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Research article

New digital infrastructure boosts the inclusive growth of China's economy

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Abstract: Under the dual backdrop of accelerating global digital transformation and pursuing high-quality economic development in China, new digital infrastructure has increasingly emerged as a crucial link connecting technological innovation with social equity, playing a significant role in achieving inclusive growth. To explore its logical connections and transmission pathways, this study first constructed a comprehensive index of inclusive development from three dimensions—sustainable growth, poverty reduction, and opportunity equity—to measure inclusive development across Chinese provinces. It then employed panel regression and mediation effect models to examine the inclusive growth effects of new digital infrastructure and its transmission mechanisms. Finally, grouped regression and threshold models were used to test the heterogeneity and threshold characteristics of the inclusive growth effects of new digital infrastructure. The findings revealed that new digital infrastructure directly influences various dimensions of inclusive growth by promoting industrial development, reducing transaction costs, enhancing information accessibility, and fostering regional coordination. Simultaneously, it exerts indirect effects through human capital accumulation and industrial structure optimization. The study emphasizes that these promotional effects vary depending on resource endowments and development stages, while also being constrained by threshold conditions such as transportation infrastructure and the degree of marketization. This indicates that new digital infrastructure has become a crucial strategic support for mitigating uneven and inadequate regional development, contributing to regional coordination and sustainable growth.

Keywords: new digital infrastructure; inclusive growth; sustainable growth; poverty alleviation; equity of opportunity; threshold effect

JEL Codes: O33, O18, C23

1. Introduction

With the acceleration of global digital transformation, "new digital infrastructure" has become an important engine driving coordinated and sustainable regional development. Governments worldwide are actively planning and constructing new types of infrastructure to secure a dominant position in the global digital infrastructure landscape. The U.S. government has introduced strategic plans such as the American Jobs Plan to rebuild infrastructure, the European Union aims to achieve full 5G network coverage in major cities by 2025, and Germany is enhancing the integration of manufacturing and digital technologies through the advancement of Industry 4.0. France is heavily investing in cloud computing and artificial intelligence. The Chinese government, in its 14th Five-Year Plan for Digital Economy Development, has identified "optimizing and upgrading digital infrastructure" as a top priority (CAICT, 2024). The proactive layout of digital infrastructure construction by various countries is precisely to seize the initiative in the new round of technological revolution and industrial transformation in order to stimulate economic growth. In the context of regional economic development, leveraging the new digital infrastructure to achieve inclusive growth has thus become an important topic.

Inclusive growth emphasizes the achievement of rapid economic growth and the assurance that the fruits of growth are shared among all segments and groups of society, thereby narrowing income disparities and promoting social equity and stability (Asian Development Bank, 2007). For China's provinces, the advancement of the new digital infrastructure presents new opportunities for achieving inclusive growth. By increasing investment in digital infrastructure, regions can better facilitate information flow and resource sharing, enhancing the balance and sustainability of economic development (Deng and Wu, 2023). However, promoting the new digital infrastructure to foster economically inclusive growth also faces challenges. On the one hand, disparities in investment and construction levels of digital infrastructure among regions may lead to an expanding digital divide; on the other hand, the development of the digital economy poses disruptions to traditional industries and employment structures, necessitating appropriate responses and adjustments. Therefore, researching how new digital infrastructure promotes the inclusive growth of China's provincial economies is crucial for policymakers and practitioners to understand its effects, mechanisms, and potential risks, essential for achieving sustainable economic development and harmonious social progress.

"New digital infrastructure" refers to advanced technological systems characterized by high penetration, strong connectivity, and extensive coverage, represented by 5G networks, data centers, industrial internet, and intelligent computing facilities. The core of this system lies in integrating technological innovation with social equity, serving as a strategic link between technological progress and inclusive economic development (such as promoting the East-West Computing project, 5G base station deployment, etc.). This fundamentally differs from traditional digital infrastructure (such as 4G networks, traditional internet, etc., which mainly focus on information transmission and basic connections). Compared to conventional facilities that focus on information exchange and local sharing, new digital infrastructure, leveraging new-generation technologies such as 5G, artificial intelligence, and the Internet of Things, can promote the deep integration of the digital economy and the real economy, facilitate cross-regional flow and virtual aggregation of data, capital, and labor, and not only directly impact sustainable development, poverty reduction, and opportunity equity through reduced transaction costs and improved information accessibility, but also indirectly contribute to inclusive growth through human capital accumulation and industrial structure optimization. Its impact is constrained by threshold conditions such as transportation infrastructure and marketization degree.

In contrast, due to technical limitations and the lack of threshold-driven synergy effects, traditional digital infrastructure makes it difficult to have similar multi-dimensional direct impacts on inclusive growth, given that the role of conventional digital infrastructure in economic growth has been widely studied. In contrast, the mechanisms of new digital infrastructure in poverty reduction, opportunity equity, and other aspects of inclusive growth have not been fully explored. Its development aligns with strategic needs, such as China's Digital Economic Development Plan, and along with these ideas, this study focuses on new digital infrastructure in order to reveal its unique role in promoting regional coordination and sustainable development.

Existing research on the economic development effects of infrastructure construction exhibits a multidimensional perspective. Some scholars have empirically demonstrated the significant role of infrastructure construction in improving the development level of digital inclusive finance (Tan and Zhang, 2023), promoting industrial structural upgrading (Yuan and Xia, 2022), and fostering high-quality economic development (Huang et al., 2023) based on empirical data from China. American scholars have analyzed the driving paths of infrastructure construction from the perspectives of information dissemination costs and technology diffusion (Stiroh, 2002), as well as its contribution to economic growth, which reaches up to 12.3% (Wolde-Rufael, 2007). Starting from the realistic characteristics of new infrastructure, such as its strong permeability, high connectivity, and wide coverage, which overcome temporal and spatial constraints (Wang and Cai, 2020), researchers have discovered its notable role in giving rise to new business formats and models, creating new employment platforms and positions, and achieving fair employment opportunities for social labor, especially for low-income workers (Golley and Kong, 2018; Liu et al., 2024; Wang et al., 2023), as well as diversified personalized services for older people (Yang, 2023). New digital infrastructure also facilitates cross-regional circulation, realizes the virtual agglomeration of interactions among data, capital, labor, and technology factors, and liberates the industrial geographical agglomeration model that relies on fixed production processes (Ru and Liu, 2022), providing opportunities for underdeveloped regions to leapfrog over market segmentation dilemmas and utilize latecomer advantages to achieve inclusive growth.

Existing research has primarily concentrated on economic growth, industrial structure, and labor employment, confirming the positive impact of new infrastructure on the economy. However, there are also challenges and regional imbalances that cannot be overlooked. Nevertheless, how the new digital infrastructure promotes inclusive growth at the provincial level and its mechanisms and influencing factors in this process have not been thoroughly studied. There are also several unresolved issues. First, the policy implementation and effectiveness evaluation of the new digital infrastructure are still in their infancy, necessitating more in-depth empirical research to address the challenges encountered during implementation. Second, the measurement standards and influencing factors of inclusive growth still need to be standardized and refined to assess policy outcomes more accurately. Lastly, while regional difference studies have revealed specific trends, more comprehensive data and models are required to explore the new digital infrastructure's optimal pathways and potential obstacles in different regions.

The marginal contributions of this study are mainly as follows: (1) Existing research primarily focuses on the growth effects of traditional infrastructure while overlooking the inherent advantages of new digital infrastructure in facilitating factor mobility and information dissemination. This study innovatively constructs an analytical framework of "digital new infrastructure—inclusive development," which comprehensively evaluates its potential to advance inclusive development regarding coverage and economic participation. (2) Based on the evaluation dimensions of a comprehensive, inclusive development index, this study examines the impact effects from three perspectives: sustainable growth, poverty reduction, and equal opportunity, providing a new perspective for quantitatively assessing the socioeconomic effects of new digital infrastructure. (3) This study considers the dual factors of human capital accumulation and industrial structure upgrading to explore the transmission mechanisms through which new digital infrastructure promotes inclusive development. By examining the synergistic effects of digital new infrastructure on growth, poverty reduction, and equal opportunity, it offers an analytical framework for leveraging next-generation information technologies to enhance efficiency and equity simultaneously. (4) Threshold effects are often neglected in prior studies. To address this, this study further investigates the constraints imposed by threshold conditions such as transportation infrastructure and marketization levels.

The remaining sections of the article are organized as follows: Section 2 introduces the theory and hypothesis; Section 3 elaborates on the model, variables, and data; Section 4 examines the heterogeneous impact of the new digital infrastructure on inclusive growth; Section 5 investigates the threshold effects of new digital infrastructure on inclusive growth, Section 6 reflects on and discusses the empirical results, and Section 7 presents the conclusions and policy recommendations.

2. Theoretical background and hypothesis analysis

2.1. Theoretical background

Against the backdrop of accelerating global digital transformation and China's pursuit of high-quality economic development, new digital infrastructure has emerged as a crucial catalyst for inclusive growth. To comprehensively understand their relationship, reviewing and synthesizing existing literature is necessary. Theorists have long regarded infrastructure as a fundamental pillar of economic progress; Rostow (1960) proposed that large-scale infrastructure investment is pivotal for a country's economic take-off, laying the groundwork for subsequent growth. However, new digital infrastructure, including 5G networks, big data centers, and industrial internet, differs significantly from traditional infrastructure as it integrates technological innovation with social equity, challenging conventional regional development theories.

Scholars, drawing on infrastructure investment and digital economy regional development theories, argue that new digital infrastructure can optimize resource allocation, reduce transaction costs, and foster regional coordination. Chen and Yang (2021) pointed out that it can break through geographical barriers to promote the free flow of production factors, and Li (2023) emphasized its role in driving industrial upgrading and innovation. Meanwhile, the concept of inclusive growth, first proposed by the Asian Development Bank (2007), emphasizes equitable participation in and distribution of economic growth, advocating a shift from efficiency-driven to socially fair and sustainable models.

Recent empirical studies have revealed the positive effects of new digital infrastructure on economic efficiency and innovation. Chao et al. (2021) demonstrated its ability to lower information acquisition costs and enhance knowledge spillover. Wang and Shao (2024) found that 5G network development significantly promotes enterprise digital transformation, improving overall economic efficiency. Nevertheless, research on its impact on the core dimensions of inclusive growth is insufficient. Although it can boost economic output, its effects on reducing regional disparities, improving public service accessibility, and empowering marginalized groups remain underexplored. Qiu and Liu (2022) warned that the "digital divide" may exacerbate social inequalities if not properly addressed.

One major limitation of existing literature is the absence of a unified framework linking new digital infrastructure to the multi-dimensional goals of inclusive growth. Traditional models often focus on direct economic effects like GDP growth, ignoring indirect pathways such as human capital accumulation and industrial structure optimization. Additionally, the spatial heterogeneity of the impact of new digital infrastructure has not been fully explored. According to the threshold effect theory (Hansen, 1999), its impact varies across regions due to differences in resource endowments. Li et al. (2023) suggested that coastal regions with advanced logistics and higher marketization can better leverage it for innovation-driven growth, while inland areas need to improve their digital access foundation.

Moreover, the spatial heterogeneity of the effects of the new digital infrastructure remains underexplored. Studies on infrastructure investment often find regional disparities (Chen et al., 2011), but how new digital infrastructure interacts with local contexts, such as urban-rural divides or industrial composition, to influence inclusive growth is unclear. The technology diffusion theory (Rogers et al., 2003) posits that new digital infrastructure's social and economic benefits depend on its acceptance and integration within diverse regional systems, highlighting the need for context-specific analyses.

Recent research offers new perspectives. Scholars empirically demonstrate how 5G deployment accelerates enterprise digitalization and productivity gains, particularly in the manufacturing and service sectors. This validates infrastructure's role in reducing transaction costs and fostering innovation-driven growth (Wang and Shao, 2024). A scholar also utilizes threshold regression to show that new digital infrastructure (e.g., data centers, industrial IoT) reduces regional income gaps only when paired with human capital investments like digital literacy programs (Li and Zhang, 2024).

This study aims to fill these gaps by constructing a theoretical framework integrating new digital infrastructure with inclusive growth from three dimensions: sustainable development, poverty reduction, and equal opportunity. The framework posits that new digital infrastructure acts through direct channels like improving public service accessibility via telemedicine and e-education, and indirect mechanisms such as enhancing human capital through digital skills training and promoting industrial upgrading through smart manufacturing. Practically, it responds to China's "East Data West Computing" strategy and the need to narrow regional digital divides. Synthesizing theory and empirical evidence provides policymakers with a nuanced understanding of leveraging new digital infrastructure for inclusive growth, especially in addressing uneven development. Using provincial panel data from 2013–2022, constructing a three-dimensional inclusive growth index, and employing various analytical methods, this study systematically evaluates the role of new digital infrastructure in fostering inclusive growth while considering regional disparities and institutional thresholds, offering a comprehensive framework for bridging economic efficiency and social equity in the digital age.

2.2. Hypothesis analysis

Based on the above theoretical framework and literature review, and combined with the core research topic of this study, the following research hypotheses are proposed:

Hypothesis 1: New digital infrastructure has a direct promoting effect on inclusive growth.

New digital infrastructure directly promotes sustainable economic growth, alleviates poverty, and promotes equal opportunity by reducing information acquisition costs, optimizing resource allocation efficiency, and breaking through geographical and spatial limitations. For example, the popularization of 5G networks and industrial internet can enhance the production efficiency of traditional industries (Wang and Shao, 2024), and the construction of big data centers can promote the flow of data factors among regions, thereby narrowing development gaps (Wang and Cai, 2020). This direct effect may be more significant in areas with higher marketization and more unrestricted factor mobility.

Hypothesis 2: Human capital accumulation and industrial structure optimization are key mediating pathways through which new digital infrastructure affects inclusive growth.

New digital infrastructure indirectly acts on inclusive growth through the following mechanisms: Human capital channel: Digital technologies (such as online education and vocational skills training platforms) lower the threshold for knowledge acquisition and promote human capital accumulation (Chen et al., 2022), and thereby enhance labor productivity and fairness in employment opportunities. Industrial structure channel: Digital infrastructure promotes the digital transformation of traditional industries (such as intelligent manufacturing and agricultural e-commerce) and facilitates upgrading industrial structures toward higher value-added directions (Yuan and Xia, 2022), thereby enhancing economic sustainability and creating inclusive job positions.

Hypothesis 3: The impact of new digital infrastructure on inclusive growth exhibits regional heterogeneity.

Affected by differences in resource endowments and development stages, the inclusive growth effect of new digital infrastructure shows different performances in coastal and inland regions: Coastal regions, with their higher economic foundations and human capital levels, make it easier for new digital infrastructure to promote sustainable growth and equal opportunity through technological spillover and industrial collaboration; inland regions may break through geographical restrictions through new digital infrastructure, and directly improve poverty alleviation efficiency in the form of rural e-commerce, remote services, etc. (Liu, 2022).

Hypothesis 4: The level of transportation infrastructure and the degree of marketization are necessary threshold conditions for the impact of new digital infrastructure on inclusive growth.

When the level of transportation infrastructure exceeds a specific threshold, the efficiency of inter-regional factor flow is improved, and the spillover effect of new digital infrastructure will be amplified (Hansen, 1999). Regions with a higher degree of marketization can more fully release the promoting effect of new digital infrastructure on inclusive growth through competitive mechanisms and optimal resource allocation (Li et al., 2023).

3. Model, variables, and data

3.1. Empirical model design

Before conducting empirical analysis, it is crucial to clarify the internal logic between research objectives and model selection. This study aims to deeply explore the impact mechanism of new digital infrastructure on inclusive growth, analyze its pathways of action across three dimensions: sustainable development, poverty reduction, and equality of opportunity, and consider factors such as regional disparities and institutional thresholds. Based on these objectives, the panel data fixed-effects model is employed in this research.

The panel data fixed-effects model can effectively control the time-invariant heterogeneity of individuals, which highly aligns with the requirement of analyzing data from 30 provinces in China during the period from 2013 to 2022 in this study (based on data integrity and availability, the Hong Kong, Macao, and Taiwan regions, which differ from the Chinese mainland in terms of politics, economy, and social systems, and the Tibet region, which has severe data shortages, are excluded). By using this model, we can accurately assess the impact of new digital infrastructure investment on inclusive growth and its sub-dimensions while eliminating the interference of the inherent characteristics of each province. This ensures that the research results are free from biases caused by region-specific factors.

To test the growth effect, poverty alleviation effect, and equity of opportunity effect generated by the new digital infrastructure, this study takes the three sub-dimensions of inclusive growth, namely the three dimensions of sustainable development, poverty alleviation, and equity of opportunity, as the dependent variables for empirical testing and analyzes the results. The specific model is as follows:

$$IG_{it} / IG1_{it} / IG2_{it} / IG3_{it} = \alpha_0 + \alpha_1 DIG_{it} + \sum \alpha_k \text{CONTROL} + \eta_i + \gamma_t + \varepsilon_{it} \tag{1}$$

Among them, *i* represents the province and *t* represents the year. Regarding the dependent variables, *IG* represents inclusive growth, *IG1* represents the sustainable growth dimension, *IG2* represents the poverty alleviation dimension, and *IG3* represents the equity of opportunity dimension. Regarding the core explanatory variable, *DIG* represents the investment level of the new digital infrastructure, CONTROL denotes the set of control variables incorporated to isolate the net effect of the key explanatory variables.

3.2. Variable and data

3.2.1. Variable selection

This study takes the inclusive growth level of 30 Chinese provinces from 2013 to 2022, and its three sub-dimensions as dependent variables, with the new digital infrastructure index as the explanatory variable, to verify the impact of the new digital infrastructure on inclusive growth.

(1) Explanatory variable

Drawing on Wu et al.'s (2020) approach, this study uses the fixed asset investment in information transmission, software, information technology services, and scientific research and technical services. The investment is deflated using the 2013 fixed asset investment price index as the base period to obtain the information infrastructure investment, and its logarithm serves as the new digital infrastructure index.

(2) Dependent variable

To systematically measure China's provincial inclusive growth, this study constructs a three-dimensional evaluation system inspired by the Human Development Index (HDI) methodology, incorporating sustainability, poverty reduction, and equity opportunity dimensions. This work takes the inclusive growth index (*IG*), the sustainable growth index (*IG1*), the poverty alleviation index (*IG2*), and the equity of opportunity index (*IG3*) as the dependent variables.

(3) Control variables

The following control variables are included:

Proportion of foreign investment (*FOR*): Calculated as actual foreign investment utilization divided by the gross regional product. Foreign investment drives regional development by injecting capital, technology, and management expertise. This variable controls the impact of external capital, enabling a more accurate assessment of the role of the new digital infrastructure.

Activity level of technology transactions (*TEC*): Calculated as technology transaction turnover divided by the gross regional product. It reflects the technology market's vitality, influencing digital technology diffusion. It also isolates the effect of technology transactions on inclusive growth.

Level of transportation infrastructure (*TRA*): Represented by the logarithm of highway length. Good transportation reduces logistics costs and promotes regional connectivity. This variable excludes transportation-related interference.

Tax burden level (*TAX*): Calculated as tax revenue divided by the gross regional product. Tax policies affect economic activities and public service provision, making it a necessary control variable.

Degree of financial development (*FIN*): Measured as the proportion of financial institution loan balances in the GDP. Financial development supports economic activities and social equity. Controlling for it clarifies the impact of the new digital infrastructure.

3.2.2. Index system and data processing

The construction of the inclusive growth indicator system adheres to four basic principles: scientificity, systematicness, representativeness, and operability. Based on the HDI methodology, this study draws on relevant previous research findings and constructs an evaluation system of 13 indicators across three dimensions.

Sustainable growth dimension (5 indicators): This dimension measures economic vitality, structural optimization, and environmental sustainability:

Per capita GDP reflects economic growth.

The proportion of *tertiary industry added value* to *total industrial added value* reflects economic transformation.

Harmless treatment rate of waste, *waste water discharge per unit of GDP,* and *energy consumption per unit of GDP* reflect capture environmental sustainability, with lower resource consumption and higher treatment rates indicating greener development pathways.

Poverty alleviation dimension (3 indicators), designed to assess income equity and living standards:

Household per capita disposable income, *Engel coefficient (proportion of food expenditure in* *total consumption),* directly reflects income inequality, with narrower urban-rural gaps signifying more inclusive growth.

Gini coefficient, an inverse indicator of living standards—lower ratios indicate reduced poverty pressure and improved consumption capacity.

Equity of opportunity dimension (5 indicators) focuses on access to public services and equal development chances:

Medical insurance coverage rate and the *number of hospital beds per 10,000 people* measure healthcare accessibility, crucial for reducing health-related opportunity disparities.

The number of senior high school students per 10,000 population reflects educational equity, as education is a key driver of inclusive growth.

Unemployment rate and *per capita fiscal expenditure on housing security* reflect the capture of employment fairness and social security, with lower unemployment and higher housing investment indicating more equitable resource allocation.

Data primarily comes from the EPS Database, China Statistical Yearbook, and China Fixed Asset Investment Statistical Yearbook. The specific indicators are listed in Table 1.

Table 1. Inclusive growth indicator system.

First-Level Indicator	Second-Level Indicator	Third-Level Indicator	Indicator Attribute
Sustainable Growth Dimension	Economic Transformation	Proportion of Tertiary Industry Added Value to Total Industrial Added Value	+
	Economic Growth	Per Capita GDP	+
	Green Development	Harmless Treatment Rate of Waste	+
		Waste Water Discharge per Unit of GDP	-
		Energy Consumption per Unit of GDP	-
Poverty Alleviation Dimension	Consumption Structure	Household Per Capita Disposable Income	+
		Engel Coefficient (Proportion of Food Expenditure in Total Consumption)	-
	Wealth Gap	Gini Coefficient	-
Equity of Opportunity Dimension	Medical Security	Medical Insurance Coverage Rate	+
		Number of Hospital Beds per 10,000 People	+
	Educational Opportunity	Number of Senior High School Students per 10,000 Population	+
	Employment Opportunity	Unemployment Rate	-
	Housing Security	Per Capita Fiscal Expenditure on Housing Security	+

3.2.3. Measurement method

In the previous section, indicators are classified into positive and negative types based on their attributes. The data processing formula for positive indicators is as follows:

$$X_{ij} = \frac{A_{ij} - m_{ij}}{M_{ij} - m_{ij}} \tag{2}$$

For negative indicators, the data processing formula is:

$$X_{ij} = \frac{M_{ij} - A_{ij}}{M_{ij} - m_{ij}} \tag{3}$$

In Formulas (2) and (3), X_{ij} represents the processed data of indicator *j* in dimension *i* of a province, m_{ij} is the minimum value of the original data for this indicator across 30 provinces over 10 years, and M_{ij} is the maximum value. These formulas ensure that $0 \le x_{ij} \le 1$. The coefficient of variation is calculated as follows:

$$V_{ij} = \frac{S_{ij}}{\overline{A}_{ij}} \tag{4}$$

where V_{ij} represents the coefficient of variation for indicator *j* in dimension *i* of a province, and S_{ij}, $\overline{A}_{ij}$ denote the standard deviation and mean of the indicator, respectively.

The weight of each indicator is calculated as:

$$w_{ij} = \frac{v_{ij}}{\sum_{j} v_{ij}} \tag{5}$$

The inclusive growth index for dimension *i* is:

$$IG_i = 1 - \frac{\sqrt{\sum_{j=1}^{n} w_{ij}^2 (1 - x_{ij})^2}}{\sqrt{\sum_{j=1}^{n} w_{ij}^2}} \tag{6}$$

where IG_i is the inclusive growth index for dimension *i*, w_{ij} is the weight of indicator *j* in dimension *i*, and x_{ij} is the standardized indicator value ($0 \le x_{ij} \le 1$). According to Formula (6), the sustainable growth index, poverty alleviation index, and equity of opportunity index can be calculated. The mean and standard deviation of each dimension's sub-index are computed, and based on these, the coefficient of variation for each dimension is derived:

$$V_i = \frac{S_i}{\overline{A}_i} \tag{7}$$

where V_i represents the coefficient of variation for dimension i in a region, and S_i, $\bar{A}_i$ denote the standard deviation and mean of the dimension's index, respectively. The weight of dimension i is calculated as:

$$w_i = \frac{v_i}{\sum_i v_i} \tag{8}$$

Overall inclusive growth index: After calculating the inclusive growth indices for the three dimensions (sustainable growth, poverty alleviation, equity of opportunity) and their respective weights, the comprehensive inclusive growth index for each region is synthesized as:

$$IG = 1 - \frac{\sqrt{w_1^2(1-IG_1)^2 + w_2^2(1-IG_2)^2 + w_3^2(1-IG_3)^2}}{\sqrt{w_1^2 + w_2^2 + w_3^2}} \tag{9}$$

Descriptive statistics of the inclusive growth index from 2013 to 2022 are presented in Table 2 below:

Table 2. Descriptive statistics of the inclusive growth index.

Year	Mean	Median	Standard Dev	Minimum	Maximum	Observations
2013	0.465	0.452	0.068	0.358	0.626	30
2014	0.500	0.480	0.070	0.382	0.685	30
2015	0.541	0.536	0.070	0.402	0.680	30
2016	0.576	0.572	0.071	0.473	0.780	30
2017	0.641	0.629	0.049	0.563	0.742	30
2018	0.589	0.576	0.057	0.505	0.763	30
2019	0.628	0.627	0.054	0.542	0.771	30
2020	0.667	0.671	0.045	0.557	0.762	30
2021	0.671	0.683	0.054	0.542	0.801	30
2022	0.633	0.633	0.055	0.523	0.749	30

3.3. Empirical results

3.3.1. Results of the overall effect

This article uses Stata 18.0 to empirically test the provincial sample panel data from 2013 to 2022. Through the Hausman test, the null hypothesis that "the individual influencing factors of provinces are independent of the investment level of the core explanatory variable, the new digital infrastructure" is rejected. To make it easier to observe the values, the investment level of the explanatory variable, new digital infrastructure, is logarithmically processed and represented by log*DIG*. The core explanatory variable, log*DIG*, was deflated by the 2013 fixed asset price index. Control variables included foreign investment proportion (*FOR*), transportation infrastructure (*TRA*), tax burden (*TAX*), financial development (*FIN*), and technology transaction activity (*TEC*). Robust standard errors were used to address potential heteroskedasticity. The benchmark regression results are shown in Table 3 below:

Table 3. Benchmark regression results.

	(1)	(2)	(3)	(4)	(5)	(6)
log*DIG*	0.038***	0.091***	0.043***	0.094***	0.063***	0.055***
	(2.82)	(6.53)	(4.02)	(3.50)	(3.81)	(3.30)
FOR		−0.660**		−0.351		−0.230
		(−2.26)		(−1.14)		(−0.97)
TRA		0.004		0.254***		0.036
		(0.43)		(3.58)		(0.77)
TAX		−0.066		−0.463		0.923***
		(−0.27)		(−1.16)		(2.65)
FIN		0.149***		0.168***		0.058**
		(10.80)		(6.44)		(2.59)
TEC		−0.297*		−0.788*		−0.971***
		(−1.73)		(−1.87)		(−2.79)
Constant	0.350***	−0.247*	−0.958***	−3.195***	0.192*	−0.331
	(4.08)	(−1.66)	(−8.66)	(−5.10)	(1.83)	(−0.59)
Location fixed effect	N	N	Y	Y	Y	Y
Time fixed effect	N	N	N	N	Y	Y
Observations	300	300	300	300	300	300
R-squared	0.026	0.405	0.565	0.697	0.812	0.830

t-statistics are in parentheses, *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$, and the following is the same.

According to the empirical results in Table 3, it can be concluded that the investment level in the new digital infrastructure has a significant promoting effect on inclusive growth. Therefore, we accept hypothesis H1. In Table 3, the first column shows the impact of the new digital infrastructure on inclusive growth under the random effects model when other variables are not controlled. It can be seen that the new digital infrastructure has a positive impact on inclusive growth at the 1% significance level, with a regression coefficient of 0.038. The data in the second column are the regression results after adding a series of relevant control variables to the model. Even with the inclusion of control variables such as the proportion of foreign investment, the level of transportation infrastructure, the tax burden level, the degree of financial development, and the activity level of technology transactions, the positive impact of the new digital infrastructure on inclusive growth still exists stably. Also, at the 1% significance level, the regression coefficient is 0.091. This fully indicates that the promoting effect of the new digital infrastructure on inclusive growth is not accidental or interfered with by other variables, but has an independent and stable influence and can continuously exert its positive effectiveness in a complex economic and social environment. The data in the third and fourth columns show the regression results after adding provincial fixed effects. Introducing provincial fixed effects can control the heterogeneity factors that do not change over time among provinces, such as geographical location, resource endowment, and historical development level. The results show that the positive impact of the new digital infrastructure on inclusive growth is significant at the 1% significance level and has increased. This indicates that after controlling for the inherent differences among provinces, the promoting effect of the new digital infrastructure on inclusive growth is more significant. The data in the fifth and sixth columns further add time-fixed effects based on the first two columns to control the impact of time trends on the results. The introduction of time-fixed effects can capture the standard shocks that change over time, such as macroeconomic policies and technological progress. The results show that the positive impact of the new digital infrastructure on inclusive growth is still significant, with regression coefficients of 0.063 and 0.055, and is significant at the 1% significance level. Although the regression coefficients are lower than those in the third column, they are still higher than the results in the second column, indicating that the promoting effect of the new digital infrastructure on inclusive growth remains stable after controlling for the time trend. In conclusion, the new digital infrastructure has a significant positive impact on inclusive growth, and this impact remains stable under different model specifications. Whether controlling for provincial fixed effects, time fixed effects, or the two-way fixed effects of provinces and time, the promoting effect of the new digital infrastructure on inclusive growth is significantly present.

It can be concluded from the results of the model that digital infrastructure reduces information asymmetry through technologies like 5G and big data. Enterprise market data acquisition costs decrease by 20% (Stiroh, 2002), prompting capital and labor to flow toward efficient sectors. The positive coefficient of *FIN* (financial development, 0.149***) indicates that the financial system reinforces this effect by allocating funds, forming a transmission chain of "digital infrastructure → information circulation → resource optimization." The network externality of digital infrastructure drives industrial collaboration. For instance, the industrial internet enhances manufacturing total factor productivity by 15% (Wang and Shao, 2024). The negative coefficient of *TEC* (technology transaction activity, −0.971***) reveals a potential contradiction: centralized technology transactions may lead to monopolies by leading firms, crowding out innovation space for small and medium-sized enterprises (SMEs), consistent with the "digitization paradox" proposed by Pang and Liu (2022).

3.3.2. Sub-effect test

After revealing the comprehensive driving effect of the new digital infrastructure construction on inclusive growth in Section 3.3.1, this study will further deconstruct its mechanism from a multi-dimensional perspective. Empirical analysis will be conducted from the three perspectives of sustainable growth, poverty alleviation, and equity of opportunity to study the effects of the three sub-effects of the new digital infrastructure and explore the specific process of how it promotes inclusive growth. Here, *IG1*, *IG2*, and *IG3,* respectively, represent the sustainable growth index, poverty alleviation effect index, and equity of opportunity index. The specific results are shown in the following table.

Table 4. Sub-exponential regression results.

VARIABLES	(1) *IG*	(2) *IG1*	(3) *IG2*	(4) *IG3*
log*DIG*	0.055***	0.052***	0.195***	0.052*
	(3.30)	(4.04)	(2.67)	(1.80)
FOR	−0.230	0.033	1.335	−0.779*
	(−0.97)	(0.18)	(1.29)	(−1.90)
TRA	0.036	0.006	−0.020	0.029
	(0.77)	(0.16)	(−0.10)	(0.35)
TAX	0.923***	0.457*	−0.085	1.151*
	(2.65)	(1.70)	(−0.06)	(1.92)
FIN	0.058**	−0.058***	0.223**	0.044
	(2.59)	(−3.37)	(2.28)	(1.14)
TEC	−0.971***	0.950***	−0.974	−1.588***
	(−2.79)	(3.54)	(−0.64)	(−2.65)
Constant	−0.331	−0.052	−0.888	−0.430
	(−0.59)	(−0.12)	(−0.36)	(−0.45)
Two-way Fixed Effects	Y	Y	Y	Y
Observations	300	300	300	300
R-squared	0.830	0.967	0.251	0.723

The second column of Table 4 presents the regression results for the sustainable growth sub-index. The new digital infrastructure exhibits a significantly positive impact on the sustainable growth index (*IG1*) at the 1% significance level, with a regression coefficient of 0.052. This finding underscores the pivotal role of the new digital infrastructure in fostering regional economic sustainability. Facilitating the deep integration of digital technologies with traditional industries enhances production efficiency. It optimizes resource allocation, propelling continuous regional economic development along a sustainable trajectory and providing a robust impetus to the sustainable growth dimension of inclusive development. The regression results of the sub-index for the poverty alleviation dimension are presented in the fourth column. The new digital infrastructure has a highly significant positive impact on the poverty alleviation index at the 1% significance level, with a regression coefficient as high as 0.195. This result profoundly reflects the remarkable effectiveness of the new digital infrastructure in alleviating poverty. The new digital infrastructure can create more job opportunities in the digital economy, broaden the channels for information access in poverty-stricken areas, and enhance low-income people's digital skills and employability. As a result, it can effectively increase the income sources of low-income families, help poverty-stricken areas and people out of poverty, play a crucial role in poverty alleviation work, and significantly contribute to achieving the poverty alleviation goal in inclusive growth.

Regarding the poverty alleviation dimension, the fourth column reveals that the new digital infrastructure exerts a highly significant positive effect on the poverty alleviation index (*IG2*) at the 1% significance level, with an impressive regression coefficient of 0.195. This outcome highlights the remarkable efficacy of the new digital infrastructure in poverty reduction efforts. It creates additional employment opportunities within the digital economy, expands information access channels in impoverished regions, and improves disadvantaged populations' digital literacy and employability. Consequently, it effectively diversifies income sources for poor households, facilitating poverty alleviation in these areas and making substantial contributions to achieving the poverty reduction objectives of inclusive growth. It is worth noting that the above data show that the tax level and the degree of financial development have a significant positive impact on inclusive growth. In terms of taxation, sufficient tax revenue provides a solid guarantee for the supply of public services and the reasonable allocation of resources. By supporting infrastructure construction, improving the uneven distribution of education and medical resources, and effectively narrowing the gaps between regions and groups, it lays the foundation for inclusive growth. At the same time, reasonable tax policies guide industrial transformation and optimization, create a suitable environment for enterprise development, promote employment and economic diversification, and further advance sustainable inclusive growth.

For the equity of opportunity dimension, as shown in the fifth column, the new digital infrastructure significantly impacts the corresponding index (*IG3*) at the 10% significance level, with a coefficient of 0.052. This result indicates its positive role in promoting social equity of opportunity. By dismantling information barriers, the new digital infrastructure enables more equitable access to digital resources and development opportunities across different regions and social strata, such as online education, telemedicine services, and digital entrepreneurship platforms. To some extent, this mitigates opportunity disparities caused by geographical and social factors, steering society toward greater fairness and inclusivity.

The tax burden level (*TAX*) and financial development degree (*FIN*) demonstrate significant positive associations with inclusive growth. Adequate tax revenues underpin public service provision and resource allocation, supporting infrastructure construction, rectifying educational and medical resource disparities, and narrowing regional and group gaps—thereby laying the groundwork for inclusive growth. Simultaneously, well-designed tax policies guide industrial transformation, foster a conducive business environment, stimulate employment, and diversify the economy, further advancing sustainable inclusive growth.

In financial development, a higher level of development enables more efficient capital allocation. It invigorates the real economy by generating jobs and growth drivers while promoting sustainable projects through innovative financial instruments like green finance. Moreover, the proliferation of financial services empowers disadvantaged groups to engage in entrepreneurship and enhance productivity. A fair and efficient financial market removes capital constraints, facilitating equal access to opportunities and promoting inclusive growth from multiple angles. Future development strategies and policies should thus prioritize optimizing tax and financial systems to fully harness their potential in advancing inclusive development.

Contrastingly, the technology transaction activity level (*TEC*) negatively impacts inclusive growth significantly. One plausible explanation is that heightened technology transaction activity may concentrate technological resources among a few enterprises or groups. Firms with technological superiority can leverage their advantages to establish monopolistic positions, erecting barriers that impede the entry and growth of small and medium-sized enterprises (SMEs)—for instance, through patent-based exclusivity and technological blockades. This exacerbates market competition inequality, curtails employment diversity, and constricts SMEs' development space, undermining inclusive growth. From an industrial structure perspective, excessive focus on high-tech sectors with intensive technology transactions diverts resources from traditional and labor-intensive industries, which are crucial for absorbing low-skilled workers. Suppressing these sectors' growth creates employment challenges for this workforce, further impeding inclusive development.

Abstracting from endogeneity complexities, the new digital infrastructure showcases multi-channeled and high-efficiency advantages. It effectively stimulates regional inclusive growth, promotes the achievement of inclusive growth objectives across sustainable development, poverty alleviation, and equity of opportunity dimensions, and establishes a robust foundation for coordinated, sustainable, and equitable regional economic and social development.

3.3.3. Mediation effect analysis

A model is constructed to better study the moderating effect of industrial agglomeration on the relationship between the new digital infrastructure and inclusive growth. Here are the basic equations:

$$LAB_{it} / STR_{it} = \alpha_0 + \beta_1 DIG_{it} + \sum \gamma_k CONTROL_{it} + \eta_i + \gamma_t + \varepsilon_{it} \tag{10}$$

$$IG_{it} = \alpha_0 + \beta_1 DIG_{it} + \beta_2 LAB_{it} / STR_{it} + \sum \gamma_k CONTROL_{it} + \eta_i + \gamma_t + \varepsilon_{it} \tag{11}$$

Among them, *LAB* represents the corresponding human capital, and *STR* represents the corresponding industrial structure variable. When exploring the impact mechanism of new digital infrastructure construction on inclusive growth, this paper further selects the level of human capital *LAB* (the number of students in higher education institutions divided by the total population) and the industrial structure *STR* (the proportion of the tertiary industry in the regional GDP) as mediating variables for the mediating effect regression analysis. The results are shown in Tables 5 and 6. Column 1 of Tables 5 and 6 shows the regression results without control variables, and Column 2 shows the regression results with control variables.

From the regression results in Column 2 of Table 5, it can be seen that new digital infrastructure construction has a significant positive impact on the level of human capital at the 1% significance level, with a regression coefficient of 33.658. So, we accept hypothesis H2. This means that the development of new digital infrastructure construction may indirectly affect inclusive growth by improving human capital. New digital infrastructure construction may bring about changes in the education field. For example, it promotes the popularization and optimization of online education resources, enabling more people to access high-quality education resources without being restricted by region and time. This will increase the proportion of students in higher education institutions relative to the total population, thereby improving the level of human capital in the entire region. Moreover, the improvement of the level of human capital will further have a positive impact on inclusive growth because a higher level of human capital in a region usually means a richer talent pool, which can drive innovation and technological progress, improve labor productivity, and provide strong support for economic development and social progress. When the level of human capital is included as a mediating variable in the regression model, under the control of other factors, it has a positive impact on inclusive growth at the 5% significance level, with a regression coefficient of 7.887, which further verifies the mediating effect of the level of human capital between new digital infrastructure construction and inclusive growth.

Table 5. Mediation effect regression results of *LAB*.

	(1)		(2)	
VARIABLES	*LAB*	*IG*	*LAB*	*IG*
log*DIG*	41.947***	0.041**	33.658***	0.041**
	(5.62)	(2.41)	(4.00)	(2.45)
LAB		8.420***		7.887***
		(3.90)		(3.38)
FOR			1.535*	−0.159
			(1.78)	(−0.68)
TRA			0.189	−0.007
			(1.05)	(−0.15)
TAX			−0.841	1.095***
			(−0.66)	(3.17)
FIN			0.215**	0.034
			(2.54)	(1.45)
TEC			0.285	−0.761**
			(0.22)	(−2.20)
Constant	5.475***	0.149	3.138	0.117
	(33.91)	(1.44)	(1.51)	(0.21)
Two-way Fixed Effects	Y	Y	Y	Y
Observations	300	300	300	300
R-squared	0.869	0.823	0.875	0.837

Regarding the industrial structure, in Column 2 of Table 6, new digital infrastructure construction hurts the industrial structure at the 5% significance level, with a regression coefficient of −0.015. This may be because the development of new digital infrastructure construction promotes the adjustment of the industrial structure and drives the transformation of traditional industries toward digitalization and intelligence, resulting in a decrease in the proportion of some labor-intensive traditional industries and thus manifesting as a relative decrease in the proportion of the tertiary sector in the local GDP. However, this adjustment of the industrial structure is not negative. As can be seen from the regression results, the industrial structure has a positive impact on inclusive growth at the 5% significance level, with a regression coefficient of 0.001. This may be because the adjustment of the industrial structure triggered by the new digital infrastructure construction promotes industrial upgrading and encourages the flow of resources to industries with higher added value and innovation. Although the proportion of the tertiary sector has decreased, optimizing the overall industrial structure may bring higher economic benefits and social value. For example, emerging digital industries may create more high-value-added job opportunities and innovation opportunities, attract high-skilled talents, and thus promote inclusive growth.

Table 6. Mediation effect regression results of *STR*.

	(1)		(2)	
VARIABLES	*STR*	*IG*	*STR*	*IG*
log*DIG*	−0.003**	0.063***	−0.015**	0.047***
	(−0.48)	(3.84)	(−2.39)	(3.37)
STR		0.001**		0.001**
		(1.01)		(0.70)
FOR			0.942	−0.203
			(1.06)	(−0.84)
TRA			0.386**	0.037
			(2.21)	(0.77)
TAX			−1.137	0.883**
			(−0.87)	(2.50)
FIN			0.425***	0.051**
			(4.83)	(2.04)
TEC			0.261	−1.043***
			(0.19)	(−2.87)
Constant	6.512***	0.116	2.020	−0.391
	(24.13)	(0.90)	(0.96)	(−0.69)
Two-way Fixed Effects	Y	Y	Y	Y
Observations	300	300	300	300
R-squared	0.853	0.813	0.871	0.830

Digital infrastructure promotes the popularization of online education. The National Smart Education Platform for Primary and Secondary Schools covers 90% of high-quality courses in rural areas, driving the gross enrollment rate of higher education to increase by 2.3% annually (Chen et al., 2022). The positive coefficient of *LAB* (7.887***) indicates that digital skills training improves labor productivity, promoting *IG*, consistent with Schultz's human capital theory. Although the early stage of digital infrastructure development may lead to a decline in the proportion of traditional manufacturing (*STR* coefficient = 0.015**), it also forces the industry to transform toward higher value-added directions (such as intelligent manufacturing). The positive coefficient of *STR* on *IG* (0.001*) indicates that although there are frictions in the short-term adjustment of employment structure (such as workers on assembly lines changing jobs), the high-skilled positions created by emerging digital industries (with average salaries higher than those of traditional positions by 40%) ultimately drive inclusive growth, confirming Schumpeter's "creative destruction" theory.

In conclusion, constructing new digital infrastructure has demonstrated a complex and multi-dimensional impact mechanism in promoting inclusive growth. In future policy formulation and practice, these impact paths should be fully considered to better leverage the advantages of new digital infrastructure construction and promote the economic society's sustained and healthy development. For example, while promoting the construction of new digital infrastructure, investment in and optimization of education resources can be increased to complement better its role in improving the level of human capital, and at the same time, guide the adjustment and upgrading of the industrial structure to ensure that the development of different industries can be balanced during the industrial transformation process, avoid the local negative impacts caused by the transformation, and maximize the promotion effect of new digital infrastructure construction on inclusive growth.

4. Heterogeneous impact of the new digital infrastructure on inclusive growth

Within China's vast territory, various provinces and regions exhibit significant differences in many aspects, such as economic development, urban environment, and cultural education. Coastal cities, relying on their unique geographical location advantages, have always been at the forefront of marketization and foreign economic cooperation. For a long time, the coastal areas have been highly economically developed, which benefits from their early integration into the global economic system, frequent foreign trade and investment activities, and the accumulation of substantial economic capital. Infrastructure construction is relatively complete, whether in transportation networks, communication facilities, or energy supply. Modern ports, airports, and dense highway and railway networks make the transportation of goods and the movement of people extremely convenient, providing efficient logistics support for commercial activities. At the same time, the complete communication facilities ensure the rapid transmission of information, which is conducive to enterprises' timely grasp of market dynamics and making scientific decisions.

In contrast, although the inland areas are not as externally oriented as the coastal cities in terms of economy, as the spatial hub of the country, they are of irreplaceable importance. The inland areas have convenient transportation, with numerous railway trunk lines and highways crisscrossing as important logistics channels connecting different regions within the country. They have a solid industrial foundation. During industrialization, they developed several highly competitive industrial sectors, such as the energy and chemical industry, equipment manufacturing, etc. As China's industrial transformation enters a new stage, the inland areas actively explore innovative development paths and open up new ecological regions for economic development. Relying on abundant natural resources, such as mineral and hydropower resources, they develop green industries such as clean energy and deep processing of resources, which not only achieve the efficient utilization of resources but also protect the ecological environment. At the same time, the profound cultural resources have also become a new engine for the development of the inland areas. By developing cultural tourism, creative cultural industries, etc., they combine traditional culture with the modern economy and embark on a unique green economic development path, seeking development differently within the national economic pattern.

Due to the apparent differences in development characteristics and resource endowments between the coastal and inland areas, there are also significant differences in inclusive growth. To deeply explore this difference and the role played by new digital infrastructure construction, a heterogeneity test of the coastal and inland areas was carried out, and the results are shown in Tables 7 and 8, respectively.

(1) Analysis of heterogeneity of overall effects

According to Table 7, the regression coefficient of new digital infrastructure construction on the coastal areas' overall inclusive growth index (IG_s) is 0.071, which is significant at the 5% level. Therefore, we can accept hypothesis H3. This indicates that constructing new digital infrastructure in coastal areas has a noticeable promoting effect on inclusive growth. The possible reason is that the developed initial economic foundation and complete infrastructure in the coastal regions provide a good foundation for implementing and applying the new digital infrastructure construction. New digital infrastructure construction further improves the information dissemination speed and resource allocation efficiency, and promotes collaborative innovation among various industries. For example, in intelligent manufacturing, the deep integration of digital technology and traditional manufacturing industries improves production efficiency and product quality, thereby driving the inclusive growth of the entire region. In terms of the overall inclusive growth index (*IG_I*) of the inland areas, the regression coefficient of the new digital infrastructure construction index is 0.062, which is significant at the 1% level, indicating that new digital infrastructure construction also has a significant promoting effect on inclusive growth in the inland areas. During the industrial transformation process in the inland areas, new digital infrastructure construction has become a key force in promoting the digital upgrading of traditional industries. For example, transforming the traditional agricultural production mode with digital technology improves agricultural production efficiency and the added value of agricultural products increases farmers' income, and promotes inclusive growth.

From the perspective of control variables, the coastal areas and the inland areas also show different characteristics. In the coastal areas, the level of transportation infrastructure has a significant positive impact on inclusive growth. This may be because the status of transportation hubs in the coastal areas enables the improvement of transportation infrastructure to significantly promote the flow of goods and people, further enhancing the region's economic vitality and degree of opening up. In the inland areas, the impact of the degree of financial development on inclusive growth is more prominent. Industrial transformation in the inland areas requires considerable capital support. The development of financial institutions and improving financial services provide the necessary capital guarantee for enterprise innovation and industrial upgrading, thus promoting inclusive growth.

Overall, due to the differences in their development conditions and resource endowments, there are differences in the promotion paths and effects of new digital infrastructure construction on inclusive growth between the coastal and inland areas. Regional heterogeneity should be fully considered when formulating relevant policies for new digital infrastructure construction, and the development of new digital infrastructure construction should be promoted according to local conditions to better promote inclusive growth in various regions. For example, the coastal areas can further strengthen the application of new digital infrastructure construction in high-end industries and innovation fields to enhance industrial competitiveness; the inland areas should focus on the combination of new digital infrastructure construction with industrial transformation and regional coordinated development, and give play to the role of digital technology in making up for geographical disadvantages and promoting balanced development.

Table 7. Results of the overall effect heterogeneity test.

VARIABLES	(1) *IG_s*	(2) *IG_I*
log*DIG*	0.071**	0.062***
	(2.24)	(3.05)
FOR	−0.187	0.007
	(−0.71)	(0.01)
TRA	0.239***	−0.068
	(2.76)	(−1.13)
TAX	0.482	0.902**
	(0.76)	(2.00)
FIN	0.006	0.078***
	(0.13)	(3.02)
TEC	−0.514	−2.242***
	(−0.96)	(−4.59)
Constant	−2.657***	0.861
	(−2.65)	(1.18)
Two-way Fixed Effects	Y	Y
Observations	100	200
R-squared	0.881	0.835

(2) Analysis of heterogeneity of sub-effects

According to Table 8, in terms of the dimension of sustainable growth, the promoting effect of the new digital infrastructure construction in coastal areas is more significant. The regression coefficient reaches 0.090, which is significant at the 1% level. This may be because, during industrial upgrading in coastal areas, more attention is paid to green development and technological innovation. The new digital infrastructure construction effectively improves sustainable development by promoting the application of digital technology in aspects such as energy management and environmental monitoring. The regression coefficient in inland areas is 0.047, which is significant at the 1% level. Although the promoting effect is weaker than that in coastal areas, the construction of new digital infrastructure also plays a positive role in the sustainable growth of the inland regions. It strengthens the digital management, development, and utilization of natural resources by constructing new digital infrastructure, improving resource utilization efficiency, and reducing waste and environmental damage.

Regarding the dimension of poverty reduction, the regression coefficient of new digital infrastructure construction in inland areas is 0.256, which is significant at the 1% level. This result shows that the construction of new digital infrastructure is significant in poverty reduction work in inland areas. Inland areas expand the sales channels of agricultural products through digital platforms and develop rural e-commerce, creating more employment opportunities and income-increasing channels for poverty-stricken areas. However, the regression coefficient in coastal areas is −0.091. Although the result is not significant, it also reflects that in coastal areas, the direct effect of new digital infrastructure construction on poverty reduction may be relatively weak. The possible reason is that the poverty level in coastal areas is relatively low, and poverty reduction work is no longer the principal contradiction in economic development. The construction of new digital infrastructure plays a greater role in improving economic quality and social fairness.

Regarding the dimension of opportunity fairness, the regression coefficient of new digital infrastructure construction in coastal areas is 0.139, which is significant at the 5% level, indicating that it positively promotes opportunity fairness. The development of new digital infrastructure construction in coastal areas enables more extensive sharing of resources such as education and medical care through digital platforms. For example, online education courses break through geographical limitations, allowing more people to have the opportunity to receive high-quality education, thus promoting opportunity fairness. The regression coefficient in inland areas is 0.040. Although the promoting effect is relatively weak, it also reflects to a certain extent that new digital infrastructure construction helps improve opportunity fairness in inland areas. For example, through telemedicine services, residents in remote areas can enjoy better medical resources, improving social fairness.

Table 8. Results of the score-effect heterogeneity test.

	(1)	(2)	(3)	(4)	(4)	(6)
VARIABLES	*IG1_s*	*IG1_I*	*IG2_s*	*IG2_I*	*IG3_s*	*IG3_I*
log*DIG*	0.090***	0.047***	−0.091	0.256***	0.139**	0.040
	(3.10)	(3.40)	(−0.56)	(2.92)	(2.62)	(1.15)
FOR	0.168	0.217	1.275	−0.323	−0.930**	−0.407
	(0.70)	(0.57)	(0.95)	(−0.13)	(−2.11)	(−0.43)
TRA	−0.144*	0.147***	−0.101	−0.106	0.333**	−0.156
	(−1.84)	(3.58)	(−0.23)	(−0.41)	(2.31)	(−1.53)
TAX	−0.080	0.620**	5.124	−1.222	0.185	1.137
	(−0.14)	(2.02)	(1.52)	(−0.63)	(0.17)	(1.50)
FIN	−0.039	−0.064***	−0.207	0.280**	0.054	0.063
	(−0.88)	(−3.66)	(−0.84)	(2.51)	(0.67)	(1.44)
TEC	−0.143	2.079***	3.005	−4.302**	−1.449	−3.481***
	(−0.30)	(6.27)	(1.11)	(−2.05)	(−1.63)	(−4.23)
Constant	1.539*	−1.758***	2.023	−0.129	−4.471***	1.861
	(1.70)	(−3.56)	(0.40)	(−0.04)	(−2.69)	(1.52)
Two-way Fixed Effects	Y	Y	Y	Y	Y	Y
Observations	100	200	100	200	100	200
R-squared	0.969	0.967	0.286	0.299	0.706	0.768

Coastal areas, with high marketization and transportation foundations, deeply integrate digital infrastructure with high-end industries. 5G+industrial internet shortens the R&D cycle of the Yangtze River Delta manufacturing industry by 30% (Wang and Shao, 2024). The high coefficients of *IG1* and *IG3* reflect technological spillover effects: digital infrastructure promotes green innovation (e.g., new energy vehicles) and service inclusiveness (e.g., online international courses), aligning with the innovation agglomeration characteristics of core regions in “core-periphery” theory. In addition, inland areas break through geographical constraints via digital infrastructure. Guizhou’s “big data + agriculture” model increases chili e-commerce sales by 50% annually (Liu, 2022). The high coefficient of *IG2* (0.256***) indicates that digital infrastructure is highly effective in reducing agricultural product circulation losses (from 25% to 8%) and connecting with consumer markets.

In conclusion, due to the differences in their own development characteristics and resource endowments between coastal areas and inland areas, the impact of new digital infrastructure construction on inclusive growth shows different effects in various dimensions. Coastal areas perform outstandingly in terms of sustainable growth and opportunity fairness. At the same time, the role of new digital infrastructure construction in the dimension of poverty reduction is more significant in inland areas. This provides an important reference basis for different regions to formulate targeted new digital infrastructure construction development strategies and inclusive growth policies. All regions should give full play to their advantages and use new digital infrastructure construction to promote inclusive growth to new heights.

5. Analysis of the threshold effect of the new digital infrastructure on inclusive growth

When examining the impact of new digital infrastructure construction on inclusive growth, it is crucial to acknowledge the heterogeneous characteristics of different regions. Significant disparities exist in economic, social, and infrastructural conditions, rendering a simple linear model insufficient to accurately capture the new digital infrastructure's influence. Its impact may vary substantially contingent upon diverse regional conditions. Threshold regression is an effective methodology to identify the nonlinear relationships between new digital infrastructure construction and inclusive growth under different circumstances, thereby enabling a more precise depiction of the complex impact mechanism. Therefore, we constructed a threshold regression model to investigate this relationship. Here are the basic equations:

$$IG_{it} = \begin{cases} \alpha_0 + \beta_1 DIG_{it} + \sum \gamma_k CONTROL_{it} + u_i + \eta_t + \varepsilon_{it}, & \text{if } Trf_{it} \leq \gamma_1 \\ \alpha_0 + \beta_2 DIG_{it} + \sum \gamma_k CONTROL_{it} + u_i + \eta_t + \varepsilon_{it}, & \text{if } Trf_{it} > \gamma_1 \end{cases} \tag{12}$$

$$IG_{it} = \begin{cases} \alpha_0 + \beta_1 DIG_{it} + \sum \gamma_k CONTROL_{it} + u_{it} + \varepsilon_{it}, & \text{if } Mak_{it} \leq \gamma_2 \\ \alpha_0 + \beta_2 DIG_{it} + \sum \gamma_k CONTROL_{it} + u_{it} + \varepsilon_{it}, & \text{if } Mak_{it} > \gamma_2 \end{cases} \tag{13}$$

In the equations, *Trf* represents the corresponding transportation level, *Mak* represents the corresponding marketization degree, *CONTROL* represents the corresponding control variables, and γ represents the corresponding threshold value.

Before conducting the threshold test, we need to prove whether the threshold effect exists. Based on the threshold existence tests presented in Tables 9 and 10, both transportation level (*Trf*, measured as the logarithm of highway mileage) and marketization degree (*Mak*, represented by the regional marketization index) exhibit single threshold effects on the relationship between new digital infrastructure investment and inclusive growth. Then, a threshold regression was conducted to obtain Table 11.

Table 11 presents the threshold regression results. For the transportation level (*Trf*), as shown in the first column, when $Trf \leq 11.272$, the impact coefficient of new digital infrastructure construction (log*DIG*) on inclusive growth is 0.056, significant at the 5% level. This indicates that in regions with underdeveloped transportation infrastructure, new digital infrastructure construction still exerts a positive but relatively weak influence on inclusive growth. The limited transportation capacity restricts inter-regional factor mobility and market expansion, thereby impeding the full realization of the new digital infrastructure's potential and constraining its role in promoting economic and social development. Conversely, when $Trf > 11.272$, the impact coefficient increases to 0.086, which is also significant at the 5% level, reflecting a substantial enhancement in influence. A higher transportation provides more favorable conditions for promoting and applying the new digital infrastructure, facilitating optimized resource allocation and coordinated industrial development across regions. For instance, a well-developed transportation network enables the new digital infrastructure to better serve logistics and commercial sectors, accelerating the flow of information, technology, and human resources, thus boosting inclusive growth. Beyond the threshold, the new digital and transportation infrastructure forms a more potent synergy, invigorating economic activities, optimizing the economic structure, and enabling broader sharing of development benefits among regions and social groups.

Regarding the marketization degree (*Mak*), as depicted in the second column, when $Mak \leq 6.310$, the impact coefficient of new digital infrastructure construction on inclusive growth is 0.077, significant at the 5% level. In regions with lower marketization, the new digital infrastructure already demonstrates a notable positive effect on inclusive growth. This may be attributed to introducing new market forces and growth drivers by digital infrastructure development, diversifying economic activities, engaging more market participants, and enhancing economic vitality and social inclusiveness. When $Mak > 6.310$, the impact coefficient rises to 0.086, which is significant at the 5% level and comparable to the coefficient observed after exceeding the transportation level threshold. The construction of new digital infrastructure in highly marketized regions further promotes economic restructuring and resource optimization by intensifying market competition and accelerating innovation. A high degree of marketization provides an open and competitive environment for digital infrastructure applications, enabling them to drive inclusive growth more effectively through fostering emerging digital enterprises and optimizing market supply-demand matching.

Therefore, we accept hypothesis H4. In summary, the degree of transportation level and marketization exhibit threshold effects on the relationship between the construction of new digital infrastructure and inclusive growth.

Table 9. Traffic level threshold existence test.

	Threshold	RSS	MSE	Fstat	Prob	Crit10	Crit5	Crit1
Double threshold	Single	0.671	0.002	27.11	0.005	19.480	23.305	26.066
	Double	0.648	0.002	10.29	0.670	59.939	66.172	77.565
Single threshold	Single	0.671	0.002	27.11	0.005	18.381	20.184	25.465

Table 10. The existence of a marketization degree threshold test.

	Threshold	RSS	MSE	Fstat	Prob	Crit10	Crit5	Crit1
Double threshold	Single	0.689	0.002	18.59	0.090	17.919	21.075	28.828
	Double	0.652	0.002	16.66	0.130	17.151	19.596	24.250
Single threshold	Single	0.689	0.002	18.59	0.090	17.354	20.206	23.371

Table 11. Threshold regression results.

VARIABLES	Trf	Mak
diglog(*Trf* ≤ 11.272)	0.056**	
	(0.009)	
diglog(*Trf* > 11.272)	0.086**	
	(0.000)	
diglog(*Mak*≤ 6.310)		0.077**
		(0.000)
diglog(*Mak*> 6.310)		0.086**
		(0.000)
fin	0.185**	0.149**
	(0.000)	(0.000)
for	−0.450	−0.291
	(0.131)	(0.333)
tra	0.251**	0.245*
	(0.000)	(0.000)
tax	−0.021	−0.659
	(0.957)	(0.093)
tec	−0.449	−0.884
	(0.274)	(0.032)
Constant	−3.141	−2.973
	(0.000)	(0.000)
R-squared	0.968	0.955

In practical terms, policymakers should formulate region-specific strategies guided by local transportation and marketization conditions. For regions with weak transportation infrastructure or low marketization, increasing investment and policy support for new digital infrastructure construction can help them surpass the threshold, unlocking the infrastructure's greater growth potential and promoting more inclusive development. Additionally, it is essential to strengthen the coordination between digital infrastructure construction and improving transportation and marketization levels. For example, integrating digital technologies into transportation management can improve transportation efficiency in transportation-lagging areas, thereby enhancing the synergy between the two. In regions with low marketization, promoting enterprises' digital transformation can accelerate the marketization process and further leverage the role of new digital infrastructure in inclusive growth.

However, this study has several limitations. First, the variables selected in this study may not fully cover all factors affecting the relationship between new digital infrastructure and inclusive growth. Other important economic, social, and environmental factors may not be considered, which may lead to certain biases in the research results. Second, the data used in this study is mainly from a specific period and region. The generalization ability of the research conclusions to other periods and regions must be further verified.

For future research, researchers can expand the scope of variable selection, incorporate more comprehensive data on economic, social, and environmental factors, and construct a more complete research model to more accurately explore the relationship between new digital infrastructure and inclusive growth. In addition, multi-period and multi-regional data can be collected for comparative analysis to improve the generalization ability of research conclusions. Longitudinal research can also be carried out to explore the dynamic evolution of the threshold effect over time, providing more in-depth theoretical support and practical guidance for promoting inclusive growth through new digital infrastructure construction.

6. Reflection and discussion on the empirical results

6.1. Theoretical and practical significance of the core findings

This is a systematic study that verifies the driving mechanism of the new digital infrastructure on China's provincial inclusive growth by constructing a three-dimensional evaluation system that includes sustainable development, poverty reduction effects, and opportunity fairness, combined with panel data models and threshold regression methods. The empirical results show that the new digital infrastructure promotes inclusive growth through direct effects and dual mediating paths of human capital accumulation and industrial structure optimization, and there are significant regional heterogeneities and threshold effects of transportation and marketization. This conclusion expands the connotation of infrastructure investment theory at the theoretical level and reveals the unique role of digital technology in promoting social equity and sustainable development. Specifically, the study finds that the new digital infrastructure not only directly improves economic efficiency by reducing information costs and optimizing resource allocation, but also indirectly promotes equal opportunities and poverty reduction by empowering human capital and industrial structure upgrading, which forms a sharp contrast with the path of traditional infrastructure that only focuses on economic growth (Chao et al., 2021).

From a practical perspective, the research results provide empirical support for implementing national strategies such as "East Data West Computing" in China. For example, with the support of the new digital infrastructure, western regions have significantly improved poverty reduction efficiency through models such as rural e-commerce, verifying the feasibility of digital technology in narrowing regional development gaps. At the same time, the study finds that the innovation-driving effect of the new digital infrastructure is more prominent in coastal areas, which is highly related to the advantages and resource endowments of the eastern regions, suggesting that policy-makers need to consider regional differential characteristics fully.

6.2. In-depth interpretation of regional heterogeneities

The results of regional-specific tests show that the impact of the new digital infrastructure on inclusive growth has significant spatial differences. Coastal areas perform outstandingly in sustainable growth and opportunity fairness, while inland provinces achieve remarkable results in poverty reduction. The following two aspects can explain this difference:

First, differences in resource endowments and development stages lead to differentiated paths of influence. With their well-developed transportation networks, high marketization levels, and strong human capital bases, coastal areas make it easier for new digital infrastructure to promote innovation-driven development through technology spillover and industrial synergy effects. For example, the deep integration of 5G networks and industrial internet has significantly improved the total factor productivity of the manufacturing industry, thereby promoting sustainable growth (Wang and Shao, 2024). In contrast, the new digital infrastructure in inland areas mainly helps poverty reduction through direct means, such as reducing transaction costs and expanding agricultural product sales channels. For instance, Guizhou Province has achieved a fivefold increase in the sales of characteristic agricultural products through e-commerce platforms, confirming digital technology's "hematopoietic" function in the rural economy (Liu, 2022).

Second, the interaction between policy orientation and regional strategies reinforces the heterogeneity. The "East Data West Computing" project has promoted a 100% year-on-year increase in the construction scale of data centers in western regions through cross-regional allocation of computing power resources. However, local human capital and industrial bases still restrict its promotion of inclusive growth. The study finds that when the transportation level exceeds the threshold value of 11.272, the poverty reduction effect of the new digital infrastructure increases by 53.6%, indicating the importance of coordinated development of infrastructure.

6.3. Economic logic and policy implications of threshold effects

The threshold regression results show that the impact of the new digital infrastructure on inclusive growth has dual thresholds of transportation level and marketization degree. When the transportation level is lower than the critical value, the marginal effect of the new digital infrastructure is only 0.056, while it increases to 0.086 after crossing the threshold. This phenomenon can be explained from the perspective of factor mobility and market integration: the improvement of transportation infrastructure can reduce logistics costs and promote inter-regional technology diffusion, thus amplifying the spillover effect of new digital infrastructure (Wang et al., 2018). Similarly, when the degree of marketization exceeds 6.310, the promoting effect of the new digital infrastructure is enhanced, reflecting the supporting role of an optimized competition environment and improved resource allocation efficiency in technological innovation (Zhu, 2020).

This finding has important implications for policy design. For regions with underdeveloped transportation networks or low marketization degrees, it is necessary to prioritize making up for the shortcomings of traditional infrastructure and deepen institutional reforms to unleash the potential of digital technology. For example, introducing social capital to participate in transportation construction through the Public-Private Partnership (PPP) model, or stimulating the vitality of the private economy by relaxing market access, can effectively break through the threshold and achieve the multiplier effect of the new digital infrastructure.

6.4. *Re-examination and expansion of the mediating mechanism*

The mediating effect analysis shows that human capital accumulation and industrial structure optimization are key mediating roles between the new digital infrastructure and inclusive growth. Specifically, the new digital infrastructure promotes the popularization of online education and skills training, increasing the gross enrollment rate of higher education by an average of 2.3% per year, thereby promoting employment opportunity fairness (Chen et al., 2022). At the same time, digital technology drives the intelligent transformation of traditional industries. Every one percentage point increase in the proportion of the tertiary industry increases the sustainable growth index by 0.001, confirming the long-term support of industrial structure upgrading for inclusive growth (Luo, 2022).

It is worth noting that the study finds that the impact of industrial structure adjustment on inclusive growth presents a non-linear characteristic. Although the new digital infrastructure may lead to a decrease in the proportion of traditional manufacturing in the short term (regression coefficient = −0.015), in the long term, it creates high-value-added jobs by giving birth to emerging industries such as digital creativity and intelligent logistics, ultimately achieving inclusive growth. This conclusion is consistent with the assertion of Pang and Liu (2022) on the dual attributes of digital transformation, suggesting that policies need to pay attention to employment structure adjustment and social security connection during the transformation process.

6.5. *Research limitations and future directions*

This study has the following limitations: First, the data coverage is from 2013 to 2022, and it does not include the latest progress after the full implementation of the "East Data West Computing" project, which may affect the judgment of long-term effects. Second, although the inclusive growth index system covers 13 indicators in three dimensions, it does not include a dynamic assessment of environmental sustainability. In the future, indicators such as green total factor productivity can be introduced for expansion. Third, the threshold effect analysis only considers transportation and marketization levels, and does not involve potential threshold variables such as digital literacy and the institutional environment, so it is necessary to further explore the mechanism of action under multiple-dimensional constraints.

Future research can be deepened in the following directions: First, we can combine the latest data after 2023 to evaluate the long-term impact of national strategies such as "East Data West Computing" on regional inclusive growth. Second, we can construct an extended model including variables such as the digital divide and digital skills to analyze the inclusive boundaries of new digital infrastructure. Third, we can introduce spatial econometric methods to explore the cross-regional spillover effects of new digital infrastructure and its role in the coordinated development of urban agglomerations.

7. Conclusions and policy recommendations

7.1. Main research conclusions

This study attempts to deconstruct the theoretical relationship between new digital infrastructure construction and regional inclusive growth, exploring practical pathways that align with China's high-quality economic development imperatives. Building upon existing theoretical frameworks, the research first dissects the direct action mechanism of digital infrastructure on inclusive growth, and then systematically expounds its indirect pathways by introducing mediating variables. Leveraging panel data from 30 Chinese provinces spanning 2013–2022, and employing econometric methods including panel models and mediating effect tests, this study conducts an empirical analysis of the impact of new digital infrastructure construction on inclusive growth and its transmission mechanisms. The key findings are summarized as follows:

(1) Overall effect test

Whether other variables are unconstrained or a series of control variables, such as the proportion of foreign investment, transportation infrastructure level, tax burden, financial development degree, and technology transaction activity, are incorporated, new digital infrastructure construction exhibits a significantly positive impact on inclusive growth. Across different model specifications, the regression coefficients of new digital infrastructure investment levels remain positive at high significance levels, indicating that the promotion of inclusive growth by new digital infrastructure construction is neither accidental nor contingent. Instead, it exerts an independent and stable influence, manifested across multiple dimensions of inclusive growth, including sustainable development, poverty alleviation, and equity of opportunity.

(2) Dimension—Specific impacts

In sustainable growth, new digital infrastructure construction injects robust impetus into regional economic sustainability. By facilitating the deep integration of digital technologies with traditional industries, enhancing production efficiency, and optimizing resource allocation, it propels the continuous development of regional economies along sustainable trajectories. In poverty alleviation, the construction of new digital infrastructure effectively diversifies income sources for low-income households. Creating jobs in the digital economy, expanding information access in impoverished regions, and enhancing digital literacy and employability among the disadvantaged significantly contribute to poverty reduction efforts. Regarding equity of opportunity, new digital infrastructure construction dismantles information barriers, enabling more equitable access to digital resources and development opportunities, such as online education, telemedicine, and digital entrepreneurship platforms, across diverse regions and social strata. This process mitigates opportunity disparities caused by geographical and social factors, steering society toward greater inclusivity.

(3) Impact mechanisms

In analyzing impact mechanisms, this study selects human capital level and industrial structure as mediating variables for regression analysis. Results reveal that new digital infrastructure construction influences inclusive growth through multiple channels. On the one hand, constructing new digital infrastructure significantly bolsters human capital development. Its advancement revolutionizes the education sector, promoting the widespread availability and optimization of online educational resources.

This enables broader access to high-quality education, elevating regional human capital levels. Enhanced human capital positively impacts inclusive growth by driving innovation, technological progress, and labor productivity, providing support for crucial economic and social development.

On the other hand, the construction of new digital infrastructure profoundly influences industrial structure. Its development stimulates industrial restructuring, propelling traditional industries toward digitalization and intelligent transformation. While this may reduce the share of particular labor-intensive traditional sectors, the resultant industrial adjustment fosters industrial upgrading and encourages resource reallocation toward higher-value-added and innovative industries. Emerging digital industries generate more high-value-added employment and innovation opportunities, attracting high-skilled talent and promoting inclusive growth.

(4) Regional heterogeneity

Due to pronounced disparities in development characteristics and resource endowments between coastal and inland regions, the impact of new digital infrastructure construction on inclusive growth varies across dimensions. The construction of new digital infrastructure in the coastal areas demonstrates a more pronounced promoting effect on inclusive growth. Their advanced economic bases and comprehensive infrastructure provide a favorable foundation for implementing and applying the new digital infrastructure. Sustainability levels are improved in the sustainable growth dimension by promoting digital technology applications in energy management and environmental monitoring. The equity of opportunity dimension enables broader sharing of educational and medical resources via digital platforms. However, given the relatively low poverty rates in coastal areas, its direct impact on poverty alleviation remains limited.

Inland regions also benefit significantly from the construction of new digital infrastructure. During industrial transformation, it serves as a pivotal driver for the digital upgrading of traditional industries. It plays a crucial role in poverty alleviation by expanding agricultural product sales channels through digital platforms, fostering rural e-commerce, and creating employment and income-generating opportunities for impoverished areas. Sustainable growth facilitates the digital management, development, and utilization of natural resources, enhancing resource efficiency. Although its impact on equity of opportunity is relatively weaker, it still improves opportunity fairness in inland areas to a certain extent.

7.2. Policy recommendations

This study systematically deconstructs the action mechanism by which the new digital infrastructure construction drives regional inclusive growth by constructing a theoretical framework and conducting empirical tests. Based on the findings, the following policy recommendations are proposed:

1. Differentiated infrastructure investment strategies based on threshold effects

Collaborative construction of transportation infrastructure: For regions with relatively low levels of transportation development, such as western provinces, we can prioritize bundling new digital infrastructure investment with upgrades to highways and railway networks. In transportation-deficient areas like Yunnan and Guizhou, joint construction of "5G base stations + cold chain logistics hubs" can reduce agricultural product circulation loss rates, unleashing the poverty alleviation effect of digital infrastructure.

Linking marketization reform with digital infrastructure: In regions with marketization below the threshold, such as northeast old industrial bases, we can advance new digital infrastructure alongside market access liberalization. Drawing from Shenzhen's experience, we can attract private enterprises to participate in industrial internet platform construction through the "digital infrastructure PPP model + negative list management," strengthening the catalytic role of market competition in innovation.

2. Targeted policies guided by regional heterogeneity

Coastal areas: Dual-drive of innovation and opportunity equity. Focusing on the strong effects of new infrastructure on sustainable growth and opportunity equity in coastal areas, we can prioritize: pilots for 5G + high-end manufacturing integration (e.g., smart factories in the Yangtze River Delta) to enhance total factor productivity through technological spillover, and building regional medical and educational cloud platforms (e.g., the "Shanghai-Suzhou-Zhejiang-Anhui" teleconsultation system) to narrow urban-rural opportunity gaps via digital service inclusiveness.

Inland areas: Integrating digital empowerment of traditional industries with poverty alleviation. Based on the significant poverty alleviation effect of new infrastructure in inland areas, we can implement: the "Special Plan for Agricultural Digital Infrastructure," promoting the "e-commerce platform + smart agriculture" model (e.g., Pinduoduo's support farmers and agriculture livestreams) in major agricultural provinces like Sichuan and Hunan to expand online agricultural product sales (referencing Guizhou's chili e-commerce growth of 50% annually), and establishing a "digital skills training + employment docking" mechanism, conducting livestream sales training through platforms like Kuaishou and Douyin to enhance digital employability among low-income groups.

3. Strengthening mediating mechanisms: Synergistic upgrading of human capital and industrial structure.

Precision cultivation of human capital. Aiming at the strong mediating effect of new infrastructure through human capital, we can implement the "Digital Education Resource Sink Plan" in central and western regions: Equip county-level middle schools with VR teaching equipment using the National Smart Education Platform for Primary and Secondary Schools, increasing coverage of high-quality courses, and carry out "5G + industrial skills" targeted training for migrant workers, such as building digital skills training bases in manufacturing clusters of Henan and Hubei to cultivate intelligent production line operators annually.

Gradual advancement of industrial structure upgrading. Given the nonlinear impact of new infrastructure on industrial structure, we can implement phased policies: Short-term: Provide "digital transformation subsidies" for traditional manufacturing in the northeast, supporting machine tool networking and production data cloudization. Long term: Layout digital economy industrial parks in central regions (e.g., Wuhan's "Optics Valley of China"), cultivating emerging industries like cloud computing and artificial intelligence to create high-value-added jobs.

Author contributions

Lanli Hu: Conceptualization, investigation, supervision, review writing, and funding acquisition.

Yijie Guo: Investigation, data collection, original draft writing, and editing.

Lu Zhu: Methodology, data analysis, result interpretation, validation, and funding acquisition.

Use of AI tools declaration

The authors declare they have not used Artificial Intelligence (AI) tools in the creation of this article.

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Conflict of interest

All authors declare no conflicts of interest in this paper.

Reference

Asian Development Bank (2007) *The new Asia and the new Asian Development Bank* [R]. Manila: Asian Development Bank.

Chao X, Lian Y, Luo L (2021) The impact of new digital infrastructure on high-quality development of manufacturing industry. *Financ Trade Res* 32: 1–13. https://doi.org/10.19337/j.cnki.34-1093/f.2021.10.001

Chen D, Li M, Zhang W (2022) Digital new infrastructure and opportunity equality: An empirical study based on educational expansion. *Manage World* 38: 120–135.

Chen L, Li J, Xu C (2011) Information infrastructure and economic growth: An analysis based on interprovincial data in China. *J Manage Sci*, 98–107.

Chen XD, Yang XX (2021) The impact of digital economic development on the upgrading of industrial structure: A study based on grey relational entropy and dissipative structure theory. *Reform*, 26–39.

China Academy of Information and Communications Technology (CAICT) (2024) *Global digital economy development research report* [R]. Beijing: China Academy of Information and Communications Technology.

Deng RR, Wu YF (2023) Sharing the benefits: Digital infrastructure construction in cities and inclusive growth of the economy. *J Shanghai Univ Financ Econ* 25: 3–18. https://doi.org/10.16538/j.cnki.jsufe.2023.01.001

Golley J, Kong ST (2018) Inequality of opportunity in China's educational outcomes. *China Econ Rev* 51: 116–128. https://doi.org/10.1016/j.chieco.2016.07.002

Hansen BE (1999) Threshold effects in non-dynamic panels: Estimation, testing, and inference. *J Econometrics* 93: 345–368. https://doi.org/10.1016/S0304-4076(99)00025-1

Huang MH, Zhang WG, Lan XJ (2023) The impact of new infrastructure construction on high-quality economic development: Heterogeneity and mechanism. *Inquiry into Econ Issues*, 28–39.

Li H, Zhang M, Wang L (2023) Digital new infrastructure, resource endowment differences, and the threshold effect of inclusive growth. *Manage World* 39: 88–102.

Li Q (2023) Research on the impact of new digital infrastructure on the integration of urban and rural commercial circulation. *J Commer Econ*, 18–21.

Li X, Zhang Y (2024) Digital infrastructure and regional disparities: Evidence from China's provincial panel data (2013–2022). *J Reg Sci* 64: 356–381.

Liu J (2022) Research on the development of digital "new infrastructure" in rural revitalization. *Social Sci Front*, 258–262.

Liu JD, Chu H, Li QH (2024) Equalization and capitalization of the digital infrastructure construction: Evidence from the national smart-city pilot. *Nankai Econ Stud*, 64–82. https://doi.org/10.14116/j.nkes.2024.08.004

Luo Q (2022) *Research on the impact of financial technology on inclusive growth* [D]. Dalian University of Technology. https://doi.org/10.26991/d.cnki.gdllu.2022.000775

Pang R, Liu D (2022) The paradox of digitization and innovation: Does digitization promote enterprise innovation? An explanation based on open innovation theory. *South China J Econ*, 97–117. https://doi.org/10.19592/j.cnki.scje.391844

Qiu, Z, Liu Y (2022) The important role of digital finance in supporting economic growth. *Guangming Daily*, C6.

Rogers EM (2003) *Diffusion of innovations* (5th ed.), New York: Simon Schuster.

Rostow WW (1960) *The stages of economic growth: A non-communist manifesto,* Cambridge University Press. https://doi.org/10.2307/2281618

Ru SF, Liu HZ (2022) New infrastructure construction, industrial virtual agglomeration and coordinated development of regional economy. *J Harbin Univ Commer (Social Science Edition)*, 104–115.

Stiroh KJ (2002) Information technology and the U.S. productivity revival: What do the industry data say? *Am Econ Rev* 92: 1559–1576. https://doi.org/10.1257/000282802762024638

Tan HF, Zhang SF (2023) New digital infrastructure, financial resource allocation and high-quality economic development. *J Yunnan Minzu Univ (Philosophy and Social Sciences Edition)* 40: 134–142. https://doi.org/10.13727/j.cnki.53-1191/c.20221228.003

Wang J, Cai S (2020) The construction of high-speed railway and urban innovation capacity: Based on the perspective of knowledge spillover. *China Econ Rev* 63: 101539. https://doi.org/10.1016/j.chieco.2020.101539

Wang L, Shao J (2024) The energy-saving effects of digital infrastructure construction: Empirical evidence from Chinese industry. *Energy* 294: 130778. https://doi.org/10.1016/j.energy.2024.130778

Wang W, Zhang H, Wang F (2018) Information infrastructure, spatial spillovers, and urban total factor productivity. *Econ Survey*, 44–50. https://doi.org/10.15931/j.cnki.1006-1096.20180712.012

Wang YF, Huang HH, Shi M (2023) The impact mechanism of new infrastructure construction on shared prosperity and its empirical test. *Chinese Population Resour Environ* 33: 192–203.

Wolde-Rufael Y (2007) Another look at the relationship between telecommunications investment and economic activity in the United States. *Int Econ J* 21: 199–205. https://doi.org/10.1080/10168730701345372

Wu X, Zhong P, Huang X (2020) Does "new infrastructure" improve the technological efficiency of strategic emerging industries? *Financ Econ*, 65–80. https://doi.org/10.13249/j.cnki.sgs.2021.11.010

Yang B (2023) New infrastructure promotes the high-quality development of elderly care services: Internal mechanism, practical dilemma, and path choice. *J Huazhong Univ Sci Technol (Social Science Edition)* 37: 109–115. https://doi.org/10.19648/j.cnki.jhustss1980.2023.06.12

Yuan H, Xia JC (2022) Research on the impact of digital infrastructure construction on upgrading China's service industry structure. *Econ Rev J*, 85–95. https://doi.org/10.16528/j.cnki.22-1054/f.202206085

Zhu Y (2020) Consensus amidst controversy on new infrastructure promotes "soft transformation" of industries. *China Bus News*.