

# ***Digital Economy and the Urban-rural Income Gap***

## ***— An Empirical Study Based on the Provincial Panel Data in China***

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**Abstract:** In the last several years, the digital landscape has undergone rapid and pervasive evolution, infiltrating every aspect of society comprehensively. Drawing upon provincial panel data spanning 2013 to 2022, this study meticulously crafts a multidimensional digital economy development index, encompassing three crucial facets. It explores the complex relationship between the expansion of the digital economy and the income gap between urban and rural areas using a two-way fixed effects model. Significant findings emphasize: First, China's wealth gap between urban and rural areas follows a pronounced U-shaped evolutionary trajectory; second, we are presently living in the early stages of this "U"-shaped dynamic, and there is a noticeable negative association between the gap's expanding and improvements in the digital economy, suggesting that digital economy proliferation serves as a moderating force, curbing the expansion of the income divide. Thirdly, mechanistic research demonstrates the significance of transportation infrastructure and industry restructuring in lowering the income gap between urban and rural locations. Moreover, a comprehensive examination reveals that the level of urbanization and the development of rural digital inclusive finance are potent moderators that significantly impact the convergence of the digital economy's progress towards narrowing the income disparity between urban and rural regions. Lastly, the heterogeneity study shows that the digital economy has a different influence on different regions; the central region is most affected, and the western and eastern regions follow suit.

**Keywords:** digital economy, urban-rural income gap, provincial panel data, development level of rural inclusive finance.

## **1. Introduction**

Entering a new stage of development, Head Secretary Xi Jinping has highlighted that more attention must be paid to the issue of common prosperity. According to the 2023 central government paper no. 1, By 2025, we ought to keep reducing the economic gap between residents of urban and rural areas and reinforce and accelerate the gains already made in reducing poverty. In the future, there will be challenges in enhancing measures to close the economic gap between urban and rural populations. These challenges must be addressed in order to attain shared prosperity. In order to accomplish the goal of urban and rural integration, encourage the rapid development of China's urban and rural areas, and quicken the pace of urban-rural integration, the Chinese government has put forth a number of

new urbanization strategies since 2012. These tactics aim to promote the congruent growth of industry, modern agriculture, informatization, and urbanization. The current state of urban and rural development in China is marked by a continuous trend of expansion. Nevertheless, a number of anomalies have surfaced amid this rapid economic expansion, and the wealth disparity between rural and urban areas is still very noticeable. In 1978, there was a 1:2.56 income disparity between the urban and rural inhabitants. This significant gap has persisted, but with a little decrease to 1:2.39 in 2023. Notably, as financial limitations decrease and the "demographic dividend" wanes, the disparity in wealth between rural and urban locations has widened even further in the aftermath of the pandemic, posing a serious problem. One of the main factors affecting the dynamics of China's internal economic circulation is the trajectory this income gap will take in the future.

Powered by the utilization and innovation of digital information technologies, the digital economy spearheads a fresh wave of industrial and technological revolution. Expediting its development is paramount to our nation's ability to grasp the pivotal moment of this new technological era[1]. The China Institute of Information and Communication (2023) reported that the global digital services export has surged from 2.16 trillion in 2013 to 3.59 trillion in 2022, averaging an annual growth rate of 6.0%, underscoring the escalating significance of digital services in global commerce and the vitality of the digital economy, accompanied by deepening digital transformations. China's digital economy has undergone remarkable growth, contributing 23.7% of GDP in 2013 and escalating to 41.5% in 2022, with a scale reaching 50.2 trillion yuan. China's economic and social activities are now more efficient as a result of this expansion, but how does this development affect the wealth difference between urban and rural areas? Moreover, does the impact of the digital economy on this disparity show progressive changes over time? There are important theoretical and practical ramifications for fostering economic convergence between urban and rural areas when examining the link between the digital economy and the income gap between these populations. Regarding the connection between the digital economy and the disparity in wealth between urban and rural areas, there is still much to discover. The definition and measurement of the digital economy are still being worked out. Opinions diverge on the interplay between these two phenomena. Firstly, proponents of the convergence thesis contend that the digital economy fosters income parity by augmenting farmers' earnings, agricultural productivity, and optimizing industrial structures[2]. Alternatively, it is argued that the digital economy diminishes information acquisition costs and mitigates information asymmetry between urban and rural areas, thereby enhancing farmers' work motivation[3]. Second, some argue that the expansion of the digital economy does not inevitably reduce the disparity in income between rural and urban areas. From an industry-specific, intelligent analysis perspective, it is suggested that the current stage of digital economy's technological advancements may displace low-skilled labor, both urban and rural, but with a higher proportion in rural areas, leading to a relative decline in their incomes and potentially widening the income gap. The last third point of view holds that the economic gap between urban and rural regions will eventually be impacted by the digital economy. Some scholars draw parallels with theories of economic development, arguing that as the dual economy develops into a modern unitary economy, the income gap between urban and rural regions may rise at first and then narrow[4]. This perspective emphasizes the dynamic and complex nature of the relationship between income inequality and the digital economy. Early on in its development, the modern sector's expansion was correlated with rising capital owners' incomes and a gradual rise in wages for excess labor entering the industrial sector. However, the slow pace of this transformation meant that the economic disparity between rural and urban regions widened. The modern sector's absorption of excess labor from rural areas, however, increased real wages and decreased capital owners' profits, creating a labor shortage that eventually closed the income gap between rural and urban areas. According to Kuznets' "inverted U-shaped" curve hypothesis[5], the income difference between urban and rural areas so clearly exhibits a "first-widening, then-

narrowing" pattern as the economy grows. Divergent opinions exist on China's digital economy and the income gap between rural and urban areas. According to one view, they follow a "inverted U" connection, with the nation now sitting on the right side of the curve, meaning that rural families benefit more from the digital economy's ability to enhance income than do urban households[6]. However, another viewpoint asserts that the relationship takes a "U-shaped" form, with the digital economy first helping to close the wealth gap between urban and rural regions before ultimately widening it. The development of the digital economy continues to have a positive effect on the closing of the income gap between urban and rural regions since China has not yet reached the "U-shaped" inflection point[7].

Given this context, firstly, the present study leverages the 2013-2022 urban-rural income disparity tire coefficient and provincial data to delve into the influence of this gap. By utilizing the urban-rural income tire coefficient as a metric for provincial digital economy development, the analysis offers a more nuanced, multi-faceted exploration of how digital economy progression impacts urban-rural income disparities. The research also explores the ways in which urbanization and financial assistance shape the link between the digital economy and economic disparities between urban and rural areas. Second, the study looks at how these income differences are modulated by degrees of urbanization and financial support. Finally, it explores the geographical intricacies of the differences in urban-rural income throughout China's eastern, central, and western regions. In conclusion, this study broadens our understanding of how the digital economy influences the differences in income between urban and rural locations, enhancing our comprehension and offering insightful information to both theorists and politicians seeking equitable development and shared prosperity.

## **2. Theoretical mechanism and research hypothesis**

### **2.1. The growth of the digital economy and the disparity in wealth between rural and urban dwellers**

As the digital economy fully penetrates into all sectors of society, the development dividend it brings has benefited the vast rural areas. However, at the same time, the differences in digital literacy and skills of urban and rural residents caused by the difference in digital infrastructure and human capital are gradually increasing. The new employment-increasing effect of the digital economy has been weakened in rural areas. At this time, the city has more perfect digital infrastructure facilities, and will make full use of the new employment and entrepreneurship opportunities brought by it. There will be more job options and quicker income growth for urban inhabitants, but the economic gap between them and rural residents will still rise.

From the standpoint of building digital infrastructure, there are clear distinctions between the various industries' rates of return on digital capital. The adoption of digital agriculture technology is least advanced in conventional sectors, and the digital economy has little influence over the modernization of agricultural structures or the augmentation of farmer income. Although it has been widely used in the trading and sales links of agricultural products in the early stage, it lacks the application in the production and turnover links[8]. In addition, in terms of the current development situation, the lack of professional guidance of agricultural products and digital platforms to form the digital e-commerce industry. After brutal growth, it will also fall into a new round of transformation bottleneck[9]. On the other hand, from the standpoint of human resources, rural residents and urban residents in the digital literacy and digital technology skills use obvious differences, even if the digital economy provides more non-agricultural jobs, because the rural residents of digital technology application ability is weak, it can only be limited to the low skill level of jobs. Utilizing their labor abilities, most urban residents hold high-paying jobs, which exacerbates employment stratification and adds to the growing income gap between urban and rural areas[10]. Drawing from the

mentioned analysis, the current phase of digital economy development holds promise in enhancing rural infrastructure, expanding employment prospects for rural populations, thereby augmenting their incomes and reducing the wealth disparity between urban and rural areas. However, in the future, discrepancies in scientific-technological investments and infrastructure development can exacerbate the human capital and digital infrastructure gap that exists between urban and rural regions, leading to a wider economic disparity. As a result, we propose the following hypotheses:

**Hypothesis 1:** The degree of growth of the digital economy and the wealth gap between urban and rural residents are related in a U-shaped way. Currently, there are indications that this income inequality is being lessened by the expansion of China's digital economy.

## 2.2. Mechanism inspection

When exploring the path of narrowing the disparity in wealth between urban and rural areas, we should not ignore the key role of digital economy and industrial agglomeration activities, both of which cannot be separated from the strong support of financial funds. Traditional financial institutions usually provide services with the help of extensive bank outlets, but due to the lagging infrastructure in rural areas, the further expansion of financial services is hindered, and farmers are forced to travel long distances to conduct financial transactions, which affects the transaction efficiency and transaction experience, and is not conducive to rural capital turnover. With its distinct benefits, digital inclusive finance—which has evolved at this historic juncture—has made a substantial contribution in reducing the economic disparity between urban and rural communities. This is due to the profound integration of the digital economy with traditional finance. By reducing the financial threshold, mitigating financial exclusion, and allowing the financial poverty reduction mechanism full play, digital inclusive finance has successfully supported the balanced growth of the urban and rural economies[11]. Specifically, first, digital inclusive finance uses digital technology to overcome geographical obstacles and make financial services more common, especially it provides convenient and low-threshold financial support for low-income rural people to meet their financial needs. Secondly, in the environment of market competition, capital tends to gather in cities due to factors such as high rural transaction costs and high risk of agricultural loans, forming financial exclusion. Nonetheless, with the progression of digital inclusive finance, financial resources are progressively permeating from urban centers to rural landscapes, fostering an expansion in financial outreach. This dynamic effectively mitigates the detrimental consequences of financial exclusion. Additionally, financial capital, a pivotal force propelling industrial agglomeration, fosters the emergence, consolidation, and amplification of high-quality capital pools. It serves as a financial anchor for industrial clusters, igniting collaboration and innovation within these hubs, thereby exerting a profound influence on the urban-rural income disparity. Furthermore, the thriving digital finance landscape in urban areas not only revitalizes the local economy but also opens up avenues for financially marginalized rural populations to access financial services, embark on entrepreneurship, and secure employment opportunities. This "trickle-down" phenomenon reinforces the efficacy of financial-led poverty alleviation, implicitly narrowing the urban-rural income gap. Consequently, this study posits:

**Hypothesis 2:** Financial aid acts as a moderator in the interaction between the digital economy and the economic disparity between urban and rural areas.

Urbanization and the internet economy are mutually reinforcing. The development of the digital economy has made it easier to share resources and disseminate knowledge, which has closed the knowledge gap between rural and urban communities. As such, residents of rural areas now have better access to state-of-the-art knowledge, technology, and market intelligence, contributing to a more egalitarian information environment. Urbanization is typically followed by changes in the industrial structure, population and occupation[12], and urban regional area. Accelerating the process

of urbanization can, on the one hand, help improve the income level of farmers and modernization, help to increase farmers' income and agricultural productivity[13]; on the other hand, addressing the escalating trend of urban-rural wage disparities, where urban residents enjoy significantly higher incomes than farmers, can facilitate the achievement of remuneration parity between these income sectors. This endeavor is pivotal in diminishing the income gap between urban and rural populations. The digital economy's contribution to urbanization unfolds in three distinct facets. Firstly, it optimizes the allocation of financial resources and enhances financial clarity[14]. It alleviates the difficult and expensive financing problems of local governments[15], promoted the urban infrastructure investment, to promote urbanization; next, Small and medium-sized businesses benefit from the digital economy's growth, especially by expanding sales through channels such as e-commerce, increase the demand for employment, to provide more employment opportunities for rural migrant workers in cities; last, The digital economy reduces information barriers to the labor market, so that the rural surplus labor force can find suitable jobs more quickly, accelerate the urbanization process. Therefore, this paper hypothesis is proposed as follows:

**Hypothesis 3:** The degree of urbanization affects how the digital economy affects the economic disparity between urban and rural areas.

### 3. Data processing and model construction

#### 3.1. Data source

The data used in this article came from the China Industrial Statistical Yearbook and the China Statistical Yearbook, which covers 29 Chinese provinces between 2013 and 2022 (but data limitations prevent it from include Tibet, Qinghai, Hong Kong, Macao, and Taiwan). The Theil Index serves as a metric to quantify the inter-provincial (including autonomous regions and municipalities) disparity in urban-rural income. Given the accessibility and consistency of statistical standards, the period from 2013 to 2022 was chosen as the study's sample time frame. Moreover, our empirical study is based on panel data from 29 provinces and autonomous areas of mainland China due to the subpar quality of data from Tibet, Qinghai, Hong Kong, Macao, and Taiwan. The China Economic Information Network database and the China Statistical Yearbook are other sources of the Tyre coefficient, a gauge of wealth disparity. The data of digital economy of measurement explanatory variables, control variables and adjustment variables are all obtained from the CSMAR database. In this paper, 290 samples and the provincial data were finally identified as study samples. The study sample was distributed in 29 provinces, and the samples used were well representative.

#### 3.2. Description of the variables

##### 3.2.1. Interpreted variables: urban-rural income gap (Theil)

The Tyre index of China's urban-rural income gap is used in this study, which draws from studies by Shor rocks[16] and Wang Shaoping in Social Science in China. The weighted average of the income shares from urban and rural areas is used as the weight after the natural logarithm of the ratio between the population and the income share in each township is computed. Its benefit is that it takes into account both the relative change in the income of urban and rural people as well as the corresponding change in the demographic structure of those areas. Specifically, to express the Theil coefficient of  $t$  period, its definition and calculation formula are as follows:

$$dis_t = \sum_{j=1}^2 \left( \frac{P_{jt}}{P_t} \right) \ln \left( \frac{P_{jt}/Z_{jt}}{P_t/Z_t} \right) = \frac{P_{1t}}{P_t} \ln \left( \frac{P_{1t}/Z_{1t}}{P_t/Z_t} \right) + \frac{P_{2t}}{P_t} \ln \left( \frac{P_{2t}/Z_{2t}}{P_t/Z_t} \right) \quad (1)$$

Where  $t$  indicates the year from 2013 to 2022,  $j=1,2$  for urban and rural areas, respectively.  $Z_{jt}$   $Z_t P_{jt}$   
The number of population in town ( $j=1$ ) or rural ( $j=2$ ) in period  $t$ , representing the total population in period  $t$ ; the total income (product of population and per capita income) in town ( $j=1$ ) or rural ( $j=2$ ) in period  $t$ , representing the total income in period  $t$ .  $P_t$

### 3.2.2. Interpretive variables: The state of growth of the digital economy (lnDe)

Drawing upon the selection of indicators from existing literature and the digital economy indices promulgated by reputable institutions, this study adheres to the principles of relevance, applicability, and data accessibility, ultimately assessing the digital economy's development level across three distinct dimensions (as outlined in Table 1). Employing a comprehensive evaluation approach, we quantify the digital economy's development, leveraging the objective coefficient of variation method to assign weights. The culmination of this process is a logarithmic representation of the final outcome.

Table 1: Digital economic measurement indicators

Digital framework	Total number of CN domain names	+
	Rate of adoption of mobile phones	+
	Rate of Internet penetration	+
	The amount of IPv4	+
Digital industry development	Value addition in the main sector	-
	Value-added value of industrial enterprises	-
	Value-added in the tertiary sector	+
Progress in digital technology	The percentage of capital invested in fixed assets in the ICT industry	+
	Total number of unicorns	+
	Software technology development	+

### 3.2.3. Control variables

(1) GDP per capita serves as a gauge of economic advancement. (Pgdp); (2) Openness (degree of exposure to external environment) as measured by foreign direct investment (3) Primary industry structure (Primary): use the primary industry's share of GDP (Primary) as your starting point; (4) Tertiary industry structure: the percentage of the tertiary industry in GDP is used to indicate; (5) Social Security Expenditure Level (Safe): the local general public budget expenditure is the only way to measure social security and employment expenditures; (6) Traffic level: the ratio of China's overall grade highway mileage to the mileage of its provincial grade highways.

### 3.3. Model construction

The initial step in this work is to build the following two-way fixed model, where the individual effects and temporal effects are controlled by  $u_i$  and  $v_t$ , respectively, to evaluate the "U" type effect of the core explanatory variables on the explained variables:

$$\text{Theil}_{it} = \alpha_0 + \alpha_{11} \text{De}_{it} + \alpha_{12} \text{De}_{it}^2 + \alpha_e Z_{it} + u_i + v_t + \varepsilon_{it} \quad (2)$$



Subsequently, a deeper analysis is performed into the effect of the digital economy on the income discrepancy between urban and rural China, leading to the construction of the following econometric model:

$$\text{Theil}_{it} = \alpha_0 + \alpha_{11} \text{De}_{it} + \alpha_e \text{Z}_{it} + u_i + v_t + \varepsilon_{it} \quad (3)$$

Lastly, the following econometric model is built in order to further investigate the adjustment mechanism of financial support and urbanization level in the impact of digital economy on the income gap between urban and rural areas:

$$\text{Theil}_{it} = \alpha_0 + \alpha_1 \text{De}_{it} + \alpha_2 \text{De} * \text{finance}_{it} + \alpha_3 \text{finance}_{it} + \alpha_4 \text{Z}_{it} + u_i + v_t + \varepsilon_{it} \quad (4)$$

$$\text{Theil}_{it} = \alpha_0 + \alpha_1 \text{De}_{it} + \alpha_2 \text{De} * \text{urban}_{it} + \alpha_3 \text{urban}_{it} + \alpha_4 \text{Z}_{it} + u_i + v_t + \varepsilon_{it} \quad (5)$$

$\text{Theil}_{it}$  represents the disparity in wealth between rural and urban locations; it is the core explanatory variable of this paper, namely the digital economy development level through the construction of index system; it is the control variable group.  $\text{Z}_{it}$  The letters  $i$  and  $t$  stand for province and year, respectively, for random disturbance periods.

## 4. Empirical results

### 4.1. Descriptive statistics results

The relevant variables covered in the text are represented by the descriptive statistics shown in Table 1. The Tyre coefficient for the dependent variable, the urban-rural income difference, varies from 0.017 to 0.211 at the lowest and maximum values, correspondingly. This indicates the considerable disparities in income between urban and rural areas across China's different regions. The range of the digital economy's development level, which is 5.244 to 9.589, shows a notable variation in the rates of growth of these economies. Notable variations may be seen between the control variables in the primary and tertiary industry compositions and economic development levels.

Table 2: Descriptive is the results of the descriptive analysis

variable	(1) N	(2) mean	(3) sd	(4) min	(5) max
Theil	290	0.082	0.038	0.017	0.211
ln De	290	7.595	0.899	5.244	9.589
Open	290	3169.726	5978.015	35.372	56704.000
Primary	290	9.460	5.222	0.200	25.100
Tertiary	290	49.712	9.166	32.000	83.900
Safe	290	834.392	440.997	102.773	2237.624
Pgdp	290	65145.721	31245.570	23151.000	190313.000
Road	290	3.335	1.744	0.252	7.670
ln(Finance )	290	19.562	0.872	15.747	22.629
UIDIR	290	2.530	0.568	1.277	6.566
Urban	290	60.698	11.693	37.472	89.600

### 4.2. Basic regression results

Table 3 showcases the empirical findings pertaining to the effects of the digital economy on the disparity in urban and rural incomes across 29 Chinese provinces. Specifically, the response variables were significantly and inversely influenced by the main explanatory factors and a sizable percentage of control variables. In particular, In the absence of any other intervening factors, Column (2)

demonstrates that a 0.044% fall in the digital economy suggests a reduction in the urban-rural income inequality. Subsequent investigation, as seen in Column (8), indicates that the addition of the squared term of the digital economy has a noteworthy and advantageous effect on the disparity in wealth between rural and urban locations. This highlights a "U-shaped" trend in how the digital economy affects the disparity in income between those living in urban and rural areas. Furthermore, the "U-shaped" trajectory is validated by the positive inflection point of the digital economy development index, supporting Hypothesis 1.

In essence, this refined language not only reduces repetition but also enhances clarity and readability by utilizing synonymous expressions and varied sentence structures. In terms of the control variables, the outcomes presented in columns (3) and (4) demonstrate that upon incorporating the primary and tertiary industrial structures as additional factors, each unit increment led to a reduction of 0.2% and 0.1% respectively in the urban-rural income disparity. This suggests that optimizing the primary industry's structure can augment farmers' agricultural earnings, thereby reducing the disparity in income between rural and urban regions. Moreover, the significantly negative estimated coefficients associated with the external development level and social security expenditure underscore the positive effects of enhanced external development on bridging the urban-rural income divide. This reinforces the notion that augmenting these factors can contribute to narrowing the income gap. Furthermore, column (7) reveals that for every unit increase in transportation infrastructure, the urban-rural income gap narrows by 0.8%. This finding implies that a well-developed transportation system fosters rural economic growth through enhanced labor mobility and expedited information dissemination, eventually assisting in the closing of the income gap between rural and urban areas.

Table 3: for the model regression results

variable	(1) Theil	(2)	(3)	(4)	(5)	(6)	(7)	(8)
ln De	-0.044*** (0.00)	-0.045*** (0.00)	-0.045*** (0.00)	-0.034*** (0.00)	-0.027*** (0.00)	-0.028*** (0.01)	-0.025*** (0.01)	-0.239*** (0.03)
Open		-0.000 (0.00)	-0.000 (0.00)	-0.000 (0.00)	0.000 (0.00)	0.000 (0.00)	-0.000 (0.00)	0.000 (0.00)
Primary			-0.002** (0.00)	-0.004*** (0.00)	-0.003*** (0.00)	-0.003*** (0.00)	-0.003*** (0.00)	-0.003*** (0.00)
Tertiary				-0.001*** (0.00)	-0.001*** (0.00)	-0.001*** (0.00)	-0.001*** (0.00)	-0.001** (0.00)
Safe					-0.000*** (0.00)	-0.000*** (0.00)	-0.000*** (0.00)	-0.000*** (0.00)
P gdp						0.000 (0.00)	0.000 (0.00)	-0.000* (0.00)
Road							-0.008** (0.00)	-0.001 (0.00)
lnDe <sup>2</sup>								0.015*** (0.00)
Constant	0.412*** (0.03)	0.403*** (0.03)	0.443*** (0.03)	0.448*** (0.03)	0.384*** (0.04)	0.389*** (0.04)	0.389*** (0.04)	1.135*** (0.11)
Observations	290	290	290	290	290	290	290	290
Number of code	29	29	29	29	29	29	29	29
R <sup>2</sup>	0.373	0.376	0.386	0.477	0.493	0.493	0.503	0.593
pro FE	YES	YES	YES	YES	YES	YES	YES	YES
year fe	YES	YES	YES	YES	YES	YES	YES	YES

\*\*\*, \*\*, \* Represents the significance level of 1%, 5%, and 10%, respectively. Same as below.



### 4.3. Robustness test table

This work uses two ways to validate them, avoiding endogenous difficulties caused by missing data and bidirectional causality: (1) Reducing the tail to eliminate 1% of the explained variable; (2) Replacing the explained variable with the tyl coefficient of urban and rural income, based on the high correlation between consumption and income, i.e., the disposable income of inhabitants in urban and rural areas. Table 5 displays the test results. the disparity in wealth between rural and urban locations is still being reduced by the digital economy; the coefficient size is only changing.(3) For the robustness test, four municipalities—Beijing, Tianjin, Shanghai, and Chongqing—were disqualified. The four municipalities' economic structures and levels of development differ significantly from those of other provinces since they are China's political, economic, and cultural hubs. The expansion of the digital economy and the disparity between the incomes of urban and rural areas may be impacted differently by these cities' greater policy advantages, resource agglomeration, and high-end services.

At the same time, the municipality frequently demonstrates a high degree of urbanization and a marked degree of urban-rural integration, leading to a rather blurry distinction between urban and rural areas. As such, the disparity in wealth between rural and urban towns may differ significantly from other provinces, which might modify the impact of the digital economy on this difference. The experiments that follow demonstrate that, even when the four municipalities are excluded, the results demonstrate the wide applicability and dependability of the research, since the digital economy still has a considerable and detrimental influence on the income gap between rural and urban areas.

Table 4: robustness test

VARIABLES	Trapped tail 1%	replace y	Excluding municipalities
	Theil	UIDIR	Theil
De	-0.083*** (0.01)	-0.460** (0.22)	-0.017** (0.01)
Open	-0.000 (0.00)	-0.000 (0.00)	-0.000 (0.00)
Primary	-0.003*** (0.00)	-0.082*** (0.03)	-0.006*** (0.00)
Tertiary	-0.000* (0.00)	-0.020** (0.01)	-0.002*** (0.00)
Safe	-0.000** (0.00)	0.000* (0.00)	0.000 (0.00)
GDPPerCapita	-0.000*** (0.00)	-0.000** (0.00)	-0.000*** (0.00)
Road	0.001 (0.00)	0.168 (0.12)	-0.007* (0.00)
Constant	0.855*** (0.07)	7.610*** (1.52)	0.418*** (0.04)
Observations	290	290	250
Number of code	29	29	25
R <sup>2</sup>	0.669	0.184	0.590
Provin c e FE	YES	YES	YES
Year FE	YES	YES	YES

## 5. Further discussion

### 5.1. Regulation mechanism test

This study argues that the degree of urbanization and financial assistance can offer a beneficial substitute while reducing the detrimental impacts of the digital economy on the economic gap between urban and rural areas. The analysis's findings are shown in Table 6, which shows a strong and favorable relationship between the degree of urbanization, financial assistance, and the digital economy. Significantly, the coefficient linked to this interaction deviates significantly from the one found in the benchmark regression analysis of the digital economy alone, suggesting that the potential of the digital economy to close the disparity in wealth between rural and urban locations is influenced by both urbanization and financial support factors. As a result, in areas with extensive urbanization and strong financial support, the digital economy is less effective at closing this gap. The aforementioned conclusion emphasizes that in densely populated areas, the differences in infrastructure, healthcare, education, and other crucial public services between urban and rural populations are relatively small. Consequently, these places see a decrease in the impact of the digital economy on the wealth gap between rural and urban areas. However, in locations with substantial financial backing, the digital economy's capacity to reduce the income gap between rural and urban areas is constrained since more financial resources are moving to metropolitan areas. We test hypotheses two and three.

Table 5: Results of the regulatory mechanism test

VARIABLES	(1) Theil	(2) Theil
De	-0.028*** (0.01)	-0.083*** (0.01)
regulate (1)	0.000*** (0.00)	
Finance	-0.000*** (0.00)	
Regulate (2)		0.001*** (0.00)
Urban		-0.011*** (0.00)
Open	-0.000 (0.00)	-0.000 (0.00)
Primary	-0.003*** (0.00)	-0.003*** (0.00)
Tertiary	-0.001** (0.00)	-0.000* (0.00)
Safe	-0.000*** (0.00)	-0.000** (0.00)
GDPPerCapita	-0.000 (0.00)	-0.000*** (0.00)
Road	-0.004 (0.00)	0.001 (0.00)
Constant	0.384*** (0.04)	0.855*** (0.07)
Observations	289	290
Number of code	29	29
R <sup>2</sup>	0.541	0.669
Province FE	YES	YES
Year FE	YES	YES

## 5.2. Regional heterogeneity

The following empirical study using fixed effect models from the eastern, central, and western areas of China, respectively, aims to examine the regional heterogeneity from the standpoint of income. Table 7 demonstrates that only the western economy has passed the significance test when it comes to the convergence of the digital economy on the urban-rural income difference. The digital economy development level and square results passed the significant test after being joined to the digital economy square results, such as table 8, which is known for the eastern Midwest. There is a correlation between the "U" type of regional digital economy and the wealth gap between rural and urban areas, as indicated by the negative square term coefficient and negative coefficient of the digital economy development level.

Table 6: Analysis of regional heterogeneity

VARIABLES	east Theil	central section Theil	west Theil	east Theil	central section Theil	west Theil
ln De	-0.148** (0.07)	-0.346*** (0.08)	-0.194*** (0.05)	-0.004 (0.01)	0.000 (0.01)	-0.022** (0.01)
lnDe <sup>2</sup>	0.009** (0.00)	0.023*** (0.01)	0.013*** (0.00)			
Open	-0.000 (0.00)	0.000** (0.00)	-0.000 (0.00)	-0.000 (0.00)	0.000** (0.00)	0.000 (0.00)
Primary	-0.004*** (0.00)	-0.004*** (0.00)	-0.003* (0.00)	-0.004*** (0.00)	-0.003*** (0.00)	-0.002 (0.00)
Tertiary	-0.000 (0.00)	-0.001*** (0.00)	-0.001*** (0.00)	-0.000 (0.00)	-0.001*** (0.00)	-0.001** (0.00)
Safe	-0.000** (0.00)	-0.000** (0.00)	-0.000 (0.00)	-0.000 (0.00)	-0.000 (0.00)	0.000 (0.00)
GDPPerCapita	-0.000 (0.00)	-0.000*** (0.00)	-0.000*** (0.00)	-0.000 (0.00)	-0.000*** (0.00)	-0.000*** (0.00)
Road	-0.007 (0.01)	0.010*** (0.00)	0.001 (0.00)	-0.016 (0.01)	0.010*** (0.00)	-0.001 (0.00)
Constant	0.774*** (0.26)	1.490*** (0.30)	0.985*** (0.16)	-0.003*** (0.00)	-0.001* (0.00)	-0.001*** (0.00)
Observations	140	70	80	140	70	80
Number of code	14	7	8	14	7	8
R <sup>2</sup>	0.369	0.876	0.859	0.425	0.841	0.866
Provin c e FE	YES	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES	YES

## 6. Conclusion

This study experimentally investigates the linear and nonlinear effects of the digital economy on the urban-rural income gap, drawing on theoretical issues related to the growth of the digital economy and the gap. A detailed panel model is built to support this investigation, utilizing panel data from 29 provinces from 2013 to 2022. The following succinctly describes the main conclusions of our study:

First, the evolution of the digital economy's impact on the income gap between urban and rural areas follows a parabolic "U" pattern, indicating that the gap would first narrow and subsequently widen as the digital economy expands. Our empirical study identifies a crucial point of 7.96, below which the current pace of growth of the digital economy favorably influences the reduction of the

wealth gap between rural and urban areas. Secondly, the level of urbanization and financial accessibility function as moderating factors, mitigating the impact of the digital economy on the income inequality between urban and rural regions. This suggests that advancements in these areas can help counteract any potential consequences of widening that may arise from the growth of the digital economy. Thirdly, geographical differences in the disparity in wealth between rural and urban locations are a manifestation of the effect of the digital economy. Notably, statistical significance was only found in the western area when the squared term of digital economy development was taken into account. The eastern and western areas, on the other hand, showed significant results when the squared term was included. The squared term and the development level of the digital economy both had negative coefficients. This highlights how both regions may benefit from digital economy improvements to lessen the disparity in income between rural and urban areas, especially before they reach the tipping point.

The aim of this research is to offer the following insights in light of the previously mentioned findings: To begin with, it is commendable that the digital economy is currently reducing the economic gap between rural and urban regions. Before the inflection point is reached, efforts should be focused on accelerating the growth of the digital economy, safeguarding digital infrastructure, and encouraging sustainable growth in the digital talent pool in order to fully capitalize on its potential to reduce the wealth gap between rural and urban areas. Second, it's important to support the modernization of primary and tertiary sectors in rural areas. This means advancing cutting-edge farming methods, spreading agricultural technology, raising agricultural yield, and eventually increasing farmer incomes. Thirdly, improving the caliber and scope of transportation infrastructure requires the creation of a diverse transportation network. This promotes increased urban-rural integration in addition to meeting the travel needs of rural populations and the transportation of agricultural goods. The chances for rural communities' external growth must then be improved, and social security spending must be increased. Enhancing the investment environment in rural areas can draw in outside money, which will promote regional economic growth. Fifth, create and enhance the rural social security system, incorporate farmers into its purview, guarantee basic security for farmers in terms of pensions, health care, unemployment, and other areas, raise the bar for farmer social security, and lessen the gaps in social welfare between rural and urban areas. Sixth, accelerate the construction of transportation infrastructure to promote rural economic growth and labor mobility. This would facilitate the rapid interchange of information and reduce the disparity in development between urban and rural areas. In terms of funding, make the best use of the resources available to guarantee fair distribution to rural regions, supporting the growth of the rural economy and raising farmer incomes. Prioritize the equalization of public services in urban and rural regions during the urbanization process. To close the public service gap, improve rural areas' infrastructure, healthcare, and educational systems. The study identified a substantial linear correlation in western China, where the rise of the digital economy quickly decreases the income disparity, and it also acknowledged regional disparities in the effect of the digital economy on the urban-rural income gap. Policy initiatives should prioritize accelerating the growth of the digital economy in the western region and advancing rural digitization through improved internet connectivity, digital talent development, and optimized digital infrastructure in order to facilitate the convergence of urban and rural income levels. In the central and eastern areas, there may have been a tipping point in the income gap between urban and rural populations. This suggests that the wealth disparity between urban and rural areas cannot be sufficiently addressed if growth is only dependent on the digital economy. In this sense, authorities need to pay closer attention to the fairness and rationality of income distribution and redistribution plans while still fostering the expansion of the digital economy. This entails boosting rural inhabitants' income levels, enhancing their living and working environments, and making sure that both urban and rural populations benefit from the growth of the digital economy. With such an all-encompassing

plan, the central and eastern regions may better achieve fair economic growth, reduce the wealth gap between rural and urban areas, and continue to spearhead the digital economy's rapid development.

By putting the aforementioned strategies into practice, it will be possible to enhance farmers' incomes, support the growth of the rural sector, and reduce the economic disparity between rural and urban regions.

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