

DO DIGITAL ECONOMY AND COLLABORATIVE GOVERNANCE OF DIGITAL ECONOMY AFFECT THE HIGH-QUALITY URBAN DEVELOPMENT?

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Received June 2023; revised September 2023

ABSTRACT. *In this paper, 216 prefecture-level cities from 2015 to 2020 were taken as samples. Fixed effect regression method was adopted to study the influence of the development level of digital economy on the high-quality development of urban economy. On this basis, this paper discusses the moderating effect of the level of collaborative governance of digital economy in the variables, and conducts further analysis according to heterogeneity. The research shows that the development level of digital economy has a positive effect on the high-quality development of cities. The collaborative governance of digital economy has a moderating effect on the relationship between the development level of digital economy and the high-quality development of cities.*

Keywords: Digital economy, High quality development, Regulation effect, Collaborative governance of digital economy

1. **Introduction.** At present, China's digital economy scale has been the second largest in the world for many years. In 2020, China's digital economy reached 4.1 billion yuan, with the fastest growth rate in the world. The digital economy has become a new driving force for China's economic growth, making important contributions to expanding domestic demand, boosting consumption, promoting investment and creating more jobs [1]. The concept of digital economy was first put forward by economist [2] in his book *Digital Economy*. Since then, studies have focused on the Internet, digital technology and its related applications [3], and the impact on the transformation of production relations [4]. In the aspect of studying the relevance of the application of digital economy to economic growth, experts and scholars believe that big data will promote the upgrading of enterprise management and the transformation of enterprise managers' social capital [5], and digital economy can carry out innovation through the integration of "scope economy" and "scale economy" at micro, mesoscale and macro levels. Achieve the effect of changing the market structure and expanding the boundary of economic allocation of resources [6].

However, at the same time, governance problems such as platform monopoly, digital divide and data ethics have emerged in the digital economy, which have seriously affected the sustainable development of China's digital economy. Zhao and other scholars [7] believe that when the governance model is reasonable, the government can maintain the normal order of the digital economy market and stimulate the innovation vitality of enterprises through legislation and the establishment of a comprehensive supervision system. In the

aspect of platform monopoly, the government should update the judgment criteria of monopoly and strengthen anti-monopoly measures to cope with new monopoly technologies. Enterprises should supervise other enterprises while improving their own awareness of data protection. Individual users can also take an active part in the governance of the digital economy.

However, no scholars have yet linked governance with the digital economy to explore the practical role of governance in the digital economy for high-quality development. In this paper, 216 prefecture-level cities and above across China from 2015 to 2020 are taken as samples, and fixed-effect regression analysis is adopted to determine the impact of the development level of digital economy on the high-quality development of urban economy. Then, the moderating effect of the level of collaborative governance of digital economy on the relationship between digital economy and high-quality urban development is discussed. From the research results, we find that (a) the development level of digital economy has a positive effect on high-quality urban development; (b) the collaborative governance of digital economy has a moderating effect on the relationship between the development level of digital economy and high quality urban development.

The innovation of this study is as follows. 1) The evaluation index of urban digital economy collaborative governance is constructed. 2) This paper examines the impact of the level of collaborative digital economy governance on the relationship between the digital economy and high-quality urban development. 3) It provides an empirical basis for the effect mechanism of digital economy on the high-quality development of urban economy. In Section 2, this paper puts forward the research hypothesis. In Section 3, the research design and sample selection of this paper are presented. In Section 4, the results of the empirical analysis are revealed and discussed. Finally, the fifth part presents the conclusion of this paper and suggestions for future research.

2. Hypothesis Development. The connection between digital economy and high-quality urban development can be considered from both micro and macro aspects [8]. At the micro level, the clustering effect of digital economy makes enterprises producing the same or similar products scale up, and the positive feedback of network externalities promotes the continuous expansion of user scale, forming economies of scale. At the same time, the specialized division of labor leads to the diversification of products, which in turn produces economies of scope and generates huge economic benefits under the effect of the long tail effect. At the macro level, it is mainly considered from the economic growth model of Robert Merton Solow. The matching mechanism better allocates production factors to different production sectors and ensures the efficiency of production. The second is to change the way and efficiency of resource allocation, which is mainly reflected in the change or addition of a new production function in the digital economy [9]. Various changes in the digital economy make the production function more unclear compared with the traditional theoretical economy, but essentially increase the marginal output of production factors. Finally, TFP is changed through technological progress. On the one hand, technological innovation greatly improves production efficiency. On the other hand, due to the development of new business models such as sharing economy, the barriers for small and medium-sized enterprises to enter the industry have been lowered, which has boosted the high-quality economic development.

Hypothesis 1. The development of digital economy has a positive effect on the high-quality development of urban economy. The relationship between digital economy governance and high-quality development can first be broken down into the relationship between digital economy development and high-quality development. The presence of governance issues can seriously hinder the digital economy's role in enhancing quality development.

Only by eliminating various digital economy governance problems can the digital economy fully play its role in promoting high-quality development.

When the governance capacity is lacking or the governance model is unreasonable, it has the following adverse effects on high-quality development. First, platforms occupying monopolistic positions hinder the entry of emerging enterprises, platform monopoly is intensifying, and large platforms resist each other and compete maliciously, hindering fair competition and affecting market vitality. Second, the data divide further expands, and it is difficult for different regions and different generational groups to have fair access to the dividends and new development opportunities of digital economy development, and the degree of digital economy development and economic disparity further expands [10]. Third, enterprises are driven by interests to use user data for illegal sale and dissemination, resulting in personal privacy leakage and social panic. This leads to hypothesis 2.

Hypothesis 2. Digital economy governance capabilities can enhance the digital economy's role in quality development.

3. Research Design.

3.1. Sample selection and data sources. This paper conducted research on 216 prefecture-level cities and above in China from 2015 to 2020, and formed the balanced panel data of 1,296 city-years. Except the number of patents granted per capita from China Patent database, the rest data are from China City Statistical Yearbook and some prefecture-level city Statistical Yearbook. The missing values of some prefecture-level cities were supplemented by interpolation method.

3.2. Selection and measurement of research variables.

3.2.1. The variable of the level of high-quality economic development. Referring to the practice of Chen and Chen [11], the total factor productivity measured by Malmquist index method of DEA is used to represent the level of high-quality economic development, which is denoted as TEP. In this paper, the actual GDP of each prefecture-level city is selected as the output variable, which is obtained by deflating nominal GDP by the GDP deflator of each municipality. Employees and capital stock of the whole society are used as input variables. Among them, the capital stock is calculated by referring to Zhang et al.'s [12] perpetual inventory method, which adopts the depreciation rate of 9.6%.

3.2.2. Digital economic variables. At present, there is no unified standard for the measurement of digital economy. In this paper, Zhao et al. [13] are referred to measure the development level of digital economy from two dimensions: The development of the Internet is measured by the number of mobile phone users per 100 people, the number of Internet broadband access users per 100 people, the proportion of employees in the information transmission, computer service and software industries, and the per capita income from telecom business. Digital financial inclusion is represented by the China Digital Financial Inclusion Index. After fitting the above five indexes with entropy value method, the urban digital economy development index obtained is denoted as DEL.

3.2.3. The variable of collaborative governance of digital economy. Collaborative governance is not a single subject, but a balance achieved through the joint action and coordination of multiple subjects. This paper constructs the collaborative governance of digital economy from three perspectives: government, society and market. Referring to the existing literature, the government level adopts two indicators of government size and government scientific research input, which are expressed by the proportion of public budget expenditure of urban government in the city's regional GDP and the proportion

of fiscal science expenditure in the general budget expenditure. At the social level, the educational level of human capital and the ability of social innovation and research and development are respectively represented by the number of university students and the number of patents granted per capita in prefecture-level cities. At the market level, the actual total retail sales of the whole society in each region is used to measure the market size. After the above five indicators are fitted by entropy method, the collaborative governance level of digital economy in prefecture-level cities is obtained, denoted as CGL.

3.2.4. Control variables. Considering the influence of other factors on the high-quality development of urban economy, on the basis of referring to the existing literature, this paper selected the following four control variables: fiscal decentralization (Finadp): it is expressed by the ratio of revenue within the fiscal budget to expenditure within the fiscal budget; Urbanization level (Urban): represented by the logarithm of population density; Finance: expressed by the ratio of deposits and loans to the gross regional product; Upgrading of industrial structure (ISU): It is expressed by the ratio of output value of tertiary industry to secondary industry.

3.3. Research model. To verify the above research hypothesis, the following panel fixed effect model is first constructed to test the direct effects of digital economy on high-quality urban development. In Formula (1), $TEP_{i,t}$ is the high quality economic development level, $DEL_{i,t}$ is the digital economic development level index, and vector $Z_{i,t}$ represents a series of control variables. μ_i represents the individual fixed effect of city that does not change with time, and δ_t controls the time fixed effect. $\varepsilon_{i,t}$ denotes the random disturbance term. a_0, a_1, a_2, a_3, a_c are all correlation coefficients. In addition to Equation (1), the following model is constructed to test whether the interaction term between the development degree of digital economy and the level of collaborative governance of digital economy has a regulating effect according to what has been mentioned in Formula (2):

$$TEP_{i,t} = a_0 + a_1 DEL_{i,t} + a_c Z_{i,t} + \mu_i + \delta_t + \varepsilon_{i,t} \quad (1)$$

$$TEP_{i,t} = a_0 + a_1 DEL_{i,t} + a_2 DEL * CGL + a_3 CGL + a_c Z_{i,t} + \mu_i + \delta_t + \varepsilon_{i,t} \quad (2)$$

4. Empirical Analysis.

4.1. Descriptive statistics. Table 1 lists the descriptive statistical results of the main variables, among which the mean and standard deviation of high-quality economic development are 0.338 and 0.132, and the maximum and minimum values are 1.164 and 0.0563, respectively. The mean and standard deviation of the development level of digital economy are 0.189 and 0.103 respectively, and the maximum and minimum values are 0.806 and 0.0313 respectively, indicating that there is a certain gap between the digital economy and the high quality development level among prefecture-level cities.

TABLE 1. Descriptive statistics for the full sample

Variables	N	mean	sd	min	max
TEP	1,296	0.338	0.132	0.0563	1.164
DEL	1,296	0.189	0.103	0.0313	0.806
CGL	1,296	0.135	0.121	0.0148	0.697
Finadp	1,296	57.09	31.51	2.781	839.0
Urban	1,296	509.9	466.6	5.750	8,828
Finance	1,296	2.752	1.308	0.910	21.30
ISU	1,296	1.187	0.570	0.364	5.350

4.2. Regression analysis. Correlation analysis and collinearity test were conducted on variables before regression, and Vif was all less than 10, indicating that there was no serious collinearity between variables. Hausman test was performed on the model, and $p < 0.05$ rejected the null hypothesis, and fixed effect model was applied. The estimated coefficient of the core explanatory variable in Column (1) of Table 2, digital economy development level (DEL), is significantly positive, and digital economy has a positive effect on high-quality economic development at the city level. In addition, after adding control variables, the estimated coefficient of the digital economy development level (DEL) is still significantly positive. In Column (2) of Table 2, using mixed regression, the influence coefficient of the digital economy on high-quality development is 0.256 and passes the significance test at the 1% level. Column (3) is the fixed-effect model controlling for time and city, which has an impact coefficient of 0.279 and passes the significance test at 1% level. Hypothesis 1 is empirically supported by the above conclusions. In order to verify the influence of digital economic collaborative governance on the high-quality urban development of digital economy, the moderating effect model is selected for verification in this paper. The regression results are shown in Column (4) and Column (5) of Table 2.

TABLE 2. The impact of DEL on TEP and the moderating effect of CGL

	OLS (1)	OLS (2)	FE (3)	(4)	(5)
	TEP	TEP	TEP	Model4	Model5
DEL	0.371*** (0.034)	0.256*** (0.044)	0.279*** (0.046)	-0.1511** (0.0675)	-0.0544 (0.0548)
CGL				0.1934** (0.0752)	0.3286*** (0.0501)
Finadp		0.000*** (0.000)	0.000*** (0.000)		
Urban		0.000*** (0.000)	0.000*** (0.000)		
Finance		-0.019*** (0.004)	-0.019*** (0.004)		
ISU		0.047*** (0.008)	0.054*** (0.008)		
DELCGL				0.7144*** (0.2015)	
DELCGL_c					0.7144*** (0.2015)
_cons	0.268*** (0.007)	0.237*** (0.010)	0.230*** (0.010)	0.3155*** (0.0116)	0.2972*** (0.0083)
N	1,296	1,296	1,296	1,296	1,296
r2	0.083	0.145	0.157	0.1439	0.1439
r2_a	0.082	0.141	0.151		

t-statistics in parentheses

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

In order to verify the influence of digital economy collaborative governance on high-quality urban development, this paper establishes the interaction term DELCGL of digital economy and digital economy collaborative governance. Results are shown in the Column (4) after the addition of the interaction term, the influence coefficient of DELCGL is 0.7144 and significant at the level of 1%, but the originally significant main effect is no longer

significant. It is considered that there may be covariance problems among the variables. Referring to the practice of most scholars, this paper decentralizes the variables. The results are presented in the Column (4). After the decentralization of the two variables of the interaction term, get DELCGL_c. The influence coefficient of the interaction term is still significant at the 1% level, but the main effect is not significant. Baron and Kenny [14] point of view is considered that the significant interaction term means the existence of the regulatory effect. Since the interaction term coefficient is positive, the collaborative governance of digital economy has a positive moderating effect on the relationship between the development level of digital economy and the high-quality development of the city. Improving the collaborative governance ability of urban digital economy has a promoting effect on the relationship between digital economy and the high-quality development of the city. It can be concluded that the enhancement of the collaborative governance capacity of the government, society and market in prefecture-level cities can enhance the promoting effect of digital economy on high quality development.

4.3. Robustness test. In this paper, the robustness test was conducted by replacing the explained variables. The total factor productivity measured by Malmquist index method of DEA was replaced by the stochastic frontier production model (SFA), and OLS mixed regression and fixed effect model were carried out. The results are shown in the table below. The influence coefficient of Column (1) digital economy on high-quality development is 0.345, and that of Column (2) is 0.376. Both pass the significance test at the level of 1%, which is consistent with the above empirical conclusions and supports hypothesis 1. In Column (3) and Column (4) of Table 3, before and after decentralization, the interaction terms are always significant at the 1% level, which supports hypothesis 2.

TABLE 3. Robustness test

	OLS (1)	FE (2)	(3)	(4)
	TEP	TEP	Model3	Model4
DEL	0.345*** (0.042)	0.376*** (0.044)	-0.1511** (0.0675)	-0.0544 (0.0548)
CGL			0.1934** (0.0752)	0.3286*** (0.0501)
Finadp	0.000*** (0.000)	0.000*** (0.000)		
Finance	-0.019*** (0.004)	-0.020*** (0.004)		
ISU	0.045*** (0.008)	0.051*** (0.008)		
DELCGL			0.7144*** (0.2015)	
DELCGL_c				0.7144*** (0.2015)
_cons	0.246*** (0.010)	0.240*** (0.010)	0.3155*** (0.0116)	0.2972*** (0.0083)
N	1,296	1,296	1,296	1,296
r2	0.119	0.130	0.1439	0.1439
r2_a	0.116	0.124		

t-statistics in parentheses

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

4.4. Suggestions.

1) Actively build a digital China and promote the development of urban digital economy. The government should improve digital economy infrastructure, increase talent introduction and protection of the digital industry, and provide policy support to related industries to lay a foundation for subsequent development. Enterprises should actively innovate, integrate government and enterprise digital technologies through government-enterprise cooperation, and establish a government-enterprise data cooperation and sharing mechanism.

2) First, improve the basic system of collaborative digital economy governance, improve the legal system and strengthen local legislation. Secondly, to clarify the functions and responsibilities of each governance body, the government should clarify its own responsibilities in the digital economy governance of multiple subjects, and should act as a “guide” rather than a “leader”; enterprises, because they have the advantages of technology and talents, should take greater responsibility in the digital economy governance; the community should participate widely, and users can use existing websites, software and other programs to participate in the governance. Enterprises should take greater responsibility in digital economy governance because they have the advantages of technology and talents; the society should be widely involved, and users can participate in governance by using the existing official websites and software. Finally, we should strengthen the legislation and supervision of the digital economy, set up a comprehensive coordination and supervision mechanism, and establish a comprehensive supervision system from government legislation, enterprise self-inspection to user supervision.

5. Conclusion. Based on 216 prefecture-level cities and above in China from 2015 to 2020 as samples, this paper adopts fixed-effect regression analysis method to study the influence of the development level of digital economy on the high quality development of urban economy. The results show that 1) the development level of digital economy has a positive effect on the high quality development of cities; 2) the collaborative governance of digital economy has a moderating effect on the relationship between the development level of digital economy and the high-quality development of cities.

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