Research on the Quality Improvement Effect and Mechanism of Digital Economy Driving Zhengzhou Real Economy

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Abstract: As an emerging economic model, digital economy can promote the real economy to recombine in factor composition, innovation mechanism and business model, and then improve its development quality. Based on the time-series data of Zhengzhou City from 2011 to 2022, the effect and internal mechanism of how the digital economy promotes the quality improvement of the real economy are deeply analyzed in terms of the impact effect and the mechanism of action. The results of the study show that, in terms of the overall effect, the digital economy has a significant role in promoting the quality of the real economy; in terms of the mechanism of action, enhancing the allocation efficiency of green resources and the innovation capacity of green technology can both enhance the pathway to the quality of the real economy in Zhengzhou City by promoting the development of the digital economy. Therefore, it is crucial to strengthen the construction of digital infrastructure and improve the data market and resource system, in order to give full play to the driving effect of the digital economy in improving the quality of the real economy of Zhengzhou City and to promote the real economy of Zhengzhou City to move towards the stage of high-quality development.

1. Introduction

The real economy constitutes the cornerstone of the modernized industrial system and is also an indispensable material support for the construction of Chinese-style modernization. Promoting the high-quality development of the real economy is an essential path to the goal of building a strong socialist modernizing country. The report of the 20th CPC National Congress emphasized that economic development should focus on the real economy and made specific plans for it, including accelerating the process of new industrialization and speeding up the pace of building a strong manufacturing country, a strong quality country, a strong aerospace country, a strong network country and a strong digital China. However, China's real economy is still facing challenges in its development, such as "comprehensive but lack of precision, large scale but weak strength", "imbalance in the distribution of resource factors", "slow pace of green and low-carbon transformation", etc. These factors have made it difficult for China to develop its real economy, and the country is still in the process of developing its real economy, and the country is still in the

process of developing its real economy. "To a certain extent, these factors impede the further improvement of the quality of the real economy.

With the onslaught of the fourth industrial revolution, the digital economy, led by key technologies such as artificial intelligence, big data and cloud computing, is rapidly emerging and has increasingly become a strong driving force for China's high-quality economic development. As an emerging economic model, the digital economy has demonstrated a high degree of innovation, strong penetration and wide coverage. With its rapid expansion, the linkage between the digital economy and the real economy is getting closer and closer, which will have far-reaching impacts on the reshaping of the factor allocation, innovation structure and business model of the real economy [1]. Under the trend of deep integration and development of the digital economy and the real economy, how to utilize the evolutionary trends and characteristics of the digital economy to boost the development quality of China's real economy has become the focus of academic attention. Based on the specific context of economic development in Zhengzhou City, this paper analyzes in-depth the impact effect of digital economy on the development quality of Zhengzhou City's real economy and its role mechanism, aiming to provide theoretical support and reference for the high-quality development of Zhengzhou City's real economy.

2. Research Design

2.1 Model Specification

First, in order to test the impact effect of the digital economy driving the quality improvement of the real economy in Zhengzhou City, an OLS econometric benchmark model is established:

$$real_t = \alpha_0 + \alpha_1 digital_t + \alpha_2 Z_t + \mu_t \tag{1}$$

Where real denotes the quality of real economic development in Zhengzhou city in year t, digital denotes the level of digital economic development in Zhengzhou city in year t, Z_t denotes a set of control variables, μ_t is a random perturbation term, and α_0-α_2 are the parameters to be estimated.

Second, in order to test the indirect effect of green resource allocation and green technology innovation in the process of quality improvement of the real economy driven by the digital economy, a mediation effect model is established:

$$mid_t = \beta_0 + \beta_1 digital_t + \beta_2 Z_t + \mu_t \tag{2}$$

$$real_t = \theta_0 + \theta_1 digital_t + \theta_2 mid_t + \theta_3 Z_t + \mu_t \tag{3}$$

In this context, *mid* stands for the collection of intermediary variables. β_1 represents the comprehensive effect of the digital economy on these intermediary variables. θ_1 denotes the direct influence that the digital economy exerts on the quality of Zhengzhou's real economy. Meanwhile, $\beta_1 \times \theta_2$ signifies the indirect effect of the digital economy's contribution to the improvement of Zhengzhou's real economy quality through these intermediary variables.

2.2 Selection of Variables

Explained variable: the quality of real economic development (real), through the construction of a comprehensive evaluation system of the quality of real economic development covering three aspects of real economic scale, structure and efficiency, and the use of principal component analysis and entropy value method to scientifically measure the quality of the development of the real economy of Zhengzhou City.

Explanatory variables: the level of digital economic development (digital), measured by taking the natural logarithm of the Peking University Digital Financial Inclusion Index at the prefecture-level city level.

Mediating variables (mid): (1) Green resource allocation (GR), selected to be measured by the Internet penetration rate [2]. (2) Green technological innovation (GA), selected to be measured by the green total factor productivity of Zhengzhou City in the past years.

Control variables Z: (1) The level of economic development (gdp), measured by the natural logarithm of the gross domestic product. (2)Population density (density), measured by the logarithmic form of population density. (3) The degree of openness (open), measured according to the total amount of imports and exports in the GDP.(4) The level of innovation investment (innovation) is chosen to measure the total R&D expenditures in the past years.

2.3 Data Description

All indicator data in this paper come from the Henan Statistical Yearbook, Zhengzhou Statistical Yearbook, and Henan Bureau of Statistics in previous years, and the indicator data cover the period of 2011-2022. All price data involved in this paper are accounted for as the real price in 2011 according to the GDP deflator of the past years. For individual missing values, this paper uses linear interpolation to fill in. The descriptive statistics of each variable are shown in Table 1.

Table 1 Descriptive statistics for each variable

variables	Observations	Mean	Std.deviation	Maximum	Minimum
real	12	0.682	0.299	1.174	0.307
digital	12	2.319	0.205	2.526	1.856
GR	12	0.111	0.053	0.197	0.048
GA	12	0.489	0.296	1.096	0.278
gdp	12	9.049	0.333	9.468	8.513
density	12	7.102	0.081	7.273	6.993
open	12	0.412	0.074	0.486	0.207
innovation	12	1.866	0.414	2.665	1.455

3. Empirical Analysis

3.1 Baseline Regression

In order to verify the impact of the digital economy on the quality of the real economy of Zhengzhou City, this paper examines the quality of the real economy of Zhengzhou City from the dimensions of comprehensive indicators and categorized indicators, respectively, and the specific results of the test are shown in Table 2.

As can be seen from Table 2, the impact coefficient of the digital economy on the comprehensive indicators of the quality of the real economy of Zhengzhou City is 0.231, and passed the test at the 1% significance level, which strongly proves that the development of the digital economy has a significant role in promoting the improvement of the quality of the real economy of Zhengzhou City. The digital economy, by providing traditional real enterprises with the impetus for transformation and development, has given birth to new industries and new business forms in the real economy and helped them to thrive, which in turn has rapidly improved the quality of the real economy. As a result, hypothesis test H1 is verified. From the perspective of the impact of the digital economy on the real economy classification indicators, first, the digital economy on the real economy of Zhengzhou City, the scale of the coefficient of influence of the digital economy reached 0.185, and

passed the test of 1% significance level, which indicates that the digital economy will significantly promote the rapid expansion of the scale of the real economy of Zhengzhou City. Secondly, the coefficient of the impact of digital economy on the structure of the real economy is significantly negative at the 5% level and the coefficient is -0.134, which indicates that the digital economy will hinder the optimization and adjustment of the structure of the real economy. Finally, the coefficient of the impact of the digital economy on the efficiency of the real economy is significantly positive at the 5% level of significance, and its coefficient is 0.129, which indicates that the digital economy will significantly promote the efficiency of the real economy in Zhengzhou City.

Table 2 Benchmark Regression Results

Variables	(1)	(2)	(3)	(4)
	Quality	Size	Structure	efficiency
digital	0.231***	0.185***	-0.134**	0.129**
	(7.534)	(6.192)	(-3.011)	(3.126)
gdp	0.361***	0.302***	0.456***	0.027
	(9.472)	(8.612)	(11.206)	(0.149)
density	0.431***	0.273**	0.169	0.035
	(4.058)	(3.926)	(0.947)	(0.420)
open	-0.182	-0.342*	-0.235	0.088
	(-1.180)	(-2.158)	(-1.533)	(0.424)
innovation	0.380**	0.150	0.146	0.108*
	(4.735)	(0.951)	(1.532)	(2.393)
Constant	-6.813	-10.512**	2.045	-0.120
	(-1.470)	(-3.134)	(1.011)	(-0.126)
N	12	12	12	12
R^2	0.981	0.993	0.918	0.942

Note: and * indicate significant at the 1%, 5%, and 10% levels, respectively; t-values are in parentheses.

3.2 Mechanisms of Action

In order to verify the mediating effect of green resource allocation and green technological innovation in the process of promoting the quality improvement of the real economy in the digital economy, the mediating effect model was used for regression analysis, and the test results are shown in Table 3.

From the aspect of green resource allocation, the coefficient of the digital economy's impact on green resource allocation is 0.219, and it passes the test at the 1% significance level, which indicates that the digital economy is able to promote the optimization of the allocation of green resources in Zhengzhou City. And the coefficient of the mediating effect of green resource allocation on the real economy of Zhengzhou City is 0.533 and passes the test at the 10% significance level, which indicates that the digital economy is able to optimize the allocation of green resources by improving the efficiency of the utilization of data elements, which in turn drives the enhancement of the quality of the real economy of Zhengzhou City, thus verifying the hypothesis H2.From the aspect of green technological innovation, the impact coefficient of digital economy on the green of Zhengzhou City is 0.219 and passes the test at the 1% significance level. technology innovation, the coefficient of influence of the digital economy on Zhengzhou city's green technology innovation is significantly positive at the 1% level, and the coefficient is 0.238, indicating that the digital economy will significantly promote the enhancement of Zhengzhou city's green technology innovation, and it has become an important driving force to promote the green

technology innovation in Zhengzhou city. The coefficient of the mediation effect of green technological innovation on the real economy of Zhengzhou City is positive at the 1% significance level, and the coefficient is 0.152, indicating that the digital economy broadens the access to green innovation resources by accelerating the flow of innovation resources, which in turn enhances the level of green technological innovation and positively influences the enhancement of the quality of the real economy, thus verifying the hypothesis H2.

<div align="center">Table 3 Mediated effects test results</div>

Variables	(1)	(2)	(3)	(4)	(5)
	real	GR	real	GA	real
digital	0.231***	0.219***	0.098**	0.238***	0.152***
	(7.534)	(6.285)	(2.579)	(4.104)	(4.185)
GR			0.533*		
			(2.082)		
GA					0.136***
					(4.053)
gdp	0.361***	0.232*	0.879***	0.222	0.391*
	(9.472)	(2.084)	(10.957)	(1.149)	(3.419)
density	0.431***	-0.018*	0.528**	0.292	0.392*
	(4.058)	(2.347)	(7.598)	(0.696)	(3.582)
open	-0.182	0.130***	-0.874	0.729**	-0.281
	(-1.180)	(4.052)	(-1.001)	(2.424)	(-0.257)
innovation	0.380**	0.031	0.212*	0.893**	0.258
	(4.735)	(1.122)	(2.101)	(2.393)	(0.792)
Constant	-6.813	-1.467**	1.019	-0.994	-6.678
	(-1.470)	(-2.48)	(0.193)	(-0.126)	(-1.351)
N	12	12	12	12	12
R^2	0.981	0.990	0.989	0.942	0.982

Note: and * indicate significant at the 1%, 5%, and 10% levels, respectively; t-values are in parentheses.

4. Conclusions

This study empirically analyzes the effect and mechanism of the digital economy to promote the quality of the real economy of Zhengzhou City from the perspectives of the impact effect and the mechanism of action, and the conclusions are as follows: (1) The digital economy will boost the quality of the real economy, specifically, every 1% increase in the level of the digital economy will lead to the quality of the real economy of Zhengzhou City to improve by 0.231%. (2) The digital economy drives the improvement of the quality of the real economy in Zhengzhou City by enhancing the efficiency of green resource allocation and the level of green technological innovation.

Based on the above conclusions, this paper puts forward the following policy recommendations: Firstly, the construction of digital infrastructure should be strengthened to create a solid external environment for the digital economy and promote the play of economic externalities, with the aim of deepening the degree of integration between digital technology and industries and accelerating the digital transformation process of industries, so as to guarantee the balanced development of the real economic structure, and to ensure that the digital economy can effectively lead and drive the development of the real economy. In order to promote the sustained and healthy development of the real economy, we must work hard to promote the positive interaction between the real economy and related industries, and ensure that they can promote and support each other [3]. Second, build and

optimize the data market system and data resource framework, fully release the inherent potential of data elements, so as to ensure that data elements play a key driving role in the real economy. Utilizing the power of data to advance the digital transformation of the real economy, we can strengthen cooperation and foster mutual progress among enterprises, thereby enhancing green total factor productivity [4]. Thirdly, we should promote the shift of real enterprises towards green innovation, expanding the green growth trajectory of the real economy. With the help of green financial tools and credit support, it provides financial backing for green innovation projects of real enterprises and leads the real economy in the direction of green and sustainable development. During this procedure, the dependence on technological advancement significantly boosts the high-quality development of actual businesses. Fourth, we need to advance the utilization of digital technologies within actual businesses, incorporating advanced technologies such as big data, cloud computing, and artificial intelligence. This integration aims to infuse new vitality into the tangible economy, boost its scale and operational efficiency, and elevate its value-added [5]. Ultimately, we need to foster the digital transformation and enhancement of tangible industries. We need to leverage the strength of the digital economy to spearhead comprehensive innovation and refinement across production, manufacturing, consumer services, and other sectors. Concurrently, we need to cultivate and expand new digital industry clusters, thereby comprehensively advancing the deep integration and synergistic growth of the digital economy with the tangible economy.

Acknowledgements

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