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Digital economy, new quality productivity and common prosperity

Zheng Li [1a*]

1School of Economics, Guangxi University for Nationalities, China

**Corresponding author:* Zheng Li

Abstract

Digital economy provides digital technology and financial foundation for cultivating and developing new quality productivity, and also Using the panel data of 30 provinces in China from 2012 to 2022 as research samples, this paper adopts benchmark regression model and intermediary effect model to study the impact and mechanism of digital economy on common prosperity from the perspective of the digital economy. Using the panel data of 30 provinces in China from 2012 to 2022 as research samples, this paper adopts benchmark regression model and intermediary effect model to study the impact and mechanism of digital economy on common prosperity from the perspective of new quality productivity. The findings are as follows: (1) Digital economy can significantly promote the development of common prosperity; (2) The mechanism test shows that the digital economy can promote the development of common prosperity in China from 2012 to 2022 as research samples. mechanism test shows that the digital economy can promote the development of common prosperity by improving the new quality productivity; (3) Heterogeneity test shows that the impact and mechanism of digital economy on common prosperity from the perspective of new quality productivity. The mechanism test shows that the digital economy can promote the development of common prosperity by improving the new quality productivity; (3) Heterogeneity test shows that the enabling effect of digital economy on common prosperity is more obvious in regions with large population density, high Heterogeneity test shows that the enabling effect of digital economy on common prosperity is more obvious in regions with large population density, high level of economic development and high level of digital infrastructure construction.

Keywords

Digital economy; New quality productivity; Common prosperity; Mediating effect

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Introduction

The report of the Twentieth Party Congress clearly states that Chinese-style modernisation is a modernisation in which all people share in the common prosperity, and that common prosperity is an essential requirement of socialism with Chinese characteristics. Common wealth is not egalitarianism; rather, while encouraging people to create wealth through labour and innovation, it focuses on narrowing the gap between the rich and the poor, and promotes the idea that all groups in society can benefit from economic growth. Under this concept, economic development is no longer purely the pursuit of total economic growth, but through the optimisation of the economic structure, the improvement of production efficiency and the rational allocation of resources, gradually eliminating the gap between urban and rural areas, regional disparities, and income disparities so as to achieve the balanced development and prosperity of the whole society.

With the promotion of cloud services, artificial intelligence and other digital technologies, the digital economy has accelerated the penetration of all levels of society and gradually become an important engine of modern economic growth. Relying on digital technology, digital economy has the characteristics of breaking the spatial division, low threshold, sharing and universal benefit, which can make up for the short board of public services and promote the equalisation of public services; it can accelerate the trans-regional flow of all kinds of factors of production and reorganisation and allocation(Chen&Zhou,2023).can enhance the interactivity of economic activities between regions, industries and groups, laying the foundation for balanced regional development and fair income distribution. (Han et al,2023). At a time when the digital economy is booming, China's goal of achieving common wealth will certainly have to rely on the digital economy.

At the same time, under the leadership of the digital economy, digital technology has promoted productivity from

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"old quality" to "new quality" by transforming the mode of production, improving the efficiency of production and optimising the means of production. The new quality of productivity formed by the structural leap in productivity is becoming the key driving force for the construction of modern industrial system(Zhou et al,204). New quality productivity is innovation-led, deeply integrating digital technology and traditional industries, opening up new fields and new tracks, shaping new kinetic energy and new advantages, injecting a steady stream of vitality into the economy and society, and making substantial progress in promoting common prosperity(Ding Min,2024). There have been more studies in the literature on the relationship between the digital economy, new quality productivity and common wealth. However, few scholars have systematically analysed the digital economy, new quality productivity and common wealth in a unified framework.

This provides a research idea for this paper, which incorporates the digital economy, new quality productivity and common wealth into a unified framework from a systematic perspective, and takes the panel data of 30 provinces in China from 2012 to 2022 as the research sample. The data sample is used to empirically test the impact mechanism of digital economy on common wealth and the transmission mechanism of new quality productivity on common wealth.

This paper will be elaborated from the following aspects: (1) From a global perspective, the digital economy, the new quality productivity and the common wealth will be included in a unified research framework, in-depth analysis of the internal logic of the three and the mechanism of influence, to make up for the research gaps. (2) It has been pointed out that the digital economy promotes the common wealth, the digital economy significantly drives the new quality productivity, and the new quality productivity is an important part of the common wealth, which provides theoretical inspiration for this paper, which introduces the mediating effect model, treats the new quality productivity as a mediating variable, and examines the conduction effect of the digital economy to promote the common wealth through the new quality productivity.

(i) Theoretical analysis of research hypotheses and research hypotheses

1. The direct impact of the digital economy on the development of shared prosperity

Common wealth is the essential requirement of socialism, an important feature of Chinese-style modernisation and the common aspiration of the people. The essential connotation of common wealth has two characteristics, that is, it contains two dimensions: "common" "affluence"(Chen &Yang,2023). With data elements as the core and information technology as an important driving force, the digital economy can effectively break the space-time barriers, make up for the short board of inclusive resources, and promote the development of economically lagging regions, and the digital economy has become an important driving force for realising common wealth in China. On the one hand, the digital economy can promote sustained and balanced growth, and on the other hand, it can also promote shared and inclusive development, with the dual characteristics of wealth creation and wealth sharing. Therefore, whether it is "common" or "affluent", the digital economy has unique advantages in this regard. Based on this, this paper proposes:

Hypothesis 1: The digital economy can contribute to the development of shared prosperity.

2. Indirect impacts of the digital economy on the development of shared prosperity

The digital economy cultivates new industries, new modes and new kinetic energy by optimising resource allocation and driving innovative technologies, and provides strong support for the realisation of common wealth while promoting the development of new quality productivity . (Ji et al,2024). Firstly, the development of digital economy is conducive to accelerating the integration process of frontier technologies such as big data, artificial intelligence and Internet of Things with traditional industries such as manufacturing and service industries (Shi &Xu , 2024) the use of digital technology can effectively improve the traditional industrial production process in the production link coordination and connectivity barriers, to promote capital, talent, technology and other types of factors of production flow and configuration is more convenient, and comprehensively drive the new quality of productivity(Bai &Peng ,2024). Secondly, the enhancement of new quality productivity not only implies the optimisation of resource allocation efficiency and the enhancement of innovation ability, but also brings about the extension of the industrial chain and the upgrading of the production process, which helps to promote the development of the industry in the direction of high quality and high value-addedness, and provides a basic guarantee for the balance of the regional economy (Yan &Niu,2024). In this process, the digital economy has brought more high-quality employment opportunities through the enhancement of new quality productivity, optimised the structure of income distribution, effectively narrowed the income gap between urban and rural areas and regions, and empowered common prosperity.

Thus, by promoting the development of new quality productive forces, the digital economy promotes sustainable economic and social growth and provides a deep technological and industrial foundation for the realisation of common wealth. This process not only enhances production efficiency and the total amount of social wealth, but also accelerates the realisation of the goal of common wealth through a fairer and more reasonable distribution that allows more people to share the fruits of prosperity in the digital economy era. Based on this, this paper proposes:

Hypothesis 2: NQPs play a mediating effect between the digital economy and the development of shared prosperity.

Research design

(i) Modelling

1. Baseline modelling

In order to investigate the effect of the digital economy on the common wealth, the following province and time double fixed-effects model is set up

$$CP_{it} = \alpha_0 + \alpha_1 DIG_{it} + \alpha_2 Control_{it} + \mu_i + \upsilon_t + \varepsilon_{it} \quad (1)$$

In equation (1),CP_{it} represents the level of common wealth of province i in period t, and DIG_{it} represents the level of digital economy development of province i in period t; control denotes a series of control variables;μ_i and υ_t are used to portray the province and time effects, respectively;

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and ε_{it} represents the random disturbance term. In order to test hypothesis 2, based on model (1), a mediation effect model is constructed with new quality productivity level (NQP) as the mediating variable:

$$NQP = \beta_0 + \beta_1 DIG_{it} + \beta_2 Control_{it} + \mu_i + \upsilon_t + \varepsilon_{it} \quad (2)$$

$$CP_{it} = \gamma_0 + \gamma_1 DIG_{it} + \gamma_2 NQP_{it} + \gamma_3 Control_{it} + \mu_i + \upsilon_t + \varepsilon_{it} \quad (3)$$

Where NQP denotes the mediating variable, the level of new quality productivity, and the definitions of the rest of the variables are consistent with equation (1). Since there are few theories to explore the impact effect on common wealth with new quality productivity as mediator, this paper adopts step-by-step regression method. First of all, use equation (1) to test the effect of the digital economy on the common wealth, if the regression coefficient of equation (1) is significant, then we can use equation (2) to verify the effect of the digital economy on the new quality of productivity, and then use equation (3) to verify that the digital economy and the new quality of productivity on the common wealth of the common effect of the digital economy and the new quality of productivity. Finally, the combination of formula (2) and formula (3) can test the mediating effect of new quality productivity.

(ii) Selection of variables

1. Explained variables

Common Wealth (NQP). Based on the existing research results of Common Wealth (Li ,2024; Liu et al,2021) , from the nature of common wealth, combined with the characteristics of digital economy and NQP. Construct the common wealth evaluation index system with four dimensions of sharing degree, affluence, common degree and sustainability, containing 25 three-level indicators, and use the entropy weight method to obtain the comprehensive evaluation index of common wealth after objectively assigning the weights to each indicator. As listed in Table 1.

Table 1 Common Wealth Evaluation Indicator System

Level 1 indicators	Secondary indicators	Tertiary indicators	Indicator properties	Weights
Mutual enrichment	Affluence	Average income level of residents	+	0.0467
		Consumption level of the population	+	0.0398
		GDP (in billions of yuan)	+	0.0462
		Engel's coefficient for rural	–	0.0090
		Engel's coefficient for urban	–	0.0087
	Commonality	Income gap between urban and rural residents	–	0.0129
		Expenditure gap between urban and rural residents	–	0.0105
		Urbanisation rate of resident	+	0.0227
	Sharing degree	Public library collections	+	0.0703
		Average years of education	+	0.0224
		Level of health care	+	0.0494
		Health technicians	+	0.0263
		Percentage of public service expenditures in local finances	+	0.0453
		Level of public transport	+	0.0235
		Level of development of public	+	0.0281
		Percentage of local finance expenditure on social security and	+	0.0457
		Social pension insurance	+	0.0651
		R&D investment intensity	+	0.0113
		Internet development	+	0.0649
		Wage level of urban employment	+	0.0498
		unemployment rate	–	0.0662
	Sustainability	Level of patent development	+	0.1290
		Level of green space in parks	+	0.0191
		forest cover	+	0.0409
		Local fiscal expenditures	+	0.0451

2. Core explanatory variables

Digital economy development level (DIG). This paper draws on existing relevant studies to construct a digital economy evaluation index system from three dimensions of digital technology application, digital infrastructure, and digital science and technology innovation (Zhang et al,2024; Zhang et al ,2019) . The specific index system is shown in Table 2.To avoid problems such as subjective evaluation, the entropy value method is also applied to measure the level of digital economy development in each province.

Table 2 Digital Economy Evaluation Indicator System

Level 1 indicators	Secondary indicators	Tertiary indicators	Indicator properties	Weights
Digital economy level of development	Numeric infrastructure	Number of Internet access ports	+	0.0314
		Number of domain names	+	0.0715
		Mobile base station density	+	0.0833
		Mobile phone penetration rate	+	0.0133

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Numeric industrialisation	Long distance optical cable length per unit area, meters per square meter	+	0.0676
	Software business revenue as a share of GDP	+	0.0728
	Revenue from IT services as a share of GDP	+	0.0831
	Number of employees in the information services industry	+	0.0580
	Total telecoms business as a share of GDP	+	0.0433
	Proportion of enterprises with e-commerce trading activities	+	0.0098
	Business e-commerce as a share of GDP	+	0.0312
	Computers per 100 persons in enterprises	+	0.0201
	Websites per 100 enterprises	+	0.0052
	Digital Inclusive Finance Index	+	0.0130
Numeric science, technology and innovation	Full-time equivalent of R&D personnel in industrial enterprises above large scale	+	0.0718
	R&D expenditure of industrial enterprises above designated size	+	0.0665
	Number of R&D projects (topics) of industrial enterprises above designated size	+	0.0789
	Total technology contract turnover	+	0.1008
	Number of patent applications granted	+	0.0775

3. Mediating variables

The starting point of new quality productivity is "new", and the focus is on "quality". The "new" is in the technology, mode and concept, and only through continuous breakthroughs in the existing technology and production mode can new vigour be injected into productivity. The new quality of productivity is not only concerned with the quantity of production, but also with the improvement of "quality", which is a whole-mode transformation and upgrading centred on high-quality development. New-quality productivity generally involves new-quality labour force, new-quality labour objects and new-quality labour materials, which are combined with relevant research results (Zhu et al,2024;Xu et al,2023) constructed a new quality productivity evaluation index system. As shown in Table 3, the entropy value method was also applied to measure the new quality productivity index.

Table 3 Indicator system for evaluating new quality productivity

Level 1 indicators	Secondary indicators	Tertiary indicators	Indicator properties	Weights
New quality production capability	New quality labour force	GDP (in billions of yuan)	+	0.0618
		On-the-job workers' wages in yuan	+	0.0475
		Share of tertiary employment	+	0.0218
		Average years of schooling per capita	+	0.0052
		Intensity of funding for education	+	0.0179
		Number of innovative enterprises per 100 people	+	0.0438
	New quality object of labour	Energy efficiency	+	0.0428
		Number of enterprises with e-commerce trading activities	+	0.0288
		Robot mounting density	+	0.1508
		Sulphur dioxide emissions	+	0.1273
		Environmental protection expenditure General financial expenditure	+	0.1692
	New quality labour resources	Number of green patent applications Number of patent applications	+	0.0268
		Road mileage	+	0.0383
		Railway mileage	+	0.0389
		Fibre optic cable line length	+	0.0579
		Treatment capacity of waste gas treatment facilities	+	0.0699
		Provision for new product development	+	0.0505

4. Control variables

In order to mitigate the bias effect of omitted variables on the empirical results, reference is made to the existing research results (Shi et al,2023;Yang et al,2023)government financial support (GOV), education development (EDU), industrial structure upgrading (IS), and the level of financial development (FIN) are selected as control variables. The measurement method is as follows: government financial support (GOV), finance, as the foundation and important pillar of regional governance, plays a crucial role in promoting common prosperity. The amount of regional fiscal expenditure is measured against the regional GDP; Education Development (EDU), education development is the foundation of people's livelihood, and quality and balanced education resources can cultivate more talents with high quality, thus creating more wealth and value for the society and promoting the common wealth of the society. Measured by the number of students enrolled in higher education per million people in the region; industrial structure upgrading (IS), the adjustment and upgrading of the industrial structure is an important means to promote high-quality economic development, through the

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optimisation of the industrial layout, the promotion of the transformation and upgrading of traditional industries and the development of new industries, which will create more employment opportunities, improve the income and welfare of workers, thus promoting the common prosperity. Especially for those regions with relatively lagging economic development, upgrading the industrial structure is a key way to realise economic development. Measured using the proportion of regional tertiary industry value added to regional GDP; the level of financial development (FIN), moderate financial development is conducive to reducing social inequality and promoting common prosperity. By providing effective financial support to the real economy, it can promote economic growth and increase employment opportunities, and narrow the gap between the rich and the poor. However, imbalances and irregularities in financial development may also lead to increased inequality. Measured with the help of the year-end ratio of the balance of RMB loans to GDP of financial institutions.

Table 4 Descriptive Statistics and Correlation Coefficient Matrix for Key Variables

	CP	DIG	NQP	GOV	FIN	IS	EDU
CP	1						
DIG	0.884***	1					
NQP	0.623***	0.588***	1				
GOV	-0.057	0.100*	-0.209***	1			
FIN	0.343***	0.269***	-0.005	0.384***	1		
IS	0.581***	0.547***	0.023	0.499***	0.692***	1	
EDU	0.539***	0.470***	-0.013	0.246***	0.363***	0.622***	1
Average value	0.271	0.123	0.167	0.113	1.462	0.503	0.272
Standard deviation	0.081	0.099	0.049	0.032	0.481	0.087	0.085
Median	0.257	0.092	0.159	0.106	1.432	0.495	0.251

(iii) Data sources and descriptive statistics

This paper takes 30 provinces in China (excluding Hong Kong, Macao and Taiwan, and Tibet) as the research object, and sets the research period as 2012-2022. The main data for the study period come from the China Statistical Yearbook, Markdata.com, Wind Database, and the statistical yearbooks of each province. Some of the data come from the Report on China's Digital Economy Development Index. In addition, considering that some of the original data are missing, interpolation or regression analysis is used to make up for the missing data in some regions and years. The descriptive statistics of each variable in the paper are shown in Table 4.

From the results in the table, the standard deviation of Common Prosperity Index (CP) is 0.081, the mean is 0.271, and the median is 0.257. It shows that there is a significant difference in the level of common prosperity among different provinces, and the main reasons for this may lie in the tilted and prioritised order of policies, inadequate social security system, uneven productivity levels, and imperfections in the system of distribution structure. The standard deviation of the digital economy (DIG) is 0.099, the mean is 0.123, and the median is 0.092, indicating that there are obvious regional differences in the level of development of the digital economy, which may be attributed to the fact that some regions are constrained by the imperfections of the digital infrastructure, the lack of endogenous motivation of the talent pool and innovation capacity, which makes the development of the regional digital economy tend to be weaker. The above descriptive statistics indicate that there is still much room for development in both the level of China's digital economy and the level of common wealth, and there is an urgent need to improve the institutional mechanism for the development of digital economy according to local conditions. In addition, the standard deviation, mean and median of the NQP index are 0.032, 0.167 and 0.159 respectively, which means that the development level of NQP is still relatively low, and there are obvious regional differences in the development level of NQP in various provinces due to the differences in the allocation and utilisation of factors of production, the differences in the level of development and structure of industries, and the differences in the policy environment and the strength of support. The correlation coefficient matrix of the variables shows that the development level of new quality productivity is still low. From the correlation coefficient matrix of the variables, it can be seen that the coefficient between common wealth and digital economy is significantly positive, which initially indicates that the digital economy helps to promote common wealth, and hypothesis 1 is initially proved. The statistical values of the rest of the variables are all within a reasonable range.

Empirical analysis

(i) Baseline regression analysis

Firstly, the fixed effects model was selected based on the Hausman test results, and secondly, to exclude the possible problem of multicollinearity, the sample data were tested for multicollinearity, and the results showed that the maximum VIF value was 4.03, and the average VIF value was 2.42, which were much less than 10, indicating that there was no multicollinearity in this data sample. In the benchmark regression results in Table 5, model (1) presents the results of the study with only the inclusion of the explanatory variables and the core explanatory variables under

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controlling for both individual and year effects. The coefficient of digital economy is found to be 0.269, which is significantly positive at the 1% level, implying that digital economy has a significant contribution to the development of common wealth. Models (2) to (5) are the test results of gradually adding government financial support (GOV), education development (EDU), industrial structure upgrading (IS), and financial development level (FIN) control variables. The regression coefficient of digital economy on common wealth in model (5) is 0.247 and significant at 1% level, which indicates that the digital economy is very favourable to the development of common wealth at the overall level, and verifies hypothesis 1. The detailed reason is that the development of digital economy not only achieves key breakthroughs in technology and innovative allocation of factors of production, but also releases the economic multiplier effect that empowers the development of common wealth. In terms of control variables, the regression coefficient of the level of financial development on the common wealth is significantly negative, indicating that the level of financial development will inhibit the common wealth, mainly due to the imperfection of the modern financial system, the development of financial science and technology will exacerbate the digital divide, the uneven distribution of financial resources will bring about the "siphon effect of capital", and more importantly, the financial regulation and policy imperfections will lead to frequent problems. More importantly, imperfect financial regulation and policies lead to frequent problems.

Variant	Model (1) CP	Model (2) CP	Model CP	Model CP	Model CP
DIG	0.269***	0.248***	0.244***	0.234***	0.247***
	(8.92)	(8.81)	(8.55)	(8.28)	(9.83)
GOV		0.444***	0.437***	0.373***	0.381***
		(7.31)	(7.17)	(7.09)	(7.09)
FIN			-0.003	-0.008***	-0.009***
			(-0.83)	(-2.62)	(-2.82)
IS				0.234***	0.219***
				(6.39)	(6.27)
EDU					0.176***
					(4.32)
Constant	0.270***	0.199***	0.207***	0.056*	-0.024
	(29.62)	(14.30)	(12.30)	(1.87)	(-0.74)
N	330	330	330	330	330
R-squared	0.977	0.980	0.980	0.983	0.984
Zone	YES	YES	YES	YES	YES
Year	YES	YES	YES	YES	YES

Table 5 Direct effect test of the impact of the digital economy on shared prosperity

Note: *, **, *** represent 10 per cent, 5 per cent and 1 per cent significance levels, respectively, with standard errors in parentheses. Same as below.

(ii) Robustness tests

In order to avoid the omission of important variables, sample selection bias and other factors adversely affecting the results of the study, and to enhance the objectivity and scientific validity of the results of the impact of the digital economy on the common wealth. In this paper, the robustness test is carried out in three aspects: replacing core explanatory variables, excluding epidemic years and removing municipalities. The first is to replace the core explanatory variables. In order to further ensure that the results of the study are real and reliable, the core explanatory variables of digital economy are lagged one period and two periods to get two new explanatory variables, and then the two are brought into the model to re-regression analyses, and the results are shown in Table 6, Column (1) and Column (2). After replacing the core explanatory variables, the test results are still consistent with the previous conclusions, which shows that the basic regression results have strong robustness. The second excludes epidemic years. As the country is affected by the epidemic in 2020, 2021, the epidemic control policies of local governments are different, the response speed to the epidemic varies, and the epidemic situation varies from place to place, which may interfere with the verification of the impact of the digital economy and common wealth. In order to exclude this interference, the data of this second year is excluded before regression. The results are presented in column (3) of Table 6. The results show that the regression coefficient of digital economy is still significantly positive after excluding the data of epidemic years, indicating that the positive effect of digital economy on common prosperity still exists after excluding the influence of epidemic. Thirdly, the sample of municipalities directly under the central government is excluded. As the sample of municipalities has great advantages in resource allocation and policy support, it is not directly comparable with ordinary prefecture-level cities. In order to reduce the sample bias and avoid the influence of the characteristic differences between municipalities and ordinary prefecture-level cities on the study, municipalities are excluded to ensure the scientific validity of the research results and the comparability of the data, and the results are shown in column (4) of Table 6. It can be seen that the regression coefficient of digital economy is still significantly positive, which proves the robustness of the benchmark regression results again.

Table 6 Robustness test results

Variant	Replacement of core explanatory variables	Excluding epidemic years	Remove municipalities

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	(1)	(2)	(3)	(4)
Delayed by one period DIG	0.237***			
	(12.03)			
Delayed by two period DIG		0.202***		
		(8.73)		
DIG			0.242***	0.262***
			(11.31)	(12.55)
EDU	0.222***	0.161***	0.177***	0.179***
	(5.83)	(3.82)	(4.42)	(4.07)
GOV	0.430***	0.446***	0.366***	0.473***
	(7.05)	(6.56)	(5.80)	(5.86)
FIN	-0.004	-0.004	-0.014***	-0.010***
	(-1.31)	(-1.12)	(-3.69)	(-2.70)
IS	0.207***	0.242***	0.222***	0.216***
	(5.46)	(5.61)	(5.70)	(5.67)
Constant	-0.041	-0.019	-0.011	0.016
	(-1.24)	(-0.51)	(-0.32)	(0.85)
N	300	270	270	286
R-squared	0.985	0.985	0.983	0.981
Zone	YES	YES	YES	YES
Year	YES	YES	YES	YES

(iii) Endogenous treatment

According to the theoretical analysis of this paper, the digital economy can promote the development of common wealth in many ways, and regions with higher levels of common wealth usually have more perfect infrastructure, stronger industrial cluster effects, and more policy support in digital incubation and digital transformation, so common wealth is likely to have an impact on the digital economy, resulting in a bi-directional causality between the two. In order to alleviate the interference of this problem on the regression results, this paper adopts the instrumental variable method for further research. The choice of instrumental variables is based on the common practice of existing studies(Cong et al,2024), the lagged period of digital economy is used as the instrumental variable (IV). As shown in column (1) of Table 7, the coefficients of the instrumental variables are significantly positive at the 1% level. And the results pass the under-identification test and weak identification test of instrumental variables, which proves that instrumental variables are reasonable and feasible. In the second stage regression in column (2), the coefficient of digital economy is significantly positive, which indicates that the promotion of digital economy on common wealth still holds after considering endogeneity issues such as reverse causality.

Table 7 Endogeneity test results

	Phase I	Phase II
variant	(1)	(2)
DIG		(0.304)***
		11.03
IV	(0.780)***	
	8.57	
Kleibergen-Paap		30.371***
Cragg-Donald		305.861
control variable	YES	YES
Constant	(0.015)	(-0.457)
	0.22	-1.55
N	330	330
R-quared		0.2607
Zone	YES	YES
Year	YES	YES

(iv) Heterogeneity test

1. Geographic location heterogeneity test

"The Hu Huanyong Line divides China into two regions with relatively stable population densities, with the north-west being sparsely populated and the south-east accounting for 40 per cent of the country's territory but home to 90 per cent of the country's population. China's economic geography, population distribution pattern has long been "Hu Huanyong line" locked, while the development of the two sides of the line is not coordinated, the Northwest region of the relatively underdevelopment of the problem may lead to the role of the digital economy on the common wealth of the effect of the difference also exists. Therefore, this paper will sample according to the "Hu Huanyong line" is divided into eastern provinces and western provinces, the digital economy on the common wealth of the impact of the role of regional heterogeneity analysis, the results are shown in Table 7, column (1), column (2). From the results in the table, it is found that the enabling role of the digital economy on common wealth is established in both cities east and west of the Hu Huanyong line, with a more pronounced facilitating role for cities east of the line. The reason for this is that the high proportion of traditional industries, the slow process of digital transformation, and the relatively insufficient allocation of digital resources in the region west of the Hu Huanyong Line have constrained the development of its digital economy. In contrast, the region east of the Hu Huanyong line started earlier in the broadband network, 5G base station construction and other aspects, the coverage and technology level is higher. The difference between the development patterns of the eastern and western regions is also an important reason for the inconsistent development of the digital economy in the east and west. In recent years, the state has strongly attached great importance to the development of the digital economy in the west, and has made concerted efforts in digital infrastructure, talent training, industrial upgrading, etc., to promote the realisation of an east-west linked digital economy situation.

2. Heterogeneity in levels of economic development

The level of urban economic development is one of the key factors in the development of the digital economy. A city's

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level of economic development will directly affect all aspects of its innovation ability, infrastructure construction, enterprise development, and talent gathering in the field of digital economy. In order to explore whether there is a difference in the impact of digital economy development on common wealth among cities with different economic levels, this paper divides the original sample with the national GDP per capita as the boundary. Cities higher than the per capita GDP are set as developed regions; vice versa, they are set as developing regions, and the sample data are analysed for heterogeneity in the level of economic development, and the results are reported in Table 7, columns (3)(4). From the results, it can be seen that in economically developed regions, the digital economy coefficient is significantly positive at the 1% level, indicating that the digital economy effectively enhances the level of common wealth in developed regions. In developing regions, the coefficient of digital economy, on the other hand, does not pass the significance test, which indicates that the impact of digital economy on common wealth is not significant in developing regions. The reason is that economically developed regions have a higher concentration of resources, including capital, technology, talent, etc., in the process of digital economy development, these resources can efficiently circulate and drive technological innovation, promoting the balanced development of the region. On the other hand, the construction of digital infrastructure in economically underdeveloped regions tends to lag behind, with problems such as incomplete network coverage and insufficient data processing capacity restricting the development of the digital economy. A single economic structure and a large share of traditional industries are common characteristics of less economically developed regions. These regions may lack an industrial structure adapted to the transformation of the digital economy, making it difficult for the digital economy to effectively penetrate and drive economic development.

3. Heterogeneity in the level of digital infrastructure development

Digital infrastructure construction is the cornerstone of the stable development of the digital economy and can provide data support for the accelerated development of the digital economy. Through digital infrastructure, all kinds of industrial resources can be ubiquitously connected, flexible and complementary and efficient allocation, promoting the deep integration of various industries, upstream and downstream linkage, and helping more enterprises to improve quality, reduce costs, increase efficiency and reduce inventory. To this end, this paper draws on relevant research results(Liu et al,2023)use the median mobile phone penetration rate as a division criterion, and define regions below and above the median value during the sample period as low-level digital infrastructure regions and high-level digital infrastructure regions. According to columns (5) and (6) of Table 8, the regression coefficient of high level of digital infrastructure development is 0.290 and is significantly positive at 1% statistical level, while the regression coefficient of low level of digital infrastructure development is positive but only significant at 5% statistical level. It shows that the impact of digital economy development on the modernisation of common wealth in areas with high level of digital infrastructure development is more significant. The reason for this is that regions with higher levels of digital infrastructure construction have laid more favourable hardware conditions for regional economic development and digital technology enhancement, and have greater resource and location advantages in the wave of digital economic development, releasing a stronger enabling effect on common wealth. Comparatively speaking, the development of digital technology innovation and industrial digital transformation in regions with lower levels of digital infrastructure construction has been slow, making it more difficult to create large-scale digital industry clusters, and providing a slightly weaker boost to the development of the digital economy.

Table 8 Results of heterogeneity test

	Geographic location heterogeneity		Heterogeneity in levels of economic		Heterogeneity in the level of digital	
	(1)	(2)	(3)	(4)	(5)	(6)
	Western region	Eastern region	Developed region	Developing region	High level region	Low level region
DIG	0.177**	0.218***	0.241***	0.041	0.290***	0.079**
	(2.29)	(8.03)	(8.84)	(1.63)	(8.10)	(2.24)
EDU	-0.040	0.139***	0.275***	0.301***	0.147**	0.244***
	(-0.33)	(3.04)	(3.61)	(6.91)	(2.20)	(4.57)
GOV	0.275**	0.472***	0.419***	0.458***	0.307***	0.525***
	(2.25)	(7.73)	(4.72)	(6.84)	(3.47)	(5.11)
FIN	-0.015	-0.007**	-0.005	-0.009	-0.008	-0.015**
	(-1.60)	(-2.14)	(-1.35)	(-1.50)	(-1.48)	(-2.54)
IS	0.204***	0.115**	0.111*	0.269***	0.212***	0.246***
	(3.15)	(2.38)	(1.87)	(7.33)	(2.90)	(4.09)
Constant	0.047	0.057	-0.015	-0.007	-0.007	-0.118***
	(1.13)	(1.18)	(-0.36)	(-0.37)	(-0.11)	(-3.13)
N	88	242	132	198	165	165
R-squared	0.971	0.986	0.990	0.975	0.987	0.983
Zone	YES	YES	YES	YES	YES	YES
Year	YES	YES	YES	YES	YES	YES

(v) Mechanism testing

Based on the previous analyses, it can be seen that digital economic development may affect common wealth through new quality productivity. In order to test this hypothesis, new quality productivity is tested and analysed as a mediating variable. From column (1) of Table 9, it can be seen that the coefficient of digital economy is significantly positive at 1% level, which indicates that digital economic

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development helps to promote common prosperity, i.e., hypothesis 1 is verified. from column (2) (3), it can be seen that the impact of digital economic development on new quality productivity is significantly positive, with a coefficient of influence of 0.372, and the coefficient of the direct impact on common prosperity is 0.123. at the same time, when all other factors remain unchanged, every 1 percentage point increase in the new quality productivity will have a significant impact on common prosperity. At the same time, when other factors remain unchanged, every 1 percentage point increase in new quality productivity will promote the common wealth index by 0.333 percentage points, and the coefficients of the digital economy and new quality productivity are both significantly positive, which confirms that both the digital economy and new quality productivity can contribute to the common wealth. Compared with column (1), the coefficient of digital economy in column (3) decreases from 0.247 to 0.123, which indicates that the new quality productivity plays a mediating effect in the impact of digital economy on common wealth, and the increase of digital economy under the influence of new quality productivity makes the common wealth indirectly increase by 0.124 percentage points (0.372× 0.333), and Hypothesis 2 holds. The possible reason is that the digital economy promotes the intelligence, automation and efficiency of the production process through the advantages of digital technology, thus raising the new quality productivity. With the development of new quality productivity, the industrial structure is optimised, and resources achieve a more rational flow and allocation between regions, thus helping low-income and less developed regions to receive greater support and further reduce the gap between the rich and the poor.

Table 9 Results of the mediation effect test

variant	(1) CP	(2) NQP	(3) CP
NQP			0.333***
			(4.89)
DIG	0.247***	0.372***	0.123***
	(9.83)	(7.63)	(4.21)
GOV	0.381***	0.300***	0.281***
	(7.09)	(3.32)	(5.81)
FIN	-0.009***	-0.017***	-0.004
	(-2.82)	(-2.82)	(-1.44)
EDU	0.176***	0.221***	0.102***
	(4.32)	(3.30)	(3.09)
IS	0.219***	0.444***	0.071*
	(6.27)	(6.59)	(1.77)
Constant	-0.024	-0.452***	0.126***
	(-0.74)	(-8.75)	(3.16)
N	330	330	330
R-squared	0.984	0.851	0.990
Zone	YES	YES	YES
Year	YES	YES	YES
Sobel test		8.595***	

In addition, this paper also argues the robustness of the mediating effect of new quality productivity by Sobel test and Bootstrap test. Firstly, as can be seen from Table 9, the Sobel statistic with new quality productivity as the mediating variable passes the significance test and rejects the original hypothesis, suggesting that there is a mediating effect in the original model. Secondly, the Bootstrap number is set to 500 and the confidence interval is 95%. Table 10 shows the results of the Bootstrap test, and it can be seen that the confidence intervals for both the direct and indirect effects do not contain a value of 0 when using new quality productivity as the mediating variable, which significantly rejects the original hypothesis and indicates that there is such an effect mechanism in the original model.

Table 10 Bootstrap method test

Variant	Effect	Ratio	Standard deviation	z	P>z	95 percent confidence interval
NQP	direct effect	0.1920	0.0282	6.79	0.000	[0.1332, 0.2467]
	indirect effect	0.4042	0.0358	11.29	0.000	[0.3340,0 .4743]

Conclusion

This paper takes the panel data of 30 provinces in China from 2012 to 2022 as the research object, uses the entropy weight method to measure the digital economy, new quality productivity and common wealth, and establishes models such as two-way fixed effects to examine the impact of the digital economy on the common wealth and the mechanism of action.

The results of the study show that, firstly, the digital economy has a significant contribution to the common wealth. Second, the new quality of productivity is an important channel through which the digital economy empowers the common wealth. Third, heterogeneity analyses show that the enabling effect of the digital economy on shared prosperity is more pronounced in areas with high population concentration and in economically developed areas and areas with high levels of digital infrastructure.

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Based on the above findings, the paper makes the following recommendations:

(1) Continuously strengthening the enabling effect of the digital economy and fully unleashing its potential in promoting common prosperity. We will accelerate the spread of digital infrastructure, promote the construction of 5G networks, fibre-optic broadband, data centres and other digital infrastructure nationwide, especially in less-developed regions, to narrow the "digital divide" and provide solid digital support for balanced development in urban and rural areas. Strongly support the integration of digital technology with agriculture, manufacturing and service industries, promote the intelligence and efficiency of industrial chains, and enhance the added value and competitiveness of various industries. Strongly support the innovative application of the digital economy in the countryside, develop rural e-commerce, smart agriculture, online education and telemedicine, etc., empowering the upgrading of rural industries and the equalisation of public services, providing farmers with more income-generating channels, and helping to revitalise the countryside and the common wealth. Strongly support digital skills training to equip more workers with the skills required by the digital economy, especially in areas with insufficient educational resources, and use digital education to bridge the education gap and empower individual and community development. Strongly support the development of low-carbon technologies and smart energy systems, promote the green transformation of traditional industries, and achieve synergistic progress in economy, society and ecology, so as to provide a sustainable foundation for common prosperity.

(2) Accelerating the cultivation of new quality productivity and giving full play to the innovation-driven role of new quality productivity. On the one hand, it is necessary to increase investment in basic research, especially to achieve technological breakthroughs in areas such as artificial intelligence, quantum computing and new materials, and to build a core technology system to support new quality productivity. Promote the deep integration of industry, academia and research, establish a mechanism for the synergistic development of the innovation chain and the industrial chain, promote efficient cooperation among universities, research institutes and enterprises in research and development and technology transformation, accelerate the transformation of scientific and technological achievements into productive forces, and promote the effective allocation of innovation resources. On the other hand, to meet the needs of the development of the new quality productivity, strengthen the cultivation of complex and highly skilled talents, promote the reform of the education system, improve the overall quality of the labour force, and form a strong intellectual guarantee to support the development of the new quality productivity. Improve the policy system to support the new productive forces, including measures such as tax incentives, innovation subsidies and intellectual property protection, so as to create an institutional environment conducive to innovation and entrepreneurship, and to stimulate the innovation vitality of enterprises and scientific research institutions.

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Author Contributions

This work was carried out in collaboration among all authors. This project was conducted jointly by the authors. The authors reviewed and agreed to the final manuscript. All authors read and approved the final manuscript.

About the Authors

Zheng Li

School of Economics, Guangxi University for Nationalities, China

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