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Does the Digital Economy Narrow or Widen the Urban-Rural Income Gap in China? Based on the Mediating Effect of Industrial Structure

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Abstract

The widening urban-rural income gap presents a significant challenge to the sustainable development of China's economy. Addressing this issue is crucial, especially in the context of the ongoing digital revolution, which has the potential to reshape economic dynamics. This study aims to provide a comprehensive analysis of how digital economy development affects the urban-rural income gap and to explore the underlying mechanisms. To achieve this, we constructed a comprehensive indicator system to evaluate the level of digital economy development, including four key dimensions: digital economy development carriers, digital industrialization, industrial digitalization, and the environment conducive to digital economy development. We utilized dynamic panel models and mediation effect models to examine the nonlinear relationship between digital economy development and the urban-rural income gap and to assess the mediating role of industrial structure. The analysis reveals a significant inverted U-shaped relationship between digital economy development and the urban-rural income gap: while the early stages of digital economy development tend to exacerbate the income gap, sustained development eventually leads to a reduction in this disparity. Additionally, the upgrading of industrial structure plays a significant mediating role in this process, whereas the optimization of industrial structure shows low statistical significance. These findings provide valuable insights for policymakers and stakeholders, helping them leverage advancements in digital economy to address income inequality issues. Future research should further explore the mechanisms of digital economy development in different regional contexts and assess its long-term impact on income distribution.

Keywords： Digital Economy, Urban Rural Income Gap, Mediating Effect, System Gmm.

Introduction

In recent years, China's digital economy has emerged rapidly, with its scale exceeding 50 trillion yuan in 2022, firmly ranking second globally in terms of total volume. Contributing 41.5% to GDP, it has become a vital engine driving the country's economic transformation and upgrading. The widespread application of information technology and the internet has facilitated the digital transformation of various industries in China, enhancing production efficiency and ushering in novel business models and employment opportunities. Notably, the digital economy plays a pivotal role in Agriculture, Rural areas, and Farmers Development and Digital Countryside Construction, serving as a robust guarantee for rural revitalization (Zhang et al., 2021). However, alongside the swift growth of the digital economy, the widening urban-rural income gap remains a concern.

In 2023, China's Gini coefficient surpassed the international warning line, reaching 0.471 (Guo & Chen, 2024). The long-standing urban-rural income gap in China stems from imbalances in resources, infrastructure, and economic opportunities between urban and rural areas. The development of the digital economy can influence this income gap through multiple channels. On the one hand, it generates digital dividends, manifested in employment effects, financial effects, and market participation effects, which are perceived as conducive to rural development and narrowing the urban-rural income gap (Fan et al., 2022; Tian & Xiang, 2024; Wu & Yang, 2022). On the other hand, the advancement of the digital economy can create a digital divide, manifested in access gaps, application gaps, and income gaps, thereby exacerbating the urban-rural income gap (Park et al., 2019; Salemink et al., 2017; Tao et al., 2024).

Concurrently, China's industrial structure is undergoing continuous adjustment. According to data from the National Bureau of Statistics of China, by the end of 2022, the combined value of the secondary and tertiary industries accounted for 92.7% of GDP, signifying a gradual shift from an industrialized economy towards a service-oriented economy. Leveraging the superposition effect, the digital economy integrates with the real economy, unifying technological development, manufacturing, and sales within the industrial chain, thereby reducing transaction costs, blurring industrial boundaries, and fostering longer and more efficient industrial chains (Liu & Ji, 2022). Optimization and upgrading of the industrial structure exert varying spatial effects on the urban-rural income gap. Enhanced rationalization tends to widen the income gap in and between regions, while upgrading can help narrow it (Zhang & Chen, 2018). Consequently, examining the mediating role of industrial structure in the relationship between the digital economy and the urban-rural income gap is crucial for comprehending this nexus and formulating pertinent policies.

Against this backdrop, a systematic study of the impact of the digital economy on the urban-rural income gap, coupled with an analysis of the transmission mechanism through the mediating effect of industrial structure, is warranted. Specifically, we will delve into the direct influence of the digital economy on the urban-rural income gap and the intermediary role played by industrial structure in this relationship. Through an in-depth investigation of this issue, we aim to provide valuable insights for Chinese policymakers, enabling them to formulate effective measures that promote coordinated urban-rural development and achieve high-quality economic growth. Academically, this research will enrich the theoretical framework concerning the relationship between the digital economy and China's urban-rural income gap, offering fresh perspectives to related fields. Practically, it can provide a scientific basis for the Chinese government to formulate policies.

Literature Review and Research Hypotheses

Digital Economy

The concept of the digital economy was first introduced by Don Tapscott in 1995 (Abbos et al., 2021). With the advancement of new digital technologies such as the Internet of Things (IoT) and Artificial Intelligence (AI), and their profound integration into agriculture, manufacturing, and services, the boundaries of the digital economy have significantly expanded. Presently, the majority of scholars no longer confine the definition of the digital economy to the narrow scope of Information and Communication Technology (ICT) industries or e-commerce, but rather perceive it as a novel economic activity or economic form based on digital technologies (Zhang & Chen, 2021; Bukht & Heeks, 2018). Despite variations in definitions, these diverse perspectives share some commonalities, namely, the development of the digital economy is intimately linked to infrastructure, digital industrialization, industrial digitization, and the environment conducive to digital economic growth. Numerous scholars have underscored the significance of digital infrastructure, encompassing the Internet, communication networks, and data storage facilities (Cheng & Zheng, 2023). Furthermore, digital industrialization pertains to the application and innovation of digital technologies across various industries, while industrial digitization focuses on the transformation and upgrading of traditional industries through digital technologies (Li & Li, 2022). These commonalities signify that the development of the digital economy relies not only on the innovation and application of cutting-edge technologies but also necessitates a favorable policy and regulatory environment to foster sustainable digital economic growth and narrow the urban-rural income gap (Tao et al., 2024). Therefore, in measuring and assessing the digital economy, these elements should be comprehensively considered to fully reflect its impact on economic and social development.

Currently, the measurement methodologies of the digital economy can be broadly categorized into two types: The first approach involves measuring the absolute scale of the digital economy. For instance, the Organisation for Economic Co-operation and Development (OECD) calculates the value added of the ICT sector in its member countries based on the International Standard Industrial Classification, encompassing seven categories of digital production activities and five categories of digital service activities (Chinoracky & Corejova, 2021; OECD, 2018). The Bureau of Economic Analysis (BEA) in the United States and the Australian Bureau of Statistics (ABS) employ input-output tables to estimate the scale of digital economy goods and services (Nicholson et al., 2023; Strassner & Nicholson, 2020). Additionally, Digital Economy Satellite Accounts (DESA) have been utilized for measurement purposes, albeit their research remains in the nascent stages of theoretical exploration. Scholars diverge in their perspectives, particularly regarding the appropriate definitions of consumption and production, methodologies for valuing free products, and asset pricing. While these methods effectively gauge the digital economy, they exhibit limitations when constructing value-added measures and DESA due to the pervasive influence of the digital economy across various aspects of our lives, rendering traditional statistical frameworks impractical(Martynenko & Vershinina, 2018). Variations in the definition of the digital economy's scope contribute to discrepancies in researchers' estimates of its scale.

The second approach assesses the relative level of digital economy development. This includes indices such as the IDI from the International Telecommunication Union(Reeve, 2006), the NRI jointly published by the World Economic Forum(Moroz, 2017) and INSEAD(Yalmaev et al., 2020), the Economic Growth and Development Index (EGDI) from the United Nations Department of Economic and Social Affairs, and the Digital Economy and Society Index (DESI) aimed at monitoring digital competitiveness in EU member states. Furthermore, scholars have conducted research on the level of digital economy development at provincial and municipal scales. In contrast to the rapid growth of the digital economy, the construction and measurement of digital economy development indicators lag behind, failing to keep pace with its advancements.

The Relationship between Digital Economy and Urban-Rural Income Gap

Research on the relationship between digital economy development and the urban-rural income gap has garnered significant attention from scholars, yet the conclusions of these studies remain inconsistent. The relevant research primarily focuses on the following aspects: Firstly, differences in participation in digital economy development between urban and rural residents. This includes examining how economic development and other factors influence the degree and extent of internet usage and penetration between urban and rural areas. At this level, the focus is mainly on the digital divide between urban and rural areas (Nishijima et al., 2016). Secondly, income effect of digital economy development on individuals and regional development: studies at this level generally agree that digital economy development significantly promotes both personal and regional development (Dimaggio & Bonikowski, 2008). Thirdly, impact of digital economy on the urban-rural income gap: Scholars have differing views on this topic. Some believe that the development of the digital economy widens the income gap, while others argue it narrows the gap. There are also views suggesting a non-linear relationship between them. For instance, it is believed that the impact of internet penetration on the urban-rural income gap exhibits an inverted U-shaped trend, initially increasing and then decreasing (Li & Xie, 2017). Similarly, the level of digital economy development is thought to have an inverted U-shaped effect on the urban-rural income gap, first expanding and then narrowing it (Li & Li, 2022). Pei et al (2019), posits a U-shaped non-linear relationship.

Upon reviewing existing research, it is evident that while scholars have explored the digital economy and its relationship with the urban-rural income gap, there remain several gaps: First, the measurement of digital economy development levels is still under discussion. Second, there is no consensus on the nature of the relationship between the digital economy and the income gap. Third, there are few empirical studies examining the role of industrial structure in this relationship. In light of this, this paper analyzes the mechanisms through which the digital economy affects the income gap, empirically investigates the relationship between the two, and examines the mediating effect of industrial structure on this relationship, thereby enriching the policy implications of the research findings.

Research Hypothesis

（1）The relationship between the digital economy and the urban-rural income gap exhibits an inverted U-shaped curve

In the early stages of digital economy development, there is a significant disparity in the construction of digital economy-related infrastructure between urban and rural areas, with urban infrastructure being considerably more advanced than that in rural areas. Rural residents face disadvantages in accessing, recognizing, and utilizing information compared to their urban counterparts, leading to a pronounced digital divide. However, as digital technologies continue to advance and the digital economy penetrates all areas of socio-economic life, the benefits of this development begin to extend to rural regions. This comprehensive penetration greatly enhances the orderly flow of resources in rural areas, promoting the upgrading of rural industrial structures. Consequently, the latecomer advantage of the digital economy in boosting rural residents' incomes helps to mitigate the widening urban-rural income gap. Therefore, this paper proposes Hypothesis 1:

H1: The impact of the digital economy on the urban-rural income gap follows an inverted U-shaped nonlinear relationship.

（2）The industrial structure acts as a mediator in the pathway of the digital economy’s impact on the urban-rural income gap

The digital economy development can promote the upgrading and optimization of the industrial structure, which, in turn, is a crucial factor affecting the distribution of income between urban and rural areas. Therefore, the impact of the digital economy development on the urban rural income gap can also be observed in its ability to influence the income distribution structure through the industrial structure upgrading and optimization.

Based on the above analysis, currently, most studies indicate that the digital economy development has a positive impact on the optimization and upgrading of industrial structure(Chen & Pei, 2021; Wang, 2021). Moreover, industrial upgrading is positively correlated with the urban rural income gap, while optimization is negatively correlated with it (Cheng, 2014; Liu et al., 2017; Xiao et al., 2022). This study proposes the following hypotheses in line with research objective three:

H2: Digital economy development inhibits urban rural income gap through industrial structure optimization

H3: Digital economy development widens urban rural income gap through industrial structure upgrading

Econometric Model

Based on the availability of data, this paper uses panel data of 31 provinces from 2013 to 2022 in China to study the impact of digital economy development on the urban rural income gap. Data related to informatization foundation and influence of informatization be collected from China Statistical Yearbook, China Information Industry Yearbook and China Population and Employment Statistical Yearbook.

3.1 Basic Regression Model

In light of the previous analysis and to test Hypothesis 1 — that the impact of the digital economy on the urban-rural income gap follows an inverted U-shaped nonlinear relationship — this study constructs the following econometric model, drawing on the econometric models used in existing literature (Chen et al., 2021; Zhong et al., 2024):

$$\mathrm{URIGI}_{j,t} = \mathrm{a_j} + \gamma_{\mathrm{j}}\,\mathrm{URIGI}_{j,t-1} + \alpha_{11} DEDI_{j,t} + \alpha_{12} DEDI_{j,t}^{2} + \beta_j X_{j,t} + \varepsilon_{\mathrm{j,t}} \tag{3.1}$$

In the above equation, $URIGI_{j,t}$ is the explained variable, which denotes the urban rural income gap. $DEDI_{j,t}$ denotes the digital economy development index, which is the core explanatory variable. $X_{j,t}$ is a group of control variables; $\varepsilon_{j,t}$ is the random error item. j indicates the province, t indicates the year, a_j is a constant item. If $\alpha_{12}<0$, the digital economy development and the urban rural income gap have an inverted U-shaped relationship; If $\alpha_{12}>0$, the digital economy development and the urban rural income gap have a positive U-shaped relationship; if $\alpha_{11}>0$, $\alpha_{12}=0$, the digital economy development has widened the urban rural income gap; if $\alpha_{11}<0$, $\alpha_{12}=0$, the digital economy development has narrowed the urban rural income gap.

To test whether the upgrading and optimization of the industrial structure play a mediating role in the impact of the digital economy on the urban-rural income gap, we perform a mediation effect test using the bootstrap method.

Variable Introduction

（1）Core Explanatory Variable:

As introduced in the literature review, the measurement of DEDI is still evolving. The research object of this study is China, focusing on its provincial administrative units. Existing literature mainly concentrates on absolute scale measurement and the relative level measurement using self-constructed indicator systems. Considering the principles of comparability, applicability, and data availability for the empirical analysis in this study, we adopt the relative level measurement method using a self-constructed indicator system. This approach mainly references the self-constructed indicators by Liu (2020) and Li (2021), evaluating the level of digital economy development from four aspects. The specific details are shown in the table below：

Table 3.5
Indicator System for the Level of Digital Economy Development Among Chinese Provinces.

Primary indicators	Secondary indicators	Unit
Digital Economy Development Carrier	Internet broadband access port density	Unit/km^2
	Proportion of Internet users to resident population	%
	Number of domain names per capita	Unit/person
	Density of mobile base stations	Unit/km^2
	Cell phone penetration rate	Unit/person
	Density of fiber optic cable lines	km/km^2
Digital Industrialization	Proportion of software business revenue to GDP.	%
	Proportion of information technology services revenue to GDP	%
	Proportion of total telecom business to GDP	%
Industrial Digitization	Proportion of enterprises with e-commerce trading activities	%
	Proportion of enterprise e-commerce to GDP	%
	Number of computers used by enterprises per 100 people	Unit
	Number of websites per 100 enterprises	Unit
	Digital Inclusive Finance Index	/
Digital Economy Development Environment	Fixed asset investment in information transmission, computer services and software industry per capita	Yuan/person
	R&D Expenditure of Industrial Enterprises Above Scale	Ten Billion Yu
	Proportion of information transmission, software and information technology service industry employed persons to total urban employment population.	%

（2）Dependent Variable

For the urban-rural income gap, existing studies often use the Theil index or the ratio of urban to rural disposable income as measures. The Theil index, which takes population changes into account, provides a more systematic measurement of the urban-rural income gap compared to the urban-rural disposable income ratio (Zhong et al., 2024). Therefore, this study uses the Theil index to measure the urban-rural income gap. The calculation formula for the Theil index is as follows:

$$\mathrm{URIGI}_{it} = \sum_{i=1}^{2}\left(\frac{I_{it}}{I_t}\right) ln\frac{I_{it}/P_{it}}{I_t/P_t} = \left(\frac{I_{1t}}{I_t}\right) ln\frac{I_{1t}/P_{1t}}{I_t/P_t} + \left(\frac{I_{2t}}{I_t}\right) ln\frac{I_{2t}/P_{2t}}{I_t/P_t} \quad (3.2)$$

i=1 and 2 represent urban and rural areas, respectively; Pit denotes urban/rural t year-end resident population (million). Pt indicates an urban and rural population in the year of t. Iit represents per capita disposable income of urban or rural residents respectively; It indicates disposable income per capita for all inhabitants.

（3）Mediating Variables

The digital economy development is intimately related to the shift in industrial structure. According to a dynamic approach, there are two perspectives to the change in the industrial structure: optimization of the industrial structure (OIS) and upgrading of the industrial structure (UIS) (Gan et al., 2011). Therefore, the industrial structure's optimization and upgrading were chosen as path variables for the digital economy's impact on the urban rural income gap. this study follows the approach of Gan et al. (2011) to calculate industrial structure optimization and the ratio of the output value of the tertiary industry to that of the secondary industry as a measure of upgrading of industrial structure. The calculation formulas are as follows:

$$OIS = \sum_{i=1}^{n}\left(\frac{Y_i}{Y}\right)\ln\left(\frac{Y_i}{L_i}\Big/\frac{Y}{L}\right) \quad (3.8)$$

Value of output is indicated by the letters Y, the number of employee by L, primary, secondary and tertiary industry by i=1,2,3 respectively, and the number of industrial sectors by n. A non-zero Theil index indicates a deviation from equilibrium and an irrational industrial structure.

$$UIS = \frac{Y_3}{Y_2} \quad (3.9)$$

Where, Y_3 represents the output value of the tertiary industry; Y_2 represents the output value of the secondary industry. This measurement method can clearly reflect the tendency of economic structure towards servitization and clearly indicate whether the industrial structure is developing towards servitization, making it a better measure. If the UIS value is increasing, it means that the economy is moving towards servitization, and the industrial structure is upgrading.

（4）Control Variables

The Control variables employed were LNGDP (The logarithm of the annual per capita GDP), EO (The total amount of imports and exports of the location of the business unit / its GDP), FE (Government general fiscal expenditure /GDP), EA (Government general fiscal expenditure /GDP) and UR (Urban resident population / total population by region).

Results and Discussion

Results of Fixed Effect Model Test

At first, the result of the F-test indicates the p-value is less than 0.05, suggesting that the FE model is more effective than the POOL model. Similarly, the result of the BT-test shows the p-value is less than 0.05, indicating that the RE model is more effective than the POOL model. Finally, the result of Hausman Test yields the p-value is less than 0.05, indicating that the FE model is more effective than the fixed model. Therefore, the fixed model is the most effective model for this study.

Table 4.1

Results of F Test, BP Test and Hausman Test

Test Type	Test Purpose	Test Value	Test Conclusion
F-test	Comparison between FE model and POOL model	p-value =0.0000< 0.05	FE model
BP Test	Comparison between RE model and POOL model	p-value=0.0000 < 0.05	RE model
Hausman Test	Comparison between FE model and RE model	p-value= 0.0012< 0.05	FE model

Benchmark Regression Results

As mentioned above, the FE model is the most effective model for this study. Therefore, the test in this part uses a static FE model to regress the data from 30 provinces in China from 2013-2022. And the results are presented in Table 4.2. It is evident that the R-squared value is 0.290 when solely considering DEDI. Upon the inclusion of control variables, the R-squared value increases to 0.907. With the addition of the squared term of DEDI, the R-squared value becomes 0.628. Furthermore, incorporating both the squared term of DEDI and control variables yields an R-squared value of 0.910. The increasing R-squared values indicate an improvement in goodness of fit. This underscores the necessity of including the squared term of DEDI and control variables.

Table 4.2
Results of Benchmark regression

Variables	3.49	3.50	3.51	3.52	FE_TW
	URIGI	URIGI	URIGI	URIGI	URIGI
DEDI	0.153***	0.009	0.046***	0.076***	0.101***
	(0.012)	(0.010)	(0.021)	(0.026)	(0.028)
LNGDP		-0.371***		-0.363***	-0.387***
		(0.044)		(0.044)	(0.040)
$LNGDP^2$		0.015***		0.015***	0.017***
		(-0.002)		(0.002)	(0.002)
EO		-0.007*		-0.009**	-0.001
		(0.004)		(0.004)	(0.004)
FE		0.025***		0.020**	0.034***
		(0.008)		(0.009)	(0.011)
EA		-0.007***		-0.006***	-0.002
		(0.002)		(0.002)	(0.002)
UR		-0.086***		-0.093***	-0.062***
		(0.016)		(0.016)	(0.014)
$DEDI^2$			-0.051***	-0.069***	-0.075***
			(0.028)	(0.025)	(0.026)
Constant	0.105***	2.391***	0.134***	2.375***	2.346***
	(-0.006)	(-0.241)	(-0.006)	(0.238)	(0.216)
N	300.000	300.000	300.000	300.000	
R^2	0.361	0.919	0.666	0.921	
R^2_A	0.290	0.907	0.628	0.910	

Note,Standard errors in parentheses; * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$; The numbers in parentheses represent the standard errors of the coefficient estimates, which are used to assess the precision of the estimated values.

Table 4.3
Results of dynamic panel model-system GMM

URIG	Coefficient	Corrected std.err.	z	P>|z|	[95%conf.	interval]
$URIGI_{jt-1}$	0.946	0.027	35.370	0.000	0.893	0.998
DEDI	0.074	0.016	4.460	0.000	0.041	0.106
$DEDI^2$	-0.082	0.019	-4.210	0.000	-0.120	-0.044
LNGDP	-0.167	0.030	-5.520	0.000	-0.226	-0.107
$LNGDP^2$	0.007	0.001	5.400	0.000	0.004	0.009
EO	-0.013	0.005	-2.710	0.007	-0.023	-0.004
FE	-0.030	0.011	-2.760	0.006	-0.052	-0.009
EA	0.001	0.001	0.850	0.395	-0.002	0.004
UR	0.014	0.016	0.870	0.385	-0.018	0.046
Constant	0.973	0.173	5.640	0.000	0.635	1.311
Arellano-Bond test for AR(1)		z = -2.72		Pr > z = 0.007		

Arellano-Bond test for AR(2)	z = -0.23	Pr > z = 0.821
Hansen test	chi2(5) = 22.84	Prob > chi2 = 0.197

In table 4.3, the p-value for the Hansen test is 0.197, falling between 0.1 and 0.25. The null hypothesis is rejected which is that all instrumental variables are exogenous. Therefore, the instrumental variables are effective and there are no over-identification issues.

Additionally, the p-value for AR(1) is 0.007, which is less than 0.01. And the p-value for AR (2) is 0.821, which is more than 0.1. The results suggests that there is autocorrelation in the first-order differenced disturbances and no autocorrelation in the second-order differenced disturbances. In conclusion, both of these diagnostics tests are passed, the System GMM approach can be used to estimate the dynamic panel model.

This study conducts the following analysis based on the results of dynamic panel model estimation, which is shown in table 4.3. The coefficient of DEDI is about 0.074. It is positive and significant at the 1% level. While its squared term coefficient is about -0.082. It is negative and significant at the 1% level. Therefore, there is an inverted U-shaped relationship between the digital economy development index and the urban rural income gap index. And the inflection point is 0.45. This conclusion suggests that the level of digital economy development initially widens the urban rural income gap. However, as the digital economy develops to a certain level, the urban rural income gap tends to narrow with the progression of digital economy development. This finding confirms hypothesis 1.

The coefficient of LNGDP is -0.167, and the coefficient of its squared term is 0.007. The p-values for both are close to 0, indicating statistical significance at the 1% level. To some extent, this indicates a U-shaped relationship between LNGDP and the urban rural income gap, suggesting that the urban rural income gap decreases initially and then increases with economic development. And the inflection point is 11.98.

The coefficients for EO and FE are -0.013 and -0.03, with p-values of 0.007 and 0.006, respectively. The coefficients of EO and FE are negative and both pass the significance test at the 1% level. This suggests that the higher of government fiscal system and the level of economic openness the lower the urban rural income gap. It is evident that improving fiscal expenditure and promoting the urbanization process can be beneficial in narrowing the urban rural income gap.

The coefficients of EA and UR are about 0.001 and 0.014, with p-values of 0.395 and 0.385, respectively. The coefficients of EA and UR are both positive, but neither passes the significance test. Therefore, based on the data in this study, the impact of the level of economic openness and education attainment on the urban rural income gap is not statistically significant.

Mediating Effect Test

Because fixed effects model works better, we control for year and province fixed effects in this testing process. Table 4.4 presents the results of the bootstrap test with OIS as the mediator. “bs1” represents the mediating effect (a*b), while “bs2” corresponds to the direct effect (c). The output results indicate 95% confidence intervals for “bs1” as (-0.010, 0.006) including 0. This implies the indirect effect (mediating effect) is not significant.

Table 4.4
Results of Bootstrap Test with OIS as the Mediator

	coefficient	std.err.	z	P>|z|	LLCI.	ULCI
bs1	-0.002	0.004	-0.49	0.623	-0.010	0.006
bs2	0.025	0.010	2.49	0.013	0.005	0.045

Note, LLCI refers to the lower limit of the 95% confidence interval of the estimate, and ULCI refers to the upper limit of the 95% confidence interval of the estimate.

The insignificant mediating effect of industrial structure rationalization between the urban-rural income gap and digital economy development may be due to its relatively indirect and limited impact. The development of the digital economy is likely to directly influence the urban-rural income gap through mechanisms such as improving productivity, altering employment structures, and facilitating technology diffusion, rather than through adjustments in industrial structure. Moreover, industrial structure rationalization is a long-term process, and its effects may require more time to become evident. The current study period may not be sufficient to capture these impacts. Additionally, significant differences in the pace and effectiveness of industrial structure adjustments across regions may have further weakened the overall impact of this mediating variable in the sample.

Table 4.5 presents the results of the bootstrap test with UIS as the mediator. bs1 represents the mediating effect (a*b), while bs2 corresponds to the direct effect (c). The output results indicate 95% confidence intervals for bs1 as (0.033, 0.0641) and for bs2 as (0.014, 0.120), both excluding 0. This implies the presence of a significant partial mediating effect of industrial structure upgrading.

Table 4.5
Results of Bootstrap Test with UIS as the Mediator

	coefficient	std.err.	z	P>|z|	LLCI	ULCI
bs1	0.034	0.016	2.17	0.030	0.033	0.064
bs2	0.067	0.027	2.49	0.013	0.014	0.120

Note, LLCI refers to the lower limit of the 95% confidence interval of the estimate, and ULCI refers to the upper limit of the 95% confidence interval of the estimate.

The development of the digital economy may exacerbate the urban-rural income gap through the advancement of industrial structure for several reasons. Firstly, it reinforces labor market segmentation, with high-value-added industries concentrated in urban areas, while rural labor struggles to adapt to this shift, leading to a widening income gap. Secondly, urban residents, benefiting from better educational resources and skills training, are more likely to secure high-paying jobs, placing rural residents at a disadvantage. Additionally, during the process of industrial upgrading, government and corporate investments often prioritize urban areas, resulting in uneven resource distribution and leaving rural areas lagging behind. Lastly, the advancement of industrial structure intensifies regional economic disparities, with developed cities leading in industrial upgrading while rural areas remain reliant on primary industries, further widening the urban-rural income gap.

Conclusions and Discussion

The aim of this study is to verify the impact of the digital economy development on the urban rural income gap in China mainland and the mediating effect of industrial structure on this relationship. The results of System-GMM estimation showed there is an inverted U-shaped relationship between the digital economy development index and the urban rural income gap index. And currently, most provinces are Currently, most provinces are on the left side of the inverted U-curve, that is, the stage where the development of the digital economy is widening the urban-rural income gap. The results of the mediating effect show that OIS and UIS play a mediating role in the relationship between the development of the digital economy and the urban-rural income gap. That is, the development of the digital economy affects the urban-rural income gap by influencing the optimization and upgrading of the industrial structure.

The policy implications of this study are as follows: firstly, the results of section 4.2 indicate that the digital economy development first widen the urban rural income gap then inhibits it. And therefore, to inhibit the urban rural income gap, it is important to make contributions to the digital economy development. From the indicator system of table 3.5, we should increase investment in digital economy development carrier, pay attation to the application of digital technology to the industries and creating a favorable external environment for the development of digital economy. Secondly, the result of 4.3 indicate that digital economy development impact urban rural income gap through industrial structure upgrading. While the mediating effect of industrial structure optimization is not significant. Therefore, to narrow the urban-rural income gap caused by the upgrading of the industrial structure, the government should strengthen rural education and vocational training to help rural labor adapt to market demands and enhance their employment opportunities in high value-added industries. At the same time, it should encourage high value-added industries to extend into rural areas, promote the downward integration of the industrial chain, create more job opportunities, and stimulate rural economic development. Additionally, it is important to promote the coordinated development of urban and rural industries. This can be achieved by developing agricultural product processing industries and leveraging urban market demand and technological support to realize mutual complementarity and joint development between urban and rural industries.

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