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Digital Economy, Industrial Resilience, and the Urban-Rural Income Gap

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Abstract: Amid national strategies for common prosperity and rural revitalization, this study examines the impact of the digital economy on industrial resilience and the urban–rural income gap using panel data from 30 Chinese provinces (2013–2022). Our analysis reveals an inverted U-shaped relationship between digital economic development and the income gap, with China currently on the widening segment of the curve. Industrial resilience serves as a significant partial mediator, indicating that digital expansion can reduce disparity by strengthening rural industries. We also identify regional heterogeneity, with more pronounced effects in eastern and economically advanced provinces. Policy measures are proposed to enhance rural digital adaptation, encourage technology market expansion, and promote digital integration in rural industries.

Keywords: Digital Economy; Resilience; Rural Industry; Urban-Rural Income Gap

1 Introduction

Despite significant economic growth since China's reform and opening-up, rural income continues to lag behind urban areas, resulting in a persistent income gap, as reflected in a Gini coefficient of 0.471 in 2023. Central Document No. 1 (2024) highlights the need to enhance rural industrial resilience to advance rural revitalization and Chinese-style modernization, though challenges such as over-reliance on subsidies and inefficient resource allocation remain. As a major driver of development, China's digital economy—valued at RMB 50.2 trillion in 2022 and supported by national strategies—holds potential to reduce information barriers, improve market adaptability, and strengthen industrial resilience[1]. This study examines the impact of the digital economy on the urban–rural income gap and assesses the mediating role of industrial resilience, with the aim of informing effective policies for sustainable rural development.

2 Literature Review

Existing research related to this study falls into three main categories: (1) the impact of the digital economy on the urban–rural income gap; (2) enhancing rural industrial resilience; and (3) the effect of industrial resilience on the income gap.

Studies on the digital economy and income gap show mixed results. Some argue it exacerbates inequality due to the digital divide[2] or skill-biased technological change[3]. Others suggest it reduces disparity by breaking information barriers, extending rural industry chains, and raising farmers' incomes . Recent research also identifies non-linear relationships, including U-shaped and inverted U-shaped patterns[4].

Regarding industrial resilience, studies propose improving market services , vocational training , logistics , and infrastructure[5]. A growing focus lies on the digital economy's role in enhancing resilience, with evidence from provincial, threshold model[6], and policy-focused studies[7].

Finally, research links industrial resilience to income reduction, emphasizing stronger industrial chains[8] or organizational resilience[9] for common prosperity.

While existing literature offers valuable insights, most studies analyze these elements in isolation. Mediation mechanisms often rely on single variables like urbanization or labor mobility[10], lacking a comprehensive framework. Industrial resilience—incorporating market, fiscal, technological, and policy dimensions[11]—provides a more integrated mediating variable. This paper aims to bridge these gaps by examining the interplay among the digital economy, industrial resilience, and income disparity, using empirical tests to inform meaningful policy implications.

3 Theoretical Analysis and Research Hypotheses

3.1 Digital Economy and the Urban–Rural Income Gap

New economic growth theory identifies technological progress as central to economic development. The digital economy—enabled by cross-regional, efficient, and low-cost information flows—drives agricultural modernization and creates new opportunities in rural areas. Digital literacy has become a key form of human capital; improved farmer digital skills boost both agricultural and non-agricultural income[12]. Digital inclusive finance enhances financial accessibility, helping rural residents leverage financial tools to raise income levels[13]. E-commerce platforms further support rural development by improving agricultural sales, cutting costs, and increasing financial inflows, thereby stimulating local economies and raising farmer incomes .

However, digital economy development is stage-dependent. Early phases often see limited infrastructure, talent shortages, and immature policies, which can widen the digital divide and income gap. As digital industrialization and transformation mature, and governments implement systematic support, the digital economy begins to narrow the income disparity. Thus, we propose:

Hypothesis 1: The digital economy exhibits an inverted U-shaped effect on the urban–rural income gap, with China currently on the left (widening) side of the curve.

3.2 Industrial Resilience as a Mediating Pathway

Common prosperity is a core goal of Chinese-style modernization. Despite overall economic growth, rural income growth continues to lag. Enhancing industrial resilience can mitigate this gap by helping rural industries adapt to changes, upgrade structurally, and improve competitiveness[14]. The digital economy supports resilience through real-time information, optimized resource allocation, and improved market responsiveness . Therefore, we propose:

Hypothesis 2: The digital economy can reduce the urban–rural income gap by enhancing rural industrial resilience.

4 Model Specification and Variable Selection

4.1 Model Specification

To examine the impact of the digital economy on the urban-rural income gap, this paper constructs the following baseline regression model:

$$Y_{it} = \alpha_0 + \alpha_1 X_{it} + \alpha Controls_{it} + \mu_i + v_t + \varepsilon_{it} \quad (1)$$

Where:

- Yit represents the urban-rural income gap level for province i in year t.
- Xit represents the digital economy development level for province i in year t.
- Controlsit represents the vector of control variables for the urban-rural income gap for province i in year t.
- μi represents the individual fixed effect.
- vt represents the time fixed effect.
- εit represents the random error term.
- α0, α1, and the coefficients in αare parameters to be estimated.

To further analyze the mechanism through which the digital economy affects the urban-rural income gap, this paper refers to Wen Zhonglin's method[15] to construct a mediation effect model to test the mediating role of industrial resilience (R) between the digital economy (X) and the urban-rural income gap (Y):

$$R_{it} = \beta_0 + \beta_1 X_{it} + \beta Controls_{it} + \mu_i + v_t + \varepsilon_{it} \quad (2)$$

$$Y_{it} = \gamma_0 + \gamma_1 X_{it} + \gamma_2 R_{it} + \gamma Controls_{it} + \mu_i + v_t + \varepsilon_{it} \quad (3)$$

Where Ris the mediating variable (industrial resilience), and β0, β1, γ0, γ1, γ2, and the coefficients in β,γ are parameters to be estimated. Equation (2) represents the impact of the digital economy on industrial resilience. Equation (3) represents the impact of both the digital

economy and industrial resilience on the urban-rural income gap.

4.2 Variable Selection

4.2.1 Dependent Variable: Urban-Rural Income Gap

Domestic research on the urban-rural income gap commonly uses measures such as the Theil index, the ratio of urban to rural per capita disposable income, and the difference in urban-rural per capita disposable income (Gap). This paper uses the more intuitive and specific index of the difference in per capita disposable income between urban and rural residents (Gap). For robustness checks, the Theil index (Theil) is also calculated following Zhang Donghui et al.'s[16] method for comparison.

4.2.2 Core Explanatory Variable: Digital Economy

Currently, there is no universally accepted evaluation index system for the digital economy domestically or internationally. Drawing on systems constructed by Liu Jun et al. and Zhao Tao et al.[17], and considering data availability, this paper selects 9 secondary indicators across three dimensions: Digital Industry, Digital Economy Infrastructure, and Digital Inclusive Finance (See Table 1). The digital economy development level (DE_level) is calculated using the entropy weight method.

Table 1:Digital Economy Index Evaluation System

Primary Indicator	Secondary Indicator	Measurement / Explanation	Unit/Direction
Digital Economy	Digital Industry	Telecom Business Volume Share	Telecom Rev / GDP
		E-commerce Sales Share	E-commerce Sales / GDP
		Software Business Revenue Share	Software Rev / GDP
	Digital Economy Infrastructure	Optical Cable Density	Cable Length / Provincial Area
		Share of Internet Industry Employees	Info Tech Emp / Total Emp
		Internet Access Port Density	Ports / Total Population
		Broadband User Penetration	Broadband Users / Total Population
		Mobile Phone Penetration Rate	Sets per 100 People
	Digital Inclusive Finance	Digital Inclusive Financial Index	Index Value

4.2.3 Mediating Variable: Industrial Resilience

Industrial resilience is measured across three dimensions—resistance, recovery, and regeneration—using the entropy weight method, consistent with existing studies[18]. This multidimensional approach captures the capacity of rural industries to withstand, adapt to, and recover from external shocks. A detailed list of indicators is provided in Table 2.

Table 2:Comprehensive Evaluation System for Industrial Resilience

Primary Indicator	Dimension	Secondary Indicator	Measurement / Explanation	Unit/Direction
Industrial Resilience	Resistance(Solidity/Stability)	Water-saving Irrigation Level	Effective Irrigated Area / Sown Area	Ratio
		Mechanization Level	Total Agricultural Machinery Power / Sown Area	kW/Hectare
		Per Capita Grain Production	Total Grain Output / Rural Population	kg/person
		Primary Industry Share	Value Added of Primary Industry / GDP	Ratio
		Labor Force Status	Primary Industry Employment / Total Employment	Ratio
	Recovery(Ability to rebound)	Market Stability	Agricultural Production Price Index (Previous Year=100)	Index (Prev Yr=100)
		Rural Per Capita Consumption Expenditure	Annual Per Capita Consumption Expenditure of Rural Residents	Yuan
		Fiscal Support Level	Gov Expenditure on Agri/Forestry/Livestock/Fishery / Total Gov Exp	Ratio
	Regeneration(Capacity for transformation/upgrading)	Industrial Development Level	Gross Output Value Index of Agri/Forestry/Livestock/Fishery (Prev Yr=100)	Index (Prev Yr=100)
		Agricultural Insurance Scale	Total Agricultural Insurance Premiums / Sown Area	Yuan/Hectare
		R&D Intensity per Researcher	R&D Expenditure / Full-time Equivalent R&D Personnel	Yuan/Person-Year

4.2.4 Control Variables

Building on existing research, the selected control variables are:

Government Intervention (Gov Intv): Ratio of government fiscal expenditure to GDP; High-Quality Human Capital (Edu): Logarithm of the number of students in higher education institutions; Economic Openness (Open): Ratio of total imports and exports to GDP; Economic Development Level (LnAGDP): Logarithm of per capita GDP; Transport Infrastructure Level (Traffic): Total length of graded highways / Provincial land area.

4.2.5 Grouping Variables

Provinces are categorized into Eastern, Central, and Western regions according to the National Statistical Yearbook. Additionally, to account for economic disparities, the sample is divided into high- and low-development groups using the median per capita GDP, following the approach of Wang Shuailong[19].

4.3 Data Sources

The study employs panel data from 30 Chinese provinces (2013–2022). The year 2013 marks the start due to a statistical transition in rural income indicators from "net income" to "disposable income," ensuring comparability with urban data. Data are drawn from the China Statistical Yearbook, China Rural Statistical Yearbook, and provincial yearbooks and bulletins.

5 Empirical Analysis

5.1 Baseline Regression

Table 4 shows the digital economy (DE) significantly widens the urban-rural income gap (coefficient 0.3544, 1% significance). Adding controls like government intervention (negative effect) and economic development (positive effect) maintains DE's positive impact. Introducing DE^2 reveals an inverted U-shaped relationship (linear: 0.6621*, squared: -0.3711**). The turning point (0.892) exceeds current DE levels, confirming the gap is still widening. Hypothesis 1 supported.

Table 4: Baseline Regression Results for Digital Economy, Industrial Resilience, and Urban-Rural Income Gap

Variable	(1) Gap	(2) Gap	(3) Gap	(4) Gap	(5) Gap	(6) Gap	(7) Gap
DE_level	0.3544***	0.3217***	0.2926**	0.2828**	0.2969**	0.3103**	0.6621***
	(3.0195)	(3.2032)	(2.3315)	(2.1065)	(2.0173)	(2.1607)	(3.0848)
DE_level_sq							-0.3711**
							(-2.4884)
Gov_Intv		-0.5639***	-0.5932***	-0.5854***	-0.3777*	-0.3615*	-0.3907*
		(-3.7176)	(-3.9295)	(-3.7398)	(-1.8334)	(-1.7827)	(-1.9360)
Edu			-0.0543	-0.0527	-0.0635	-0.0638	-0.0885
			(-0.8088)	(-0.7803)	(-0.9458)	(-0.9559)	(-1.3421)
Open				-0.0396	-0.0435	-0.0047	-0.0452
				(-0.5607)	(-0.6166)	(-0.0880)	(-0.9794)
LnAGDP					0.0750	0.0701	0.0728*
					(1.4912)	(1.4912)	(1.6536)
Traffic						0.0183	0.0223
						(1.0623)	(0.7500)
Time FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Individual FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Constant	9.5994***	9.7389***	10.4484***	10.4316***	9.6584***	9.7394***	10.0087***
	(1200.00)	(257.75)	(9.1340)	(9.1781)	(8.3696)	(8.3592)	(9.4042)
R^2	0.977	0.982	0.982	0.982	0.983	0.983	0.984

*Notes: t-statistics in parentheses; * p<0.1, ** p<0.05, *** p<0.01.* Same as above.

5.2 Mediation Effect

DE enhances industrial resilience (Table 5, Column 2: 0.4537*). Resilience significantly reduces the income gap (Column 3: -0.2649**), confirming its partial mediating role. DE narrows the gap by boosting resilience. Hypothesis 2 supported.

Table 5:Results of the Industrial Resilience Mediation Effect Model

Variable	(1) Gap	(2) Resilience	(3) Gap
DE_level	0.3103**	0.4537*	0.4305***
	(2.1607)	(1.9012)	(2.9564)
Resilience			-0.2649**
			(-2.0494)
Control Vars	Yes	Yes	Yes
Time FE	Yes	Yes	Yes
Individual FE	Yes	Yes	Yes
Constant	9.7394***	1.2023**	10.0579***
	(8.3592)	(2.3197)	(8.8448)
R^2	0.983	0.674	0.984

5.3 Robustness Checks

Replacing the dependent variable with the Theil index or using lagged DE yields consistent, significantly positive results (Table 6), confirming robustness.

Table 6:Robustness Check Results.

Variable	(1) Theil Index	(2) Gap (Lagged DE)
DE_level	0.0885***	
	(4.9656)	
L.DE_level		0.3380***
		(3.9494)
Control Vars	Yes	Yes
Time FE	Yes	Yes
Individual FE	Yes	Yes
Constant	0.6134***	10.5394***
	(3.8967)	(19.1800)
R^2	0.914	0.905

5.4 Heterogeneity Analysis

The income-widening effect of DE is strongest in the Eastern region and in high-GDP provinces (Table 7), indicating significant regional and development-level disparities.

Table 7:Heterogeneity Analysis Results

Variable	(1) Gap East	(2) Gap Central	(3) Gap West	(4) Gap High Dev	(5) Gap Low Dev
DE_level	1.0552***	0.9970***	0.7354***	0.9906***	0.6466***
	(11.3279)	(3.3599)	(4.0451)	(11.2725)	(4.2730)
Control Vars	Yes	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes	Yes
Individual FE	Yes	Yes	Yes	Yes	Yes
Constant	-2.4362*	3.0794*	1.7452*	-4.1482***	1.0657
	(-1.9521)	(1.8513)	(1.9794)	(-3.3719)	(1.4197)
R^2	0.955	0.943	0.929	0.959	0.934

6 Conclusions & Policy Implications

6.1 Conclusions

An inverted U-shaped relationship exists between DE and the income gap, currently on the widening left side. Industrial resilience is a key partial mediator. Significant regional heterogeneity exists.

6.2 Policy Implications

●Government: Build rural digital infrastructure (broadband, IoT), promote digital literacy training, and create information-sharing platforms.

●Enterprises: Expand into rural markets via tech partnerships, digital industrial parks, and tailored financial/insurance products.

●Rural Entities: Adopt digital technologies (drones, sensors) and develop innovative, personalized services to boost resilience and income.

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