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Original Paper

A Study on the Impact of Urban Digitalization on the Urban-rural Income Gap

Jin Zheng[1*], Zhengwei Tan[1], Mengmeng Dou[1] & Danni Mao[1]

[1] University of South China, Heng Yang, Hu Nan 421001, China

[*] Corresponding author, Jin Zheng, University of South China, Heng Yang, Hu Nan 421001, China

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Abstract

The empirical research topic for this paper is a panel dataset of 31 provinces and urban areas from my country from 2011 to 2020. On the one hand, it gauges the level of regional digital economic development. On the other side, we'll talk about the structural impact of the level of digitalization on the urban-rural income difference and further debate whether the digital economy helps close or widen this gap. The findings show that the degree of digitization has a significant impact on reducing the income gap between urban and rural areas, while an increase in the Internet coverage index helps do so. However, the overall impact makes the digital economy unfavorable to reducing the income gap between urban and rural areas.

Keywords

Digital degree, Urban-rural income gap, Digital economy

1. Introduction

The digital economy has grown as a result of the steady advancement of digital technologies like big data, cloud computing, and blockchain. The rapid development of the digital economy not only promotes continuous improvement and leaps in productivity, but also affects employment in the industry. According to the statistics of the Ministry of Human Resources and Social Security of my country, by 2020, the scale of our country's digital economy will reach 39.20 trillion yuan, and recruitment positions in the field of digital industrialization will account for 32.6% of the total number of recruits, accounting for 24.2% of the total number of recruits. It is expected that by 2025, my country's digital economy will drive 379 million people into employment. At the same time, under the historical opportunities provided by the digital economy, China has achieved transcendent development in many fields. A significant portion of labor employment has been absorbed as a result of the growth

of the digital economy in the form of numerous new jobs and professions. In addition, the digital economy improves the quality of employment by affecting the employment environment, employability, income level, and labor protection, which is conducive to improving rural income levels and triggering new changes in labor protection. While increasing the employment rate, new employment models such as flexible employment have also become an important way for flexible employees to increase their sources of income (Qi, Liu, & Ding, 2015).

Modernizing agriculture and rural areas is crucial to the socialist modernization of my nation. It is essential to consistently close the gap between urban and rural areas, particularly the economic disparity between urban and rural populations if you want to achieve the goal of agricultural and rural modernization. This is also a necessary condition for continually fulfilling peoples' aspirations for a better living, and the growth of the digital economy will unavoidably have a significant effect on how jobs and income are distributed between urban and rural populations. Therefore, to improve the wealth disparity between urban and rural people and the distribution of resources, it is crucial to investigate how the new economic engine of the digital economy influences the urban-rural income divide.

2. Review of the Literature

General Secretary Xi Jinping first brought up the digital economy in China during the G20 summit in Hangzhou in 2016, and in the government work report for China in 2017, it was formally noted that the growth of the digital economy has taken precedence over all other avenues for innovation in China. The definition of the digital economy was further clarified in the White Paper on China's Digital Economy Development Report (2020) published by the China Academy of Information and Communication Research, which stated that the digital economy primarily includes four parts: digital industrialization, technological advancement of the industry, governance of digital assets, and data valuation. The economy of the internet can be separated into an arrow sense and a broad sense, claim foreign academics. In a limited sense, the digital economy is referred to as an economy based on manufacturing. In other words, digital industrialization is the process by which traditional national economic sectors are disrupted to produce, consume, and distribute digital goods or services (IMF). An industrial economy that includes technology and allied industries in the areas of integrated circuits, big data, artificial intelligence, the Internet of Things, blockchain technology, etc. is what the digital economy, taken in its narrowest meaning, can be viewed as. The term "digital economy" refers to a wide range of economic actions, including e-commerce, electronic payments, online advertising, the creation of digital content, digital cultural products, and other areas (OECD). The digital economy is typically characterized by digital information and knowledge as new factors of production and through the application of networks of information technology as carriers to promote efficiency and macroeconomic structural optimization. The macroeconomic phenomenon known as the "broader digital economy" is focused on the usage of electronic technologies. A microeconomic phenomenon, the narrow digital economy is the center.

2.1 Research on Urban Digitalization and Employment Structure

First, changes in the skill structure of the workforce have been triggered by the development of technological innovations. The growth of the digital economy has increased the complexity required for high-skilled jobs as well as the demand for high-skilled workers (Yang, Hou, & Wang, 2022). There are two main tendencies for middle-skilled workers in developed and emerging nations. According to Acemoglu et al. (2011), middle-skilled labor will be the first to be replaced as the digital economy develops quickly, creating a "polarization" of employment. Second, the growth of the digital economy encourages modifications to the composition of the industrial labor force. The economy's rapid growth will encourage ongoing adjustments and optimizations to the manufacturing structure and workforce framework, allowing the service sector to continue to absorb jobs (Cai, 2017). Li et al. (2017) believe that employment in the service industry and manufacturing employment will affect each other, and there will be certain interaction multiplier effects and spatial spillover effects, which will affect the industrial employment structure. According to Yang et al. (2018), the emergence of new industries like the platform economy and the sharing economy has led to the creation of numerous new jobs as well as the absorption of numerous workers from the tertiary sector. Third, the gender makeup of the workforce has changed as a result of the growth of the digital economy. According to international experience, compared with men, women are often disadvantaged in terms of social resources, education, employment opportunities, etc., and women have relatively few opportunities to use the Internet, but the increasing popularity of Internet technology will help narrow this gap and increase women's employment opportunities and salary levels (Wasserman & Richmond-Abbott, 2015). According to Mao and Zeng (2017), the usage of online resources will considerably raise the likelihood of women engaging in self-employment and the labor supply rate, boosting the percentage of women in the labor force.

In conclusion, the discussion above demonstrates that the advancement of digital technology presents both great opportunities and challenges. To adapt to the needs of the internet-based economy, it is necessary for people to continuously improve their skills and literacy as well as to develop and implement the corresponding government policies.

2.2 Research on Urban Digitization and Employment Quality

A high-quality environment for economic development is necessary to achieve higher-quality employment. The digital economy is currently seen as a new source of economic growth, and it must be energetically developed if high-quality employment is to be attained. Since employment quality is a broad notion, there are numerous ways for the growth of the digital economy to have an impact on it. The material that is now available focuses mostly on the next topics.

First, the development of technological advances will affect the overall effectiveness of production and the labor market. The development of electronic technology not only helps to increase production efficiency but also fosters economic development and a better working environment in general (Cao & Zhou, 2018). The ability to balance work and family life is now possible more than ever before thanks

to the autonomous and flexible nature of job searching, working, and working locations in the digital economy. These new features can significantly increase workers' satisfaction with the employment environment (Wang, 2020). Second, the growth of the digital economy will have an impact on salary levels and employment prospects for workers. According to Autor et al. (2022), improvements in digital technology have raised overall income levels by increasing productivity and the demand for highly skilled labor. Acemoglu et al. (2018) made the point that over time, low-skilled individuals can develop their competencies through continuous learning, which can raise both their chances of getting hired and labor pay. Third, labor relations will be significantly impacted by the growth of the digital economy. According to Liu et al. (2022), the conventional operating framework of employment, production, and consumption activities has changed as a result of the new economic model, which has platform enterprises as its core organization and is supported by digital technology. This has also led to new changes in labor relations. New characteristics and new adjustment directions. Ding et al. (2022) believe that the advancement of digital technology will help to achieve effective matching of personnel and positions by affecting the human resource planning of enterprises and changes in the demand for workers' skills, which has a positive impact on improving labor relations. However, Zhang and Dong (2019) believe that human capital investment takes a certain amount of time, additionally, there can be a mismatch between the cultivation of high-skilled talent and the fast growth of digital technology, leading to a shortage of high-skilled personnel, which is not helpful for the betterment of labor relations.

2.3 Research on Urban Digitization and Urban-rural Income Gap

The following two areas make up the majority of academic studies on urban digitization's impact on the economic gap between urban and rural areas. According to some academics, urban digitalization can reduce the economic difference between urban and rural areas (Zhou, Feng, & Yi, 2020). The study concluded that digital inclusive finance has a noteworthy "digital dividend" influence on the urban-rural revenue discrepancy, and the marginal effect on rural areas is greater, which is conducive to narrowing the urban-rural revenue discrepancy. This was done by building a household credit threshold model and using the percentiles MM decomposition method. Wang and Xiao (2021) Based on data from 30 Chinese provinces from 2013 to 2019, they discovered that while regional heterogeneity exists in the eastern, central, western, and northeastern regions, the expansion of the digital economy can help to close the income disparity between urban and rural populations. Li (2021) The application of the dynamic panel GMM model can encourage labor mobility and indirectly reduce the income gap between urban and rural areas based on panel data from 31 provinces and cities across the nation from 2004 to 2019. The urban-rural income disparity would widen as a result of urban digitization, according to additional studies and development by academics. According to a study by Tan et al. (2017), there is no discernible difference between urban and rural areas in terms of how much emphasis is placed on the Internet, but there are considerable differences between urban and rural residents in terms of the return on income from informatization. The panel data study by Yu et al. (2022), which

included 30 provinces and regions in my nation from 2013 to 2019, discovered that the overall impact of technological infrastructure and digital economic growth is not favorable for reducing the income disparity between urban and rural areas. This is primarily caused by the knowledge and skill gaps that exist between urban and rural micro-entities, which lead to inadequate identification and use of information technology. In response to the different views mentioned above, scholars need to further explore the mechanisms and channels of influence of digital economy development on the urban-rural income gap, to better guide policy formulation and implementation. They can specifically assess the current situation and challenges of regional imbalances faced by urban and rural development of the digital economy as well as strengthen links between urban and rural digital economy development and other aspects (e.g., agricultural modernization, public services, etc.). They can also assess the role of digital technologies such as digital inclusive finance in promoting income in rural areas. The government may adopt targeted policies to encourage the joint promotion and advantages of the digital economy in both urban and rural regions, reduce the income gap between urban and rural areas, and accomplish the aim of balanced urban-rural development via in-depth study and analysis.

3. Index System and Empirical Model Construction

3.1 Model Design

3.1.1 Empirical Model Construction

The econometric regression model developed in this study to empirically examine the effect of digitization on the income difference between urban and rural areas is as follows:

$$\text{Income-gap}_{it}=a_0+\beta_k X_{it}+a_{xui}+a_{xrt}+\varepsilon_{it} \quad (1)$$

Among them, "i" represents the province, "t" represents the year, Encome-gap represents the urban-rural income gap, u_i is the fixed effect of the province, u_i is the individual effect that does not change due to time, r_t is the individual effect of the year, and r_t is the time effect that does not change due to the individual. ε is a random perturbation term.

3.1.2 Data Sources

1. Description of data sources. Panel data are data that include both time series and cross-sectional data, with a long time and a large cross-sectional sample, which can not only reflect the heterogeneous characteristics of the sample individuals and time, but also observe and control the fixed and random effects of some individuals and time, and can avoid the problems of endogeneity and omitted variables that exist in cross-sectional and time series data respectively. In addition, the presence of inter-individual and inter-temporal correlations in panel data facilitates the study of linkages and evolutionary processes between economic variables. Therefore, the data used in this research originates from the panel statistics of 31 provinces across China for the period of 2011-2020 as the major data source, to enable the subsequent analysis and processing.

2. An account of time. One of China's long-standing socioeconomic issues is the disparity in income between urban and rural people, as well as the unequal distribution of resources for public services like

housing, healthcare, and education. The urban-rural dual structure problem has many complicated root causes. These issues not only threaten the stability and advancement of Chinese society but also highlight the harsh reality of uneven urban and rural development. Over time, these problems have not been effectively solved, and related studies have shown a trend of increasing year by year. This paper, therefore, chooses 10 years to conduct an overall study of urban-rural development changes.

3.2 Selection of Variables

Among them, the ratio of urban disposable income per individual to rural disposable income for each person, the Gini coefficient, and the Thiel index are the sources of the urban-rural revenue discrepancy, the calculation of the index of the urban-rural gap, and the indicators for measuring the urban-rural revenue discrepancy. The percentage of the population living in urban and rural regions is not included in the per capita disposable income ratio since it is a static indicator and cannot account for population mobility between urban and rural areas. The Gini coefficient, which is more sensitive to changes in middle-class income, gauges the total income disparity. The Gini coefficient cannot accurately capture the urban-rural income disparity since the bulk of it is at both extremes. At both extremities of the income distribution, the Thiel index is more vulnerable to variations in high- and low-income groups' incomes. As a result, the Thiel index is used in this study to calculate the income disparity between urban and rural China. The Thiel index's calculation formula, which is based on Wang and Ouyang (2007)'s method is as follows:

$$theili,t=\sum[P_{ij,t} /P_{i,t}] \ ln[(P_{ij,t}/p_{i,t})/(Z_{ij,t}/Z_{i,t})] \quad (2)$$

Where j = 1 and 2 represent urban and rural areas, respectively, z_i, t represents the total population of I region in t year, and z_{ij}, t represents an urban or rural population. Pit represents total disposable income and $p_{ij,t}$ represents the disposable income of urban or rural residents. Total regional income is calculated by multiplying the regional population by the regional per capita disposable income.

The level of digitalization is the main explanatory factor. This study chooses the sub-coverage breadth index, usage depth index, and digitalization index from the Digital Inclusive Finance Index, which was published by the Peking University Digital Finance Research Center in April 2019.

Table 1. Variable Names and Calculation Methods

Variable classification	Variable name	Data source
interpreted variable	Urban-rural income gap-Thiel index (index)	
explanatory variable	Degree of digitization (digitization)	Peking University Digital Research Center
control variable	Coverage depth (depth)	Peking University Digital Research Center
	Coverage (width)	Peking University Digital Research Center

Table 2. Descriptive Statistics of Each Selected Variable

Variable		Mean	Std.Dev.	Min	Max
Width	overall	196.6696	96.556	1.96	397.0019
between			27.56318	156.4497	269.6552
within			92.68658	22.14878	339.7733
Depth	overall	211.1211	98.18741	22.14878	488.6834
between			37.26758	6.76	305.0997
within			91.06232	158.6125	394.7048
Digitization	overall	290.1421	117.2521	-7.738602	462.2278
between			5.121742	7.58	301.9315
within			117.1434	274.983	456.4636
Gap	overall	0.0906548	0.3819075	1.815747	3.672
between			0.3729023	1.845	3.4688
within			0.1041508	2.263981	2.931881
Index	overall	0.0906548	0.0398114	0.018	0.202
between			0.0383798	0.0209	0.1722
within			0.0124435	0.0556548	0.1266548
GDP	overall	3694.586	1588.629	1849.921	10023.16
between			1605.558	1934.818	9432.62
within			144.9471	3235.015	4285.128

3.3 Model Testing

3.3.1 Multicollinearity Test

In this paper, the depth of coverage, breadth of coverage, Thiel's index, and the dependent variable in the model were selected to test for multicollinearity, and the correlation coefficient matrix obtained is shown in Table 3. Through observation, it can be found that the correlation coefficient between the degree of digitization, Internet breadth, and depth is relatively high, and it can be considered that there is a more serious multicollinearity between the explanatory variables.

Table 3. Table of Correlation Coefficients

Variables	(1)	(2)	(3)
(1) digitization	1.000		
(2) width	0.868	1.000	
	(0.000)		
(3) depth	0.785	0.946	1.000
	(0.000)	(0.000)	

For the presence of multicollinearity, a stepwise regression approach was used to solve the problem, and the empirical results are shown in Table 4:

Table 4. Stepwise Regression Results

Source	SS	df	MS	Number of obs =310		
Model	0.163	3	0.054	Prob>F=0.000		
Residual	0.326	306	0.001	R-squared=0.334		
Total	0.490	309	0.002	RootMSE=0.033		
index	Coef.	Std.Err.	t	P>t	[95% Conf.	Interval]
depth	-0.000	0.000	-2.750	0.006	-0.000	-0.000
digitization	0.000	0.000	6.000	0.000	0.000	0.000
width	-0.000	0.000	-3.200	0.001	-0.000	-0.000
_cons	0.116	0.005	21.770	0.000	0.105	0.126

3.3.2 Heteroscedasticity Test

The residuals Figure 1 shows a large fluctuation in the residuals, indicating that there may be heteroskedasticity, so check the results of processing with the robust standard deviation plus ols method as shown in Table 5, in the robust standard deviation estimation summer, the t-test p-value of each estimator changed significantly, and the coefficient passed the test at 5% confidence level.

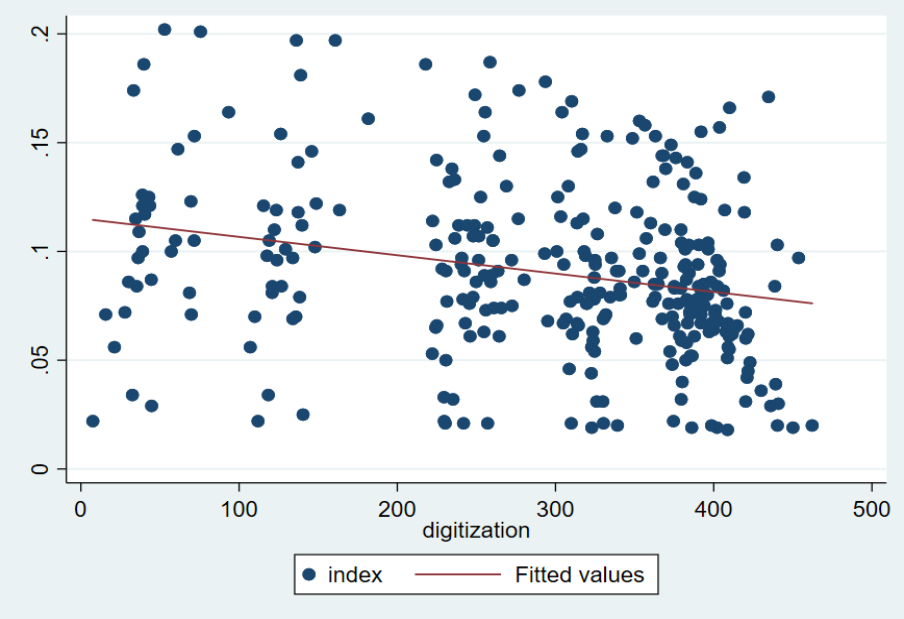

Figure 1. Scatterplot

Table 5. Robust Standard Deviation Tests

index	Coef.	St.Err.	t-value	p-value	[95% Conf	Interval]	Sig
digitization	0	0	4.74	0	0	0	***
width	0	0	-10.59	0	0	0	***
depth	0	0	4.71	0	0	0	***
Constant	.111	.008	13.79	0	.095	.127	***
Mean dependent var	0.091		SD dependent var		0.040		
Overall r-squared	0.216		Number of obs		310		
Chi-square	263.714		Prob > chi2		0.000		
R-squared within	0.836		R-squared between		0.400		

*** *p<.01, ** p<.05, * p<.1*

3.3.3 Hausman Test

In order to illustrate the suitability of the model, the mixed model and individual effects were first selected for the test analysis, the mixed model and random effects were selected for the test analysis, and then the fixed effects and random effects were selected for the test analysis, and the test results showed that the fixed effects model was more appropriate.

Table 6. Hausman Test Results

	Coef.
Chi-square test value	1.233
P-value	.025

The aforementioned test results demonstrate that the econometric model chosen for this article is the ideal model and also verify the correctness and dependability of the findings.

3.4 Model Results

Table 7 may be obtained and verified using stata software; the information in the table allows for the following inferences to be made: First, there is a positive association between the degree of digitization and the urban-rural discrepancy, meaning that the higher the degree of digitization, the wider the urban-rural difference is likewise. However, this relationship does not necessarily translate into a good promotion impact. Second, both the depth of use and the breadth of Internet coverage will have some impact on the income disparity between urban and rural areas, with the depth of usage's usefulness being more clear for increasing the urban-rural gap and the width of coverage being more obvious for closing it.

Table 7. Analysis of Regression Results

index	Coef.	St.Err.	t-value	p-value	[95% Conf	Interval]	Sig
digitization	.0000274	0	4.51	0.000	.0000	0	***
width	-.0002191	0	-14.80	0.000	-.0002	0	***
depth	.0000713	0	5.87	0.000	.0000	0	***
Constant	.1107471	.001	122.92	0.000	.1089	.113	***

Mean dependent var	0.091	SD dependent var	0.040
R-squared	0.836	Number of obs	310
F-test	467.460	Prob > F	0.000
Akaike crit. (AIC)	-2392.530	Bayesian crit. (BIC)	-2377.584

*** $p<.01$, ** $p<.05$, * $p<.1$

4. Conclusions and Recommendations

This paper empirically tests the impact of digital economy development on the urban-rural income gap using panel data from 31 provinces and regions in China from 2011 to 2020, and obtains the following conclusions:

The level of education, gender, and skill acquisition of a group may all have an impact on the employment structure. The digital economy can also have an impact on the quality of employment through factors like the working environment, salary level, labor relations, etc. In general, both urban and rural jobs may be impacted by the digital economy. The study's findings indicate that while the overall impact of digitalization makes the digital economy unfavorable to closing the income gap between urban and rural areas, its positive influence is less clear. As a consequence, additional research on the effect of the digital economy on the employment gap between urban and rural areas is required.

Based on the findings of this paper, we propose the following relevant recommendations:

Promoting urban-rural digital growth is favorable to encouraging the development of a deeper integration of technological innovation and urban-rural progress from the standpoint of the good effect of digital development on reducing the income gap between urban and rural areas. The incorporation of digital technology into conventional factors of production like land, capital, and labor may not only boost their vitality but also increase the efficiency of their allocation, supporting the high-quality growth of the industrial system. Additionally, it's important to satisfy the need for high-end research and development and give the universality of digital technology applications greater consideration to support the multi-level growth of digital technology. First, empowering agriculture with digital technology more quickly can advance agricultural information technology studies and research and promote agricultural technology, as well as fully utilize the information matching mechanism of the "digital countryside" to improve the modularity of the agricultural system. Second, the development,

adoption, and innovation of digital technology not only significantly contribute to the improvement momentum for economic development.

The improvement of digital infrastructure building, particularly in rural regions, is favorable to enhancing digitalization in rural areas and reducing the digital divide, from the viewpoint that digital growth is adverse to the growth of the urban-rural income difference. Meanwhile, promoting digital technology diffusion and use, and providing training, education and technical support for farmers can improve their digital literacy as well as the productivity of residents in rural areas. Additionally, the state and government should promote the growth of the digital economy, assist businesses and individuals in it with innovation and entrepreneurship, create harmonized and equitable economic development, and narrow the urban-rural divide. Meanwhile, government agencies can strengthen policy guidance and regulation to ensure the fairness and sustainability of digital development and promote rational orientation and fair competition in digital development through taxation, policy incentives, or restrictive measures to promote urban-rural integration and common development.

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