Impact of the digital economy on rural and urban incomes

Qiumei Cai, Zhaoyang Xing*

School of Public Administration, Changchun University Of Technology, Changchun, China, 130012

* Corresponding Author Email: 15568861211@139.com

Abstract. As the digital economy in our country continues to develop and improve, It has entered into a new phase of development. For purpose of facilitating a widespread adoption of the digital economy, it is essential to address the issue of income inequality between urban and rural residents and enhance the government's ability to formulate economic policies based on evidence. Therefore, this study takes 31 provinces and cities in our country from 2011 to 2019 as the research objects and conducts empirical analysis on them. Based on this, the project aims to deeply explore the mechanism of the influence regarding the income gap of digital economy between cities and countryside through empirical analysis, and conduct empirical analysis from two aspects: widespread implementation, reduction of the gap, and scientific decision-making. The research conclusion indicates that over the next few years, as the digital economy develops, people's income levels in different regions and cities will increase in China and it will experience significant improvements.

Keywords: Digital economy, Tyrell's index, Two-way fixed effects modeling

1. Introduction and Literature Review

To solve the wealth gap problem in China, the most effective way is to narrow the urban-rural wealth gap through the development of the digital economy. The rapid development of the digital economy in China has led to the emergence of major e-commerce platforms, which have brought new opportunities for farmers to sell their agricultural products.[1]. Meanwhile , the emergence and fast development of the Internet have also offered new opportunities for the swefit advancement of the digital economy. The digital economy in China has experienced three different stages of growth, with the first phrase (1995-2002) being the start-up stage, in which the digital infrastructure was gradually improved and China was officially connected to the international Internet, which directly led to the rise of digital economy, the second stage (2003-2012) is the stage of high-speed growth. With the number of Internet users continuing to maintain double-digit growth, e-commerce, represented by e-tailing, was the first to take off, driving the digital economy from the embryonic stage into awholly new developmental stage. The current phase (2013-present) is characterized by maturation, as the mobile era has ushered in a comprehensive linkage between online and offline activities, resulting in profound two-way impact. At this stage, the digital economy industry is marked by traditional industry internetization, as well as the rapid emergence of internet-based model innovations. Furthermore, the digital economy has opened up new avenues of employment for rural residents, particularly in the fields of commerce, internet-based advertising, and the generation of digital content. As more and more rural areas get connected to the internet, demand for local produce is increasing, forcing farmers to demand higher prices for their crops. As a result, the income of the peasants will be increased, and the income gap between the city and the countryside will be reduced. In order to drive the digital economy's growth even faster and reduce the income divide, government policies should continue to prioritize rural broadband infrastructure expansion, digital skill training for rural residents, and support for digital entrepreneurship. It is also important to promote the digital economy integration with traditional industries, such as agriculture, to create more job opportunities and enhance productivity. Based on information interoperability, smartphones comprehensively link the online and offline lives of human beings, and have exerted a far-reaching two-way impact. In the mature stage, the digital economy industry possesses two main features: first, the traditional industry is Internetised. Second, Internet-based model innovations continue to emerge at a fast pace.

China is currently in a period of unbalanced industrial progress. The rapid development of the digital economy can quickly break through the information barriers between industries, improve the efficiency of economic operation, avoid resource misallocation, and promote balanced industrial development[2-4]. In recent years, domestic and international researchers have taken part in a comprehensive debate on the influence of the digital economy increasing of the urban-rural income gap.[5]. This article empirically analyzes and concludes that promoting rural financial development and It provides a practical and feasible approach to solving the problem of the effect of the personal income with unequal distribution between the countryside and the city. This project aims to measure the level of economic development among different areas in China by means of empirical research, construct a spatial econometric approach, examine the technology diffusion impact between different regions, and thus narrow the income gap between regions[6-7]. Some scholars believe that developing the digital economy, which can reduce the income gap, between the city and the countryside is a chance, while measures such as deepening household registration system reform and improving transportation infrastructure can alternatively shorten the income disparity between the city and the countryside[8]. In the field of employment, some scholars use macrodata of Chinese cities above the prefecture level and microdata such as sustainable land use efficiency (CLDS) to study the "digitalization" of urban areas in China, which reduces the likelihood of "migrant worker shortages". This project takes 282 prefecture-level cities as samples, combines methods such as Chinese household income surveys and household income surveys, and finds that while digital economy development increases unemployment, it can enhance entrepreneurial behavior, and have positive effects on the entrepreneurial density within the region, individual entrepreneurial behavior, and long-term social employment[9-10]. To this end, this project proposes to use a kind of tool named panel data, and it includes 31 provinces and cities in China from 2011 to 2019 , establish a dynamic relationship model between the influence of "digital economy" on urban and rural disposable income inequality, and it make an empirical study on the profound integration between "digital economy" and "real economy".[11-12].

2. Analysis of the mechanism by which digital income affects the income gap between urban and rural residents

Reducing the income gap between urban and rural regions with the digital economy is a good idea. The economy, which has the characteristic of digitalization, speeds up the circulation of capital. Along with the fast development of Chinese economy, the informatization level of city and country is continuously increasing, and the level of informatization in towns and villages is also becoming higher and higher. At the beginning of the digital economy, a country's economic growth is dependent on the development of a well-developed infrastructure and development levels. The sound infrastructure will speed up the development of the digital economy. The growth of the digital economy primarily relies on the integration of factors and capital investment in infrastructure, and its development is rapid, with a significant impact on cities. Based on the provincial panel data from 2012 to 2018, this project has some problems of Chinese rural urbanization at the beginning of the development of digitalization through an in-depth analysis of the process of rural urbanization in China. Presently, despite China's rapid growth, it is still in the initial stage, and there are still significant regional gaps. Digital technology has not been fully rolled out in rural areas. Although the digital economy cannot directly increase farmers' income, it plays a significant role in promoting urban development. Cities can also radiate and promote the digital economy in rural areas. Simultaneously, it has also expedited the growth of rural agricultural economy, making agricultural operations more intelligent and flexible, and gradually realizing the industrialization of agriculture, thereby reducing the disparity in income between town and country.

Therefore, the current digital economy has great potential to connect the wage gap about urban-rural residents. In our nation, a notable inequality exists in the progression of the digital economy about the urban-rural regions. Currently, China's demographic dividend is gradually disappearing,

and there is still a shortage of low, middle, and high-tech labor, which has pushed up the salary levels of low-tech labor. In our country, the majority of low-tech labor is farmers, the rise in their wages will contribute to decreasing the gap in earnings between urban and rural communities. But, on a long view, on the one hand, while the digital economy continues to develop, it is also necessary to adjust the employment structure appropriately. Due to reasons such as low cultural level and occupation, agricultural labor will be replaced and may become low-tech labor in the industrialization and digitalization process, which is likely to exacerbate urban-rural income gap. Meanwhile, as the digital economy develops, the transformation of enterprises' productivity will also experience significant changes. Capital-intensive and high-tech industries have higher productivity than labor-intensive and low-tech industries, and intellectual workers' wages are higher than those of physical workers, further exacerbating urban-rural income gap.

3. Research Design

3.1. Model Setting

Examining how the advances in the digital economy impact the income levels of both urban and rural inhabitants, this article develops a two-way fixed effects model (1) for evaluation purposes.

$$Income_{it} = \alpha_0 + \alpha_1 Dige_{it} + \alpha_2 X_{it} + \mu_i + \delta_t + \varepsilon_{it} \quad (1)$$

In Eq.$Income_{it}$ denotes the resident income level of city i under period t.$Dige_{it}$ denotes the digital economic development index of different city in period t.x_{it} represents a set of control components, such as: the level of economic growth (Economic), the level of industrialization (Industry), the degree of human resources (Human), foreign direct investment (Foreign), and the proportion of green spaces in urban areas (Green), and the level of innovation (Innovative),μ_i Control for individual fixed effects,δ_t Control for time fixed effects,ε_{it} denotes the randomized perturbation term.

3.2. Description of indicators

3.2.1. Explained Variables

Residents' disposable income (Income). This article categorizes residents' income indicators into two groups: net income for rural residents and disposable personal income for urban inhabitants. Urban residents' disposable income specifically represents the actual income used for their daily living expenses, including food, medical care, wearing, housing, transport and communication, recreation, education and services, etc., which is an important indicator of urban residents' income level and living standard. The net income of rural residents refers to all the income left for rural residents after deducting all the costs and extra expenses, and is an important indicator for observing the real income of rural residents and expanding the re-production capacity. This paper further refines the level of residents' income, dividing it into disposable income in the Yangtze River Economic Zone and disposable income in the non-Yangtze River Economic Zone, and the disposable Income in the eastern region in relation to disposable income in the central and western regions, in order to investigate the potential influence of economic development speed on the advancement of the digital economy.

3.2.2. Core Explanatory Variables

Digital economy level (Dige). Numerous experts have developed diverse digital economy growth indices from various viewpoints. Here, we refer to the index system established by Zhao Tao et al. (2020), incorporating provincial dataset from 2011 to 2019. We assess the digital economy advancement in two dimensions: internet progression and digital finance. On this basis, the weight of each index is used to assign by entropy method , so that it can obtain the digital economy development degree of each province.

3.3.3. Mechanistic Variables

The Tel index is utilized to assess the wealth disparity, with a higher value indicating a wider income inequality between the affluent and the impoverished. Secondly, this project intends to use the Tel Index method to study how China's digital economy affects the income inequality of urban and rural residents in China. This includes estimating the difference between discretionary income and the overall population. On this basis, the project further included the urban registered unemployed in the scope of analysis to explore the mechanism of digital economy on the income difference of urban and rural residents.

3.3.4 Other Control Variables

As per the study's content, the control variables chosen in this paper primarily consist of: The level of economic development, expressed in terms of gross domestic product per capita; (industry) industry (industry), the number of industrial and fixed asset investments in logarithms; the level of human capital (Human), demonstrated by the ratio of education investment to GDP; foreign direct investment (Foreign), indicated by the ratio of foreign utilization and exchange rate to GDP; green coverage of developed areas (Green), presented as the ratio of forested area to total forested area; the level of innovation (Innovative), symbolized by the logarithm of research and development (R&D) and financial input data, with specific variable descriptions detailed in Table 1.

Table 1. Descriptive statistical analysis of variables

Varablies	Obs	Mean	Std.Dev.	Min	Max
Residents' disposable income	279	9.947	0.419	8.919	11.14
Digital economy level	310	0.234	0.181	0.031	1
Economic development level	310	12515.72	7905.688	5125.47	47118.4
Industrialization level	310	0.314	0.092	0.072	0.556
Human capital level	310	0.02	0.006	0.008	0.041
Foreign direct investment	310	0.019	0.015	0	0.08
Green coverage rate of the built-up area	310	39.401	3.871	18.1	49.1
Innovation level	310	9.429	1.587	4.394	12.285

4. Empirical estimation results and analyses

4.1. Benchmark regression

On this basis, a fixed effect model of two variables is constructed and regression analysis is carried out. Columns (1), (2) and (3) in Table 2 show the regression results. Only the digital economy variables are included in column (1), time and individual fixed effects variables are added along with the digital economy variables in column (2), and control variables such as the degree of economic development and the degree of industrialisation are added along with the above variables in column (3). In Table 2's data, the regression coefficients in columns (1), (2), and (3) exhibit negative values and demonstrate statistical significance at a 10% level of significance, suggesting that the growth of the digital economy indeed raises the disposable income of the population.

Table 2. Benchmark regression results

Varables	(1) Disposable income of the population	(2) Disposable income of the population	(3) Disposable income of the population
Dige	1.5635*** -0.154	0.3700** -0.171	0.3295* -0.175
Economic			0 0
Industry			0.1184 -0.208
Human			5.6559 -5.111
Foreign			1.3753** -0.642
Green			0.004 -0.003
Innovative			0.014 -0.02
Constant	9.5839*** -0.046	9.4280*** (0.042)	8.9045*** -0.225
Observations	279	279	279
R^2	0.1797	0.9338	0.9377
City fe	*No*	*Yes*	*Yes*
Year fe	*N0*	*Yes*	*Yes*

4.2. Mechanism Test

Developing the digital economy is very important in shortening the urban-rural income gap. For the sake of verifing the robustness of this mechanism, the document incorporates a Tel index and a number of registered urban unemployed persons to further explore the digital economy's potential to reduce urban-rural disposable income is possible. Moreover, the integration of the digital economy's growth indicators, such as the Tel index, provides a more comprehensive understanding of its impact on income inequality.

The conclusion of the mechanism study is as follows: First, the progress of digital economy can raise the disposable personal income of urban people, however, its effect on the disposable income of rural inhabitants is comparatively negligible. Secondly, the downward trend of the Tel Index helps to narrow the income disparity between urban and rural populations. Third, the figure of urban registered unemployment is negative, raising the number of urban registered unemployment. The analysis of the mechanism shows that the friction of employment structure is caused by the development of digital economy. Developments such as digital technology and intelligent machines have replaced some of the mental and physical strength, labour-based jobs have been gradually reduced, the number of urban unemployed has increased, furthermore, the disparity in wages between urban and rural residents has been reduced.

Table 3. Mechanism analysis results

Varablies	(1) Countryside	(2) Town	(3) Tyrell's index	(4) Urban registered unemployment
Dige	0.0460	0.3911***	-0.1082***	0.3667*
	(0.327)	(0.121)	(0.030)	(0.209)
Control variables	*Yes*	*Yes*	*Yes*	*Yes*
Observations	279	279	279	279
R-squared	0.7693	0.9757	0.6218	0.1912
City fe	*Yes*	*Yes*	*Yes*	*Yes*
Year fe	*Yes*	*Yes*	*Yes*	*Yes*

4.3. Robustness test

In this study, the level of economic development, degree of industrialization, human capital, foreign capital, green coverage rate of developed regions, innovation level and other control variables were used to construct a two-dimensional fixed effect regression model. This approach helps mitigate the endogeneity issue to some extent. The research conclusion shows that in our country, the digital economy can effectively solve the income inequality of urban and rural residents. For the sake of enhancing the reliability of our research conclusions and address potential endogeneity concerns, we modified the variables in this section.

Undoubtedly, the rapid development of the digital economy will have an impact on the income of urban and rural residents, but the findings are somewhat circumstantial and not truly representative. Thus, it becomes essential to substitute the residents' net income and perform a regression on the substituted variables using a two-way fixed effects model. Given that the residents' net income stems from their total income, we replace the net income with the total income to make the results more persuasive. The research results are shown in column (1) of Table 4, which is consistent with the benchmark regression analysis, indicating that the development of digital economy will help reduce the income inequality between urban and rural residents.

The article mainly utilize entropy value method to measure. Due to the strong subjectivity in the selection of indicators in the measurement process, and the assignment of different weights to each indicator, it may cause the measurement of indicators is not robust. In order to avoid the subjectivity of indicator measurement, this paper utilizes principal component analysis to further evaluate the development degree of the digital economy and its impact on residents' disposable income. The measurement outcomes are displayed in Table6. During the process of robustness testing, and on this basis, the two-dimensional fixed effect regression model is used to re-evaluate the urban and rural digital economy development index and test its reliability. The results corresponding to the basic regression are shown in column (2) of Table 4, demonstrating that the level of development of digital economy will help reduce the income inequality between urban and rural residents.

Table 4. Robust type test for total population income

Varablies	(1) *Gross population income*	(2) *Gross population income*
Dige	0.2992* (0.178)	
Principal Dige		0.3395* (0.175)
Control variables	*Yes*	*Yes*
Constant	26.0731*** (0.230)	8.9196*** (0.226)
Observations	279	279
R-squared	0.9428	0.9372
City fe	*Yes*	*Yes*
Year fe	*Yes*	*Yes*

4.4. Heterogeneity Analysis

China is a huge nation with a considerable population. There are disparities in economic development levels, resource richness, and population distribution among regions, and in addition, there are some differences in the development of digital economy among different regions, which results in the gap of disposable income between urban and rural residents. The article divides it into three areas concerning east, middle and west in order to further explore the income differences between different regions of digital economy. The subgroup regression analysis of spatial heterogeneity was carried out according to economic zone and urban area. Analysis of heterogeneity in Yangtze River Economic Belt is shown in Table 5, column (1) and (2), and the results for the geographical divisions of Furban are given in table 5, columns 3 and 4.

Table 5. Results of heterogeneity analysis

Variables	*Yangtze River Economic Belt*	*Non-Yangtze River Economic Belt*	*East*	*Central and western part*
Dige	0.2113* (0.115)	0.4022 (0.255)	0.3340*** (0.118)	-0.0241 (0.283)
Control variables	*Yes*	*Yes*	*Yes*	*Yes*
Constant	8.7967*** (0.120)	9.0923*** (0.350)	9.9166*** (0.304)	8.9202*** (0.290)
Observations	99	180	99	180
R-squared	0.9973	0.9090	0.9890	0.9288
City fe	*Yes*	*Yes*	*Yes*	*Yes*
Year fe	*Yes*	*Yes*	*Yes*	*Yes*

5. Conclusion and Recommendations

The paper has drawn the following conclusions: First, the rapidly developing digital economy has greatly increased our disposable income, and the above conclusions remain valid after multiple robustness tests. Secondly, Data analysis shows that with the emergence of the digital economy, the disposable income of urban residents has been greatly increased, but it does not have much influence on the disposable income of rural residents, and it has also increased the employment rate in cities. Thirdly, through the study of regional differences, it is found that in the regional division, The more developed the financial sector, the more rapidly its digital economy can develop and drive more regional economies. Based on the aforementioned research outcomes, the paper puts forward the following recommendations while maintaining the original meaning: First, it is necessary to

strengthen investment in the digital economy and promote its development to a deeper level. Secondly, Employment should be a cornerstone for narrowing the urban-rural income gap and promoting the harmonious development of urban and rural regions. At the same time, we must realize the comprehensive planning of city and countryside. Third, according to the outcome of the heterogeneity analysis, more investment should be increased by government in areas with vulnerable digital economy according to its developmental levels in different regions.

References

[1] Acemoglu, D. and P. Restrepo (2019). "Automation and New Tasks: How Technology Displaces and Reinstates Labor." Journal of Economic Perspectives 33(2): 3-30.

[2] Chen, S. and J. Golley (2014). "'Green' productivity growth in China's industrial economy." Energy Economics 44: 89-98.

[3] de Chaisemartin, C. and X. D'Haultfœuille (2020). "Two-Way Fixed Effects Estimators with Heterogeneous Treatment Effects." American Economic Review 110(9): 2964-2996.

[4] Hsieh, C.-T. and P. J. Klenow (2009). "Misallocation and Manufacturing TFP in China and India*." The Quarterly Journal of Economics 124(4): 1403-1448.

[5] Johansson, L., V. Epitropou, K. Karatzas, A. Karppinen, L. Wanner, S. Vrochidis, A. Bassoukos, J. Kukkonen and I. Kompatsiaris (2015). "Fusion of meteorological and air quality data extracted from the web for personalized environmental information services." Environmental Modelling & Software 64: 143-155.

[6] Jones, C. I. and C. Tonetti (2020). "Nonrivalry and the Economics of Data." American Economic Review 110(9): 2819-2858.

[7] Lee, C.-C. and C.-C. Lee (2022). "How does green finance affect green total factor productivity? Evidence from China." Energy Economics 107: 105863.

[8] Lu, Y. and L. Yu (2015). "Trade Liberalization and Markup Dispersion: Evidence from China's WTO Accession." American Economic Journal: Applied Economics 7(4): 221-253.

[9] Luo, K., Y. Liu, P.-F. Chen and M. Zeng (2022). "Assessing the impact of digital economy on green development efficiency in the Yangtze River Economic Belt." Energy Economics 112: 106127.

[10] Mueller, M. and K. Grindal (2019). "Data flows and the digital economy: information as a mobile factor of production." Digital Policy, Regulation and Governance 21(1): 71-87.

[11] Qin, X., H. Wu and R. Li (2022). "Digital finance and household carbon emissions in China." China Economic Review 76: 101872.

[12] Wang, M., M. Xu and S. Ma (2021). "The effect of the spatial heterogeneity of human capital structure on regional green total factor productivity." Structural Change and Economic Dynamics 59: 427-441.

[13] Xia, F. and J. Xu (2020). "Green total factor productivity: A re-examination of quality of growth for provinces in China." China Economic Review 62: 101454.

[14] Yu, D., X. Li, J. Yu and H. Li (2021). "The impact of the spatial agglomeration of foreign direct investment on green total factor productivity of Chinese cities." Journal of Environmental Management 290: 112666.