optimizing the business environment is a central factor in enhancing the micro-efficiency of high-quality economic development. Using relevant data for 217 countries (regions) from 2000 to 2017 provided by the World Bank, Fraser Institute, and Polity IV, He Daxing and Wang Jing (2020) used a combination of fixed effects models and systematic generalized moments estimation to find that business environment optimization significantly improves the development quality of economies.

6. Optimization Measures of New Infrastructure for Quality Improvement of Economic Growth

First of all, strengthen the top-level design and increase the support of supporting policies and funds. First, strengthen the pre-research and forecasting for new infrastructure construction areas, strengthen the direction of investment guidance. Second, increase the support of supporting funds for infrastructure construction. Third, the establishment of a new infrastructure support system to strengthen the support of various policies.

Besides, strengthen the role of government guidance and expand the sources of funds through multiple channels. First, set up national industrial investment funds and local government guidance funds for the new infrastructure sector. Second, guide social security funds to participate in equity investment in new infrastructure leading enterprises. Third, to retain special funds for state-owned enterprises to support key upstream and downstream new infrastructure projects.

What's more, clarify the leading and construction role of the market, and stimulate the investment vitality of various market players. First, encourage private equity funds to participate in investment, focusing on supporting new infrastructure projects. Second, to guide the insurance funds directed investment, the construction of new infrastructure investment long-term mechanism. Third, to support the participation of various types of capital management plans, the introduction of social capital professional investment.

Last but not least, cultivate application scenarios, explore business model innovation, and form a closed loop of investment income. First, to promote the 5G network, cloud computing and other technologies and application scenarios of synergistic development, cultivate and optimize the industrial ecology. Second, improve the construction of the standard system and promote the innovation of business models in the field of new infrastructure. Third, to promote cross-border integration and development, innovative

investment models.

Acknowledgment

Anhui University of Finance & Economics Postgraduate Research and Innovation Fund Project "Study on The 'Quality Effect' of New Infrastructure Construction" (Project Approval Number: ACYC2021013).

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