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The Digital Infrastructure Construction and Regional Income Gap

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Abstract. As the material carrier of the growth of the digital economy, how digital infrastructure development affects regional income gap has become a frontier topic in the cross field of development economics and regional economics. Digital infrastructure was only a kind of communication network at the earliest, and now it has developed into a new infrastructure system with 5G, Gigabit optical network, computing power network, data infrastructure with so on. Digital infrastructure has expanded information availability, reduced transaction costs, promoted industrial upgrading, and improved public services. Yet it can also create a digital divide arising from differences in regional construction capabilities, digital skills, and industrial agglomeration. In recent years, as the advancement of China's Broadband China and other strategies, the research scale has further sunk from the transnational and provincial levels to the prefecture and city level, and the marginal effect, spatial spillover and digital transmission infrastructure have become new research hotspots. The association of digital infrastructure and regional income inequality may vary in developmental stages. Only when network coverage can be transformed into application ability, employment opportunities and industrial undertaking ability, will it have the effect of inclusive growth.

Keywords: Digital infrastructure, regional income gap, digital divide, inclusive growth, common prosperity

1. Introduction

Today, the world, digital economic activity has become an increasingly important contributor to economic growth worldwide. As the material carrier of the digital economy, the construction level of digital infrastructure is directly linked to the digitalisation process and long-term growth potential for a country or region. In August 2013, State Council released it is the Broadband China Strategy, which positioned broadband network as a national strategic public infrastructure. Since then, China's digital infrastructure construction has entered a systematic promotion stage while the number of broadband Internet access users has grown rapidly. In 2015, the State Council issued the "Guiding Opinions on Actively Promoting 'Internet +' Action", and the depth and breadth for digital infrastructure rollout and application have been further expanded. China has gradually moved beyond the initial expansion of network coverage towards a greater emphasis on the practical use of

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digital infrastructure. Nevertheless, digital industries and related resources remain unevenly distributed across the eastern, central and western parts of the country, and the digital divide has not been automatically resolved despite the spread of the Internet. At the same time, although China's regional income gap has shown a relatively narrowing trend, the absolute gap is still prominent, and regional coordinated development is still a key issue while advancing common prosperity. In this context, whether digital infrastructure development narrows or enlarges the regional income gap, and what its mechanisms and constraints are have become a frontier issue that China's digital economy construction needs to answer.

From the theoretical point of view, the existing research focuses on how infrastructure contributes to promoting economic growth, and the discussion of its income distribution effect is not sufficient, in particular, less emphasis has been placed on the conditions under which wider infrastructure access can translate into more equal digital capabilities. Empirical research shows that the inclusive effect generated by digital infrastructure is not spontaneously formed, and its policy benefits will be constrained by realistic conditions such as industrial agglomeration, non-agricultural employment scale, and local industrial base [1]. From the perspective of practical significance, clarifying the internal logic of digital infrastructure affecting regional income gap has important reference value for optimizing the spatial layout of digital infrastructure, improving supporting policies, preventing the formation of new digital divide, and then promoting regional coordinated development and shared prosperity. Its evolution of income distribution pattern itself will also be affected by the comprehensive impact of industrial restructuring and the threshold effect of economic development quality [2].

This paper takes the influence of digital infrastructure development upon regional income gap as the research topic. Based on the systematic review of relevant literature at home and abroad, combined with the latest statistical data and realistic characteristics of China in 2025, this paper uses a combination of theoretical mechanism analysis and comparative research to explain the role of digital infrastructure in narrowing the regional income gap from three dimensions: lowering the costs associated with geographical distance, raising productivity, and widening access to public services. Meanwhile, it analyzes the constraints that may enlarge the gap from the aspects of digital skill differences, industrial agglomeration effects, and regional undertaking capabilities. Then the paper makes a comprehensive judgment on the income distribution effect of digital infrastructure. This study aims to reveal the dual mechanism and stage characteristics of digital infrastructure affecting regional income gap, and to clarify the transformation conditions from network coverage to inclusive income increase, so as to provide theoretical support and decision-making basis for China's next stage of digital infrastructure development and regional coordinated development policy formulation.

2. The realistic characteristics of digital infrastructure and regional income gap

2.1. From coverage expansion to application capacity

By the end of 2025, the 5G base-station count in China has reached 4.838 million, the 5G base-station total per 10,000 people has reached 34.4, the 10G PON ports supporting gigabit connectivity has reached 31.62 million, and 5G-A covers more than 330 cities [3]. The number of racks in the country's computing power facilities is greater than 13.73 million standard racks, and the scale of intelligent computing power is 1.59 million PFLOPS [3]. The network terminal has realized 100 % Gigabit access in the county, 100 % 5G coverage in the townships of the county, and more than 95 % of the administrative villages in the townships have 5G coverage [3]. The spatial distribution of

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digital industry still has obvious gradient. Regional differences remain substantial in digital industry income. In 2025, the eastern region generated RMB 29.5 trillion, representing 74.3% of the national total. The corresponding shares were 9.3% for the central region, 5.6% for the western region and 4.8% for the northeast [3]. With the expansion of infrastructure coverage, the benefits of the digital industry will not be equalized.

The network base of digital infrastructure continues to expand during the "14th Five-Year Plan" period. Table 1 shows the total of 5G sites in China from 2021 to 2025. The count of base stations in China in 2021 is 1,425 million, and the number of 5G sites in China in 2025 is 4.838 million. The proportion of 5G in all mobile phone base stations also continues to increase. The substantial increase in network supply capacity provides less developed areas with access to the national unified market with lower cost and higher frequency information channels than traditional transportation infrastructure.

Table 1. China's 5G base station construction, 2021-2025 [3]

Year	5G network units (ten thousand)	Mobile base-station count (ten thousand)
2021	142.5	996.3
2022	231.2	1083.0
2023	337.7	1162.0
2024	425.1	1265.0
2025	483.8	1287.0

2.2. Relative income gap narrowed but gradient remains

Figure 1 highlights a substantial regional difference in disposable income. In 2025, residents in the east reported the highest per capita disposable income at RMB 54,798, while the western region recorded RMB 34,531. The corresponding figures for the central and northeastern regions were RMB 36,850 and RMB 36,681 respectively [4].

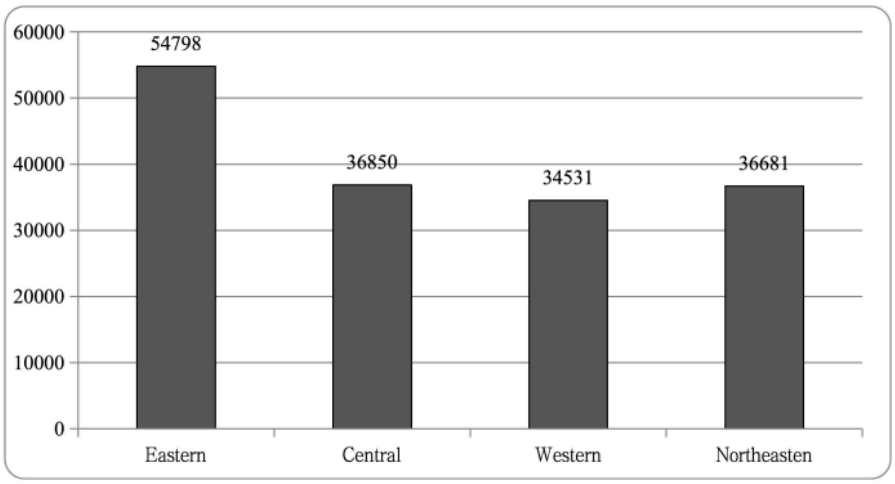


Figure 1. Per-capita disposable income in residents in China: four main regions, 2025 [4]

The income level gap between regions is large. In 2025, the per capita disposable income of residents in the east is about 1.59-1.6 times that of residents in the west, while that across central and

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NE regions is basically the same. Therefore, the distribution effect of digital infrastructure needs to examine both the coverage of the network and the higher productivity and income obtained through the digital network. A larger stock of digital infrastructure does not automatically mean a smaller regional income gap.

The existing spatial measurement research also shows that that digital development in China's infrastructure continues to rise on the whole, but a substantial gap remains between provinces. The eastern region has formed a strong advantage due to its economic foundation, innovative resources and industrial supporting facilities. Some central and western areas have accelerated the pace of catch-up driven by policy investment, eastern and western calculation and other projects, thus forming a realistic starting point for digital infrastructure to affect regional income gap [5].

2.3. The interaction between digital infrastructure and regional income gap

In general, there is no synchronous matching between the spatial convergence between digital infrastructure and change of regional income gap. Spatially, the distribution, the hot spots of China's digital infrastructure development level are mainly concentrated across Yangtze and Pearl River Deltas plus Beijing-Tianjin region, which is highly coincident with this spatial pattern of high-income regions. However, when examining time series changes, the Gini coefficients of per-person disposable income of Chinese residents in 2021-2024 are 0.466, 0.467, 0.465 and 0.465 respectively, which are always hovering at a high level between 0.465 and 0.470, and have not decreased synchronously with the narrowing of the regional gap of digital infrastructure. The expansion of infrastructure access has therefore not been accompanied by an equivalent convergence in income distribution, indicating that the popularity of network access cannot automatically translate into a narrowing of the income gap.

More importantly, there is a significant time mismatch between the narrowing of digital infrastructure gap and the expansion of digital industry income gap. According to data from China's fifth national economic census in 2023, the operating income of the core industries within the digital economy in the eastern region accounts for 73.0 % of the national proportion, and 13.8 %, 11.9 % and 1.3 % for central, western and northeastern regions, respectively. In 2024, the proportion of digital-industry income in the eastern region to the whole country rose to 73.6 %. In 2025, the digital industry income in the eastern region reached 29.5 trillion yuan, accounting for 74.3 % of the whole country. The growth rates of digital industry income in the central, western and northeastern regions are 9.3 %, 5.6 % and 4.8 %, respectively, which are lower than the absolute incremental expansion corresponding to the 9.2 % growth rate in the east. In other words, in 2023-2025, the regional access gap of digital infrastructure continued to narrow, while the concentration of digital industry revenue in the east increased year by year, showing a reverse movement. This mismatch shows that underdeveloped areas are catching up faster in the access of facilities, but are still at a disadvantage in the capabilities such as digital skills, industrial support, and application scenarios. That is, the equalization of network coverage precedes the equalization of industrial value-added capabilities, and wider infrastructure coverage alone has therefore not produced a comparable convergence in digital industry income.

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3. The mechanism of digital infrastructure for narrowing regional income gap

3.1. Reduce space transaction costs, expand the market radius of less developed areas

The most direct role of digital network is to compress information search, communication, payment, transaction costs. The traditional location conditions are poor, the central and western counties and rural areas rely on e-commerce platforms, live broadcast marketing, cloud services, and remote collaboration to enter a larger market, and local products are no longer completely dependent on offline channels and geographical distance. The marginal cost of obtaining orders, financing and supply chain information is reduced, which will also increase the opportunities to micro and small firms as well as individual operators to participate in market competition. Relevant research on broadband China believes that digital infrastructure can widen access to home networks, improve public services, and promote transformation and modernisation of industrial structure, so as to achieve the effect for inclusive growth while they have a certain spillover effect [6]. This effect gives new ways to increase income in areas that are less restricted by distance.

3.2. Improve productivity and promote industrial re-layout

Digital infrastructure can facilitate both the diffusion of technology and changes in how firms organize their activities. Industrial Internet, cloud computing and computing services reduce the fixed cost of enterprises using digital technology, so smaller and mid-sized enterprises can obtain software, data and computing power on demand. Evidence on how investment in new digital infrastructure can strengthen firms' digital capabilities, which may subsequently raise total factor productivity [7]. However, productivity growth alone does not automatically narrow regional disparities. Only when productivity gains occur in the tradable sectors of central and western areas and drive local employment and wage growth can regional income disparities be narrowed. When the productivity increase occurs in the manufacturing, agriculture and service industries across central and western areas, the local labor demand and operating income will improve at the same time, and the multiplier effect will be generated through the industrial chain matching. Computing hub, data center and other projects also have a certain role in location remodeling. If they can be combined with local energy, manufacturing, scientific research and talent system, they will further transform "data generation in the east and computing power undertaking in the west" into regional reallocation of industry and employment.

3.3. Improve public service accessibility and reduce inequality of opportunity

The income gap is not only the current wage gap, but also related to the availability of education, health care, finance, and employment information. Digital government, telemedicine, online education, digital finance, etc., can make up for the uneven distribution of public service resources. The problem is that residents living in remote areas can also enjoy public resources comparable to urban development levels. For rural and underdeveloped areas, only by promoting building digital systems, skills training, logistics system, public services, etc., can farmers' income continue to increase. Existing research has found that there are thresholds such as human capital, transportation infrastructure, and urbanization level for digital infrastructure to narrow urban-rural income inequality. After crossing the corresponding threshold, its narrowing effect is more obvious [8]. Therefore, the value lies not in how many base stations are built, but whether it can be transformed into development opportunities that residents can actually use.

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4. The constraints of digital infrastructure may magnify regional income disparities

Network coverage does not automatically eliminate the digital divide. In economically developed areas, there are more digital enterprises, more high-skilled workers, more R&D institutions and more venture capital. The same network conditions can produce higher commercial value. Without industrial foundation and digital skills, underdeveloped areas can only become the consumer side of digital products, rather than the creation side of digital income. At this time, capital, talent and high value-added business are gathered to the central city through the digital network, which will strengthen the cumulative effect of "the strong always strong". From the perspective of endogenous growth theory, digital infrastructure is essentially the material carrier of knowledge spillover and technology diffusion. Digital infrastructure greatly reduces information transmission costs and knowledge exchange. In theory, it should promote the diffusion of knowledge to underdeveloped areas. Yet, because of the non-rivalrous and partially excludable nature of knowledge, face-to-face communication between highly skilled workers, collaboration of R&D teams, and tacit knowledge transfer between upstream and downstream along the industrial chain will not automatically cross geographical space due to the increase of the network. More importantly, digital technology is a typical skill-biased technical change (SBTC). This means that the more perfect the digital infrastructure, the stronger the need for highly skilled labour, the higher the wage premium, and thus attract more high-skilled talent inflows, forming a causal cycle of enhanced regional innovation capabilities and further upgrading of infrastructure.

Some research suggests digital infrastructure in the western, non-coastal areas from application capacity and expand the income gap across urban and rural areas, only when the level of education, rural financial development to achieve certain conditions, the impact of the direction will change [9]. More studies have shown that digital economy and its urban-rural income gap follow a U-shaped pattern, and infrastructure investment, rural finance, and digital skills can adjust the non-linear effects [10]. That is, at an early stage of development, with the gradual expansion of digital infrastructure from scratch and coverage, the regional income gap tends to narrow; once digital infrastructure passes a certain critical threshold, if the application capacity of the less developed areas fails to follow up, the income gap will widen again. Although the samples and indicators are different, they all show that the income distribution effect of digital infrastructure is phased. At the initial stage of construction, the "yes or no" is solved. After the deepening of development, it is more critical to solve the "will it be used, can it be used to increase income". Once the application ability cannot keep up, the equalization of network coverage will not only not bring about the equalization of income, but may aggravate the new digital divide from the agglomeration of factors.

5. Impact judgment and policy implications

According to the realistic data of 2025, it appears that national digital infrastructure coverage is large, the income growth rate of residents in central and western areas is faster than that in the east, and the relative income gap between regions tends to narrow. Synchronous changes indicate that digital infrastructure has the conditions to promote regional coordinated development, but the change of income gap cannot be completely attributed to digital infrastructure. Industrial policy, transfer payments, population mobility, equalization of public services, regional strategies and so on also play a role. A more reasonable judgment is that digital infrastructure plays a basic role in narrowing the information gap, and also is important for narrowing the development capacity gap, but the specific effect depends on the supporting system and local undertaking capacity.

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The focus of construction has shifted from increasing the number of facilities toward more efficient inclusive use. Across central and western areas as well as counties, 5G, Gigabit optical network and computing nodes should be linked with characteristic industries, rural e-commerce, intelligent manufacturing and modern agriculture, so that data flow can be transformed into orders, employment and operating income. Digital skills training should cover farmers, flexible employees and SME enterprise operators more, so as to prevent problems that cannot be applied after infrastructure construction is completed. It is essential to stress that external support such as training, policies, etc., must also go through the intermediate link of users' digital self-efficacy if it is to be truly transformed into use ability. Otherwise, it is easy to become a mere formality; the layout of computing power and data infrastructure should also strengthen cross-regional scheduling and revenue sharing to prevent the one-way flow of data, capital and high-end talents to a few central cities. Public financial support should focus on digitization of network quality, application scenarios and public services, not just the number of base stations and ports.

6. Conclusion

After the emergence of digital infrastructure, there will be two effects of regional income gap. The inclusive property can reduce transaction costs, increase productivity, expand employment, improve public services, and increase the income-increasing ability of underdeveloped regions. Network effects, skill bias, and industrial agglomeration will make digital dividends first concentrated in developed regions. In 2025, China's regional income gap will continue to narrow, indicating that digital development has an inclusive basis, but the high concentration of digital industries in the east also suggests that "equalization of infrastructure" needs to be promoted after "equalization of digital capabilities".

Since this paper belongs to the conceptual review, which was based largely on the theoretical mechanism and the description of realistic characteristics, there are still limitations in the research methods and data levels. First, there is a lack of causal inference support for micro data. This paper mainly relies on the macro summary data from provincial and regional levels. The mechanism analysis of how digital infrastructure affects regional income gap is mainly based on theoretical deduction and phenomenon induction. It fails to use enterprise-level data such as industrial enterprise database, listed company data, or family tracking data such as CFPS, CHFS to conduct more detailed empirical tests on wage changes, employment conversion and enterprise location selection at the individual level. Therefore, it is difficult to strictly identify the heterogeneous effects of digital infrastructure on different skill groups and different types of enterprises. Second, the study does not use quasi-natural experiments to construct quantitative empirical analysis, and it is difficult to separate a net impact of digital infrastructure from industrial policies, transfer payments, population mobility and other comprehensive factors. The conclusion of mechanism analysis is more at the logical level than strict causal evidence.

In view of the above limitations, future research can use the "Broadband China" pilot as a quasi-experimental design, use a multi-period DID approach to identify the causal impact of digital infrastructure for regional income gap, and decompose the contribution of access effect and application effect using an mediation model to analyze the realistic factors that the income gap is not synchronized ; in addition, focusing on comprehensive computing infrastructure rather than just communication base stations, using the establishment of computing hub nodes as exogenous shocks, the authors can test whether the decline in computing costs can promote the gradient transfer of data-intensive manufacturing toward central and western regions, or whether this transfer is heterogeneous due to industry technology intensity, urban human capital level, and energy price

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differences. The research in this direction will make up for the existing literature's emphasis on communication base stations and neglect of computing infrastructure. It can also provide empirical evidence for whether strategies such as "East data West Computing" can serve as another driver for narrow the regional income gap.

Author contribution

All the authors contributed equally and their names were listed in alphabetical order.

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