Study on the Mechanism of the Impact of the Digital Economy on Common Prosperity

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Abstract. Common prosperity is an essential requirement of socialism and an important feature of Chinese modernization, and how the digital economy, as a core driving force of economic growth, empowers the common prosperity through the new quality of productivity has become an urgent issue to be explored. Based on the panel data of 30 provinces in China from 2014 to 2022, this paper explores the relationship between the digital economy, new productivity and common prosperity, and empirically examines the mechanism of the digital economy's impact on common prosperity and its spatial spillover effect. The study finds that: (1) the digital economy significantly contributes to the increase of common prosperity, which is proved to be reliable by the endogeneity and robustness tests; (2) the NQP plays a partly intermediary role in the relationship between the digital economy and common prosperity, that is to say, the digital economy indirectly contributes to the common prosperity through the promotion of the development of NQP;(3)There is regional heterogeneity in the contribution of the digital economy to the common prosperity, with a significant contribution in the central and western regions, but not in the eastern region;(4) the digital economy has a positive spatial spillover effect on common prosperity, and it can raise the level of common prosperity in neighboring provinces and municipalities.

Keywords: common prosperity, digital economy, new quality productivity, mediating effects, spatial spillovers

1 Introduction

As an essential requirement of socialism and an important feature of Chinese-style modernization, common prosperity has attracted much attention in recent years. The Decision of the Central Committee of the Communist Party of China on Further Comprehensively Deepening Reform and Promoting Chinese Modernization, adopted at the Third Plenary Session of the Twentieth Central Committee of the Communist Party of China (CPC), explicitly states that it is necessary to promote more obvious and substantial progress in the common prosperity of all people. As the fastest and most promising part of China's development, the digital economy, through its deep integration

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with the rest of the industry, further empowers China's economic development and plays an extremely important role in creating jobs, liberating productivity, and pulling together financing, etc. According to reports released by the China Academy of Information and Communication Technology (CAICT) and the Ministry of Commerce, the size of China's digital economy will grow from 35.8 trillion yuan in 2019 to 50.2 trillion yuan in 2022, with an average annual growth rate of more than 10%. The share of digital economy in GDP will increase from 36.2% in 2019 to 41.5% in 2022, indicating that the digital economy has become one of the core drivers of China's economic growth. The rapid development of the digital economy not only promotes economic growth, but also provides important support for the realization of the goal of common prosperity, the core of which lies in the fact that the digital economy has given rise to new quality productive forces through revolutionary technological breakthroughs, innovative allocation of factors of production, and in-depth transformation and upgrading of industries. New quality productivity is the advanced productivity of our time, which has been generated by revolutionary technological breakthroughs, innovative allocation of factors of production, and in-depth transformation and upgrading of industries. New quality productivity is not only a continuation of traditional productivity, but also a profound change in the mode of production and relations of production, emphasizing digital technology, intellectual capital and collaborative innovation as the core driver, integrating intelligent, data and ecological features, and is a comprehensive embodiment of high-technology productivity, high-efficiency productivity and high-quality productivity.

At present, there are significant theoretical gaps in the study of the relationships between digital economy and shared prosperity, how digital economy promotes shared prosperity through new quality productivity (NQP), and the spatial spillover effects.Existing research primarily focuses on the interpretations of the concept of shared prosperity[1], the exploration of implementation paths, and the innovation of measurement methods [2] . The study of the relationship between digital economy and shared prosperity is often limited to single-path models such as fixed effects, transmission effects, threshold effects, and dynamic space autoregressive models with heterogeneity [3] . There is a lack of theoretical frameworks and mechanisms that explain how digital economy acts through new quality productivity to promote shared prosperity. Additionally, research on new quality productivity (NQP) is mainly limited to the explanation of its concept[4], policy interpretation[5], and path exploration [6], with less focus on its relationship with digital economy and the study of spatial spillover effects, especially the mechanism study of how digital economy promotes shared prosperity through NQP and the analysis of regional heterogeneity.

Furthermore, existing research has generally overlooked the spatial spillover effects, i.e., how different regions interact through the development of digital economy and the NQP mechanism to jointly affect the spatial distribution characteristics and regional differences of shared prosperity. This research gap not only limits the understanding of the systemic role of digital economy in promoting shared prosperity but also fails to fully exploit the heterogeneity impacts of digital economy and NQP on different regions at different stages of development and resource endowments. Therefore, it is urgent to construct a comprehensive theoretical framework to clarify the mechanism by which

digital economy promotes shared prosperity through NQP and analyze its spatial spillover effects and regional heterogeneity.

Based on the new development concept, this study constructs a theoretical model to explore how digital economy promotes shared prosperity through new quality productivity (NQP) and analyzes its spatial spillover effects and regional heterogeneity. Specifically, the theoretical framework of this study includes the following key components: shared prosperity, digital economy, and the connotations and measurements of new quality productivity; the spatial spillover effects and regional heterogeneity between digital economy and shared prosperity; and the mediating effects and mechanism research. Using panel data from 30 provinces (excluding Hong Kong, Macau, Taiwan, and Tibet) from 2014 to 2022, this study not only provides a new perspective for understanding the intrinsic link between digital economy and shared prosperity but also offers scientific decision-making references for policymakers to assist in achieving shared prosperity and the high-quality development of digital economy .It helps to ensure that the dividends of the digital economy benefit the entire society, contributing to sustainable development and the overall progress of society.

2 Theoretical Analysis and Research Hypothesis

2.1 Mechanism of Action Analysis

The digital economy, centered on the sharing and application of data, has significantly raised technological levels and production efficiency through its innovation-driven engine, and has significantly contributed to the optimization of factor markets and the efficient allocation of resources, weakening factor market barriers while intensifying market competition, prompting enterprises to improve the efficiency of their supply chains and factor allocation, and alleviating factor market distortions[7] . It greatly promotes the development of new quality productivity. Through the leap in energy level of key, breakthrough and original technologies, the new quality productivity can enhance the added value of digital products, thus promoting the transition from the crude export model driven by factor inputs to the intensive export model centered on technological innovation. This transition can help mitigate the impact of export vulnerability due to technological lag and enhance the export risk resistance of core industries of digital economy[8] .Therefore, it can be said that there is an inherent consistency between the digital economy and the development of NQPs[9] .New quality productivity is expressed in high-tech productivity, high-efficiency productivity and high-quality productivity, and high-tech productivity and high-efficiency productivity are directly transformed into new technology and new production mode, and the support of high-tech will inevitably accelerate the upgrading of industrial structure and promote low-carbon development. Low-carbon development will further promote the optimization and upgrading of industrial structure, improve employment, and thus promote the common prosperity of the region[10].As a product of the qualitative leap of traditional productivity in the era of digital economy, the new quality productivity can promote the common prosperity by promoting the high-quality development of the economy and improving the fairness of the initial distribution[11] . The booming development

of the digital economy provides fresh impetus for China's economy to achieve high-quality development, and makes great contributions to China's economic development, making a big cake, and provides material protection for the realization of common prosperity. At the same time, the three rural products live broadcast with goods, cross-regional small video also breaks the time and space limitations, for the economic development of the temporarily backward areas to increase more jobs and income. In summary, the digital economy can not only promote the development of common prosperity, but also rely on the new quality of productivity to push back the development of the digital economy and improve the resilience of the digital economy. The development of new productivity can directly contribute to the development of common prosperity. Based on this, this paper puts forward the following hypotheses: Hypothesis 1: The development of the digital economy can contribute to the realization of common prosperity, and this effect can be transmitted through the intermediary channel of new quality productivity. As the goal of economic and social development, common prosperity has significant spatial dependence, that is, the common prosperity level of a region will have spillover effects on neighboring regions through labor migration, capital flow, technology sharing and other channels. However, the digital economy also has spillover characteristics. The development of the digital economy has broken through the spatial barriers, stimulated the spatial mobility of factors of production such as labor and capital, broken the access thresholds between regions and urban and rural areas, liberated the time and space constraints, and weakened the correlation between economic activities and geographical locations, thus promoting the synergistic development of regions and urban and rural areas. With the increase in the breadth and depth of coverage of digital technology, digital economy can expand the function of cyberspace, innovate the spatial scope of resource allocation, and greatly narrow the gap between urban and rural development[12] .Therefore, this paper puts forward the following hypotheses: Hypothesis 2: The digital economy has a spatial spillover effect on common prosperity. As a country with a vast territory and complex national conditions, China's regional disparities are particularly prominent in the process of promoting the deep integration of economic development and digital technology, which not only breeds abundant opportunities, but also brings a series of challenges that need to be solved in the pursuit of the long-term goal of common prosperity[13] . By virtue of the policy dividend of the early stage of reform and opening up, the massive influx of capital, the highly market-oriented economic system, and the intensive concentration of innovation resources, the eastern region has taken the lead in establishing a relatively mature digital economy ecosystem, which not only promotes the rapid growth of the local economy, but also provides a realistic and feasible path and potential development impetus for driving the economic development of the central and western regions through the spillover effect of technology and the extension of industrial chain.

However, for the central and western regions, although they are actively integrating into the wave of digital economy and seeking to achieve leapfrog economic development through this new economic model, they still face many constraints in the rapid expansion and deep release of the influence of the digital economy due to factors such as a relatively weak economic foundation, a relatively lagging behind market-oriented reform process, and a late start in the development of the information industry,

which have led to a significant decline in the development of the digital economy. These regions still face many constraints in the rapid expansion and deep release of the influence of the digital economy, and thus face more difficult tasks and more complicated challenges in using the digital economy to promote local economic growth and narrow the wealth gap with the eastern region, and urgently need policy support and guidance at the national level to realize the coordinated development of the regional economy[14] . Based on this, this paper puts forward the following hypotheses; Hypothesis 3: There is regional heterogeneity in the promotion effect of digital economy on common prosperity.

3 Study Design

3.1 Methodology of the Study

Benchmark Regression Model. Benchmark regression of the spatial panel model is a crucial foundational step in spatial econometric analysis. It is primarily used to conduct preliminary estimation and testing of the fundamental relationships in the model before accounting for spatial effects. This paper constructs a fixed effects model to test the impact of digital economy on common prosperity. The specific model is as follows:

$$\ln Compro_{it} = \beta_0 + \beta_1 lnDEI_{it} + \sum \beta_j X_{jit} + \mu_i + \varphi_t + \epsilon_{it} \quad (1)$$

where i stands for province, t stands for year, common prosperity Index is com pro, Digital Economy Index is DEI, X_{it} is a control variable, μ_i is a region fixed effect, φ_t is a time fixed effect, and ϵ_{it} is a random disturbance term.

Mediated Effects Model. The digital economy has the potential to affect the level of common prosperity in China through the new quality of productivity, so the following econometric model is constructed for analysis. The specific model is as follows:

$$\ln prod_{it} = \alpha_0 + \alpha_1 \ln DEI_{it} + \sum a_j x_{jit} + \mu_i + \varphi_t + \epsilon_{it} \quad (2)$$

$$\ln compro_{it} = b_0 + b_1 \ln DEI_{it} + b_2 \ln prod_{it} + \sum b_j x_{jit} + \mu_i + \varphi_t + \epsilon_{it} \quad (3)$$

where $prod_{it}$ is the mediating variable, the new quality productivity index.

Spatial Correlation Tests. In this paper, we test the spatial correlation between the level of common prosperity and the level of digital economy development with the help of Moran's I. Moran's I is a statistical metric used to measure spatial autocorrelation. It helps determine whether observed values in geographic spatial data exhibit spatial correlations, as well as the strength and direction of such correlations. The formula of Moran's I is as follows:

$$I = \frac{\sum_{i=1}^{n}\sum_{j=1}^{n} W_{ij}(X_i - \bar{X})(X_j - \bar{X})}{S^2 \sum_{i=1}^{n}\sum_{j=1}^{n} W_{ij}} \quad (4)$$

where W is the spatial weight matrix which is able to demonstrate the degree of dependence between provinces, i.e. :

$\overline{X}$ represents the mean of the attribute values of each province; S^2 represents the variance; X_i and X_j represent the attribute values of provinces i and j, respectively. When the local Moran's index is positive, it indicates the existence of highhigh aggregation or low-low aggregation; on the contrary, it indicates the existence of low-high aggregation or high-low aggregation.

Spatial Measurement Models. In order to test the spatial spillover effect of the digital economy on common prosperity, the following spatial Durbin model (SDM) is developed by introducing a spatial interaction term.

$$\ln Compro_{it} = \theta_0 + \rho W \cdot \ln DEI_{it} + W \cdot \sum \alpha_j \cdot \ln Control_{jit} + \sum \beta_j \ln Control_{jit} + \mu_i + \varphi_t + \varepsilon_{it} \quad (5)$$

Where ρ is the spatial autoregressive coefficient, which indicates the degree of influence of the common prosperity level of neighboring provinces on the common prosperity level of this province; W is the spatial weight; θ_0 represents the intercept term, θ_1 represents the regression coefficient of the core explanatory variable, θ_2 represents the regression coefficient of the spatial interaction term of the core explanatory variable, α_j represents the regression coefficient of the spatial interaction term of the control variable, and β_j represents the regression coefficients of the control variables; the meanings of the other variables are the same as in the previous section.

Entropy Weight Method. The Entropy Weight Method is an objective weighting approach, the core idea of which is to determine the weights based on the degree of variation of each indicator. The smaller the information entropy, the greater the dispersion degree of the indicator, and the more information it provides. Therefore, the weight of this indicator should also be larger. The specific steps are illustrated in the figure 1.

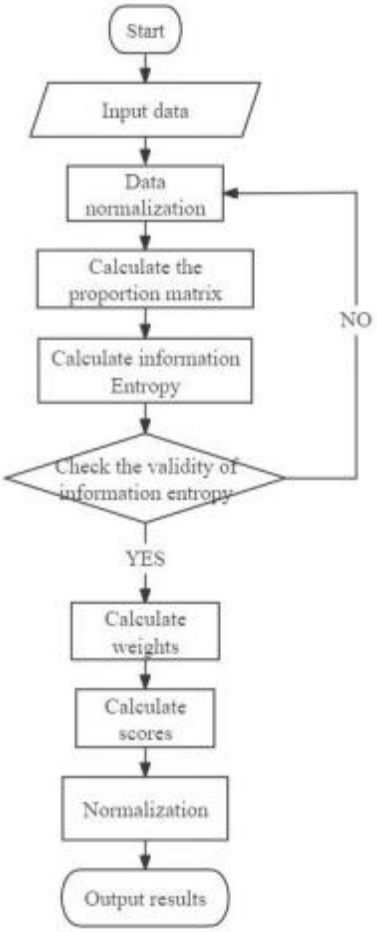

Fig. 1. Schematic diagram of entropy weight method

3.2 Variable Selection

Explained Variables. common prosperity (Compro).This paper refers to the research of Huiai Yuan et al[15] ., and constructs the indicator system from the dimensions of affluence and commonness, and from the four aspects of residents' life, housing, medical care and education, as shown in Table1, and quantifies the scores by using entropy weight method.

Table 1. Indicator System for Evaluating the Level of Shared Prosperity

Level 1 indicators	Level 2 indicators	Indicator measurement modalities	Positive or negative	Unit of measure	Weights

affluence	people's livelihood	GDP per capita	+	yuan per person	0.107480297
		Per capita disposable income	+	yuan	0.098748844
		Consumption expenditure per inhabitant	+	yuan	0.089405179
		Urban Engel's coefficient	-	/	0.025458823
		Rural Engel coefficient	-	/	0.02967229
		consumer price index CPI	-	/	0.027608751
	shelter	Average sales price of commercial properties	+	Yuan/square meter	0.224741209
	medical care	Number of beds in medical institutions per 10,000 population	+	per 10,000 persons	0.103635404
	educational enterprise	Average income from education	+	%	0.169857408
commonality	people's livelihood	The Thiel index of the urban-rural income gap	-	/	0.029577621
		The Thiel index of the urban-rural consumption gap	-	/	0.026582128
	medical care	The Thiel index of the urban-rural healthcare gap	-	/	0.009419454
	shelter	Housing Gini coefficient	-	/	0.032293996
		House price to wage ratio for urban workers	-	/	0.010357415
	educational enterprise	Gini coefficient for education	-	/	0.015161181

Core explanatory variables. Digital Economy Index (DEI). This paper refers to Yingjie Li's research[16] , and constructs the evaluation index system of digital economy development level from four dimensions of infrastructure, digital industrialization, industrial digitization and digital environment as in Table 2, and quantifies the scores by using entropy weight method.

Table 2. Digital Economy Evaluation Indicator System

Dimension	Indicator layer	Unit of measure	Positive or negative	Weights
infrastructure	Cell phone penetration rate	per hundred people	+	0.015698602
	Mobile telephone exchange capacity	10,000 households	+	0.029336271
	Number of Internet broadband interfaces	ten thousand	+	0.031575687
	IPv4 addresses	ten thousand	+	0.086238963
	Number of Internet domain names	ten thousand	+	0.073617688
digital industrialization	Revenue from software operations Total telecommunications business	ten thousand yuan	+	0.112019237
	Number of software and information technology services	hundred million yuan	+	0.07186366
	Total profit of software and information technology service business	items	+	0.08380169
	Number of enterprises with e-commerce	ten thousand yuan	+	0.128772596
	transaction activities	items	+	0.058925082
	E-commerce purchases E-commerce sales	hundred million yuan	+	0.086580403

Industrial digitization	Number of websites per 100 enterprises	hundred million yuan	+	0.080328636
	Research and Experimental Development	items	+	0.006806377
	(R&D) Expenditures as a Percentage of GDP	%	+	0.035834763
digital environment	Number of domestic patents granted	items	+	0.084461771
	Average number of students	items	+	0.014138574

Intermediate Variables. New quality productivity (Prod). As a concrete expression of advanced productivity, the new quality productivity is characterized by high technology, high efficiency and high quality. This paper refers to the research of Hai Zhang et al[17], and constructs the indicator system of new quality productivity from the above three aspects as shown in Table 3, and measures the score of each region with the help of entropy weight method.

Table 3. New Quality Productivity Indicator System

Level 1 indicators	Level 2 indicators	Indicator measurement modalities	Positive or negative	Unit of measure	Weights
High-tech productivity	Innovative inputs	Internal Expenditures on R&D Funding for Higher Education Institutions	+	ten thousand yuan	0.054379225
		Internal Expenditures on R&D Funding of Industrial Enterprises Above Scale	+	ten thousand yuan	0.068381224
		R&D investment intensity	+	%	0.032890466
	Innovation Platform	Number of general higher education institutions	+	items	0.017717724
		Number of incubators in operation	+	items	0.064821424
		Number of R&D organizations in high-tech industries	+	items	0.128777521
		Number of industrial units above designated size	+	items	0.056165381
	Innovation performance	Number of patent applications granted to domestic applicants	+	Items	0.077522125
		Number of authorized trademark registrations	+	items	0.066967761
		Technology market turnover	+	ten thousand yuan	0.096574268
		Number of new product development projects	+	items	0.093901426
Efficient productivity	Resource utilization	Industrial water use/GDP	-	Cubic meters/10,000 yuan	0.005383565
		General solid waste consolidated utilization/generation	+	%	0.016028182
	emission	Industrial S02 emissions/GDP	-	Tons/billion dollars	0.002340186
		COD emissions/GDP	-	Tons/yuan	0.003366315

		Treatment capacity of industrial wastewater treatment facilities	+	Million tons/day	0.042493406
	economic efficiency	GDP per capita growth index	+	Previous year = 100	0.003902548
		Profitability of high-tech enterprises	+	%	0.000512259
High-quality productivity	Talent Advantage	Full-time equivalent of R&D personnel	+	person-year	0.059493517
		Average years of education	+	year	0.011306186
		Percentage of persons in tertiary education	+	%	0.02846089
	Industrial quality	Tertiary value added/GDP	+	%	0.016388591
		Internet broadband access port density	+	per person	0.013392649
		Share of enterprises with e-commerce trading activities in the total number of enterprises	+	%	0.012892696
	Green development	forest cover	+	%	0.023753091
		Non-hazardous treatment rate of domestic waste	+	%	0.002187374

Control Variables. There are many factors affecting the common prosperity, in order to reduce the possibility of missing variables, the control variables are: industrial structure (ind), scientific and technological innovation level (tech), openness to the outside world (open), financial development level (fin), and the level of transportation facilities (tran). Among them, the ratio of the value added of the tertiary industry to the value added of the secondary industry indicates the industrial structure; the intensity of R&D investment in each region indicates the level of scientific and technological innovation; the ratio of the total amount of import and export of each region to the GDP indicates the level of openness to the outside world; the ratio of the balance of deposits and loans to the GDP indicates the level of financial development; and the ratio of the local mileage of the local highway to the size of the local area indicates the level of transportation facilities. In order to avoid the problems of heteroskedasticity and nonlinearity caused by the difference of measurement units of each variable, all variables are logarized.

3.3 Data Sources

The empirical data of this paper mainly come from China Statistical Yearbook, statistical yearbooks of 30 provinces (cities) except Hong Kong, Macao, Taiwan and Tibet, China Information Industry Yearbook, China Ecommerce Yearbook, China Science and Technology Statistical Yearbook, China Education Statistical Yearbook, China Communication Statistical Yearbook, China Industrial Statistical Yearbook, China Energy Statistical Yearbook, EPS database and so on. The time frame of the data is from 2014 to 2022. Individual missing data are filled in using linear interpolation.

4 Empirical Analysis

4.1 Benchmark Regression Analysis

In this paper, in order to test the impact of the development of digital economy on the common prosperity of 30 provinces and municipalities in China, a panel data model is established with the common prosperity as the explanatory variable, the digital economy index as the core explanatory variable, and the level of transportation facilities, industrial structure, the level of scientific and technological innovation, the level of opening up to the outside world, and the level of financial development as the control variables. Through the F-test and Hausman test results to determine the use of individual time two-factor fixed effects model, through the progressive basic regression, the results are shown in Table 4, model M (1) results show that the regression coefficient of digital economy 0.2355 is significant at the level of 1%, the digital economy and the common prosperity shows a positive correlation. Models M (2)-(6) gradually add control variables on the basis of model M (1). Since some of the factors affecting common prosperity are absorbed by the control variables, the regression coefficients of digital economy are reduced, but the significance remains unchanged. In conclusion, the higher the degree of development of digital economy, the more it can significantly promote the level of common prosperity, and the two are significantly positively correlated.

Table 4. Benchmark Regression Results

variable	M(1) lnCompro	M(2) lnCompro	M(3) lnCompro	M(4) lnCompro	M(5) lnCompro	M(6) lnCompro
lnDEI	0.2355*** (7.43)	0.2054*** (7.19)	0.2071*** (7.29)	0.1601*** (5.76)	0.1611*** (5.77)	0.1437*** (5.30)
lntran		0.4607*** (7.76)	0.4577*** (7.75)	0.3776*** (6.63)	0.3773*** (6.61)	0.3516*** (6.38)
lnind			0.0788* (1.89)	0.0217 (0.54)	0.0268 (0.64)	0.0733* (1.77)
lntechi				0.1828*** (5.80)	0.181*** (5.69)	0.1574*** (5.08)
lnopen					-.0072 (-0.47)	0.0007 (0.05)
lnfin						-0.09*** (-4.47)
Constant	-0.4133*** (-9.66)	-4.7796*** (-8.47)	-4.7796*** (-8.63)	-4.8571*** (-8.24)	-4.3384*** (-7.97)	-3.2142*** (-5.54)
individual effect	yes	yes	yes	yes	yes	yes
time effect	yes	yes	yes	yes	yes	yes
sample size	270	270	270	270	270	270
R^n	0.9821	0.9858	0.9861	0.9878	0.9879	0.9888

Note: Values in parentheses are t-statistics, * denotes
significance level (* p < 0.1, ** p < 0.05, *** p < 0.01), same below.

4.2 Test of Mediating Effect

In this paper, new quality productivity is selected as the mediating variable to establish the mediating variable model, the results are shown in Table 5, in Model M (1), the coefficient of influence of the core explanatory variable of digital economy on the explanatory variable of common prosperity is 0.1437, which is significant at the 1% level. In Model M (2), the coefficient of digital economy on the mediator variable of new quality productivity is 0.1374, which is significant at 1% level, indicating that the digital economy has a significant role in promoting new quality productivity. In Model M (3), the regression coefficient of new quality productivity is 0.1869, which is significant at 1% level, indicating the existence of mediation effect; the regression coefficient of digital economy is 0.118, which is significant at 1% level, and is smaller than that of the regression coefficient of digital economy in Model M (1), which is 0.1437, indicating that the new quality productivity plays a partial role of mediation.

Table 5. Results of the intermediary effect test

variable	M(1) lnCompro	M(2) lnCompro	M(3) lnCompro
lnDEI	0.1437*** (5.30)	0.1374*** (3.77)	0.118*** (3.89)
lnProd			0.1869*** (4.35)
Constant	-3.2142*** (-5.54)	-0.4606 (-0.59)	-3.1282*** (-5.55)
controlled variable	yes	yes	yes
individual effect	yes	yes	yes
time effect	yes	yes	yes
sample size	270	270	270
R2	0.9888	0.9929	0.9895

At the same time, the nonparametric Bootstrap method was used to test the results of 500 released draws, and the results are shown in Table 6. The analysis of mediated effects showed that the effect value was 0.0257 (SE=0.0105), and the Bootstrap test (499 valid replications) indicated that the mediated effect was significant (z=2.44, p=0.015), with a 95% confidence interval of [0.0050, 0.0463].

Table 6. Bootstrap test results for mediation effect

	Observed coefficients	Standard error	z	P>z	95% interval estimate
med_eff	0.0257	0.0105	2.44	0.0150	[0.0050,0.0463]

4.3 Heterogeneity Analysis

From the previous analysis, it can be seen that the level of economic development in different regions presents a relatively unbalanced phenomenon. In order to study the regional heterogeneity of the relationship between digital economy and common prosperity in different regions, the research sample is divided into three subsamples of East, Central and West for testing with reference to the standard of China's regional

planning division, and the empirical results, as shown in Table7, show that in the central and western regions, the digital economy promotes the common prosperity by a significant positive effect, while in the eastern region, the promotional role of the digital economy is not significant. The possible reason for this is that compared with the central and western regions, the eastern region has a higher level of economic development, and has realized the improvement of the overall economic level of the region by virtue of the advantages in industrial structure, opening up to the outside world, transportation and so on, and therefore the influence of the common prosperity in the eastern region is not limited to the digital economy. Due to the geographical location and other factors, the central and western regions are in the backward level of economic development, but the digital wave has successfully weakened the impact of the unfavorable factors of the development of the central and western regions, and realized the direct realization of the products through the Internet mobile payment, and improved the level of common prosperity [18] .

Table 7. Results of Heterogeneity Test

	Eastern region	Central Region	Western region
lnDEI	0.0355(0.0400)-	0.209***(0.0531) -	0.219***(0.0599)
constant term	3.423***(0.937)	3.546***(0.840)	0.707(1.308)
controlled variable	yes	yes	yes
individual effect	yes	yes	yes
time effect	yes	yes	yes
sample size	99	72	99
R2	0.991	0.983	0.976

4.4 Analysis of spatial effects

Spatial correlation test. By calculating the Moran's I of common prosperity and digital economy development level in 30 provinces and cities in China, the results are shown in Table 8, it is easy to see that the Moran's I of common prosperity and digital economy are all greater than 0, and the Moran's I of common prosperity is significant at 1% level, indicating that common prosperity and digital economy have positive spatial autocorrelation, i.e. there is a high-high aggregation or low-low aggregation situation. Moran's I is significant at 1% level for common prosperity and 5% level for digital economy, which indicates that common prosperity and digital economy have positive spatial autocorrelation, i.e., there is a high-high aggregation or low-low aggregation.

Table 8. Moran's I for Digital Economy and common prosperity Development Levels, 2014-2022

year	lnDEI			lnCompro		
	I	Z	P-value	I	Z	P-value
2014	0.2169**	2.0287	0.0425	0.4161***	3.7088	0.0002
2015	0.2285**	2.1225	0.0338	0.4227***	3.7848	0.0002
2016	0.2662**	2.4271	0.0152	0.3933***	3.5697	0.0004

2017	0.2609**	2.3871	0.0170	0.4016***	3.6510	0.0003
2018	0.2542**	2.3377	0.0194	0.4066***	3.6989	0.0002
2019	0.2572**	2.3686	0.0179	0.3803***	3.5111	0.0004
2020	0.2389**	2.2227	0.0262	0.3961***	3.6440	0.0003
2021	0.2508**	2.3139	0.0207	0.4264***	3.8588	0.0001
2022	0.2572**	2.3622	0.0182	0.4316***	3.8860	0.0001

Analysis of spatial spillover effects. The data were subjected to LM test, Hausman test, Wald test, and LR test, and the test results are shown in Table 9, LM error and LM lag are both significant at the 1% level, and Robust LM error and Robust LM lag are also both significant at the 1% level, so the spatial Durbin model (SDM) was used. Through Hausman test and comparing the results of individual one-factor, time one-factor, and individual time two-factor models, it was determined that the model was an individual time two-way fixed model.

Table 9. Spatial econometric model test table

	Test	Statistic	p-value
LM test (Spatial error)	Moran's I	1.4690	0.1420
	Lagrange multiplier	29.0380***	0.0000
	Robust Lagrange multiplier	16.1460***	0.0000
LM test (Spatial lag)	Lagrange multiplier	43.4130***	0.0000
	Robust Lagrange multiplier	30.5210***	0.0000
Hausman test	Individual and Bidirectional	50.26***	0.0000
	Time and Bidirectional	596.31***	0.0000
Wald test	SDM and SAR	10.16	0.1180
	SDM and SEM	37.59***	0.0000
LR tet	SDM and SAR	2080.56***	0.0000
	SDM and SEM	2108.35***	0.0000

From the above table, the LR and Wald tests show that the spatial Durbin model can be simplified to a spatial lag model (SAR), and that the spatial econometric model should be a spatial posterior model with individual time fixed in both directions, as follows:

$$\ln Compro_{it} = \theta_0 + \rho W lnCompro_{it} + \theta_1 lnDEI_{it} + \sum \beta_j \, lnControl_{jit} + \mu_i + \varphi_t + \epsilon_{it} \quad (6)$$

The estimation results of this spatial econometric model are shown in Table 10. The regression coefficient of lnDEI under the 0-1 neighbor weight matrix is 0.0943, which is positive and significant at the 1% level. The spatial autoregressive coefficient is p=0.4871, which is positively significant at the 1% level, indicating that there is a clear spatial dependence in the level of common affluence.

Table 10. Spatial econometric model regression results

Variant	Ratio	Z	P-value
lnDEI	0.0943***	4.26	0.0000
lntran	0.2837***	6.42	0.0000
lnind	0.0450	1.37	0.1700
lntech	0.1221***	4.92	0.0000
lnopen	0.0074	0.63	0.5290
lnfin	-0.0609***	-3.75	0.0000
p	0.4871***	8.91	0.0000
controlled variable	yes	yes	yes
individual effect	yes	yes	yes
time effect	yes	yes	yes
sample size	270	270	270
R2	0.8886		

The results of the decomposition of spatial spillover effects are shown in Table 11. The direct effect refers to the influence mechanism of digital economy on the common prosperity of the province and city, while the indirect effect refers to the spatial spillover effect of digital economy on the common prosperity of neighboring provinces and cities. Under the 0-1 neighboring weight matrix, the total, direct and indirect effects of digital economy (lnDEI) are all positive and significant at the 1% level, indicating that the digital economy is not only conducive to the promotion of common prosperity in the province and city, but also has a spatial spillover effect on the neighboring provinces and cities.

Table 11. Decomposition results of spatial spillover effects

Variant	Direct effect	Indirect effect	Aggregate effect
lnDEI	0.1021***	0.0848***	0.1870***
	(4.22)	(3.26)	(4)
lntran	0.3030***	0.2527***	0.5557***
	(6.63)	(3.88)	(5.55)
lnind	0.0521	0.0433	0.0954
	(1.55)	(1.44)	(1.52)
lntech	0.1303***	0.1081***	0.2384***
	(5.14)	(3.72)	(4.84)
lnopen	0.0078	0.0066	0.0144
	(0.64)	(0.61)	(0.63)
lnfin	-0.0650***	-0.0539***	-0.1189***
	(-3.86)	(-3.13)	(-3.7)
sample size	270	270	270
R2	0.8886		

Note: Values in parentheses are z-statistics.

4.5 Endogeneity Test

Reverse causality and omitted variables can cause endogeneity problems, and the increase in the level of common prosperity and the sharing of fruits will promote the development of the digital economy, and there may be a reverse causality between the

common prosperity and the digital economy, so this paper adopts the instrumental variable method to alleviate the endogeneity problems caused by reverse causality. Drawing on the method of Lin Dang [19], the lagged first order of the digital economy is included as an instrumental variable in the baseline model for regression, and the p-value obtained from the Durbin-Wu-Hausman endogeneity test is 0.0235 < 0.05, which indicates that there is an endogeneity problem of the digital economy as the core explanatory variable, and verifies the necessity of using the instrumental variable method. Table 12 reports the 2SLS regression results of instrumental variables, the F-statistic is greater than 10, which proves that the weak instrumental variable test is passed at 10% level, there is a strong correlation between instrumental variables and endogenous variables, and the coefficients of the core explanatory variables are still significantly positive at 1% level, which supports the conclusion of this paper, indicating that the digital economy can help to promote the common prosperity.

Table 12. 2SLS Regression Results

First-stage regression results		
variant	F-statistic	DEI
IV	6807.54	0.991***(0.0120)
Second-stage regression results		
lnDEI		0.0963***(0.0315)
Constant		-0.358(0.832)
controlled variable		yes
individual effect		yes
time effect		yes
sample size		240
R2		0.884

4.6 Robustness Tests

In order to check the robustness of the above findings, this paper uses the method of adding control variables and excluding four municipalities to conduct the robustness test. The control variable of government intervention (gov, measured by the share of general public budget expenditure in GDP of each region) is added. In addition, the sample of this paper consists of 30 provinces except Hong Kong, Macao, Taiwan and Tibet. Considering the special characteristics of the four municipalities in terms of their status and policy enjoyment, the four municipalities are removed from the sample and then analyzed in the regression analysis. The test results of the two methods are shown in Table 13.The regression coefficients and significance of the results are basically consistent with the benchmark regression results, proving that the empirical results of this paper are robust and credible.

Table 13. Robustness Test Results

	Adding controlled variable	Excluding municipalities
lnDEI	0.126***(0.027)	0.205***(0.029)
constant term	2.478***(0.627)	3.270***(0.621)
controlled variable	yes	yes
individual effect	yes	yes
time effect	yes	yes
sample size	270	234
R2	0.989	0.983

5 Conclusions and Recommendations

This paper empirically investigates the impact of the digital economy on the common prosperity using panel data of 30 provinces in China from 2014 to 2022, and the conclusions of the study are as follows:

1.The digital economy can promote the level of common prosperity, and this conclusion passes the robustness test.

2.There is regional heterogeneity, with the central and western regions playing a significant role and the eastern region playing an insignificant role, indicating that the digital economy has an obvious universalizing effect on the less-developed regions.

3.The new quality productivity plays a partly intermediary role between the digital economy and common prosperity, i.e., the digital economy can promote the common prosperity through promoting the development of the new quality productivity.

4.There is an obvious spatial effect between the digital economy and common prosperity, and the promotion of the digital economy on common prosperity has positive spatial spillovers, which can raise the level of common prosperity in neighboring provinces and cities.

Based on the above conclusions, this paper puts forward the following recommendations:

1.Construct a Gradient Development System Based on Factor Endowment Disparities to Strengthen Interregional Adaptability in Digital Economy Strategic Layout. Given the knowledge and capital-intensive characteristics of eastern regions, the focus should be on deploying digital technology source innovation capabilities. By leveraging National AI Innovation and Application Pilot Zones (e.g., Shanghai Zhangjiang, Shenzhen Pengcheng), an innovation chain integrating" basic research scenario validation-commercial transformation" can be established to cultivate globally competitive digital industrial clusters (exemplified by Suzhou Industrial Park's industrial internet empowerment ecosystem). For central and western regions, implement a "Digital Infrastructure-Characteristic Industry" Coupled Development Strategy, transforming energy advantages into computing power economies through the national "East Data West Computing" project (e.g., Ningxia Zhongwei Green Data Center Cluster).Additionally, advance Characteristic Industry Digital Leap Plans (referencing Yunnan Pu'er Tea Blockchain Traceability System) to build differentiated competitive advantages in agricultural product distribution, cultural tourism, and other fields, enabling late-mover regions to achieve" lane-changing overtaking" in the digital economy.

2. Refine Digital Technology Penetration Mechanisms to Reconfigure Common Prosperity Pathways Through New Quality Productive Forces. Establish a" Digital Innovation → Factor Reorganization → Productivity Leap" Transmission Framework, breaking through core technologies via a national digital technology priority list system (covering 12 frontier fields including 5G/6G and quantum computing). Prioritize developing industrial internet platform economies (e.g., Rootcloud's connectivity of 720,000 industrial devices), driving total factor productivity growth in manufacturing. Implement a "Digitally Inclusive Growth Initiative" for livelihood sectors, utilizing platforms like smart agriculture cloud systems (e.g., Jilin Rice Industry Digitalization System boosting farmer incomes by 28%) and telemedicine networks (with "5G+Healthcare" pilots covering 81.3% of counties), ensuring digital dividends permeate vulnerable groups. This forms a virtuous cycle where new quality productive forces and common prosperity reinforce each other.

3. Innovate Regional Collaborative Governance Paradigms to Unleash Spatial Spillover Effects of the Digital Economy. Build a "Core-Periphery" Digital Synergy Network, establishing cross-regional data flow mechanisms through national computing hub nodes (referencing the Yangtze River Delta Eco-Green Integrated Development Demonstration Zone's tax-sharing model).Deepen the spatial spillover effects of the digital economy via" digital enclave" co-construction models (e.g., Shenzhen-Shanwei Special Cooperation Zone Digital Economy Industrial Park) to facilitate technology diffusion and industrial gradient transfer. Develop a Digital Collaborative Development Index Evaluation System, incorporating metrics such as data element mobility intensity (current interprovincial disparity coefficient: 0.67) and digital technology spillover contribution rates into governance performance assessments.

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