sustainability

MDPI

Article

Can the Digital Economy Reduce the Rural-Urban Income Gap?

Zhengge Tu [1,2], Jiayang Kong [3,4], Liping Sun [5] and Botao Liu [1,2,6,*]

[1] School of Economics and Business Administration, Central China Normal University, Wuhan 430079, China
[2] Research Center of Low-Carbon Economy and Environmental Policies, Central China Normal University, Wuhan 430079, China
[3] College of Computer and Information Science, Qinghai University of Science and Technology, Xining 810016, China; jason.kong@qhu.edu.cn
[4] Department of Computer Technology and Application, Qinghai University, Xining 810016, China
[5] Audit Office, Shandong Normal University, Jinan 250014, China
[6] School of Mathematics and Statistics, Central China Normal University, Wuhan 430079, China
* Correspondence: botaoliu0328@mails.ccnu.edu.cn

Abstract: Currently, the Chinese government is considering two major strategies, namely, developing the digital economy and achieving common prosperity, to address regional development imbalances. Using panel data from 276 Chinese cities spanning from 2011 to 2019, the article first employs the entropy method to measure China's digital economy development, digital fusion application, and Internet accessibility. Subsequently, the paper evaluates the influence of the digital economy on regional development imbalances, focusing on the rural-urban income gap. The results show a significant reduction in the rural-urban income gap due to digital economy development. Notably, digital fusion applications have a greater impact on reducing the rural-urban income gap than Internet accessibility. In addition, a heterogeneity analysis reveals that the influence of the digital economy on the rural-urban income gap is only reflected in the eastern and western regions, with a more substantial effect observed in the western region. This study, to some extent, helps Chinese government officials distinguish the diverse impacts of different dimensions and regional variations in digital economies on the rural-urban income gap. Such insights can guide the government in strategically advancing digital economy development to accelerate the mitigation of regional disparities and achieve sustainable economic development.

Keywords: digital economy; entropy method; internet development; regional development imbalance; rural-urban income gap

check for updates

Citation: Tu, Z.; Kong, J.; Sun, L.; Liu, B. Can the Digital Economy Reduce the Rural-Urban Income Gap? *Sustainability* **2024**, *16*, 938. https://doi.org/10.3390/su16020938

Academic Editor: Stephan Weiler

Received: 10 December 2023
Revised: 16 January 2024
Accepted: 18 January 2024
Published: 22 January 2024

1. Introduction

The "Global Digital Economy White Paper (2022)", issued by the China Academy of Information and Communications Technology (CAICT) [1], pointed out that China's digital economy contributed 38.1 trillion US dollars in value added in 2021, constituting approximately one-third of the GDP for that year. In 2016, the OECD defined the digital economy as the application of digital technology (including cloud computing, big data, etc.) to the traditional economy [2]. With the widespread commercial adoption of artificial intelligence, cloud computing, and other emerging information technologies, digital economy development has played a pivotal role in supporting China's economic recovery and is gradually emerging as a major driver of post-epidemic coordinated economic development. Following the proposal to build a "digital China" outlined in the 19th CPC National Congress, the subsequent report presented at the 20th CPC National Congress emphasized the need to expedite digital economy development and promote deep integration between the digital economy and the real economy. Chinese-style modernization entails sustainable growth for the entire society. Despite the Chinese digital economy currently ranking as the world's second-largest after the United States and experiencing rapid growth, there persists an issue of inadequate and imbalanced regional development [3]. As part of the goal of building socialism, "common prosperity" is a concept of socialism with Chinese characteristics. As the name suggests, common prosperity seeks "equal distribution" based on "making the cake bigger". It calls for all individuals to have equal opportunities for development and achievements, with sharing manifested in population distribution, geographical balance, and the rural-urban income gap [4]. The rural-urban income gap, in particular, directly mirrors the shortcomings of imbalanced development. Thus, in the era of the digital economy, reducing income disparities between rural and urban areas becomes a direct and positive approach to addressing regional development imbalances. This endeavor not only aligns with people's aspirations for an improved standard of living but also ultimately fosters the achievement of sustainable development and common prosperity. In addition, thoroughly evaluating the development level of the Chinese digital economy and the current state of the rural-urban income gap could help the Chinese government to gain a profound understanding of the association between digital economy development and the rural-urban income gap. This understanding can prove beneficial in efforts to diminish the income disparity between rural and urban areas, thereby contributing to the realization of sustainable economic development and common prosperity in China.

Currently, significant disparities exist in the development of the digital economy and the rural-urban income gap across China. Much debate has been sparked in the economic community about this more advanced economic stage relative to the agricultural and industrial sectors. Economists have been discussing whether low cost and high sharing, typical characteristics of the digital economy, could address rural-urban development challenges, particularly in reducing the income gap between rural and urban areas. However, a consensus has not yet been reached. There are three main opinions. First, some scholars suggest that the development of the digital economy has the potential to mitigate the income disparity between rural and urban areas. For example, Zhang and Wu [5] and Zhang et al. [6] conducted a series of empirical studies. They found that digital finance development could raise rural residents' income levels. In particular, some studies found that people living in families with a poor material foundation or social capital were starting new businesses, such as Internet trading [7,8] or agricultural e-commerce [9,10]. These digital economic activities contribute significantly to reducing the income gap between rural and urban areas [11–15]. Second, some academics believe that the growth of the digital economy could widen the income disparity between rural and urban areas [16,17]. They reason that economic development in developed regions would increase investment in digital infrastructure, which could encourage economic growth and enhance the income level within developed regions and eventually lead to a huge imbalance between the developed and less-developed regions [18,19]. Moreover, with the widespread implementation of digital technology in industrial activities, demand for workers, particularly those originally from the agricultural department, would gradually decrease. This reduces their bargaining power and employment stability [20] and ultimately increases the rural-urban income gap [21]. According to Wei and Chen [22], the construction of the digital infrastructure has a significant influence only on the local rural-urban income gap, with no perceptible influence in the surrounding areas; that is, there is no spatial spillover impact resulting from the growth of the digital economy on the income disparity between rural and urban areas. Finally, some scholars believe that the influence of the digital economy's growth on the rural-urban income divide is not linear. These scholars frequently hold divergent viewpoints on the relationship between the digital economy and the disparity in income levels between rural and urban areas. For instance, some believe that the digital economy's growth has a "U-shaped" association with the income disparity between rural and urban areas [23], while others think it is an inverted "U-shaped" relationship [24,25].

Furthermore, it is contended that the influence of the digital economy's advancement on the income disparity between rural and urban areas would vary based on factors such as the degree of urbanization, the level of technological innovation, and the overall economic development. For example, some studies suggest that the influence of the digital economy on income disparity between rural and urban areas tends to decrease as the level of urbanization rises [26]. In contrast, Li and Li [27] discovered that raising economic development and technological innovation levels could be beneficial in increasing the influence of the digital economy's growth on the income gap between rural and urban areas.

Despite the abundance of literature on the impact of the digital economy on income disparity between rural and urban areas, these discussions exhibit certain limitations. Considering that the digital economy may encompass different dimensions and cannot be comprehensively measured by a single indicator, it is crucial to measure the development level of the digital economy in a scientific and reasonable manner. Based on this, this paper employed an entropy approach to measure the state of digital economy development of China's 276 cities. Meanwhile, to further explore the impact of different dimensions of the digital economy on regional balanced development, this paper also measures digital fusion applications and Internet accessibility and empirically examines their impact on the rural-urban income gap. Our study provides evidence that the digital economy's growth is beneficial in reducing the income disparity between rural and urban areas. In particular, digital fusion applications have a more pronounced effect on reducing the income disparity between rural and urban areas than Internet accessibility. Through heterogeneity analysis, the influence of the digital economy on the rural-urban income gap is observed specifically in the eastern and western regions, with it being more evident in the western region. This, to some extent, complements existing research in the field.

In comparison with previous studies, this study offers three notable contributions. First, most scholars merely focus on the mechanism of its effects and lack empirical tests [28], while this paper empirically explores the relationship between the digital economy and the rural-urban income gap. Second, despite a limited number of studies objectively exploring this relationship at the empirical level, they often rely on a single indicator or provincial-level indicator system to measure and gauge digital economy development [29,30]. The regression results may be biased due to the endogenous factors that could be caused by measurement errors and reverse causality [22]. To address the subjectivity and endogeneity issues in indicator selection found in the existing literature, this paper utilizes city-level data, constructs an index system, and employs an entropy approach to comprehensively interpret digital economy development. Finally, this study, to some extent, enriches the existing body of literature by providing more insights into the relationship between the digital economy and the rural-urban income gap. The findings of this study also provide several important suggestions for how Chinese government officials can develop the digital economy and achieve sustainable economic development.

2. Theoretical Analysis and Research Hypotheses

As early as the 1920s, British economist Lewis proposed the theory of the rural-urban dual economic structure, which was later refined by scholars such as Lanis and Jorgensen. The theory posits that the productivity gap between the agricultural and industrial sectors is a primary factor contributing to the income disparity between rural and urban areas. Thus, to overcome the economic division between villages and cities, it is essential to enhance the efficiency of agricultural production. However, in China, the phenomenon of economic and social dichotomy has persisted in both rural and urban areas for a long time. This dichotomy is one of the factors contributing to the persistent imbalance in regional development. Despite recent successes in the fight against poverty and a trend toward reduced income disparity between rural and urban areas, these improvements have not been adequate to propel balanced regional development toward sustainable development and common prosperity. In 2021, the average disposable income of urban dwellers in China reached 47,412 yuan, in contrast to the significantly lower figure of 18,931 yuan for rural residents. Compared with urban residents, rural populations continue to experience lower income levels.

The advent of digital technologies, such as the Internet and cloud computing, has brought about significant changes in the conventional economic framework. The "National Big Data Strategy" was originally proposed in 2015 during the fifth plenary session of the

18th Central Committee, and a series of policies on the growth of the digital economy was subsequently introduced and implemented.

In one sense, the digital economy could break through spatial barriers and accelerate the exchange of information and technology within rural and urban regions, which would help to improve rural production efficiency. Furthermore, the enhancement in production efficiency would result in a surplus of labor, thus facilitating labor mobility between rural and urban regions and creating opportunities for underutilized rural labor to seek employment in metropolitan areas. In addition, the development of the digital economy has led to the emergence of novel economic manifestations, notably e-commerce. To some extent, this has also broadened farmers' income channels and reduced the income disparity between rural and urban areas. Specifically, the microscopic mechanism is shown in Figure 1.

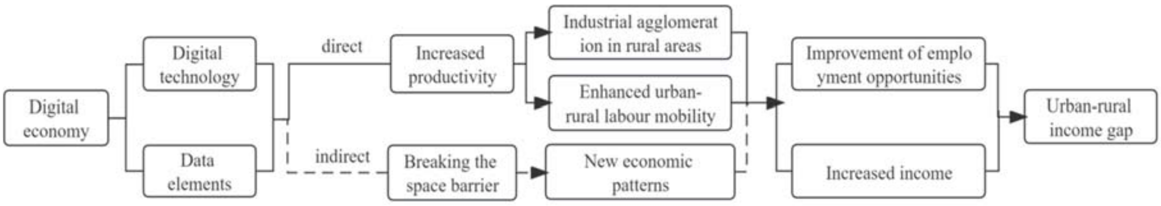

Figure 1. Microscopic mechanism diagram of the digital economy on the rural-urban income gap.

In light of the aforementioned considerations, this study proposes the following two hypotheses for examination:

Hypothesis 1. *The digital economy will narrow the income disparity between rural and urban areas.*

Hypothesis 2. *There is regional heterogeneity in the narrowing effect of the digital economy on the rural-urban income gap.*

3. Index Construction and Research Design

3.1. Index Construction

Currently, the measurements of the level of the digital economy primarily focus on two aspects.

The first involves assessing the scale of digital economy development in absolute terms. The US Census Bureau and the US Bureau of Statistical Analysis estimated the level of the digital economy in 2001 and 2018, respectively, by counting products and services purchased through computer-mediated networks [31] using supply-use tables and the satellite account method [32]. Conversely, domestic scholars like Hong [33] determined the digital economy classification and major industries catalog based on the National Economic Industry Classification (GB/T 4754-2017) [34] and conducted accounting using these criteria. Guan et al. [35] also reclassified the goods and services from the Statistical Product Classification and calculated the scale of the digital economy by accounting for a digitized infrastructure, media, transactions, and products. An alternative approach involves building an index system to measure the development of the digital economy, and various scholars have adopted distinct methods to measure it based on different perspectives. Liu and Chen [36] analyzed three dimensions: digital industrialization, industrial digitalization, and digital infrastructure. Shan et al. [37] established a comprehensive evaluation system of Chinese digital economy development indicators through ternary space theory. Liu and Meng [38] and Zhang and Jiao [39], however, constructed a digital economy development index system containing first-level indicators such as digital infrastructure, digital applications, and digital technology development and many second-level indicators.

This paper aims to assess the extent of digital economy development in 276 Chinese cities between 2011 and 2019, and its current situation is quantitatively reflected based on realistic index data. Therefore, referring to Tang et al. [40], this paper has constructed an index system of the digital economy development level. Then, we employ the entropy approach to measure the level of digital economy development and assign weights to each index. The specific calculation steps are as follows:

Taking the standardization of positive indicators as an example, the first step is to standardize the indicator data:

$$y_{ij} = \frac{x_{ij} - \min(x_{ij})}{\max(x_{ij}) - \min(x_{ij})}$$

where i represents the city and j represents the indicator.

Calculating the weight p_{ij} of the ith city sample data for the jth indicator:

$$p_{ij} = \frac{y_{ij}}{\sum_{i=1}^{n} y_{ij}}$$

where n = 287 denotes the 287 prefecture-level and above cities selected in this paper.

The information entropy e_j of the jth index is calculated

$$e_j = -\ln(m)^{-1} \sum_{i=1}^{n} p_{ij} \ln p_{ij}$$

where m is the sample size.

Calculating the redundancy of information entropy d_j:

$$d_j = 1 - e_j$$

Defining the sample value weights w_j:

$$w_j = \frac{d_j}{\sum_{i=1}^{k} d_j}$$

Calculating the level of digital economy development in each city:

$$Digital = \sum_{i=1}^{k} w_j p_{ij}$$

Based on the indicator's weight, we can calculate the digital economy development index, with values ranging between zero and one. A higher value indicates a well-developed digital economy, while a lower value suggests that digital economy development is comparatively lagging.

Due to the research question's applicability and the availability of data, and considering the fundamental characteristics of the digital economy—particularly its reliance on modern information networks and deep integration with the real economy [1]—this paper incorporates digital fusion applications. Building on the work of Zhao et al. [41] and Huang et al. [42], the evaluation index system contains seven indicators categorized into two dimensions: digital fusion application and Internet accessibility.

Internet accessibility consists mainly of four indicators: the international Internet penetration rate per one hundred individuals; the percentage of employees in the information transmission, computer services, and software industries; the total amount of telecommunication services per capita; and the number of mobile telephone subscribers per one hundred individuals. The digital fusion application is measured by the breadth of digital financial coverage, the depth of digital financial use, and the degree of digital financial inclusion. Table 1 shows the specific evaluation index framework for the digital economy development level.

Table 1. The index system of the digital economy development level.

Dimension	Indicator	Sign	Weight
Internet accessibility	The number of international Internet users per one hundred individuals	+	19.55%
	The percentage of ICT employment	+	16.76%
	Telecommunications services revenue per capita	+	29.05%
	The number of mobile telephone subscribers per one hundred individuals	+	16.24%
Digital fusion application	Coverage breadth	+	6.09%
	Usage depth	+	6.04%
	Digitization level	+	6.27%

Note: + represents that the index is positive, and the larger the index value is, the better the evaluation is.

3.2. Regression Model Setting

After analyzing the digital economy development level to test its potential influence on the income disparity between rural and urban areas, we used panel data from 276 Chinese cities between 2011 and 2019. We also refer to earlier research [36,39] and set the below two-way fixed effects model:

$$Gap_{it} = \alpha + \beta_1 \ln digital_{it} + \gamma X_{it} + \mu_i + \delta_t + \varepsilon_{it}$$

The variable (Gap) in Model (7) represents the disparity in income between rural and urban areas. It is quantified by the ratio of per capita urban disposable income to per capita rural disposable income, as well as by the Theil index [43], respectively. The larger the ratio, the greater the rural-urban income gap. The Theil index is an important indicator of the income gap between individuals or regions, and its value is positively correlated with the rural-urban income gap [44]. The variable (ln(digital)) denotes the logarithm of the digital economy development level plus one. The vector X encompasses a range of control variables, containing the economic development level ("ln(gdp)", the logarithm of GDP per capita), the financial development level ("finance", the ratio of financial institutions loan balances to GDP), the degree of openness to the outside world ("ln(fdi)", the logarithm of the actual amount of foreign capital used in the year), industry structure ("ind", the ratio of added value in secondary industry to GDP), unemployment rate ("unemployment", the ratio of the registered unemployment to the total population), and the degree of urbanization ("urban", the ratio of the urban registered population to the total registered population).

α represents a constant term, t indicates the specific year (t = 2011, 2012, . . ., 2019), and i indicates the specific city (i = 1, 2, . . ., 276). μ_i represents the city fixed effect, δ_t represents the year fixed effect, and ε_{it} represents the error term.

3.3. Data Source

The research used panel data from 276 Chinese cities between 2011 and 2019. Although the publication of the Digital Financial Inclusion Index by Peking University's Digital Finance Center was updated in 2021, due to the availability of other indicator data, this paper selects 2011–2019 as the sample research period to keep the sample size uniform.

Data for the relevant indicators measuring the level of digital economy development were sourced from the China Urban Statistical Yearbook and the Peking University Finance Research Center. Data on the control variables were obtained from local statistical bureaus, the China Regional Economic Database, and the China Research Data Service Platform. To address issues such as data accessibility and the presence of extreme values, this paper modified the dataset by excluding or adding certain observations in the main variables. First, prefecture-level cities with significant data deficiencies were removed, including

Rikaze, Linzhi, Shannan, and Naqu in the Tibet Autonomous Region; Karamay, Turpan, and Hami in the Xinjiang Uygur Autonomous Region; and Sansha and Danzhou in Hainan Province. Second, cities experiencing administrative level changes during 2011–2019 were excluded due to the potential impact on regional digital infrastructure investment and local digital economy development. For example, in July 2011, Chaohu City was officially downgraded from a prefecture-level city to a county-level city, and some of its administrative areas were also changed; in December 2018, Laiwu City in Shandong Province was abolished as the Laiwu District and transferred to the jurisdiction of Jinan City. Finally, considering the distinctive institutional systems of Hong Kong, Macao, and Taiwan in comparison to the mainland, the research sample of this paper does not include these three regions.

3.4. Descriptive Statistics

Based on the index system of the digital economy development level, we also measured the level of digital economy development for three major regions in China between 2011 and 2019. The results are shown in Figure 2. As observed, the entire country and the three major regions in China all showed an upward trend between 2011 and 2019. The eastern area had a higher level of digital economic development than the other regions in China between 2011 and 2019, with an average value of 0.1693. The average values, which indicate the digital economy development level, were 0.1315 and 0.1314 in the central and western regions, respectively. In addition, we could see that despite the lower level of economic development in the western region, there was no significant gap between the overall level of digital economy development in the western region and that in the central region. To some extent, the level of digital economy development in the two regions even converged once.

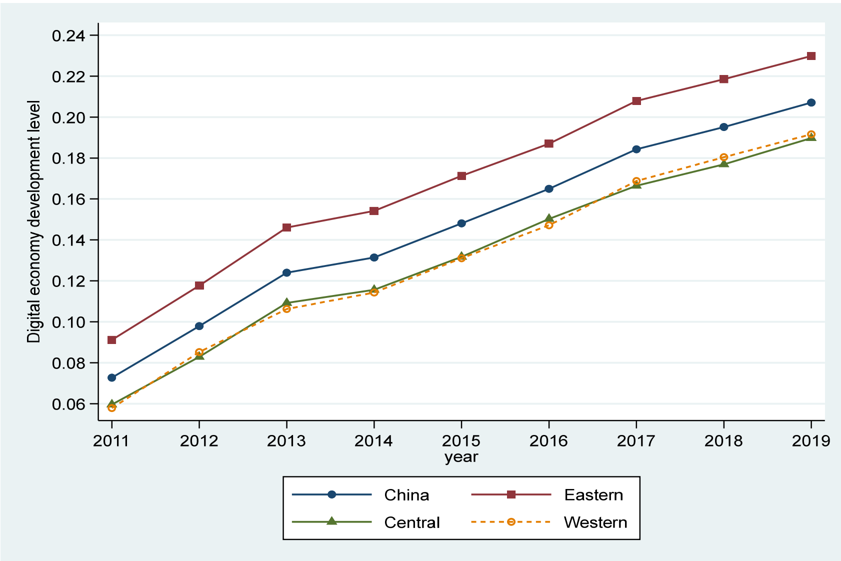

Figure 2. The digital economy development level for China and the three regions.

Table 2 displays the descriptive statistics for the various study variables. As can be seen, the average value of income disparity between rural and urban areas was 2.381 for "Gap", while for the variable "Theil", it was 0.081.

Table 2. Descriptive statistics of variables.

Variable	Period	N	Mean	S.D.	Min	Max
Gap	2011–2019	2442	2.381	0.476	1	4.290
Theil	2011–2019	2440	0.081	0.046	−0.094	0.257
Digital	2011–2019	2502	0.147	0.072	0.011	0.615
Ln(digital)	2011–2019	2502	−2.024	0.475	−4.509	−0.486
Ln(digital1)	2011–2019	2466	−2.881	0.555	−4.665	−0.638
Ln(digital2)	2011–2019	2502	−2.626	0.530	−4.954	−1.847
Ln(gdp)	2011–2019	2502	10.70	0.562	9.091	13.06
fia	2011–2019	2502	0.983	0.603	0.118	9.622
Ln(fdi)	2011–2019	2501	9.998	1.978	0.693	14.94
ind	2011–2019	2484	46.874	10.395	10.680	82.050
unemployment	2011–2019	2502	3.040	0.750	0.900	4.900
urban	2011–2019	2416	0.548	0.148	0.182	1
Ln(post_int)	2011–2019	2502	6.880	1.608	2.755	10.64

Figure 3 plots the trend in the ratio between per capita urban disposable income and per capita rural disposable income from 2011 to 2019. A larger ratio represents a greater disparity in income between rural and urban areas. We can see that the disparity in income between rural and urban areas experienced a decline from 2.62 in 2011 to 2.22 in 2019. Based on the results depicted in Figure 1, it can be observed that there is a negative association between the level of digital economy development and the rural-urban income gap. This observation provides valuable guidance for our subsequent regression analysis.

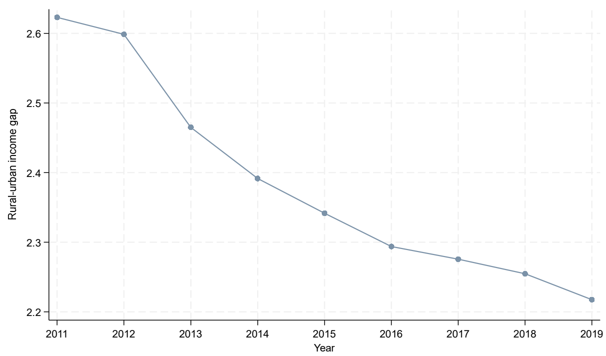

Figure 3. The ratio between per capita urban disposable income and per capita rural disposable income.

In addition, we plotted the negative association between the level of digital economy development and the rural-urban income gap in Figure 4 using a fitting line.

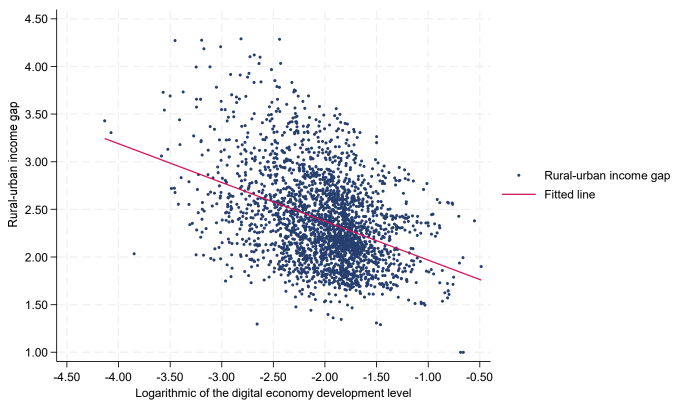

Figure 4. Fitting line indicating the negative association between the rural-urban income gap and the digital economy development level.

4. Results and Analysis

4.1. Basic Regression Result

First, to study the impact of the digital economy development level on the income disparity between rural and urban areas, this work performs a regression analysis based on Model (1). Table 3 reports the regression results, in which the explained variable is the ratio between per capita urban disposable income and per capita rural disposable income. From this table, it is evident that the development of the digital economy had a considerable negative impact on the income disparity between rural and urban areas. Although the increased control of urban characteristics in column (3) is relative to the first two columns, the estimated results are similar across these three columns. The results suggest that the growth of the digital economy helps to reduce the income disparity between rural and urban areas.

Table 3. Basic regression results.

Model	**(1)**	**(2)**	**(3)**
Variable	Gap	Gap	Gap
Ln(digital)	−0.2524 ***	−0.2281 ***	−0.2198 ***
	(0.0296)	(0.0296)	(0.0300)
Ln(gdp)		−0.2093 ***	−0.2049 ***
		(0.0298)	(0.0303)
Fia		0.0111	0.0064
		(0.0123)	(0.0123)
Ln(fdi)		0.0042	0.0035
		(0.0041)	(0.0042)
Ind		−0.0020 *	−0.0019 *
		(0.0011)	(0.0011)
Unemployment			0.0335 ***
			(0.0095)
Urban			0.1803 **
			(0.0992)
Constant	1.9178 ***	4.2121 ***	4.0032 ***
	(0.0818)	(0.3046)	(0.3154)
Year fixed effect	YES	YES	YES
City fixed effect	YES	YES	YES
Observations	2442	2423	2337
R^2	0.456	0.480	0.484
N	276	276	276

Note: *, **, and *** indicate significance at levels of 10%, 5%, and 1%, respectively. The values in the parentheses () represent standard errors. The subsequent tables follow the same format.

This result may be related to low cost and high sharing, which are major characteristics of the digital economy. As digital technologies improve, it may be possible for everyone to participate in economic activities without geographical or temporal restrictions. This could finally reduce the income disparity between rural and urban areas, allowing for sustainable growth and common prosperity [43].

Moreover, in terms of the regional control factors, higher levels of economic development are found to be more conducive to reducing the income disparity between rural and urban areas. This observation can be attributed to the current information and communication technology landscape, where cities experiencing significant economic advancement are likely to intensify the installation of network infrastructure and foster the progression of the digital economy. This, in turn, strengthens inter-industry linkages, tightens connections between the wealthiest and the second wealthiest regions, and enhances collaboration between advanced and less advanced industries. The coefficients for financial development and the degree of openness to the outside world are both positive but not statistically significant. This suggests that financial development and greater openness to the outside world are insufficient to reduce the income gap between urban and rural areas. Typically concentrated in urban areas, especially along the eastern seaboard, financial development and foreign trade have a limited impact in remote rural areas. As a result, they do not contribute significantly to reducing the income gap between urban and rural areas. In addition, the coefficient between the unemployment rate and the degree of urbanization is significantly positive. This indicates that the higher the unemployment rate and degree of urbanization, the greater the income disparity between rural and urban areas. This is in accordance with our economic intuition.

4.2. Endogenous Issues

Although many control variables that could simultaneously affect the amount of digital economy growth and income disparity between rural and urban areas have been controlled in our analysis, there may be endogenous problems due to omitted variables, measurement errors, and reverse causality. Thus, the instrumental variables method is adopted to address endogenous problems. An effective instrumental variable must satisfy both requirements. A robust correlation between the endogenous and instrumental variables is necessary. The second condition requires the instrumental variable to be exogenous.

First, we consider the instrumental correlation requirement. As we know, the number of international Internet users per one hundred individuals is one of the original indicators, and this helps to measure the development level of the digital economy. Thus, there must be a strong correlation between the explanatory variables and the number of international Internet users per one hundred individuals. Next, we consider the instrumental exogenous requirement. As we know, the number of post offices in 1984 is a fixed value, and our sample period is between 2011 and 2019. During this period, the number of post offices in each city remained the same as in 1984, which means that it did not change over time. Based on the above analysis, we referred to the instrumental variable construction from the study by Nunn and Qian [45] and constructed our instrumental variable, that is, the natural logarithm of the interaction term between the number of post offices in 1984 and the number of international Internet users per one hundred individuals in the period between 2011 and 2019 (ln(post_int)). Table 4 displays the regression results from the instrumental variable approach.

Table 4. Regression results for instrumental variables.

Model	**(1)**	**(2)**
Variable	First stage Ln(digital)	Second stage Gap
Ln(post_int)	0.0304 *** (0.003)	
Ln(digital)		−1.0176 *** (0.289)
Ln(gdp)	0.2426 *** (0.013)	0.1740 * (0.091)
Fia	0.0900 *** (0.008)	0.3427 *** (0.036)
Ln(fdi)	0.0032 (0.002)	−0.0412 *** (0.007)
Ind	−0.0062 *** (0.000)	0.0005 (0.002)
Unemployment	−0.0194 *** (0.005)	−0.0228 (0.015)
Urban	0.5575 *** (0.041)	−0.3964 * (0.209)
Constant	−5.4399 *** (0.113)	−1.5878 (1.697)
Year fixed effect	YES	YES
City fixed effect	YES	YES
Observations	1857	1857
R^2	0.895	0.174

Note: * and *** indicate significance at levels of 10% and 1%, respectively. The values in the parentheses () represent standard errors.

The first-stage regression results presented in Table 4 indicate a statistically significant positive correlation between the instrumental and explanatory variables, with an R^2 of 0.895. This suggests that the instrumental correlation requirement is satisfied. In addition, the F-statistic for the first stage is 1047.03, surpassing the empirical threshold of 10. This implies that there is no issue of weak instrumental variables. Moving on to the results of the second-stage regression, the coefficient on the digital economy development level is statistically significant and negative at a significance level of 1%. This finding reinforces the idea that the growth of the digital economy contributes to the reduction in income disparity between rural and urban areas.

4.3. Robustness Test

4.3.1. Using Another Explained Variable

To assess the robustness of fundamental outcomes, we utilized the Theil index as an indication of income disparity between rural and urban areas [43]. The Theil index is constructed as follows:

$$\begin{aligned} Theil_{it} &= \sum_{j=1}^{2} \left(\frac{Y_{jit}}{Y_{it}}\right) \ln\left(\frac{Y_{jit}}{Y_{it}} / \frac{P_{jit}}{P_{it}}\right) \\ &= \left(\frac{Y_{1it}}{Y_{it}}\right) \ln\left(\frac{Y_{1it}}{Y_{it}} / \frac{P_{1it}}{P_{it}}\right) + \left(\frac{Y_{2it}}{Y_{it}}\right) \ln\left(\frac{Y_{2it}}{Y_{it}} / \frac{P_{2it}}{P_{it}}\right) \end{aligned}$$

In Model (8), $j = 1$ and $j = 2$ stand for urban and rural areas, respectively. Y_{jit} indicates the total urban ($j = 1$) or rural ($j = 2$) income of city i during period t. Y_{it} is the aggregate income encompassing both urban and rural areas within city i during period t. P_{jit} denotes the urban ($j = 1$) or rural ($j = 2$) population of city i during period t. P_{it} reflects the entire population of both urban and rural areas within city i during period t.

The outcomes are presented in Table 5. It is obvious that the coefficient of ln(digital) remains statistically significant and negative, which suggests our baseline results. That is, the growth of the digital economy helps to reduce the income disparity between rural and urban areas.

Table 5. Changing the explained variable.

Model	**(1)**	**(2)**	**(3)**
Variable	Theil	Theil	Theil
Ln(digital)	−0.0294 ***	−0.0273 ***	−0.0252 ***
	(0.0027)	(0.0027)	(0.0027)
Ln(gdp)		−0.0213 ***	−0.0194 ***
		(0.0027)	(0.0027)
Fia		0.0001	−0.0001
		(0.0011)	(0.0011)
Ln(fdi)		0.0010 ***	0.0011 ***
		(0.0004)	(0.0004)
Ind		−0.0000	−0.0000
		(0.0001)	(0.0001)
Unemployment			0.0027 ***
			(0.0009)
Urban			−0.0318 ***
			(0.0090)
Constant	0.0162 **	0.2345 ***	0.2280 ***
	(0.0074)	(0.0276)	(0.0286)
Year fixed effect	YES	YES	YES
City fixed effect	YES	YES	YES
Observations	2440	2422	2336
R^2	0.349	0.376	0.379
N	276	276	276

Note: **, and *** indicate significance at levels of 5%, and 1%, respectively. The values in the parentheses () represent standard errors.

Next, using principal component analysis, we replaced the explanatory variables and remeasured the level of digital economy development. The results are shown in Table 6. According to the regression results, the coefficient of ln(digital) is still significantly negative, which is consistent with the above results.

Table 6. Changing the explanatory variable.

Model	**(1)**	**(2)**	**(3)**
Variable	Gap	Gap	Gap
Ln(digital)	−0.1609 ***	−0.1474 ***	−0.1441 ***
	(0.0117)	(0.0118)	(0.0120)
Ln(gdp)		−0.1724 ***	−0.1723 ***
		(0.0293)	(0.0299)
Fia		0.0152	0.0105
		(0.0119)	(0.0120)
Ln(fdi)		0.0022	0.0016
		(0.0040)	(0.0041)
Ind		−0.0020 *	−0.0020 *
		(0.0011)	(0.0011)
Unemployment			0.0318 ***
			(0.0094)
Urban			0.2175 **
			(0.0967)
Constant	2.3841 ***	4.2672 ***	4.0764 ***
	(0.0182)	(0.2800)	(0.2926)
Year fixed effect	YES	YES	YES
City fixed effect	YES	YES	YES
Observations	2405	2386	2301
R^2	0.480	0.499	0.501
N	274	272	272

Note: *, **, and *** indicate significance at levels of 10%, 5%, and 1%, respectively. The values in the parentheses () represent standard errors.

4.3.2. Explanatory Variables Lagged by One Period

Given the potential delayed influence of the digital economy on the income disparity between rural and urban areas, we opted to introduce a lag of one period for both the explanatory and control variables. Subsequently, we re-estimated the effects of the digital economy on the income disparity between rural and urban areas. The estimated outcomes are shown in Table 7. The regression coefficients and their significance closely align with the results from the basic regression analysis. Therefore, we assert that our estimated results are robust, and Hypothesis 1 has been verified.

Table 7. Explanatory variables lagged by one period.

Model	**(1)**	**(2)**	**(3)**
Variable	Gap	Gap	Gap
L.Ln(digital)	−0.1852 ***	−0.1743 ***	−0.1778 ***
	(0.0296)	(0.0293)	(0.0300)
L.Ln(gdp)		−0.1342 ***	−0.1404 ***
		(0.0336)	(0.0343)
L.Fia		0.0271 *	0.0235
		(0.0164)	(0.0165)
L.Ln(fdi)		0.0056	0.0046
		(0.0043)	(0.0044)
L.Ind		−0.0062 ***	−0.0063 ***
		(0.0013)	(0.0013)
L.Unemployment			0.0094
			(0.0101)
L.Urban			0.2169 **
			(0.0981)
Constant	1.9137 ***	3.5742 ***	3.5011 ***
	(0.0502)	(0.3473)	(0.3598)
Year fixed effect	YES	YES	YES
City fixed effect	YES	YES	YES
Observations	2187	2170	2096
R^2	0.410	0.439	0.440
N	276	276	276

Note: *, **, and *** indicate significance at levels of 10%, 5%, and 1%, respectively. The values in the parentheses () represent standard errors.

5. Further Analysis

Some differences may exist in the influence on the income disparity between rural and urban areas of the digital economy's growth; hence, we refer to the different dimensions of the digital economy. Thus, we split the growth of the digital economy into two dimensions: the digital fusion application (ln(digital1)) and Internet accessibility (ln(digital2)). These dimensions were chosen based on their relevance in measuring the digital economy's growth. We then conducted a regression analysis using the two indicators to evaluate their impacts on the income disparity between rural and urban areas. The estimated findings are presented in Table 8.

Columns (1)–(3) estimate the impact of the digital fusion application on the income disparity between rural and urban areas. Columns (4)–(6) estimate the effect of Internet accessibility on the income disparity between rural and urban areas. The regression outcomes are all statistically significant and negative. The findings imply that, regardless of the dimension considered, the growth of the digital economy aids in closing the income disparity between rural and urban areas. It is observed that the coefficient on the digital fusion application is larger than Internet accessibility in absolute terms. This suggests that, while the development of the telecommunication and network infrastructure is crucial to the process of digital economic development affecting the rural-urban income disparity, as a public infrastructure, the marginal utility of Internet development is not as large as that generated by digital fusion applications. The reason for this may be that the Internet's progress has only broken through the spatial barrier, making it possible to carry out activities related to data traffic without any restrictions on time or geography. By contrast, digital fusion applications have led to a change in the traditional transaction model, which reduces transaction costs, creates novel goods and models, brings new supply and demand, and affects the consumption structure of the population. The explanation above accurately reflects the direct effect of the digital economy on the income gap between urban and rural areas, as shown in Figure 1.

Table 8. The influence of different types of digital economy on the income disparity between rural and urban areas.

Model	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**
Variable	Gap	Gap	Gap	Gap	Gap	Gap
Ln(digital1)	−0.0463 **	−0.0399 **	−0.0358 *			
	(0.0183)	(0.0182)	(0.0183)			
Ln(digital2)				−0.3826 ***	−0.3833 ***	−0.3883 ***
				(0.0438)	(0.0444)	(0.0452)
Ln(gdp)		−0.2344 ***	−0.2233 ***		−0.2186 ***	−0.2145 ***
		(0.0302)	(0.0307)		(0.0295)	(0.0299)
Fia		0.0079	0.0028		0.0091	0.0042
		(0.0125)	(0.0125)		(0.0122)	(0.0122)
Ln(fdi)		0.0021	0.0016		0.0037	0.0030
		(0.0042)	(0.0043)		(0.0041)	(0.0041)
Ind		−0.0014	−0.0014		−0.0017	−0.0017
		(0.0012)	(0.0012)		(0.0011)	(0.0011)
Unemployment			0.0381***			0.0345 ***
			(0.0097)			(0.0095)
Urban			0.1010			0.2380 **
			(0.0998)			(0.0995)
Constant	2.4596 ***	4.9618 ***	4.6978 ***	1.1692 ***	3.4852 ***	3.2088 ***
	(0.0594)	(0.2966)	(0.3084)	(0.1653)	(0.3388)	(0.3499)
Year fixed effect	YES	YES	YES	YES	YES	YES
City fixed effect	YES	YES	YES	YES	YES	YES
Observations	2414	2395	2310	2442	2423	2337
R^2	0.439	0.467	0.471	0.457	0.484	0.489
N	274	272	272	276	276	276

Note: *, **, and *** indicate significance at levels of 10%, 5%, and 1%, respectively. The values in the parentheses () represent standard errors.

6. Heterogeneity Test

Here, we explore whether the impact of the digital economy on the income disparity between rural and urban areas is dependent upon geographical factors. To investigate this, we first classified the cities in our sample into three groups based on the geographical classification standard from the NDRC of China: eastern region cities were placed in the first group, central region cities were put into the second group, and western region cities were assigned to the third group.

Table 9 reports the estimated results. From this table, we can see that the digital economy development level only has a statistically strong and negative influence on the rural-urban income gap in the eastern and western regions. We also see that the western region has experienced a more significant effect, while there is no statistically significant effect in the central region.

As we know, the central area includes numerous economically underdeveloped cities that possess a large secondary industrial market share. Due to the central region's inherent economic strength and the fact that the rural-urban income disparity was not initially as wide as in the western region, the influence of the digital economy on the income disparity between rural and urban areas would be minimal [41]. Meanwhile, the central region exhibits a comparatively lower level of economic development compared to the eastern region. This means that there is a lower level of investment in infrastructure development in the central region. Thus, the influence of the digital economy on the income disparity between rural and urban areas would be limited and less than that in the eastern region. Most enterprises located in the eastern coastal regions are service-oriented, specifically high-tech industries that are intricately linked to the digital mega-infrastructure and have a relatively developed economy. This is an appropriate area to carry out basic livelihood services involving healthcare and education, such as online registration, remote consultation, cloud classes, and online classroom platforms. Therefore, the eastern region exhibits greater efficacy in reducing the income disparity between rural and urban areas. In the western region, although the overall economy is relatively backward, there is a significant disparity in income between urban and rural residents. Consequently, following the emergence of the digital economy, rural-urban income disparity is likely to be narrowed more significantly as urban and rural labor mobility increases, unemployed rural workers go to the city for employment, and the avenues available for farmers to augment their income are broadened. As a result, the influence of the digital economy on income disparity is only reflected in the eastern and western regions, and compared with the eastern region, it has a stronger effect on narrowing the rural-urban income gap in the western region.

In order to visually reflect the spatial distribution differences of the rural-urban income gap, this paper uses ArcGIS10.8 software and the natural discontinuity grading method to present the rural-urban income gap of 276 cities in 2011 and 2019, as shown in Figure 5.

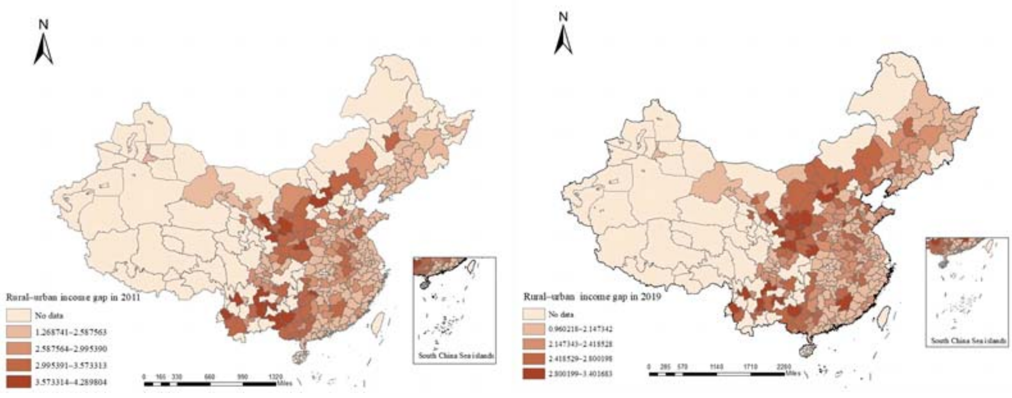

Figure 5. Spatial distribution of the rural-urban income gap in 2011 and 2019.

Table 9. Heterogeneity test.

Model	(1)	(2)	(3)
Variable	Eastern Gap	Central Gap	Western Gap
Ln(digital)	−0.2811 ***	−0.0212	−0.3046 ***
	(0.0507)	(0.0541)	(0.0516)
Ln(gdp)	−0.2610 ***	−0.0054	−0.2511 ***
	(0.0458)	(0.0546)	(0.0740)
Fia	0.0459	−0.0174	0.0212
	(0.0328)	(0.0207)	(0.0151)
Ln(fdi)	−0.0060	0.0148 **	0.0002
	(0.0073)	(0.0073)	(0.0069)
Ind	0.0010	−0.0024	−0.0070 ***
	(0.0020)	(0.0020)	(0.0020)
Unemployment	0.0414 ***	0.0339 **	0.0387 *
	(0.0152)	(0.0145)	(0.0234)
Urban	0.6788 ***	−0.7389 ***	0.0042
	(0.1442)	(0.1908)	(0.1947)
Constant	3.9862 ***	2.8266 ***	4.8523 ***
	(0.5077)	(0.5391)	(0.7269)
Year fixed effect	YES	YES	YES
City fixed effect	YES	YES	YES
Observations	1001	859	468
R^2	0.452	0.498	0.700
N	114	107	54

Note: *, **, and *** indicate significance at levels of 10%, 5%, and 1%, respectively. The values in the parentheses () represent standard errors.

It can be seen that the rural-urban income gap in the eastern coastal cities is significantly lower than that in the central and western regions. This could be attributed to economic development and better capitalization of the eastern region of the country. Furthermore, certain cities exhibit greater support for foreign trade policies, possess a higher quality labor force, provide a favorable environment for foreign investment, and have a wealthier population. As a result, the income disparity between urban and rural areas is lower than in other regions. Next, from 2011 to 2019, there was no significant change in the rural-urban income gap in the central region. With the gradual increase in the level of the digital economy, central cities such as Wuhan and Changsha have advanced their overall economic level towards high-quality development. However, it is important to note that this development has not significantly reduced the rural-urban gap. Finally, the western region has seen particularly significant changes in this process. Although some of the cities in Figure 5 do not show a change in color, their legend values have decreased overall from 2011 to 2019. The above conclusions are consistent with the previous heterogeneity analysis; that is, the influence of the digital economy on the rural-urban income gap is only reflected in the eastern and western regions, and it has a more significant effect in the western region.

7. Conclusions and Discussion

Using panel data spanning from 2011 to 2019 for 276 Chinese cities, we applied principal component analysis and the entropy approach to assess the levels of digital economy, digital fusion application, and Internet accessibility. We also evaluated the influence of the digital economy on the income disparity between rural and urban regions and conducted a series of robustness and heterogeneity analyses. Our results reveal that the expansion of the digital economy has a statistically significant and negative effect on the rural-urban income divide. This implies that the growth of the digital economy is conducive to reducing income disparity between rural and urban regions. These findings remained robust under various tests, including the use of the instrumental variables method, modifications to the indicators of explanatory variables, and the incorporation of a lag for the explanatory variables by one period. Additionally, our research demonstrates that the digital fusion application has a greater influence than Internet accessibility on eliminating the income disparity between rural and urban regions. Furthermore, we discovered that the impact of the digital economy on income disparity between rural and urban regions is contingent upon geographical location. Specifically, this impact was evident only in the eastern and western regions, with a more pronounced effect in the western region. To some extent, our findings provide insights for the government to distinguish the differential impact of various dimensions of the digital economy on the rural-urban income gap in different regions, facilitating targeted development of the digital economy.

In light of China's future economic development, the emphasis on cultivating a digital economy and fostering sustainable development has become a prominent approach. A crucial aspect of this strategy involves addressing the income disparity between rural and urban areas, recognizing that narrowing this gap is pivotal for meeting the population's aspirations for an improved standard of living and resolving regional development imbalances. Ultimately, this approach aims to foster a state of sustainable development and common prosperity. To leverage the potential of the digital economy in reducing the income disparity, several key measures are proposed. First, the construction of rural digital infrastructures should be strengthened. Although the digital economy is being promoted widely, compared with urban cities, rural areas are constrained by economic and human capital and lag in the application of the new generation of information technologies such as big data, cloud computing, and artificial intelligence. Thus, governments should increase financial subsidies for the construction of basic networks in rural areas and then promote the development of the rural digital economy to alleviate the imbalance between urban and rural areas. Second, since different regions have different levels of economic development and digital economy development, which have various impacts on reducing the income disparity between rural and urban areas, pillar industries and development modes that are in line with the actual production conditions and comparative advantages of rural areas should be actively explored. Combining regional resource endowments with information technology, the Internet can be used to strengthen the output of knowledge and skills at a lower cost, improve the professionalism of rural residents and their own abilities, and sustainably increase rural incomes through the accumulation of human capital. Third, due to the highly technical nature of digital economy development, the importance of professional talents is underscored. Strengthening personnel exchanges and cooperation is deemed necessary to facilitate coordinated regional development, resource flow, economic growth, and the sharing of development outcomes. Finally, recognizing that narrowing the rural-urban income gap is just an initial step toward achieving regional balanced development, this study acknowledges its limitations in fully representing the impact of the digital economy on overall regional development. Future research endeavors are proposed to comprehensively explain and measure regional balanced development, delving deeper into the internal relationship between the development level of the digital economy and regional balance.

Author Contributions: Conceptualization, Z.T. and B.L.; methodology, J.K.; software, J.K. and L.S.; Formal analysis, J.K. and B.L.; Methodology, B.L.; Project administration, Z.T.; Resources, L.S.; Supervision, Z.T.; Validation, J.K.; Writing—original draft, L.S. and B.L.; Writing—review and editing, B.L. All authors have read and agreed to the published version of the manuscript.

Funding: We acknowledge funding from the National Natural Science Foundation of China (Grant no. 72171100), the National Natural Science Foundation of China (Grant no. 72073049), the National Natural Science Foundation of China (Grant no. 71703052), the Natural Science Foundation of Qinghai Province (Grant no. 2023-QLGKLYCZX-026), and the Construction Program of Doctoral Thesis Extended Project for New Teachers at Qinghai University of Science and Technology, Qinghai Unversity (Grant no. 202302lwys017). This paper does not reflect an official statement or opinion from the organizations.

Institutional Review Board Statement: Not applicable.

Informed Consent Statement: Not applicable.

Data Availability Statement: Data will be made available on reasonable request.

Conflicts of Interest: The authors declare no conflicts of interest.

References

1. China Academy of Information and Communication Research. *Introduction to Digital Economy*; People's Posts and Telecommunications Press: Beijing, China, 2022.
2. Dahlman, C.; Mealy, S.; Wermelinger, M. *Harnessing the Digital Economy for Developing Countries*; OECD iLibrary: Paris, France, 2016; pp. 12–22. [CrossRef]
3. Wang, J.; Zhu, J.; Luo, X. Research on the measuremen of China's digital economy development and the characterisics. *J. Quant. Technol. Econ.* **2021**, *38*, 26–42. [CrossRef]
4. Liu, P.L.; Qian, T.; Huang, X.H. The Connotation, realization path and measurement method of common prosperity for all. *J. Manag. World* **2021**, *37*, 117–129. [CrossRef]
5. Zhang, B.Q.; Wu, W.T. Digital inclusive finance, entrepreneurship and income distribution: An empirica research from the perspective of urban-rural differences in China. *Chin. Rev. Financ. Stud.* **2021**, *13*, 31–44+124.
6. Zhang, X.; Wan, G.H.; Zhang, J.J. Digital economy, financial inclusion, and inclusive growth. *Econ. Res. J.* **2019**, *54*, 71–86.
7. Zhang, Y.F. Can internet trade narrow the income gap?: Double heterogeneous model and evidences from China. *Inq. Econ. Issues* **2019**, *6*, 50–58.
8. Lan, G.X.F.; Wu, Y.T.; Kuang, X.M. Internet Trade Development and Income Distribution Gap. *J. Ind. Technol. Econ.* **2020**, *39*, 107–115. [CrossRef]
9. Guan, H.L.; Chen, J.C.; Qian, Y.W. The research on the trade mode and development of agricultural product in the light of e-commerce. *China Bus. Mark.* **2010**, *24*, 45–47. [CrossRef]
10. He, D.H.; Han, X.Y.; Li, Y.Z. Factors affecting consumers' purchase intention in electronic commerce of fresh agro-products. *J. Northwest A&F Univ. (Soc. Sci. Ed.)* **2014**, *4*, 85–91.
11. Zhang, X.Y. The impact of financial inclusion development on the urban-rural income gap in the context of Internet finance. *Financ. Account. Mon.* **2016**, *17*, 94–97. [CrossRef]
12. Song, X.L. Empirical analysis of digital inclusive finance bridging the urban-rural residents income gap. *Financ. Econ.* **2017**, *6*, 14–25.
13. Ge, H.P.; Zhu, H.W. A study of provincial differences and influencing factors of digital inclusive finance in China. *New Financ.* **2018**, *2*, 47–53.
14. Zhang, H.; Bai, Q.X. Does the digital inclusive finance reduce the income gap between urban and rural areas?: Based on panel threshold regression of provincial data in China. *Inq. Econ. Issues* **2018**, *10*, 122–129.
15. Liang, S.L.; Liu, P.P. Digital inclusive finance and the income gap between urban and rural areas. *J. Cap. Univ. Econ. Bus.* **2019**, *21*, 33–41. [CrossRef]
16. Li, Y.; Ke, J.S. Three-level digital divide: Income growth and income distribution effects of therural digital economy. *J. Agrotech. Econ.* **2021**, *8*, 119–132. [CrossRef]
17. Zhang, L.; Han, L. Has e-commerce economy development expanded urban-rural residents income gap? *Res. Econ. Manag.* **2017**, *5*, 3–13. [CrossRef]
18. Lam, P.L.; Shiu, A. Economic growth, telecommunications development and productivity growth of the telecommunications sector: Evidence around the world. *Telecommun. Policy* **2010**, *34*, 185–199. [CrossRef]
19. Michael, R.W.; Zheng, S.L. Mobile telecommunications service and economic growth: Evidence from China. *Telecommun. Policy* **2016**, *40*, 89–101. [CrossRef]
20. He, Y.P.; Xu, K.N. Internet and income gap between urban and rural residents: Factual examination from China. *Econ. Surv.* **2019**, *36*, 25–32. [CrossRef]
21. Liu, H. How does industrial intelligence affect rural-urban income disparity? An interpretation from the perspective of employment of migrant population. *Chin. Rural. Econ.* **2020**, *5*, 55–75.
22. Wei, P.; Chen, X.W. Digital economy, spatial spillover and urban-rural income gap——Based on the research of spatial dubin model. *J. Shandong Univ. Sci. Technol. (Soc. Sci.)* **2020**, *22*, 75–88. [CrossRef]
23. Chen, W.; Wu, Y. Digital economy's development, digital divide and the income gap between urban and rural residents. *South China J. Econ.* **2021**, *11*, 1–17. [CrossRef]
24. Cheng, M.W.; Zhang, J.P. Internet popularization and urban-rural income gap: A theoretical and empirica analysis. *Chin. Rural. Econ.* **2019**, *2*, 19–41.
25. Luo, C.P.; Zhu, P.W.; Zhang, C.C. Internet, urbanization and the urban-rural income gap: Theoretical mechanism and empirical test. *West Forum* **2021**, *31*, 28–43. [CrossRef]
26. Liu, J.; Zhao, X.H.; Cheng, R. Study on the threshold effect of digital economy to improve the income gap between urban and rural areas. *Res. Dev.* **2020**, *6*, 105–113. [CrossRef]
27. Li, X.Z.; Li, J.Y. Research on the influence of digital economy development on urban-rural income gap. *J. Agrotech. Econ.* **2022**, *322*, 77–93. [CrossRef]

28. Xia, C.J.; Liu, C. Empowerment of Common Prosperity Through Digital Economy: Pathwaysand Policy Design. *Res. Econ. Manag.* **2021**, *42*, 3–13. [CrossRef]
29. Liu, J.; Yang, Y.Y.; Zhang, S.F. Research on measurement and driving factors of China's digital economy. *Shanghai J. Econ.* **2020**, *6*, 81–96. [CrossRef]
30. Wang, Y.J.; Peng, D.Y.; Zhao, S.Q. Influence of Digital Economy Development on Common Prosperity. *Enterp. Econ.* **2023**, *42*, 28–39. [CrossRef]
31. Mesenbourg, T.L. Measuring the Digital Economy. United States Bureau of the Census 1–19. 2001. Available online: http://www.census.gov/content/dam/Census/library/working-papers/2001/econ/umdigital.pdf (accessed on 2 March 2021).
32. Barefoot, K.; Curtis, D.; Jolliff, W.; Nicholson, J.R.; Omohundro, R. Defining and Measuring the Digital Economy. Working Paper. 2018. Available online: https://www.bea.gov/system/files/papers/WP2018-4.pdf (accessed on 2 June 2021).
33. Hong, X.J. The digital economy: Content, accounting and evaluation. *China Stat.* **2019**, *8*, 49–52.
34. General Administration of Quality Supervision. Inspection and Quarantine of the People's Republic of China, Industrial classification for national economic activities. *Standard. Adm. People's Repub. China* **2017**, *6*, 30.
35. Guan, H.J.; Xu, X.C.; Zhang, M.H. Research on Industrial Classification for Digital Economy in China. *Stat. Res.* **2020**, *37*, 3–16. [CrossRef]
36. Liu, Y.; Chen, X.D. The effect of digital economy on industrial structure upgrade in China. *Res. Econ. Manag.* **2021**, *42*, 15–29. [CrossRef]
37. Shan, G.Z.; Xu, Q.Y.; Ma, C.J. The evaluation system of and prospects for the development of digital economy based on the ternary space theory. *Macroecon. Manag.* **2020**, *2*, 42–49. [CrossRef]
38. Liu, F.; Meng, Q. Digital economy development: Measurement, International comparison and Policy advice. *Qinghai Soc. Sci.* **2019**, *4*, 83–90. [CrossRef]
39. Zhang, X.L.; Jiao, Y.X. A preliminary study of China's digital economy development index and its application. *Zhejiang Soc. Sci.* **2017**, *4*, 32–40+157. [CrossRef]
40. Tang, Y.J.; Wang, Y.; Tang, C.H. Digital economy, market structure and innovation performance. *China Ind. Econ.* **2022**, *10*, 62–80. [CrossRef]
41. Zhao, T.; Zhang, Z.; Liang, S.K. Digital economy, entrepreneurship, and high-quality economic development: Empirical evidence from urban China. *J. Manag. World* **2020**, *36*, 65–76. [CrossRef]
42. Huang, Q.H.; Yu, Y.Z.; Zhang, S.L. Internet development and productivity growth in manufacturing industry: Internal mechanism and China experiences. *China Ind. Econ.* **2019**, *8*, 5–23. [CrossRef]
43. Yu, Y.Z.; Cao, R. Digital economy and common prosperity—An analysis based on the perspective of yrban-rural income gap in China. *J. Lanzhou Univ. Financ. Econ.* **2023**, *39*, 1–15.
44. Li, Y.L.; Shen, Y. Digital Financial Inclusion and Regional Economic Imbalance. *China Econ. Q.* **2022**, *22*, 1805–1828. [CrossRef]
45. Nunn, N.; Nancy, Q. US Food aid and civil conflict. *Am. Econ. Rev.* **2014**, *104*, 1630–1666. [CrossRef]