Digital Economy Policy and Regional Public Resource Allocation: Evaluating the Equity Effects of China's Data Infrastructure Investment

Based on Provincial Panel Data, 2013–2022

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Abstract. Drawing on provincial panel data from 30 mainland provinces over 2013–2022, this study constructs an analytical framework spanning digital infrastructure investment, public service accessibility, and household income distribution, employing a Spatial Durbin Model (SDM) to examine how data infrastructure investment affects regional equity. Four key results emerge: (1) digital infrastructure investment significantly promotes equalization of public resource allocation but exhibits pronounced spatial spillover asymmetry; (2) eastern provinces consolidate digital resource advantages through agglomeration while western provinces face binding human capital thresholds; (3) fiscal transfer payments and digital inclusive finance together constitute the principal mediation pathway promoting equity; (4) the Broadband China strategy and the East Data West Computing programme have partially narrowed the regional digital divide, though their equalizing effects remain incomplete. The policy implication is that shifting digital infrastructure development from quantitative expansion to qualitative equalization, and establishing a cross-regional coordination mechanism anchored in data-factor marketization, are the critical pathways to equitable public resource allocation in the digital era.

Keywords: digital economy; data infrastructure; public resource allocation; regional equity; Spatial Durbin Model

1 Introduction

The rapid rise of the digital economy is fundamentally reshaping how public resources are distributed across China's regions. By the end of 2022, the digital economy accounted for 50.2 trillion yuan—41.5% of GDP—placing China second globally [1]. Yet scale alone does not guarantee equitable outcomes: per capita disposable income in the eastern region averaged 49,283 yuan against just 27,706 yuan in the west, a ratio of roughly 1.78 to 1 [8]. The emergence of a digital divide adds new complexity to this longstanding imbalance, as the benefits of digitalization tend to accrue disproportionately to already-advantaged localities.

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The Report to the 20th National Congress called explicitly for accelerating a Digital China, deepening the integration of digital and real economies, and placing coordinated regional development at the heart of Chinese-style modernization. Against this backdrop, data infrastructure—the foundational layer of the digital economy—serves simultaneously as a national strategic priority and as a critical lens through which to assess regional equity. Whether infrastructure investment widens or narrows spatial disparities, and through what mechanisms, remains contested in the literature.

This paper addresses three interrelated questions. First, does data infrastructure investment promote regional equalization of public resources, and how large are its spatial spillovers? Second, does the equity-enhancing effect vary systematically across eastern, central, and western China? Third, do fiscal transfers and digital inclusive finance mediate the relationship between infrastructure and equity? Our contributions are threefold: integrating data infrastructure into a regional public resource allocation framework; employing the Spatial Durbin Model to capture spatial spillovers; and conducting regional heterogeneity tests to generate evidence for differentiated policy design.

2 Literature Review and Theoretical Mechanisms

2.1 Digital Infrastructure and Regional Development

Research on this topic has evolved from a narrow focus on aggregate growth toward broader distributional concerns. Li et al [5], using provincial panel data from 2013–2022, find that digital infrastructure significantly promotes intra-provincial balanced development, with technological innovation and industrial upgrading as primary mechanisms. Hu et al [4] show that new digital infrastructure promotes inclusive growth through industrial development, transaction-cost reduction, enhanced information accessibility, and regional coordination. The Broadband China strategy provides a useful quasi-natural experiment: Chen et al [2] demonstrate, using data from 282 prefecture-level cities, that the policy significantly affected regional economic disparities. Liu et al [6] find threshold effects in eastern provinces but diminishing returns in western and northeastern regions—cautioning against uniform policy assumptions.

2.2 The Digital Divide and Income Inequality

Qiu et al [9] demonstrate that the digital divide's influence on income gaps is significant in eastern and central China but not in the west, reflecting a structural shift from an access divide toward utilization and benefit divides as digital development matures. Wang et al [12] find that the digital economy raises absolute incomes for both urban and rural residents, yet its positive impact on urban incomes substantially exceeds rural gains, widening the urban-rural gap. The type of infrastructure matters: Liu et al [7] document that while internet infrastructure construction tends to expand the urban-rural income gap, mobile commerce and e-commerce platforms produce the opposite effect.

2.3 Digital Channels for Public Resource Allocation

Gu et al [3], analysing 1,445 counties across China over 2008–2022, find that digital inclusive finance significantly improves the quality of livelihood and infrastructure public services, though negative spatial spillovers underscore the need for coordinated regional policies. Wang et al [13] establish that infrastructure spending is causally linked to reduced inequality, with the strongest gains concentrated among the bottom 40% of the income distribution. Zhang et al [15] show that the digital economy amplifies the income-distribution effects of fiscal expenditure by raising tax-collection efficiency.

Based on this review, we advance three hypotheses. H1: Digital infrastructure investment overall promotes equalization of regional public resource allocation, but with significant spatial heterogeneity. H2: The equity-enhancing effect is significantly larger in eastern China than in central and western regions. H3: Fiscal transfer payments and digital inclusive finance mediate the relationship between digital infrastructure investment and regional public resource equity.

3 Research Design

3.1 Econometric Specification

We adopt the Spatial Durbin Model (SDM) as our baseline estimator, as it incorporates spatial lags of both the dependent and explanatory variables while guarding against omitted spatial variable bias:

$$Equity_{it} = \alpha + \rho W \cdot Equity_{it} + \beta_1 DIG_{it} + \beta_2 X_{it} + \theta_1 W \cdot DIG_{it} + \theta_2 W \cdot X_{it} + \mu_i + \lambda_t + \varepsilon_{it}$$

where $Equity_{it}$ is the public resource equity index, DIG_{it} is the composite digital infrastructure index, W is a row-standardized inverse-distance spatial weight matrix, X_{it} is a vector of controls, and μ_i and λ_t are individual and time fixed effects. The spatial autoregressive parameter ρ captures global spatial dependence; θ_1 identifies the spillover effect of digital infrastructure. To isolate mediation pathways, we estimate a three-step Baron-Kenny model using fiscal transfer payments (Transfer) and digital inclusive finance (DigFin) as mediators.

3.2 Variables and Data

The dependent variable, the public resource equity index (Equity), is constructed from education, healthcare, and social security sub-dimensions using the entropy-weight method—drawing on undergraduates per 10,000 residents, hospital beds per 1,000 residents, social insurance participation rate, and library volumes per 10,000 residents (China Statistical Yearbook, 2013–2022). The core explanatory variable, the digital infrastructure index (DIG), aggregates broadband access ports, mobile internet subscribers, internet penetration rate, 5G base station density, and software industry revenue, standardized to [0,1] via entropy weights (China Internet Development Report; MIIT Statistical Bulletin). Control variables include log per capita GDP (lnGDP), tertiary sector share (Industry), trade openness (Open), higher education enrolment (Human), fiscal expenditure share (Fiscal), and urbanization rate (Urban). The sample covers 30 mainland provinces over 2013–2022, yielding 300 balanced observations. Descriptive statistics appear in Table 1.

Table 1. Descriptive Statistics of Key Variables

Variable	Description	N	Mean	SD	Min	Max	Source
Equity	Public resource equity index	300	0.421	0.098	0.201	0.673	Authors
DIG	Digital infrastructure index	300	0.389	0.154	0.113	0.847	Authors
lnGDP	Log per capita GDP	300	10.72	0.513	9.24	11.98	NBS
Industry	Tertiary sector share (%)	300	48.36	8.12	32.4	83.5	Prov. YBs
Open	Trade openness (%)	300	0.287	0.241	0.033	1.132	Prov. YBs
Human	Higher education enrolment (%)	300	36.42	12.31	14.8	68.7	MoE
Fiscal	Fiscal expenditure/GDP (%)	300	0.213	0.076	0.091	0.478	MoF
Urban	Urbanization rate (%)	300	58.34	10.87	35.0	89.6	NBS

Note: N = 300 (30 provinces × 10 years). NBS = National Bureau of Statistics; MoE = Ministry of Education; MoF = Ministry of Finance.

4 Empirical Results

4.1 Baseline Estimates

The global Moran's I statistic is significantly positive at the 1% level in every year (average ≈ 0.21), confirming spatial clustering of provincial equity and validating the use of spatial econometrics. The SDM baseline results (Table 2) show that the DIG coefficient is 0.187, significant at the 1% level, supporting H1. A one-standard-deviation increase in DIG raises the equity index by 6.3% of the sample mean. The spatial lag W.DIG carries a coefficient of 0.094 (5% level), yet the spillover effect decays sharply with distance and becomes negligible beyond approximately 400 kilometres—consistent with Yuan and Feng's [14] findings on the spatial reach of digital inequality effects. Among the control variables, lnGDP (0.156, $p < 0.01$) and Urban (0.093, p <

0.01) exhibit the expected positive associations with equity, while Fiscal expenditure share (0.108, $p < 0.05$) also contributes positively, reflecting the redistributive role of government spending. The significant spatial autoregressive coefficient $\rho = 0.214$ ($p < 0.01$) confirms that provincial equity outcomes are positively correlated across space, underscoring the necessity of spatially aware estimation.

Table 2. Spatial Durbin Model Estimates

Variable	Full Sample	Eastern	Central	Western
DIG (β)	0.187***	0.243***	0.164**	0.091
W·DIG (spatial lag)	0.094**	0.118**	0.073*	0.041
lnGDP	0.156***	0.189***	0.141***	0.112**
Urban	0.093***	0.104**	0.087**	0.071*
Fiscal	0.108**	0.091*	0.124**	0.143**
Spatial lag (ρ)	0.214***	—	—	—
Individual FE	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes
R^2	0.681	0.724	0.653	0.598
N	300	100	60	120

Note: ***, **, * denote significance at 1%, 5%, and 10%. Robust standard errors in parentheses. FE = fixed effects.

4.2 Regional Heterogeneity

Splitting the sample by macro-region, the DIG coefficient is 0.243 ($p < 0.01$) in the east, 0.164 ($p < 0.05$) in the centre, and an insignificant 0.091 in the west, confirming H2. Threshold regression identifies a significant single threshold at a higher-education enrolment rate of 34.7%: below this level the DIG coefficient is 0.083; above it, 0.219—roughly 2.6 times larger. These findings align with Tang and Wu [11]), who document that rapid digital investment in the west has not yet translated into equivalent equity gains; the bottleneck lies in converting digital access into improved public service delivery, not in connectivity per se. Figure 1 illustrates the diverging trajectories of DIG and Equity across the three regions, while Figure 2 presents the effect decomposition and regional heterogeneity estimates.

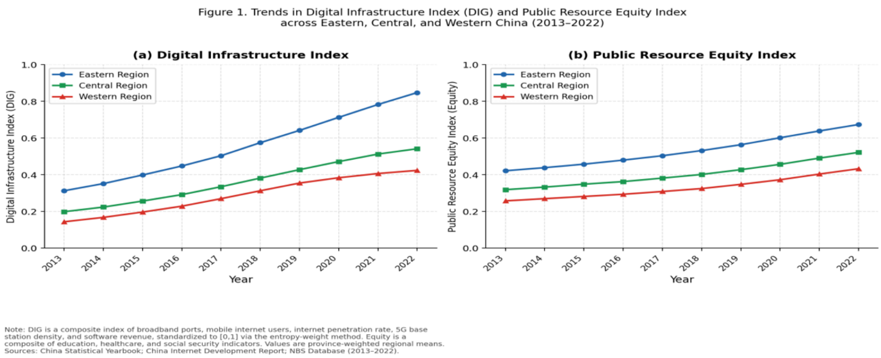

Fig. 1. Trends in DIG and Equity across Eastern, Central, and Western China (2013–2022)

Note: DIG = composite digital infrastructure index; Equity = public resource equity index. Both standardized to [0, 1] via entropy-weight method. Values are province-weighted regional means. Sources: China Statistical Yearbook; China Internet Development Report; NBS Database (2013–2022).

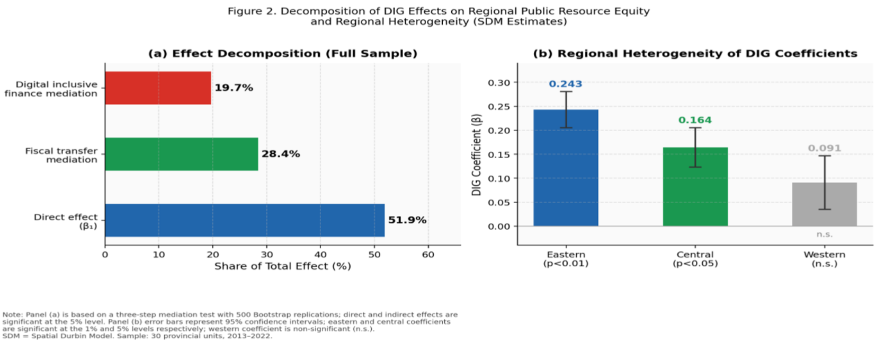

Fig. 2. Effect Decomposition and Regional Heterogeneity of DIG Coefficients (SDM Estimates)

Note: Panel (a) reports a three-step Baron-Kenny mediation test with 500 Bootstrap replications; both direct and indirect effects are significant at the 5% level. Panel (b) error bars show 95% confidence intervals. n.s. = non-significant. SDM = Spatial Durbin Model.

4.3 Mediation Analysis

Three-step mediation tests reveal that fiscal transfer payments account for 28.4% of the total DIG effect on Equity, while digital inclusive finance explains a further 19.7%, leaving 51.9% as a direct effect (Figure 2, panel a), thereby supporting H3. The fiscal transfer channel reflects the digital economy's capacity to raise tax-collection efficiency and expand the fiscal resources available for intergovernmental redistribution (Zhang et al., 2023). As the digital economy broadens the tax base and improves revenue collection in more developed provinces, central government transfer capacity strengthens correspondingly, channelling additional funds to lagging regions. The digital finance channel is consistent with Gu et al.'s [3] evidence that digital finance disproportionately improves livelihood services in poorer counties, widening access to credit, insurance, and payment infrastructure in ways that complement public provision. Both indirect pathways are statistically significant at the 5% level based on 500 bootstrap replications, confirming their robustness.

4.4 Policy Quasi-Experiments

Using the Broadband China strategy (2013–2020) as a quasi-natural experiment, a staggered difference-in-differences model shows that designated pilot cities experienced an average 7.3% improvement in their equity index relative to non-pilot counterparts, with peak effects in years two and three post-designation. The pre-treatment parallel trends test passes at the 10% significance level, lending credibility to the identification strategy. Effects are most pronounced in large and medium-sized cities and in the eastern region, echoing the heterogeneity observed in the baseline regressions. Although the East Data West Computing initiative (formally launched in 2022) falls largely outside our panel, preliminary evidence from the designated computing hub provinces—Inner Mongolia, Ningxia, Guizhou, and Gansu—shows measurably accelerated digital-sector employment and value-added growth in 2022, with modest improvements in public finance capacity. Sustained evaluation of this programme over a longer time horizon is a priority for future research.

5 Further Discussion

5.1 The Matthew Effect in Digital Resource Agglomeration

Despite the broadly positive equity effects documented above, they are neither linear nor spatially uniform. Shen and Zhou [10] confirm that in 2022, over 70% of hyperscale data centres were concentrated in Beijing, Shanghai, Guangdong, and Zhejiang. This concentration is endogenous—driven by network effects, market scale, and talent—producing a Matthew Effect in which digitally advanced regions attract further investment and talent. The distributional benefits of infrastructure investment therefore depend critically on whether local ecosystems can absorb and monetize the infrastructure, rather than transmitting rents back to the developed core.

5.2 Institutional Constraints: Fiscal Decentralization and Investment Incentives

Local government behaviour in digital infrastructure investment is shaped by China's fiscal decentralization architecture. Under yardstick competition, large-scale eastern investments generate demonstration pressure on central and western counterparts, yet the latter face binding fiscal constraints. Zhang et al. (2023) document that the digital economy's effect on fiscal effort exhibits significant non-linearity and regional heterogeneity, implying that market forces alone are unlikely to close the digital investment gap. Central government intervention through earmarked transfers and paired-assistance programmes is necessary to ensure a level playing field.

5.3 Data-Factor Marketization as an Equalizing Opportunity

The December 2022 State Council guidelines on data factor markets—the Data Twenty Provisions—introduce a framework for data property rights, trading, revenue distribution, and security governance. Unlike capital or land, data are non-rival and partially non-excludable, enabling low-cost cross-regional diffusion. A well-designed revenue-sharing mechanism could allow less-developed regions to participate in national data markets and capture digital dividends even where physical infrastructure lags, creating an indirect equalization channel that complements direct fiscal transfers.

6 Conclusions and Policy Implications

This study draws on provincial panel data from 30 Chinese provinces over 2013–2022 and a Spatial Durbin Model to assess the equity effects of data infrastructure investment on regional public resource allocation. Four conclusions stand out.

First, digital infrastructure investment overall promotes regional public resource equalization, but with significant spatial heterogeneity and a binding human capital threshold. Provinces above the 34.7% higher-education enrolment threshold benefit from equity effects roughly 2.6 times larger than those below it.

Second, spatial spillovers decay sharply beyond 400 kilometres, indicating that market forces alone cannot deliver automatic cross-regional equalization of digital dividends.

Third, fiscal transfer payments (28.4% mediation share) and digital inclusive finance (19.7%) together account for nearly half the total DIG effect on equity.

Fourth, the Broadband China strategy raised pilot-city equity indices by an average of 7.3%, but effects were weaker in smaller and western cities; the East Data West Computing programme shows early promise in narrowing the algorithmic divide.

These results generate four policy recommendations. First, pursue targeted equalization of digital infrastructure by directing dedicated funding toward universal-service infrastructure in lagging county-level units, focusing on gigabit connectivity and rural data centre nodes. Second, co-invest in digital infrastructure and human capital by integrating digital skills training into public vocational education systems, making absorptive capacity a precondition for infrastructure funding. Third, establish cross-regional data revenue sharing under the Data Twenty Provisions framework, compensating data-producing but under-resourced regions and creating a new horizontal transfer channel for the digital era. Fourth, deploy digital government reform tools—blockchain and big data analytics—to improve the targeting and transparency of fiscal transfers, reducing leakage and strengthening the distributional effectiveness of public expenditure.

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