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Digital Economy, Industrial Structure and Common Prosperity

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Abstract: China is actively promoting the development of the digital economy and advancing industrial structural upgrades as an essential path toward achieving common prosperity. This is also a hot topic of research among numerous scholars. This study is based on national annual data from 2013 to 2022, utilizing an authoritative indicator system and assigning values to core variables using proportional and entropy methods. The relationship between the digital economy, industrial structure, and common prosperity was explored using the least squares method, mediation effect model, and difference-in-differences method. The conclusions are as follows: The level of digital economic development directly impacts the index of common prosperity, exhibiting a nonlinear structure in the form of an arc but overall showing a positive correlation. Both the level of digital economic development and the index of industrial structural upgrades are positively correlated with the index of common prosperity, indicating the presence of a mediation effect. After incorporating the mediating variables, the regression equation model showed improved significance levels and optimized fit, suggesting that the mediating variables enhance the explanatory power of the regression equation model. The results of the difference-in-differences model, validated through significance-level tests, demonstrate that national policies promoting the development of the digital economy can positively impact common prosperity. In conclusion, the following recommendations are provided: strengthening the construction of digital infrastructure, fostering innovative enterprises in the digital economy, promoting research and application of digital technologies, enhancing the cultivation of digital talents and skills, and reinforcing policy guidance and support.

1. Introduction

The way to govern a country begins with enriching its people. For China, common prosperity is not only a goal but also the foundation of its governance.

As an innovative economic growth model, digital economy is characterized by information and knowledge as the core, emphasizing innovation-driven development and pursuing intelligent high-quality growth. The development of digital economy provides new opportunities for industrial upgrading. Through the application of digital technologies, it is possible to achieve intelligent production processes, enhance innovation capabilities, promote the digital transformation of various industries, improve production efficiency and product quality, and drive the development of sectors

toward high value-added and knowledge-intensive directions.

In summary, as the world's second largest economy entity, China actively promotes the digital economy's growth and considers it an essential path towards achieving common prosperity. This is also a hot research topic among numerous scholars.

2. Literature Review and Research Hypothesis

There is extensive domestic and international research on the topics of digital economy, upgrading industrial structure, and common prosperity. The following discussion will illustrate the study on these two aspects: the empowerment of common prosperity through the digital economy and the relationship between the digital economy and industrial structure.

2.1. The empowerment of common prosperity through the digital economy

The significance of digital economic development for economic growth was analyzed from both the demand and supply sides[1]. Ouyang Rihui[2], through the study of the innovation, synergy, and inclusiveness effects of the digital economy, has ultimately demonstrated the pathways which the digital economy promotes common prosperity. Heo and Lee[3] argue that the digital economy, through the construction of information infrastructure, fosters knowledge generation and technological diffusion in network access markets, making it one of the main drivers for high-quality regional economic development. The digital economy can advance toward common prosperity by improving social production efficiency, expanding development pathways, and enriching individual social lives[4]. Ai Xiaoqing and Tian Yamin[5] researched the income growth and distribution effects of the digital economy. They found that the digital economy can alleviate poverty by promoting increased household income and reducing income inequality. According to Zhang Ying[6], The development of the digital economy has driven the growth of Internet infrastructure, resulting in differences in Internet dividends and reducing urban-rural disparities[7].

2.2. The relationship between the digital economy and industrial structure

Zhu Chunhong[8] found that the digital economy, by promoting the development of the information industry, indirectly drives the upgrading of the industrial structure. Research based on industrial linkage has found that informatization is an important foundation for optimizing and upgrading industrial structures[9]. Information technology can transform the manufacturing industry into high-tech sectors and force the industrial structure to shift from labor and resource-intensive to knowledge-intensive[10]. Jin Zhiqi[11] found that knowledge and information are increasingly becoming intrinsic elements of economic growth and altering the industrial structures of various countries. The digitization of traditional industries has improved the efficiency of commodity use value, reflecting the inherent mechanisms through which digital technology propels the upgrading of traditional industries[12]. The promotion of the digital economy has emerged as a crucial catalyst in driving the growth of China's industrial structure towards the mid-to-high end[13].

2.3. Literature reviews

In the literature on the role of the digital economy in promoting common prosperity, researchers widely recognize the significance of the digital economy. These studies commonly emphasize the positive impact of the digital economy on economic growth, job creation, and social development.

In the literature on the relationship between the digital economy and industrial structure, researchers commonly emphasize the role of the digital economy in promoting industrial structural

upgrades. These studies highlight how digital technologies bring innovation and opportunities to traditional industries. By introducing and applying digital technologies, traditional industries can improve production efficiency, enhance product quality, and innovate business models.

There is abundant literature on the relevant content mentioned above, but few scholars have studied the comprehensive relationship between the digital economy, industrial structure, and common prosperity. This article believes that the digital economy can positively impact common prosperity. But the importance of upgrading the industrial facility as a vital transmission mechanism in enabling common prosperity through the digital economy should not be overlooked.

2.4. Research Hypothesis

This article aims to comprehensively study the relationship between the digital economy, industrial structure and common prosperity. It is based on national annual data from the past decade, referencing authoritative variable index systems. The relationship between the digital economy, industrial structure, and common prosperity is studied based on the following three hypotheses.

H1: The digital economy has a positive promoting effect on common prosperity.

H2: The digital economy plays an intermediary role in common prosperity through the upgrading of industrial structure.

H3: National policies promoting the development of the digital economy can positively impact common prosperity.

3. Indicator system

3.1. Indicator system of common prosperity

Scholars have proposed corresponding common prosperity index systems from different perspectives, including fundamental indicators of overall development level, core indicators of wealth disparity, and evaluation indicators categorized into material and spiritual dimensions[14,15,16]. Chen Lijun[17] has summarized and put forward a more detailed and widely accepted common prosperity indicator system. It mainly covers three dimensions: developmental, distributive, and sustainability.

For the sake of objectivity, this paper conducts an analysis of the weights of the common prosperity index indicators using the entropy weight method. Due to the selection of numerous indicators in this article, each carrying different meanings and playing distinct roles in achieving common prosperity, we need to perform dimensionless normalization on all these indicators. Furthermore, during the process of dimensionless normalization, we need to take into account both the positive and negative impacts of these indicators. The specific calculation formula is as follows:

Positive indicators: $x_i^* = \frac{x_i - x_{min}}{x_{max} - x_{min}}$

Negative indicators: $x_i^* = \frac{x_{max} - x_i}{x_{max} - x_{min}}$

x_i^* represents the dimensionless normalized indicator, x_i represents the specific value of a tertiary indicator variable, x_{max} represents the maximum value, and x_{min} represents the minimum value.

After dimensionless normalization, the data obtained needs to be further converted based on the weights of primary and secondary indicators.

Indicator calculation formulas: $Q_i = \sum_{i=1}^{n} x_i^* * w_i$

Q_i represents primary and secondary indicators, x_i^* represents the specific values of secondary and

tertiary indicators, and w_i represents the weights of the corresponding indicators[18].

The final formula for calculating the common prosperity indicators: $P = \sum_{i=1}^{N} Q_i * w_i$

3.2. Indicator System for the Development Level of Digital Economy

Based on previous research, the Indicator System used in this article mainly covers three dimensions: digital infrastructure, digital industry development, and digital inclusive finance [19,20,21].

Similar to the above text, the entropy weight method is used to analyze the weights of the indicators to ensure the objectivity of the weights. The difference here is that all the indicators are positive, so there is no need to consider the distinction between positive and negative. The main calculation process is the same as the other indicator system mentioned above, so it will not be repeated here.

4. Empirical models, variables and data

4.1. Empirical model

4.1.1. Baseline Regression

Based on Yang Wenpu's method, this paper uses the following Baseline Regression model to verify the direct effects of digital economic development on common prosperity[22].

$$SP_t = \alpha_0 + \alpha_1 DE_t + \alpha_2 DE_t^2 + \sum \alpha_j Control_t + \varepsilon_t \quad (1)$$

t represents time; SP_t represents the common prosperity index; DE_t represents the level of digital economic development. $Control_t$ represent control variables, including Gini coefficient ($GINI_t$), financial development level (FI_t), education development level (ED_t) and government fiscal expenditure (GF_t). ε_t represents stochastic disturbance term.

4.1.2. Mediation effect

The industrial structure upgrading index is introduced as a new variable in the model to demonstrate the indirect effect of digital economic development on common prosperity through its influence on industrial structure upgrading. The mediation effect model is as follows:

$$SD_t = \beta_0 + \beta_1 DE_t + \beta_2 DE_t^2 + \sum \beta_j Control_t + \delta_t \quad (2)$$

SD_t represents the industrial structure upgrading index, while the other variables are the same as mentioned above. δ_t represents stochastic disturbance term.

$$SP_t = \eta_0 + \eta_1 DE_t + \eta_2 DE_t^2 + \eta_2 SD_t + \sum \eta_j Control_t + \pi_t \quad (3)$$

If Model (2) passes the significance level test, the industrial structure upgrading index will be substituted into Model (3). Furthermore, If Model (3) also passes the significance level test, and the signs of x1 and x2 are the same, it can be concluded that there is a mediation effect. π_t represents stochastic disturbance term.

4.1.3. Differences-in-Differences

To verify the driving effect of national policies on common prosperity, the following Differences-in-Differences model is constructed.

$$SP_t = \phi_0 + \phi_1 DID_t + \sum \phi_j Control_t + \pi_t \quad (4)$$

t represents time; DID_t represents the implementation of national policies related to common prosperity in that year. $Control_t$ represent control variables that affect the common prosperity index, including the level of digital economic development (DE_t), the national Gini Coefficient ($GINI_t$), financial development level (FI_t), and education development level (ED_t). π_t represents stochastic disturbance term.

5. Empirical Results and Analysis

5.1. Benchmark Regression

Benchmark regression is conducted to examine the impact of the level of digital economic development on the common prosperity index. The specific results of the baseline regression are shown in Table 1. Column (1) represents the regression without the inclusion of control variables. The results show that the regression coefficient of the level of digital economic development on the common prosperity index is 0.621 and is significant at the 1% level. This positive correlation confirms the direct impact of the level of digital economic development on the common prosperity index. Column (2) show that the coefficient of the level of digital economic development on the common prosperity index is positive for the linear term and negative for the quadratic term, showing a curved nonlinear structure. However, the relationship is still positive overall.

Table 1: Benchmark Regression.

Variable	(1)	(2)
DE	0.621***	2.434***
	(6.07)	(9.05)
DE2		-1.575**
		(-4.16)
FI		-8.643
		(-1.14)
ED		-64.236**
		(-3.74)
GF		8.462
		(1.57)
GINI		-4.212
		(-0.88)
adj. R^2	0.713	0.967
r2	0.745	0.989
F	36.834	47.984

t statistics in parentheses
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

5.2. Mediation effect model

Firstly, regression analysis of the industrial structure upgrading index is conducted with the digital economic development level and its quadratic term, as well as control variables. The results, as shown in Column (1) of Table 2, indicate a strong positive correlation between digital economic development and the industrial structure upgrading index, which is significant at the 5% level. However, many of the control variables in Column (1) are not significant, possibly due to multicollinearity. To address multicollinearity, stepwise regression is utilized, with a significance

level of 5% as the P-value threshold for variable removal. After removing the variables, the regression results, as shown in Column (2) of Table 2, indicate that digital economic development still has a strong positive correlation with the industrial structure upgrading index. Therefore, it can be conclusively demonstrated that the development of the digital economy promotes the upgrading of China's industrial structure.

After incorporating the intermediate variable (industrial structure upgrading index) into the model, the regression is conducted again. The regression results, as shown in Column (3) of Table 2, indicate that both the level of digital economic development and the industrial structure upgrading index have a positive impact on the common prosperity index, confirming the existence of a mediation effect.

Table 2: Mediation effect.

Variable	(1)	(2)	(3)
	SD	SD	CP
DE	16.148**	19.674**	1.692**
	(3.29)	(3.85)	(8.60)
DE2	-23.895*	-26.086**	-0.477
	(-2.87)	(-3.99)	(-1.91)
FI	134.919		-14.843**
	(0.89)		(-5.58)
ED	-372.964		-47.096**
	(-0.97)		(-8.63)
GF	-103.690	-100.213*	13.227***
	(-0.82)	(-2.33)	(10.94)
GINI	-228.917*	-319.053**	6.308
	(-2.35)	(-3.23)	(1.99)
SD			0.046**
			(5.33)
_cons	138.737*	170.504**	-2.575
	(2.50)	(3.15)	(-1.53)
adj. R^2	0.521	0.658	0.997
r2	0.840	0.810	0.999
F	7.992	5.323	2426.092

t statistics in parentheses
$^{*}p < 0.1$, $^{**}p < 0.05$, $^{***}p < 0.01$

5.3. Differences-in-Differences model

The realization of common prosperity relies on the support of national policies. The Differences-in-Differences model is used to explore the impact of national policies on common prosperity. Common prosperity refers to affluence for everyone. 2018 marked a turning point in the intensity of China's common prosperity-related policies. Therefore, 2018 was chosen as the dividing point to distinguish the experimental group from the control group.

The results of the Differences-in-Differences model analysis are shown in Table 3. Column 1 displays the regression results without the inclusion of control variables. It can be observed that the model did not pass the significance level test. The possible reason for this result could be insufficient data volume and the absence of additional control variables. Column 2 presents the regression results after including control variables. The results indicate that the model successfully passes the significance level test, and there is a significant improvement in the R^2 value. In conclusion, through the empirical analysis of the double-difference model, it has been confirmed that national policies significantly positively affect common prosperity.

Table 3: Differences-in-Differences.

	(1)	(2)
times	0.415***	0.282**
	(17.53)	(9.72)
treated	0.092	0.037**
	(1.81)	(6.74)
_diff	0.132	0.231**
	(1.92)	(8.97)
DE		0.368***
		(10.48)
SD		0.110***
		(15.20)
FI		-8.035
		(-2.43)
GINI		2.219
		(0.73)
_cons	0.259***	-0.156
	(1.13e+08)	(-0.09)
adj. R^2	0.823	0.995
r2	0.882	0.999
F	132.918	.

t statistics in parentheses
$^{*}p < 0.1$, $^{**}p < 0.05$, $^{***}p < 0.01$

6. Conclusions

This article is based on national annual data from nearly ten years (2013-2022) and employs an authoritative indicator system. This article uses the Least Squares Method, Mediation effect model, and Difference-in-Differences method to investigate the relationship between the digital economy, industrial structure, and common prosperity. The main conclusions are as follows:

1) The level of digital economic development has a direct impact on the common prosperity index. The coefficient of the first term of the digital economy's development level on the common prosperity index is positive. In contrast, the coefficient of the second term is negative, showing a curved non-linear structure. However, the overall trend is positively correlated.

2) Both the level of digital economic development and the industrial structure upgrade index are positively correlated with the common prosperity index, indicating the presence of a mediating effect. After introducing the mediating variable, the significance level of the regression equation model has been improved.

3) The results of the Difference-in-Differences model pass the significance level test, indicating that national policies to promote digital economic development can positively influence common prosperity.

Based on the conclusions of this paper, the following recommendations are given:

1) Digital infrastructure construction should be strengthened; Investment should be made in broadband network construction; Solid technological support and infrastructure should be provided for the digital economy.

2) The government should cultivate innovative enterprises in the digital economy, encourage the development of innovative enterprises in the digital economic field

3) To meet the talent demand of the market, the government should strengthen the cultivation and introduction of talent in the digital economy, providing relevant training and educational opportunities and enhancing the professional competence and innovative ability of skills in the digital economy.

References

[1] Qi J., Chu X. (2021) 'Digital Economic Development, Economic Structural Transformation, and Escaping the Middle-Income Trap'. Journal of Finance and Economics, 47, 7, 18-32.

[2] Ouyang, R. (2022) 'The Logic, Mechanisms, and Pathways of Digital Economy Promoting Common Prosperity'. Journal of Chang'an University (Social Sciences), 24, 1, 1-15.

[3] Heo, P. S., and Lee, D. H. (2019) 'Evolution of the linkage structure of ICT industry and its role in the economic system: The case of Korea'. Information technology for development, 25, 3, 424-454.

[4] Jiang Y, Kang Y. (2022) 'Promoting Common Prosperity through Digital Economy: Intrinsic Mechanisms, Risk Assessment, and Practical Requirements'. Economic Review Journal, 5, 21-30.

[5] Ai, X., Tian, Y. (2022) 'Research on the Poverty Reduction Effect of the Digital Economy'. Journal of Hunan University (Social Sciences), 36, 1, 50-56.

[6] Zhang, Y., Huang, J. (2019) 'Financial Innovation, New Urbanization, and Regional Economic Growth: An Empirical Analysis Based on Spatial Durbin Model'. Journal of Industrial Technological Economics, 38, 12, 93-101.

[7] Qiu, Z., Zhang, S., Liu S. and Li, G. (2019) 'From the Digital Divide to Dividend Disparities: An Internet Capital Perspective'. Social Sciences in China, 40, 1, 63-81.

[8] Zhu, C. (2005) 'Research on the Relationship between Information Industry Development and Industrial Structure Upgrading'. Research on Economics and Management, 9, 67-69.

[9] Lee, S., Kim, M. S. and Park, Y. (2009) 'ICT Co-evolution and Korean ICT strategy—An analysis based on patent data'. Telecommunications Policy, 33, 5, 253-271.

[10] Chang, Z., Meng, Q. (2018) 'Mediation Analysis of Information Technology's Impact on Industrial Structure Optimization and Upgrading: Empirical Evidence from the Provincial Level in China'. Economic Theory and Business Management, 6, 39-50.

[11] Qi, Y., Xiao, X., and Cai, C. (2020) 'Digital Restructuring of Industrial Organizations'. Journal of Beijing Normal University (Social Sciences), 2, 130-147.

[12] Jin, Z. (2005) 'An Analysis of the Role of Information Technology in Industrial Structure Changes and Upgrades'. Modern Finance and Economics-Journal of Tianjin University of Finance and Economics, 25, 7, 74-77.

[13] Zhang, Y. (2018) 'Development Ideas and Main Tasks for the Digital Economy Driving the Transition of Industrial Structure towards the Middle and High Ends'. Economic Review Journal, 9, 85-91.

[14] Shen, Y., Li, J. (2020) 'Research on the Evaluation Index System of Rural Residents' Prosperous Life in China: Based on the Perspective of Building a Moderately Prosperous Society in an All-Round Way'. The World of Survey and Research, 1, 42-50.

[15] Song, Q. (2014) 'Preliminary Exploration of the Connotation, Characteristics, and Evaluation Indicators of China's Common Prosperity'. Globalization, 1, 35-47.

[16] Chen, Z., Zhang, N. (2013) 'Calculation Model and Empirical Analysis of Common Prosperity Based on Purchasing Power Parity'. Journal of Chongqing Technology and Business University (Natural Science), 30, 6, 1-5.

[17] Chen, L., Yu, J., Xu, I. (2021) 'The Construction of the Common Prosperity Index Model'. Governance Studies, 37, 4, 5-16.

[18] Li, X., Gao, X. (2021) 'Assessment of the Effectiveness of Dimensionless Methods'. Statistics and Decision, 37, 15, 24-28.

[19] Bai, P., Yu, L. (2021) 'Digital Economic Development and Enterprise Price Premium: Theoretical Mechanism and Empirical Facts'. China Industrial Economics, 11, 59-77.

[20] Zhao, T., Zhang, Z., and Liang, S. (2020) 'Digital Economy, Entrepreneurial Activity, and High-Quality Development'. Management World, 36, 10, 65-76.

[21] Zhang, X., Wan, G., Zhang, J., and He, Z. (2019) 'Digital Economy, Inclusive Finance, and Inclusive Growth'. Economic Research Journal, 54, 8, 71-86.

[22] Yang, W. (2022) 'Digital Economy Promotes High-Quality Development: Improving Production Efficiency and Expanding Consumption'. Journal of Shanghai University of Finance and Economics, 24, 1, 48-60.