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RESEARCH ARTICLE

STUDY ON THE IMPACT OF DIGITAL ECONOMY DEVELOPMENT ON THE EQUALIZATION OF BASIC PUBLIC SERVICES IN URBAN AND RURAL AREAS: BASED ON EMPIRICAL EVIDENCE FROM CHINA

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ABSTRACT

Digital economy is a new economic form after agricultural economy and industrial economy. Its influence in various fields of economy and society is deepening, and its impact on basic public services that cannot be ignored. To this end, this paper takes 268 prefectural cities of China as samples to explore the impact of digital development on the equalization of basic public services in urban and rural areas. The study shows that, first of all, digital economy can significantly improve the equalization level of basic public services in urban and rural areas, and there are many heterogeneity characteristics such as commercial charm urban level, spatial geographical location and different urban size. Secondly, the development of digital economy has a variety of effects on the equalization of basic public services in urban and rural areas, such as the transmission effect of regional innovation, the adjustment effect and threshold effect of the urban and rural income ratio, and the threshold effect of the digital economy itself. Finally, according to the research findings, this paper proposes relevant policy implications and countermeasures.

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INTRODUCTION

As a new economic form, the digital economy has injected new vitality into the economic development. It has not only promoted the transformation and upgrading of the traditional economy, but also promoted the cross-border integration and innovative development. According to the White Paper on the Global Digital Economy (2023) released by the China Academy of Information and Communications Technology, the development of the digital economy in major countries in the world continues to accelerate. In 2022, the digital economy of five major countries in the US, China, Germany, Japan and South Korea, was US $31 trillion, accounting for 58% of GDP; the digital economy scale increased by 7.6% year on year, 5.4 percentage points higher than the GDP growth rate. Industrial digitization continues to drive the development of the digital economy in five countries, accounting for 86.4% of the digital economy.The Digital China Development Report (2022) released by the State Internet Information Office of China shows that the digital economy has become an important engine for stabilizing growth and promoting transformation. In 2022, China's digital economy will reach 50.2 trillion yuan, ranking second in the world in total, with a year-on-year nominal growth of 10.3%, accounting for 41.5% of GDP. Further progress was made to integrate digital technology with the real economy. The information rate of agricultural production exceeded 25 percent. The CNC rate of key processes and the penetration rate of digital R & D and design tools in national industrial enterprises increased to 58.6% and 77.0%, respectively. Basic public services are the basic needs to ensure the survival and development of all the people, and they are their most basic social rights. Basic public services are not only directly related to people's quality of life, but also affect people's sense of fairness, happiness and gain. Although China has achieved phased achievements in the construction of basic public services, there are still obvious problems such as insufficient supply scale, uneven supply between urban and rural areas, and regions. Especially in rural areas and economically underdeveloped areas, the construction of basic public services lags behind, and there is still a significant gap between it and the urgent needs of the people. For example, although the national education budget has maintained an average annual growth rate of around 8% in recent years, there is still a significant gap in its proportion to the national GDP compared to developed countries. The development of digital economy has accelerated the digital development process of basic public services, making digital basic public services more inclusive and convenient, and has become an effective measure to enhance people's sense of gain and happiness. Digital medical care, digital culture and digital transportation have become a well-known new forms of basic public services. The digital economy has already had a significant impact on basic public services. Therefore, studying the impact mechanism and effects of the digital economy on the

equalization of basic public services in urban and rural areas is not only important for the theoretical analysis and healthy development of the relationship between the digital economy and basic public services, but also has significant theoretical significance and practical value for improving people's livelihoods and resolving social conflicts. However, there are two distinct views on the impact of digital technology and digital economy on the equalization of basic public services between urban and rural areas. The first point of view is that digital or digital economy promotes the equalization of basic public services between urban and rural areas. Fan *et al*. (2021) believe that to achieve the equalization of basic public services, the future exploration should be conducted from the perspective of scientific and technological innovation, rather than being limited to traditional means such as financial decentralization and transfer payments. In particular, the intelligent identification of basic public service needs by digital innovation technology will help local governments to optimize the allocation of public service resources, so as to improve the fairness of basic public service supply opportunities in urban and rural areas (Wang and Wang, 2018). The second view is that digital application and the development of digital economy will bring "digital divide", "siphon effect" and other problems, which is not conducive to the realization of equalization of basic public services between urban and rural areas, and will even expand the disequilibrium of basic public services. The problem of the digital divide has made the rural groups and the elderly groups gradually marginalized in the development of the digital economy. Research data show that the mitigation effect of digital inclusive finance on rural residents' relative poverty has decreased significantly (Liu *et al*., 2021).

Due to the two sides of the influence of digital economy on the equalization of basic public services in urban and rural areas, it is necessary for this study to further test the influence of digital economy development on the equalization of basic public services in urban and rural areas through objective data, and dialectically view the contradictory views in the existing research. In view of this, this article will analyze the impact of digital economy development on the equalization of basic public services in urban and rural areas during the empirical testing stage, including direct influence effect, transmission effect, adjustment effect and threshold effect, so as to accurately answer the practical question of whether the development of digital economy is conducive to improving the equalization of urban and rural basic public services. And these influence effects are the innovation points of this paper.

LITERATURE REVIEW

Based on the profound impact of the development of digital economy on social development, its impact on basic public services has also attracted special attention from the academic community. Especially in the past two years, a number of relevant documents have emerged in recent years, including the supply level, quality or efficiency of regional basic public services, as well as the equalization of supply. First, the impact on the high-quality development of basic public services, supply capacity, supply quality and supply efficiency of basic public services. In terms of promoting high-quality development, in general, the digital economy can enable high-quality development of basic public services and has a positive spillover effect (Zhou and Wen, 2023). Specifically, the digital economy through digital technology, digital public services and digital fu can effect three mechanisms on the basic public services (Xia and Wang, 2021), and leading the basic public service innovation, promote the coordinated development of urban and rural basic public services, promote green development of basic public service, enhance the level of basic public service opening to the outside world and promote the basic public service achievement sharing development five aspects promote the development of basic public service high quality (Cao Yingzi and Hui party, 2023). In terms of improving the supply capacity and supply level of government basic public services, the digital economy is mainly realized through two ways: improving the fiscal revenue capacity and reducing the vertical fiscal imbalance (Su and Li, 2023; Chen *et al*., 2024). In terms of improving the quality of basic public services, the digital economy has improved the quality of basic public services by strengthening digital governance, driving scientific and technological innovation (Bao and Huang, 2023), enhancing fiscal transparency and reducing financial pressure on local governments (Hui and Ning, 2023). In terms of improving the efficiency of basic public services, the digital economy mainly plays a role through mechanisms such as technology effect and human capital effect (Tianwei *et al*., 2022). Secondly, the impact on the equalization of basic public services. In terms of the equalization of regional basic public services, the research is mainly conducted at the provincial level. The conclusion shows that digital economy can significantly improve the level of equalization of regional basic public services by improving government governance efficiency and easing financial pressure (Xu *et al*., 2023) and reducing administrative costs (Zhang *et al*., 2024). Duan and Zeng (2023) found that the influence of digital economy development on equalization of regional basic public services is "inverted U" type, but overall positive impact. In addition, the Lyu *et al*. (2024) found that the digital economy will aggravate the gap in basic public services between regions, but the institutional environment can play a key role in reducing the adverse impact of the digital economy on the supply of basic public services. In terms of the equalization of basic public services in urban and rural areas, only Zhang *et al*. (2023) have analyzed the positive spatial spillover effect of digital economy on the equalization level of basic public services in urban and rural areas from the perspective of spatial effect. Through the above literature review, it can be found that there is only one literature on the impact of digital economy development on the equalization of basic public services between urban and rural areas, that is, a paper published by Zhang Yongqi *et al*. in 2023, which uses spatial measurement method from the perspective of population flow. On the basis of using the information entropy method to measure urban and rural equalization, this paper uses the two-way fixed effect model to explore from the perspectives of direct influence effect, conduction effect, adjustment effect and threshold effect, which greatly enriches the existing research content.

METHODS AND DATA

The regression model construction

Benchmark regression model: This paper aims to examine the impact of digital economy development on the equalization of basic public services in urban and rural areas. In order to accurately test whether the development of digital economy has a significant impact on the level of equalization of basic public services in urban and rural areas, this paper mainly

adopts two measurement methods for regression estimation, namely, the mixed OLS regression model and the two-way fixed effect model commonly used in the literature to estimate the benchmark results. In addition, existing studies have shown that the equalization level of basic public services in urban and rural areas is affected by many factors, and it is difficult to cover all aspects in the measurement model. However, if some important influencing factors are not controlled, the reliability of the estimation results and the accuracy of the research conclusions will be directly affected. In view of this, this paper refers to the existing research literature, selects the level of economic development, financial autonomy, urbanization level, population size and financial development level as the control variables, and the selection of related variables, data processing and data sources will be elaborated in the following. The benchmark regression model is set as follows:

$$EBPSUR_{it}=\gamma_0+\gamma_1 DIG_{it}+\gamma_2 X_{it}+\omega_i+\delta_t+\varepsilon_{it} \quad (1)$$

In equation (1), $EBPSUR_{it}$ represents the region i (i = 1,... , 268) in the t (t = 2006, ... , 2021), the larger the value, the higher the equalization level; on the contrary, the smaller the value, the lower the equalization level. γ_1 represents the influence coefficient of digital economy development on the equalization level of urban and rural basic public services, reflecting the influence degree of the digital economy development of i prefecture-level and above cities in year t on the equalization level of urban and rural basic public services in that year. DIG_{it} present the development level of digital economy in cities at prefecture level and above. X_{it} represents a series of control variables. γ_2 present the influence coefficient of each control variable on the equalization of basic public services in urban and rural areas. ω_i present the fixed effect of individual (section) to handle the individual heterogeneity of each city. δ_t present annual (time) fixed effect for non-observable factors with year. ε_{it} present given as the random error term.

Mechanism test model: According to the theoretical mechanism analysis above, the digital economy can have an impact on the equalization of basic public services between urban and rural areas by promoting urban innovation. In order to test the mechanism of the development of digital economy affecting the equalization level of basic public services between urban and rural areas, the existing literature method in this paper constructs the following mechanism test model:

$$EBPSUR_{it}=\gamma_0+\gamma_1 DIG_{it}+\gamma_2 X_{it}+\omega_i+\delta_t+\varepsilon_{it} \quad (1)$$

$$M_{it}=\alpha_0+\alpha_1 DIG_{it}+\alpha_2 X_{it}+\omega_i+\delta_t+\varepsilon_{it} \quad (2)$$

$$EBPSUR_{it}=\beta_0+\beta_1 DIG_{it}+\beta_2 M_{it}+\beta_3 X_{it}+\omega_i+\delta_t+\varepsilon_{it} \quad (3)$$

The variables in equations (2) and (3) are consistent with equations (1), and γ, α and β are the estimated coefficients of each variable. Equation (1) Is used to test the direct impact of digital economy development on the equalization level of urban and rural basic public services, if its coefficient is $\gamma_1$if significant non-zero, the influence of the digital economy on the mechanism variable M can be tested with Equation (2).If the coefficient α_1 if it is significant and not zero, it can enter the next test, using Equation (3), and the core explanatory variable digital economy and action mechanism variable M are added for analysis.

Regulatory effect model: In order to further identify whether there are other factors in the process of the development of digital economy affecting the equalization of basic public services in urban and rural areas. This paper will discuss the overall impact of urban-rural income ratio in the process of digital economy affecting the equalization of basic public services between urban and rural areas, and build a regulatory effect model, as shown in Equation (4):

$$EBPSUR_{it}=\varphi_0+\varphi_1 DIG_{it}+\varphi_2 IR_{it}+\varphi_3 DIG_{it}\times IR_{it}+\varphi_4 X_{it}+\omega_i+\delta_t+\varepsilon_{it} \quad (4)$$

In equation (4),$\varphi_3$is the estimated coefficient of the interaction term of the core explanatory variables and the regulatory variables. IR_{it} represents the income ratio of urban and rural residents in year t. Since the income ratio of urban and rural residents is measured by the ratio of the disposable income of urban and rural residents to the disposable income of rural residents, the larger the ratio is, the greater the income gap between urban and rural residents. Generally speaking, a large income gap indicates an unhealthy economic phenomenon. Therefore, the urban-rural income ratio affects the digital economy and is the result of the equalization of basic public services between urban and rural areas. $DIG_{it}\times IR_{it}$is the product of the development level of digital economy and the income ratio of urban and rural residents in each prefecture-level city. The meaning, selection, calculation and data sources of other variables are consistent with Equation (1).

Threshold effect model: The benchmark regression panel data model tests the linear relationship between digital economy and the equalization of basic public services in urban and rural areas, but it cannot test the non-linear relationship between digital economy and the equalization of basic public services in urban and rural areas. Equalization of basic public services in urban and rural areas is affected by digital economy. Generally speaking, the higher the development level of digital economy, the greater the impact on the equalization of basic public services in urban and rural areas. However, the development of digital economy is a continuous and dynamic process, and different levels of development will have different effects. That is to say, different levels of digital economy development may affect the equalization of basic public services between urban and rural areas. At the same time, the urban-rural income gap is also an important factor affecting the equalization of the supply of basic public services between urban and rural areas. Generally speaking, the income gap between urban and rural areas is small, that is, the urban-rural income ratio is small, and the level of equalization of basic public services between urban and rural areas will be higher. Therefore, this section constructs a panel data threshold model with the development level of digital economy and urban-rural income ratio as the threshold variable, so as to test the nonlinear relationship between digital economy and the equalization of urban-rural basic public services. The detailed model is set as follows:

$$\begin{cases} EBPSUR_{it}=\chi_0+\chi_1 DIG_{it}+\chi_2 q_{it}+\chi_3 X_{it}+\omega_i+\delta_t+\varepsilon_{it}, & EBPSUR\le r \\ \vdots \\ EBPSUR_{it}=\chi'_0+\chi'_1 DIG_{it}+\chi'_2 q_{it}+\chi'_3 X_{it}+\tilde{\omega}_i+\delta_t+\varepsilon_{it}, & EBPSUR>r \end{cases} \quad (5)$$

In equation (5) q_{it} represents the threshold variable. The meaning of other variables is consistent with the above, and r is the threshold value in this study. Equation (5) is a detailed process of the panel data threshold model presented in the form of segment function, but in fact, in order to make the model

more concise, the segment function in Equation (5) can be combined into the following commonly used single panel data threshold model:

$$EBPSUR_{it}=\xi_0+\xi_1 DIG_{it}+\xi_2 DIG_{it}\times I(q_{it}\le r)+\xi_3 DIG_{it}\times I(q_{it}>\square) +\xi_4 X_{it}+\omega_i+\delta_t+\varepsilon_{it} \quad (6)$$

In equation (6), I(•) represents the representation function in the panel data threshold regression model. In parentheses, if the expression is true, the value is 1, otherwise, the value is 0. r is the specific threshold value of the panel data threshold regression model, and ξ is the coefficient to be evaluated corresponding to each variable.

Variable selection

Explanatory variable: equalization of basic public services in urban and rural areas (*EBPSUR*).To measure the degree of equalization of basic public services between urban and rural areas, most scholars use the *Gini* coefficient to measure the degree of equalization between urban and rural areas. However, there are two deficiencies in the calculation of urban and rural equalization: statically, the *Gini* coefficient can only describe the unequal supply level of basic public services, but it cannot explain the unequal supply of basic public services; dynamically, the *Gini* coefficient cannot describe the widening path of the supply gap of basic public service. Therefore, based on the practice of Yang and Chen (2020), this paper defines the municipal districts of prefecture-level cities as cities, defines the areas outside the municipal districts as rural areas, and uses the comprehensive evaluation model of entropy right method to calculate the basic public service supply level of urban and rural areas at the prefecture-level level from 2006 to 2021 respectively. Due to the serious lack of data on basic public services in rural areas, six specific indicators of basic education and medical and health care were selected to construct the evaluation index system of the supply level of basic public services in urban and rural areas, and to calculate the supply level of basic public services in urban areas and rural areas respectively, as shown in Table 1.

On the basis of measuring the supply level of basic public services in urban and rural areas respectively, and using the method of Han *et al*. (2015), the principle of information entropy is used to calculate the equalization level of urban and rural basic public services in prefecture-level cities. Information entropy is Shannon (1948) using the principle of thermodynamics, called the average information after excluding redundancy "information entropy", and gives a mathematical expression for calculating information entropy. Information entropy can better measure the disorder degree of the system, eliminate the uncertainty, and ensure that the evaluation results are more objective and more effective, so this method can be used to measure the equilibrium degree of the system. Generally speaking, the larger the information entropy, the more chaotic the system; instead, the smaller the information entropy, the more orderly the system is. Therefore, the information entropy can also be said to be a measure of the degree of system ordering. Based on this, the information entropy function for measuring the equalization level of urban and rural basic public services is set as follows:

$$E_S=-\left(\frac{PS_C}{\sum PS_C}ln\frac{PS_C}{\sum PS_C}+\frac{PS_R}{\sum PS_R}ln\frac{PS_R}{\sum PS_R}\right) \quad (7)$$

In equation (7), PS_C and PS_R represents the supply level of basic public services in urban areas and rural areas respectively. The higher the information entropy is, the more dispersed the information is, the smaller the gap between urban and rural basic public service supply level is, the higher the equalization level.When the supply level of urban and rural basic public service reaches the same state ($PS_C = PS_R$), the entropy is the maximum state ($E_{max}=Ln\ 2$), that is, the supply level of urban and rural basic public services is at the highest equal level. Therefore, the ratio of the actual entropy value and the ideal maximum entropy value is taken as the measure of urban and rural equalization of basic public services. The calculation formula is as follows:

$$E = E_S / E_{max} \quad (8)$$

Thus, the larger the E-value is, the closer the supply level of urban and rural basic public services is, and the higher the level of equalization is. In the above calculation process, in order to maintain the consistency of the weight of each index in the evaluation system of urban and rural basic public service supply level. Firstly, the weight value of all indicators is calculated by the city; then, the supply level of basic public services is calculated by the data of urban and rural indicators; finally, the information entropy function is used to calculate the equalization level of basic public services between urban and rural areas.

Core explanatory Variables: Digital Economy (*DIG*). The specific selection methods of the comprehensive evaluation index system of digital economy in prefecture-level cities are as follows: digital economy infrastructure includes the number of Internet broadband access users in 100 and the number of mobile phone users in 100. The scale of digital economy includes the proportion of computer service and software employees in urban units, total telecommunication business per capita and China digital financial inclusion index. The specific index description is shown in Table Table 2. The data are from the 2006-2021 China City Statistical Yearbook and Peking University Digital Financial Inclusion Index.

Mechanism variables: Urban innovation level (*inno*). The development of digital economy is not only the result of technological innovation, but also an important force to promote technological progress and urban innovation. The improvement of the city's innovation ability will enrich the supply form of basic public services, and improve the efficiency and level of the supply of basic public services. The calculation method of urban innovation level is based on the Report on Chinese Cities and Industrial Innovation Power 2017 released by Kou and Liu (2017) of the Industrial Development Research Center of Fudan University.

Adjustment variables and threshold variables: urban-rural income ratio (*IR*). Using the ratio of urban disposable income to rural disposable income, there is also a literature to use this ratio to measure the income gap between urban and rural residents. Generally speaking, the higher the urban-rural income ratio, it means that the income growth of urban residents is faster than that of rural residents, and the gap between the two is widening. The widening of the income gap between urban and rural areas will not be conducive to the improvement of the equalization of basic public services between urban and rural areas, because the low income of rural residents will affect the demand of rural residents for basic

Table 1. Index system of urban and rural basic public services supply

Level 1 indicators	Secondary indicators	Computational method	Unit	Indicator attributes
Basic education	Per capita education funds	Fiscal expenditure on education / total population	Yuan / person	Positiver
	Elementary school teachers and students than	Number of students / number of teachers	People / people	Positiver
	Middle school teacher / student ratio	Number of students / number of teachers	People / people	Positiver
Health care	Medical institutions per 10,000 people	Number of medical facilities / total population	Ten thousand people	Positiver
	Number of beds per 10,000 people	Number of hospital beds / total population	Zhang / ten thousand people	Positiver
	Number of doctors per 10,000	Number of physicians / total population	People / ten thousand people	Positiver

Table 2. Measurement indicators of urban digital economy

Dimension	Measuring indicators	Indicator instructions	Reference documentation
Digital economy infrastructure	Number of Internet broadband access users	Reflect the status of regional data facilities	Zhao *et al*. (2020); Liu *et al*. (2020); Huang *et al*. (2019)
	Number of mobile phone users	Measure of mobile data facilities	
The scale of the digital economy development	The proportion of computer service and software employees in the employees of urban units	Characterize the labor input related to the digital economy	Xie *et al*. (2020); Zhao *et al*. (2020); Reinsdorf and Ribarsky (2019)
	Per-capita telecommunications business volume	Describe the revenue situation of urban data services	
The development degree of digital finance	Digital Financial Inclusive Index	Represents the city's digital financial services situation	Guo *et al*. (2020)

Table 3. Descriptive statistics

Variable name	Sample capacity	Mean	Median	Least value	Crest value	Standard deviation
EBPSUR	4288	0.5550	0.5300	0.1070	1.8600	0.2080
DIG	4288	0.0839	0.0760	0.0010	0.5500	0.0718
inno	4288	10.4800	1.5130	0.00513	620.900	33.6200
IR	4288	2.5070	2.4050	1.1640	6.3780	0.5980
pgdp	4288	10.2300	10.2100	7.9260	12.6200	0.7080
FA	4288	0.4400	0.4060	0.0544	1.2560	0.2150
urb	4288	0.5030	0.4960	0.1150	0.9760	0.1490
pop	4288	5.9110	5.9410	3.8070	8.1360	0.6260
fin	4288	2.2370	1.9550	0.5880	21.3000	1.0750

Table 4. The variance expansion factors

Variable	VIF	1/VIF
DIG	2.27	0.4407
pgdp	4.16	0.2402
FA	1.93	0.5190
urb	3.07	0.3258
pop	1.13	0.8874
fin	1.47	0.6796

Table 5. Panel unit root test

Variable	LLC checkout	IPS checkout	Fisher-PP	Fisher-ADF	Conclusion
EBPSUR	-58.0927***（0.0000）	-46.4644***（0.0000）	139.2957***（0.0000）	140.1746***（0.0000）	Sequence smooth
DIG	-49.7960***（0.0000）	-44.6696***（0.0000）	131.5451***（0.0000）	140.1746***（0.0000）	Sequence smooth
pgdp	-5.8757***（0.0000）	-8.7004***（0.0000）	6.0248***（0.0000）	7.7794***（0.0000）	Sequence smooth
FA	-38.4774***（0.0000）	-38.7128***（0.0000）	90.3958***（0.0000）	139.4592***（0.0000）	Sequence smooth
urb	-37.9754***（0.0000）	-39.9721***（0.0000）	94.6573***（0.0000）	139.8159***（0.0000）	Sequence smooth
pop	-46.0676***（0.0000）	-43.2466***（0.0000）	98.2291***（0.0000）	140.1746***（0.0000）	Sequence smooth
fin	-32.7281***（0.0000）	-37.5944***（0.0000）	76.4320***（0.0000）	132.4303***（0.0000）	Sequence smooth

Note: The null hypothesis H0 of the four unit root tests: if the null hypothesis H0 is rejected, the data sequence is stable; P value is in brackets, * * *, * * and * are significant at 1%, 5%, and 10% respectively; constant and trend items are included in the test form.

public services, and then affect the supply of basic public services in rural areas, and eventually lead to the increasing gap between the demand and supply of basic public services between urban and rural areas.

Control variables: Level of economic development (*pgdp*). The level of economic development is an important factor influencing the supply of basic public services. In this chapter, the per capita GDP of each sample region is taken as the measure of the economic development level, and the log is taken in the metrological analysis. Financial autonomy (*FA*). Fiscal autonomy refers to the proportion of local governments' independent fiscal revenue in their independent fiscal expenditure, which reflects the independence and sustainability of local governments in their fiscal operation. Urbanization (*urb*). This paper uses the proportion of the regional urban population in the total regional population to measure the level of urbanization. Population size (*pop*). This chapter uses the total population at the end of the sample years and takes logarithm in the metrological analysis. Financial development level (*fin*). Considering the availability of China's long-term bank-led financial system and the availability of regional panel data, using the methods of Fang and Xing (2017), the level of financial development is measured by financial-related ratio, that is, the ratio of the combined deposits and loans of financial institutions at the prefecture level and above to nominal GDP.

Data sources and descriptions: The variable data periods in this paper span from 2006 to 2021, with a total of 16 years. The reason for the selection is that in 2006, the sixth plenary of the communist party of China by the central committee of the communist party of China on building a harmonious socialist society several major issues decision "improve the system of public finance, and gradually achieve equal basic public services", this is the concept of "equal basic public services" for the first time in the national documents, so choose 2006 as the starting year. According to the availability of data, the samples were selected from 268 prefecture-level cities, and the number of observed samples was 4288. Among them, municipal district data represents urban data, and non-municipal district data represents rural data. The data are mainly obtained from China City Statistical Yearbook, each city statistical Yearbook or statistical bulletin over the years, and the missing data is interpolated by the mean method. Descriptive statistics for each variable are presented in Table 3.

EMPIRICAL TEST

Benchmark regression results: The presence of multicollinearity between the variables was tested before performing the regression analysis. The variance inflation factor method was used here to test for the problem of multicollinearity between the variables. Table 4 reports the variance of the main variables, numerical can be found from the table, the core explanatory variables and threshold variables of digital level of economic development, economic development, financial autonomy, urbanization level, population size and financial development level of control variables, the VIF value are less than 10, according to the rule of thumb, the probability of serious multicollinearity between variables is low. According to the VIF value, the sample data can be constructed model for measurement analysis. To avoid pseudo-regression, a smoothness test needs to be performed on each sample data before using it for regression estimation. In this paper, the unit root test method is used. If the unit root exists in the data series, the data is a non-stationary time series, on the contrary, if the unit root is not stored, the data is stable. Here, LLC, IPS, Fisher-PP and Fisher-ADF are still used to test each data series, and many methods can ensure the robustness of the test results. The test results of the four methods are shown in Table 5. According to the test results, it can be seen that the original data series of the explanatory variable urban-rural basic public service equalisation, the core explanatory variable variable digital economy development level, as well as the original data series of the control variables such as the economic development level, the degree of financial autonomy, the level of urbanisation, the size of the population, and the level of financial development, have rejected the original hypothesis of the existence of a unit root, and thus each of the original data series is a smooth series. From the specific data, the results of LLC test and IPS test showed that the coefficient estimates of the seven variables were negative and all passed the significance test at 1% level; the results of Fisher-PP and Fisher-ADF test showed that the coefficient estimates of the seven variables were positive, and all passed the significance test at 1% level.

This section is based on Equation (1) to test the impact of digital economy development on the equalization of basic public services between urban and rural areas. Since the sample is typical panel data, the common estimation method requires model selection between mixed OSL model, fixed effect model and random effect model, while Husman test is a common model determination method. This section also compares the two, and the Hausman-test showed a P-value of $0.0000<0.05$, indicating that the null hypothesis was significantly rejected, namely the rejection of the random effect model. Thus this section estimates using fixed effects models. Since the unobservable characteristics and the changes in time of different cities will affect the estimated results to a certain extent, this section also controls both the urban fixed effect and the time fixed effect, namely the double fixed effect. Therefore, regression estimates of 268 panel data from 2006-2021 in cities were performed using Stata14.0 software and using a double fixed effects model, and the specific results are shown in Table 6. Column (1) and (2) report the estimated results without fixed time effect under the fixed effect model, columns (3) and (4) report the two-way fixed effect model estimates using both fixed time effect and market effect, columns (1) and (3) are the estimated results without the control variables, and columns (2) and (4) represent the estimated results including the control variables.

Table 6 reports the benchmark regression results of the impact of digital economy development on the equalization of basic public services between urban and rural areas.

The results show that column (1) has no added control variables, and its estimated coefficient value is significantly positive at the 1% level. However, the other three columns, regardless of whether they add the time fixed effect or not, show that the estimated value of digital economy development on the equalization of basic public services between urban and rural areas is positive, and the three results are significant at 1%. This result shows that the development of digital economy has a significant positive impact on the equalization of basic public services in urban and rural areas. At the same time, comparing columns (2) and (4), it can be found that the estimated value column (4) of the digital economy is smaller than column (2), indicating that the estimated value value of

the two-way fixed effect model is smaller. For this purpose, this section mainly analyzes the results of the two-way fixed-effect model. Column (4) The results show that the estimated equalization of digital economy development to basic public services in urban and rural areas is 0.3694, which is significant at the 1% level, indicating that the development of digital economy can significantly improve the level of equalization of basic public services in urban and rural areas. In addition, the column (5) and (6) respectively test the digital economy development of the rural and urban the level of basic public services, the results show two results at 1% level, which shows that the digital economy development can not only enhance the level of equal basic public services between urban and rural areas, and can promote rural and urban basic public service supply level, which is to narrow the gap between urban and rural areas, one of the important reasons for the equalization of urban and rural areas.

From the perspective of control variables, taking the results of column (4) as an example, the estimated values of economic development level and financial development level on the equalization of basic public services between urban and rural areas are both significantly positive. This shows that the improvement of overall economic development level is conducive to improving the supply of basic public services in urban and rural areas, especially promoting rural basic public services, and can narrow the gap between urban and rural areas; and financial development can provide financial support for the supply of basic public services and narrow the gap between urban and rural areas. However, the influence effect of financial autonomy is not obvious, which is mainly influenced by China's fiscal system. The local finance is generally under great pressure, and the funds are mainly used for economic development and the supply of urban basic public services, and the supply of basic public services in rural areas is inadequate. However, urbanization has an inhibitory effect on the equalization of basic public services in urban and rural areas, which is not conducive to the improvement of the equalization level between urban and rural areas. This is mainly because the development of urbanization requires a large amount of high-quality resources to meet the daily needs of urban residents and urban economic development, which further widens the gap between urban and rural areas in infrastructure construction, basic education and medical and health care. Similarly, the size of the population has a significant negative effect on the equalization of basic public services in urban and rural areas. This shows that with the expansion of the population size, the supply gap of basic public services between urban and rural areas is also increasing. The larger the population size, the demand for basic public services also increases, the supply pressure increases, and the promotion of urbanization, the urban-rural dual economic structure is obvious. The combination of these factors leads to the widening gap between urban and rural areas.

Enogenicity and robustness test: First, endogenous problem analysis. By lagging behind the core explanatory variables by one period and then conducting two-way fixed-effect regression estimation, this method can avoid the impact of the equalization of basic public services in urban and rural areas on the development of digital economy in the current period, so as to overcome the endogenous problem caused by reverse causality. The process is to lag the digital economy by one period and then include this data in the model for regression estimation. In this section, the two-way fixed effect model is used. According to the regression results in Table 7 (1), after the lag period of the digital economy for the equalization of basic public services between urban and rural areas is 0.3484, which is significant at the 1% level. This result is basically consistent with the benchmark regression results in the numerical direction and significance. In addition, considering the endogenous variables that the model itself may still affect the accuracy of the results, as well as the two-way causality of digital economy and the equalization of basic public services between urban and rural areas, the instrumental variable method is used to deal here. The instrumental variables should have no direct relationship with the explained variables, namely, the equalization of basic public services in urban and rural areas, but they should have a certain correlation with them. Therefore, this paper uses the urban Internet broadband access users as the tool variable of digital economic indicators. This is because this variable represents the digitalization situation of each city at the fixed end. The number of Internet broadband access users can reflect the popularization and application degree of regional information technology, which has a strong correlation with the digital economy, but has no direct impact on the equalization of basic public services in urban and rural areas. The sample data period used here is 2011-2021. In the column (2) of Table 8, the regression results of the first phase are reported. The results showed that this instrumental variable was significantly associated with the level of digital economy development, with a correlation coefficient of 0.1359, and it passed the 1% significance level test. Meanwhile, the LM statistic test for Kleibergen-Paap rk was 61.895, greater than 10 and significant at 1%; the Cragg-Donald Wald F statistic test was 272.909. This shows that the instrumental variables meet the identifiable test and the weak instrumental variable test, indicating that the instrumental variables selected here are reasonable and effective. From the perspective of regression estimation coefficient value, the estimated coefficient value of digital economy development for equal basic public services between urban and rural areas is 14.7216, which is significant at the 5% level, basically consistent with the benchmark regression results, and the absolute value of the coefficient is greater than the absolute value of the benchmark regression coefficient value. This result shows that after considering the endogenous problem, the development of digital economy still has a significant positive impact on the equalization of basic public services in urban and rural areas, that is, the endogenous problem does not have a significant impact on the above benchmark regression conclusion.

Secondly, the robustness test. This section mainly uses the following methods for the robustness testing. The first method, adjust the sample period. In the calculation index system of digital economy adopted in this paper, the digital financial inclusion index has only been included in the index system since 2011, so the development level of digital economy is quite different around 2011. Therefore, this paper also adjusts the sample period to 2011-2021. The regression results are shown in Table 6 (1), and the estimated value of digital economy is significantly positive at the 5% level, indicating that the development of digital economy can still promote the equalization of basic public services in urban and rural areas. This result is basically consistent with the benchmark regression. The second method is to adjust the sample size and eliminate the key cities. Since the sample data does not include municipalities directly under the Central Government, some

cities separately listed in the plan and a few sub-provincial cities, cities are excluded in two ways, one is to eliminate the sub-provincial and above cities, leaving 258 regions; the other is the provincial capital and above cities, leaving 243 prefecture-level cities. Column (2) and column (3) in Table 6 report the regression estimation results after excluding key cities. The results show that under the two ways of excluding key cities, the digital economy estimation coefficient is significantly positive at the 1% level, which is consistent with the benchmark regression results. The third method, is quantile regression. The regression estimation results are shown in columns 4-6 of Table 6, in the 25%, 50% and 70%, the estimated coefficient of digital economy is significantly positive at the 1% level, and the estimated coefficient is also increasing with the improvement of quantile, indicating that the development of digital economy has a significant positive effect on the equalization of basic public services in urban and rural areas. The robustness test results of the above four methods all indicate the good robustness of the benchmark regression results.

Heterogeneity analysis: (1) Heterogeneity of business charm hierarchy. Through the classification and heterogeneous analysis of urban commercial charm level, we test whether the development of digital economy has different effects on the equalization of basic public services between urban and rural areas under different commercial charm levels. The indicators and data of urban commercial charm level are closely related to the development of urban digital economy, which can objectively reflect the development level of urban digital economy. This paper is based on the 2021 ranking, and combines first-tier cities, new first-tier cities and second-tier cities into first-tier cities, fourth-tier cities as third-tier cities, and fifth-tier cities as fourth-tier cities. Finally, all the sample cities are divided into one to four grades and four grades, so as to test the impact of digital economy development on the equalization of cities with different commercial charm levels and basic public services between urban and rural areas.

From Table 9, it can be concluded that in cities with first and fourth levels of commercial charm, the estimated coefficient value of digital economy development on the equalization of basic public services between urban and rural areas is positive and significant at the 1% level. The results indicate that the development of digital economy in first - and fourth tier cities has a significant promoting effect on the equalization of basic public services between urban and rural areas. The reason for this result may be that first tier cities are first tier cities, new first tier cities, and second tier cities, which have high levels of economic development, large population size, high talent concentration, and high commercial charm, so the level of digital economy development is relatively high. At the same time, the level of basic public service supply in cities is relatively high, so the digital economy has a significant promoting effect on the equalization of basic public services between urban and rural areas. And fourth tier cities are mainly fifth tier cities, whose development status is exactly opposite to that of first tier cities, with relatively backward development. However, driven by the government's policy of emphasizing regional coordinated development, their development often has a significant advantage as latecomers. Although the level of development lags behind, the speed of development is relatively fast, and the coordination of development may be better. Therefore, in this situation, the promotion effect of digital economy development on the equalization of basic public services between urban and rural areas will be more significant. In second tier and third tier cities, the impact of digital economy development on the equalization of basic public services between urban and rural areas is not significant, and these cities are mainly third tier and fourth tier cities. Because third - and fourth tier cities are at a moderate level and catching up in the development of digital economy and basic public services, the government places more emphasis on economic development while neglecting the supply of basic public services and the balanced development of urban and rural areas. Therefore, the impact of digital economy development on the equalization of basic public services between urban and rural areas is not significant. (2) Heterogeneity of spatial and geographical location. In order to test the difference of digital economy on the equalization of basic public services in urban and rural areas. This paper divided the samples into four regions, eastern, central, western and northeast. Two-way fixed-effect model is still used to test the impact of digital economy on the equalization of basic public supply in urban and rural areas, and to conduct heterogeneity analysis. Among them, 73 cities in eastern region, 78 cities in central region, 83 cities in western region and 34 cities in northeast China. Table 6.8 reports the results of the spatial geographic location heterogeneity estimates.

As can be seen from Table 10, first of all, in the eastern region, the development of digital economy has a significant positive effect on the equalization of basic public services in urban and rural areas, and it has passed the 1% significance level test. This shows that the development of digital economy in eastern China can improve the equalization of basic public services between urban and rural areas. This is due to the economic and social development in the leading position in China, the development concept and technology accumulation are better than other regions, the digital economy takes the lead in development, its development level is higher than other regions, and it is also widely used, which has the most significant impact on the equalization of basic public services between urban and rural areas. Secondly, in the central and western regions, the estimated values of the digital economy are similar, and both of them are significantly positive at the 5% level, which also indicates that the digital economy has a significant role in promoting the equalization of basic public services between urban and rural areas. However, the estimated coefficient value and significant level are lower than those in the eastern region. This is related to the development status of the central and western regions, the Midwest economic development and so on various aspects behind the east, especially the digital economy development level and application, so the influence of digital economy development of urban and rural basic public services is lower than the eastern region, but the equalization of urban and rural basic public services still has a significant role in promoting. Third, in northeast China, although the influence coefficient of digital economy development on the equalization of basic public services in urban and rural areas is positive, it is not significant, which is related to the history and current situation of economic development in northeast China. Northeast China is the heavy industry base of China and has made important contributions to China's industrial development. However, since the beginning of the 21st century, the transformation of economic development model has been put on the agenda, while the industrial transformation and upgrading in northeast China has been slow, especially the development level of digital economy is low.

(3) The heterogeneity of urban size. Divided by population size. According to the Notice on Adjusting the Standards for the Classification of Cities issued by the Central Government in 2014, on the basis of 2014, cities with an urban population of 1 million or more will be set as large cities, cities with a population of 500,000-1 million as medium-sized cities, and cities with a population of 500,000 or less as small cities. Among them, 125 are large cities, 98 are medium-sized cities and 45 are small cities. Table 6.9 reports the regression estimates in spatial geographic location heterogeneity.

According to the results of Table 11, first of all, in large cities, the development of digital economy has a positive impact on the equalization of basic public services in urban and rural areas, with a coefficient of 0.4268, which is significant at the 1% level. The reason is that, on the one hand, large cities have large population size, talent concentration and technology accumulation; on the other hand, most large cities are the eastern region or provincial capital cities, and their economic level of development is higher. For these reasons, the development level of digital economy and basic public services in large cities is higher than that of other types of cities, so the impact of digital economy development on the equalization of basic public services between urban and rural areas is more obvious. Secondly, in medium-sized cities, the impact coefficient of digital economy development on the equalization of basic public services in urban and rural areas is positive, but not significant. The possible reason for this result is that, on the one hand, despite the progress in digital economy, the impact on the economy and society has not been effectively released; on the other hand, medium-sized cities are in the stage of economic transformation, and the government attaches more importance to economic development while ignoring the supply and equalization of basic public services. Third, in small cities, the influence coefficient of digital economy development on the equalization of basic public services in urban and rural areas is 0.8429, which is the highest among the three types of scale cities and significant at the level of 1%. Because small cities are mainly cities in western regions, small cities, despite their relatively low development level, have the advantages of late development. Therefore, the impact of digital economy development on the equalization of basic public services between urban and rural areas is significantly higher than that of medium-sized cities.

Mechanism effect test results: The development of the digital economy can significantly improve the equalization of basic public services in urban and rural areas. So through what mechanism does the digital economy affect the equalization of basic public services in urban and rural areas? In order to answer this question, this paper will explain the function mechanism of urban innovation ability improvement, and then provide a realistic basis for theoretical inference. Use equations (1) and equations (3) for regression estimation. First, Table 12 column (1) confirms the positive impact of digital economy development on the equalization of basic public services between urban and rural areas, which can further examine the impact of digital economy development on urban innovation capacity. Secondly, columns (2) and (3) report the role mechanism that the development of digital economy affects the innovation capacity of cities and thus affects the equalization of basic public services between urban and rural areas. Column (2) shows that the regression coefficient of digital economy development on urban innovation ability is significantly positive at the statistical level of 1%, indicating that the development of digital economy can promote the effective development of urban innovation activities and the improvement of innovation ability. Column (3) The impact of the improvement of urban innovation capacity has a significant impact on the equalization of urban and rural basic public services, indicating that promoting urban innovation can improve the level of equalization of basic public services in urban and rural areas. At this time, the regression coefficient value of digital economy development is 0.1993, which is less than 0.3694 in column (1). It shows that urban innovation plays a part of the transmission effect. According to the test results of Soble, it shows that the transmission effect of urban innovation exists, and the transmission effect of digital economy development promotes urban innovation and improves the level of equalization of urban and rural basic public services accounts for 46.05% of the total effect. Table 12 regression results, driving urban innovation is an important reason for the development of digital economy to promote the equalization of basic public services in urban and rural areas.

The results of the regulatory effect test: In order to further identify the regulatory effect of other factors in the development of digital economy affecting the equalization of basic public services in urban and rural areas. This paper will discuss the adjustment effect of urban-rural income ratio in this process from the perspective of urban-rural development gap. In the process of regulating effect testing, due to the need to add the product term in the econometric model, it may lead to the production of multicollinearity between the core explanatory variable and the regulatory effect variable and the product term of both. To eliminate the problem of multicollinearity, Robinson and Schumacker (2009) are used here to decentralize the data. According to the theoretical analysis, this paper will use formula (4) to empirically test the adjustment effect of urban-rural income ratio. After decentralization of the core explanatory variables and regulatory effect variables, the product $DIG \times IR$ of the two was replaced with equation (4) and regression estimated. The regression estimation results are shown in Table 12 column (4), and the product term DIGIR is-0.1941, and all passed the 1% significance level test. The results show that the urban-rural income ratio has a significant negative adjustment effect on the development of digital economy and the equalization of urban and rural basic public services, that is, the urban-rural income ratio hinders the improvement of the equalization of urban and rural basic public services. The urban-rural income ratio is a negative index, that is, the larger the ratio means the greater the income gap between urban and rural residents. From another perspective, narrowing the urban-rural income ratio can play a positive adjustment role. Therefore, efforts should be made to narrow the gap between urban and rural areas and accelerate the balanced development between urban and rural areas. In addition, the estimated coefficient of the digital economy remained significantly positive at the 1% level after adding the interaction term.

Threshold effect test results

Threshold inspection: It has been verified above that the development of digital economy has a significant positive impact on the equalization of basic public services between urban and rural areas, in order to test whether there is a nonlinear impact in the process of this positive impact. Therefore, the development level of digital economy and the urban-rural income ratio were tested as the threshold variables.

In order to accurately determine the specific form of the panel threshold model, the effect of three thresholds (alternative hypothesis), two thresholds (alternative hypothesis), one threshold (alternative hypothesis) is tested, to ensure the effectiveness of the subsequent threshold effect test, to avoid the deviation of the empirical results caused by the omission of the threshold effect. The grid search method is set to 400 grid search points and the number of Bootstrap (self-sampling method) to 300 times, so as to calculate the F statistics, P value and critical value of the threshold variable. The threshold effect test results as shown in Table 13, in the process of digital economy development on the equalization of urban and rural basic public services, digital economy development level and urban-rural income ratio have a single threshold effect, the F value of 158.62 and 49.08 respectively, P value of 0.0000 and 0.0167 respectively, through the significance level of 1% and 5% respectively. However, the results of double threshold and triple threshold test did not pass the 10% significance level test, that is, there is no double threshold and triple threshold effect in both.

Threshold value estimation: Threshold effect after the test results, in the digital economy development on the equalization of basic public services in the process, digital economy development level and urban and rural income ratio is a single threshold effect, the digital economy development level and the threshold of urban and rural income and confidence interval estimate, test the authenticity of the estimated results. After inspection, it is concluded that the single threshold value of digital economy development level is 0.0308, and the confidence interval is 0.0293-0.0321; the single threshold value of urban-rural income ratio is 2.1848, and the confidence interval is 2.1768-2.1884. Figure 1 is the likelihood ratio function diagram of the development level of the digital economy, and Figure 2 is the likelihood ratio function diagram of urban and rural income. The estimated value and confidence interval of the threshold variable can be clearly observed from the two plots. The estimated value of the threshold variable refers to the γ value of the likelihood ratio statistic L is zero, and the lowest point of LR takes the threshold estimate, the interval constituted by the critical value of less than 5% significance level. From Figure 1 and Figure 2, we can conclude that the LR value of the threshold value is smaller than its rejection domain, indicating that the threshold effect estimate is true and valid.

The threshold effect estimation results: On the basis of the above threshold test and the threshold value test, this section conducts the fixed-effect regression estimation of the panel threshold effect model formula (6), and the results are shown in Table 14. Column (1) Results show that when the development level of digital economy is less than 0.0308, the coefficient of digital economy development for basic public services in urban and rural areas is 7.5970, and it is significant at the 1% level; when the development level of digital economy is equal to or greater than 0.0308, the coefficient of digital economy development for urban and rural areas is 1.3429, also passing the significance level of 1%. This result shows that with the continuous improvement of the development level of digital economy, its positive impact on the equalization of basic public services in urban and rural areas is shrinking. The reasons for this result may lie in three aspects. On the one hand, with the economic development and the government's supply level of basic public services in urban and rural areas, the gap between urban and rural areas will narrow with the improvement of the supply level, and the effect of the development of digital economy will decrease. On the other hand, in the early stage of the economic development of digital economy, as a new economic form, its influence effect is usually obvious, so its influence on the equalization of basic public services between urban and rural areas is be significant. However, as digital economy gradually becomes a mainstream economic form, its influence on other economic factors will gradually weaken. Third, when the level of equalization of basic public services in urban and rural areas reaches a certain level, it will be more difficult to continue to improve, which will also reduce the role of the development of digital economy in improving the equalization of basic public services in urban and rural areas. The results of Table 14 in column (2) show that when the urban-rural income ratio is lower than 2.1848, the coefficient of the equalization of basic public services between urban and rural areas is 1.2870, and significant at the level of 1%; and when the urban-rural income ratio is equal to or greater than 2.1848, the coefficient of the equalization of basic public services is 0.9639, which also passes the significance level of 1%. When the urban-rural income ratio passes the threshold value, the role of digital economy development in promoting the equalization of basic public services in urban and rural areas is weakened. Because the income gap between urban and rural areas will affect rural basic public service supply, such as affecting rural residents in education, health care, pension and technology, although the basic public services is provided by the government, but under the condition of market economy, many basic public services is the government investment to the third party enterprises, enterprises need to provide other services beyond the basic public services to obtain benefits. In the case of a widening income gap between urban and rural areas, rural residents will reduce their consumption related to basic public services, which in turn leads to a decline in the quantity and quality of basic public services, such as reduced educational and medical resources, as well as lower quality. As the above adjustment effect analysis, the widening income gap between urban and rural areas will weaken the role of digital economy development in promoting the equalization of basic public services between urban and rural areas.

CONCLUSION

In this paper for the digital economy of equalization and the urban and rural basic public services equalization empirical test, mainly from the direct influence effect, regional innovation mechanism effect, the adjustment effect of urban and rural income ratio, urban and rural income ratio and the threshold effect of the digital economy of four aspects, test the digital economy on the effect of urban and rural basic public services equalization. The following conclusions are drawn. Firstly, the effect of digital economy in promoting the equalization of basic public services between urban and rural areas. Through the benchmark regression, it is found that digital economy can significantly improve the equalization level of basic public services in urban and rural areas by 0.1469 units, indicating that digital economy can effectively improve the equalization degree of basic public services in urban and rural areas. In order to strengthen the robustness of the benchmark regression conclusion, the robustness test methods include instrumental variable method, adjusted sample duration, adjusted sample size, and quantile regression. Multiple test results show that the development of the digital

economy can significantly improve the imbalance between basic public services in urban and rural areas. Secondly, the heterogeneity analysis is carried out from the perspectives of commercial charm city level, spatial geographical location and city size, to investigate the differentiated performance of digital economy on the improvement of equalization of basic public services in urban and rural areas in different situations. The empirical results show that in the first and fourth grade cities of commercial charm, digital economy can significantly promote the production of the equalization of basic public services between urban and rural areas, while there is no significant impact in the second and third grade cities. In terms of spatial geographical location, the digital economy in the eastern, central and western regions is significantly better than the equalization of urban and rural basic public services in the region than that in northeast China. In terms of the difference of urban population size, the improvement effect of digital economy on the equalization of basic public services between urban and rural areas in large cities and small cities is more obvious than that in medium-sized cities. Finally, through the empirical examination of the influence mechanism of digital economy on urban and rural basic public services, it is found that digital economy can improve the equalization degree of basic public services in urban and rural areas through regional innovation capacity. The urban-rural income ratio affects the digital economy and affects the equalization of basic public services between urban and rural areas. At the same time, in the digital economy affects the equalization of basic public services in urban and rural areas, there is the threshold effect of urban-rural income ratio and the development level of digital economy, which is a single threshold effect. Moreover, when the urban-rural income ratio and the development level of digital economy exceed their respective threshold values, the promoting effect of digital economy on the equalization of basic public services in urban and rural areas is weakened.

In view of the above conclusions, this paper proposes the following policy implications. Reduce the digital divide between urban and rural areas, promote the coordinated development of basic public services, should increase investment in digital infrastructure construction in rural areas, strengthen rural residents digital literacy cultivation, improve the data elements flow mechanism, and promote the digital economy and rural basic public services depth fusion, promote digital transformation of rural basic public services, provide rural basic public service level. First, strengthen the construction of digital infrastructure in rural areas, and narrow the "digital hardware gap" between urban and rural areas. Digital infrastructure is the basic condition for promoting the digital transformation of basic public services. Therefore, the rural-urban gap in digital infrastructure should be balanced first. The government investment in rural areas is relatively small, and the income of rural residents is relatively low, so the government should set up special funds for the construction of rural digital infrastructure, especially for remote areas. At the same time, operators and Internet enterprises are encouraged to increase investment in digital infrastructure construction in rural areas; and enterprises are encouraged to strengthen technological innovation, research and develop digital infrastructure technologies suitable for benefiting rural areas, and improve network coverage and network quality in rural areas. We will move faster to achieve full coverage of the Internet in rural areas and effectively bridge the "digital hardware gap" between urban and rural areas. Second, cultivate the digital literacy of rural residents, and narrow the "digital literacy gap" between urban and rural areas. Due to the limitations of hardware conditions and application scenarios, rural residents lack sufficient understanding of the development of digital economy, and their skills in using digital equipment are generally low. To this end, relevant training activities should be held to improve the digital literacy and digital skills of rural residents. At the same time, people who go back to their hometown and superior departments to the countryside should actively publicize and guide the use of digital devices, so that rural residents can learn the basic skills of using digital devices such as computers and smart phones, so as to share the dividends brought by intelligent basic public services. Third, improve the flow mechanism of data factors and narrow the "digital resource gap" between urban and rural areas. Digital economy promotes the coordinated development of basic public services between urban and rural areas, and cannot be separated from the flow and sharing of data elements. In the era of digital economy, education, health care, culture, and many other resources can be realized through the "Internet +" in urban and rural sharing, therefore, should strengthen the basic public service resources and urban and rural data resources sharing platform construction, realize the education big data, medical care, big data, cultural data security, smooth flow, promote the equalization of basic public service data resources, to promote the coordinated development of urban and rural basic public services.

Due to data limitations and other reasons, the paper still has some deficiencies and space for exploration, which can be further considered and expanded in future research. First of all, due to the lack of data from some studies, the interpolation method was used to fill in, while the regions with more missing data were not included in the study. For example, only 286 cities at prefecture level and above were included in the study, while Hong Kong, Macao, Taiwan and Tibet were not included in the study. Secondly, the content and projects of basic public services are defined in China's National Basic Public Service Standards (2021 edition), including 9 systems and 22 aspects and 80 specific subdivision projects. However, due to the lack of statistical data of the subdivision projects, all cannot be obtained. Although this paper aims to build a comprehensive measurement index system for calculating the development level of basic public services, due to the lack of data, it still cannot cover all the 12 National Basic Public Service Standards (2021 edition) due to the indicators. Third, the research scope of this paper did not go deep to the county level. The coverage of county-level administrative regions is wider, and the test results are more universal. Due to the limitation of county-level data, it is difficult to construct a corresponding index system and calculate the basic public services of county-level governments. Continuing studies will be followed by this, such as regular data collection and analysis.

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