

# Analysis the Mechanism of Digital Economy Development on Urbanization Development

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**Abstract**—Based on the panel data from 2015 to 2021 of 31 provinces in China, this article empirically explores how the impact mechanism of digital economy development level on new urbanization, and explores the mediating effect of rationalization of the tertiary industry structure. The results show as following. (1) The level of digital economy development has a positive impact on new urbanization, which is still significantly valid after robustness test. (2) The rationalization of the tertiary industry structure plays a partial mediating role in the impact of digital economy development on the level of new urbanization, that is, the development of the digital economy indirectly affects new urbanization through the path of rationalization of the tertiary industry structure. (3) The quantile regression analysis of the relationship between regional digital development level and new urbanization development level indicates that the development level of the digital economy has a promoting effect on the development level of new urbanization, but this effect shows differently in different regions.

**Keywords**—new urbanization, development of digital economy, mediation effect, quantile regression

## I. INTRODUCTION

In the era of the development of digital economy, the development of new urbanization is facing new changes. This is because the new urbanization combined with the development of digital economy promotes the flow of people and reduces production costs simultaneously. Specifically, the development of new urbanization become more perfect for the construction of logistics network due to the support of digital economy technology. The integration of technology combines with the city that is a smart city, which is built on big data, Internet technology and intelligent technology. These intelligent technologies will improve the production efficiency of the industry greatly and promote the transformation and upgrading of the industry. This is driven by digital economy technology. That is with the intelligent upgrading and structural improvement of the industry, this will promote the development of new urbanization. The idea of smart city will widespread popularity in all walks of life, such as the medical, transportation, logistics, finance, that is, to promote the development of various industries and promote the sustainable development of the industry.

This paper deals with the following key questions: If the digital economy and new urbanization are compatible through intelligent technology and big data, can the development of the digital economy bring a positive role in promoting the development of urbanization? If this effect is confirmed, what is the mechanism of action behind it? What is the relationship between the development of digital economy and urbanization in various regions? The result

would be given in this study by using the regression model, mediation effect model and quantile regression.

## II. LITERATURE REVIEW AND RESEARCH HYPOTHESES

The development of digital economy can promote the rational flow of resources and the rational and effective allocation of resources, which can bring certain benefits to the development of new urbanization, that is, to promote the flow of resources in cities and accelerate the transformation and upgrading of cities.

### A. Theory between the Development Level of Digital Economy and New Urbanization Review Stage

According to the view of economic theory, technology can improve the efficiency of the allocation of labor, capital and other resources. For instance, the structure of the industry could be optimized due to the injection of the Internet of things, big data, artificial intelligence. This makes the industry operates more intelligently and automatedly. This improves the flow and allocation of means of production between regions (Chen *et al.*, 2022). Specifically, with the support of these digital technologies, the efficiency of workers' operation has been improved and the optimization of the industry has been promoted. Moreover, the benefits brought by the development of digital economy promote the development of urbanization. The development of urbanization level is related to the optimization of industry. Then, the transformation and development of the industry brought about by the development of digital technology will promote the development of new urbanization. Based on this, this paper proposes the first hypothesis.

Hypothesis 1 (H1): Digital economy has a significant positive impact on new urbanization.

### B. Indirect Effect of Digital Economy Development and New Urbanization Development Level

The development of digital economy needs to realize the rapid flow of production means such as logistics, information flow and capital flow through certain "media" to promote the development of new urbanization. Under the influence of digital economy, digital technology is injected into the development of industrial service industry (Guo & Ma, 2023). For example, digital technology is added to the logistics industry, thus the logistics industry would operate automatedly and manage intelligently and improve the operation efficiency of enterprises. For instance, smart tourism. This is the combination of digital technology and tourism. Specificities tourism combines with technology of VR, blockchain, metauniverse and other core technologies, thus, these industries optimize the allocation of resources by

introducing data technology. These are examples of “digital technology+service industry”, which belong to the category of tertiary industry. The development of tertiary industry plays an important role in the economic development of cities. The combination of the tertiary industry with digital technology has accelerated the flow of factors between cities, improved the production efficiency of industries, accelerated the transformation and upgrading of industries, and thus improved the development level of cities. Therefore, the second hypothesis is put forward.

Hypothesis 2 (H2): The rationalization of tertiary industry structure plays an indirect role between the development of digital economy and the development level of new urbanization.

### C. Digital Economy Development and New Urbanization Level in Different Regions

Different regions have different levels of economic development, resources, talent accumulation, science and technology investment and other factors, so different regions have different levels of digital economic development. The development level of digital economy in the area with more developed cities will be higher, so the level of urbanization will also be improved. Therefore, hypothesis H3 is proposed.

Hypothesis 3 (H3): There are regional differences in the level of digital economy promoting new urbanization

## III. RESEARCH DESIGN

### A. Benchmark Regression Model

To empirically analyze the impact of digital economy on urbanization, a benchmark regression model is set to verify the direct effect. The model is as follows:

$$City\_index_{it} = \alpha_0 + \alpha_1 Dig\_index_{it} + \sum_{c=1}^n Controls + \varepsilon_{it} \quad (1)$$

Among the models set, City\_index represents the new urban development level index, Dig\_index represents the digital economy development level index, Controls represents some control variables in the model, i represents provinces, t represents years,  $\varepsilon_{it}$  stands for random error term.

### B. Mediation Effect Model

The setting of the mediation model is based on the model established in (1) to construct the mediation model.

$$Serscale_{it} = \beta_0 + \beta_1 Dig\_index_{it} + \beta_2 \sum_{c=1}^n Controls + \varepsilon_{it} \quad (2)$$

$$City\_index_{it} = \delta_0 + \delta_1 Dig\_index_{it} + \delta_2 Serscale_{it} + \delta_3 \sum_{c=1}^n Controls + \varepsilon_{it} \quad (3)$$

In the set model, Tertiary industry represents the mediating variable, represents the rationalization of the tertiary industry structure, and City\_index represents the development level index of new cities, Dig\_index represents the level of digital economic development index, Controls represents some control variables in the model, i represents provinces, and t represents years,  $\varepsilon_{it}$  represents the random error term.

### C. Quantile Regression Model

To verify the relationship between the development level of digital economy and the level of new urbanization among the eastern, central, and western regions, the following model is set up and quantile regression analysis is conducted.

$$City\_index_{it} = \gamma_0 + \gamma_1 Dig\_index_{it} + \varepsilon_{it} \quad (4)$$

In the set model, City\_Index represents the development level index of new cities, Dig\_index represents the level of digital economic development index, where i represents provinces and t represents years,  $\varepsilon_{it}$  represents the random error term.

## IV. VARIABLE

### A. Explanatory Variable

New City Development Level Index (City\_index). Regarding the construction of this index, this article refers to measurement indicators from currently available literature for reference (Peng & Feng, 2023). And use the entropy method to calculate the level of digital economy development index in various provinces of China, with the following measurement indicators.

Table 1. Measurement indicator of explanatory variable

Measurement indicator	Symbol	Weights (%)
Gross regional product per capita (yuan/person)	+	24.64%
General budget revenue of local governments (100 million yuan)	+	29.90%
Urbanization level of each province	+	6.56%
Per capita disposable income of urban residents (yuan)	+	24.71%
Per capita urban road area (square meters)	+	8.04%
Per capita green park area (square meters/person)	+	6.15%

“+” Represents the attribute as positive

### B. Core Explanatory Variable

Table 2. Measurement indicator of core explanatory variable

Measurement indicator	Symbol	Weights (%)
Mobile phone exchange capacity (10,000 households)	+	6.92%
Long-distance optical cable line length (10,000 kilometers)	+	6.07%
Internet broadband access ports (10,000)	+	7.91%
Number of websites per 100 companies (number)	+	1.69%
Proportion of enterprises with e-commerce transaction activities (%)	+	5.63%
E-commerce sales (100 million yuan)	+	18.87%
Mobile phone penetration rate (per hundred people)	+	4.30%
Internet penetration rate	+	3.63%
Total telecommunications business volume (100 million yuan)	+	15.55%
Digital Financial Inclusion Index	+	5.30%
Total postal business volume (100 million yuan)	+	24.13%

V. “+” REPRESENTS THE ATTRIBUTE AS POSITIVE

Digital Economy Development Level Index (Dig\_index). There is no unified conclusion in the academic community regarding the indicator construction system of the digital economy. This article uses the entropy method to calculate the development level of the digital economy index in various provinces of China for reference from existing research indicators (Qian, 2023; Zhu & Sun, 2023). The specific indicators are shown in the Table 2.

A. Mediating Variable-Tertiary Industry Rationalization

The impact of the digital economy on new urbanization has an indirect effect. This article selects the rationalization of the tertiary industry structure as an intermediary variable for empirical research on the indirect effect. Referring to the indicator of (Feng, 2018), the proportion of the added value of the tertiary industry to the GDP of each region is calculated.

B. Control Variable Selection and Measurement Methods

Table 3. Measurement of control variable

Control variable	Variable abbreviation	Measurement
Technological innovation	Crea	Number of domestic patent applications granted in China (items)
Research investment intensity	Techinvest	R&D expenditure/regional GDP
Opening level	Opening_level	Amount of foreign direct investment
Degree of government intervention	GI	Local fiscal general budget expenditure/regional GDP
Financial development level	FD	Balance of deposits and loans of financial institutions/regional GDP

The control variables selection reference by (Peng & Feng, 2023; Zhu & Sun, 2023).

VI. DATA SOURCES AND DESCRIPTIVE STATISTICS

The confirmation of the starting point of China’s digital economy development can be regarded as starting from 2015, which is based on the continuous emergence of relevant policies referring to “Internet plus”. The word “digital economy” did not appear in the government work report until 2017 (Liu *et al.*, 2020). Therefore, this paper will start the research from 2015 when selecting the research time point. This article selects panel data from 2015–2021 from 31 provinces in China (the data excluding Hong Kong, Macao, and Taiwan) for empirical research. The data comes from the National Bureau of Statistics of China, China Statistical Yearbook, China Science and Technology Statistical Yearbook, and People’s Bank of China. The Digital Finance

Index is sourced from the official website of the Digital Finance Research Center of Peking University. The descriptive statistical results of each variable are shown in Table 4.

Table 4. Descriptive statistical analysis

Variable abbreviation	Variable description	Sample size	Mean	Max	Min
Dig_index	Digital economy index	217	0.179	0.761	0.055
City_index	New urban development index	217	0.297	0.733	0.086
Crea	Technological innovation	217	83391.88	872209	198
Techinvest	Research investment intensity	217	0.019	0.065	0.002
Opening_level	Opening level	217	86.425	288.53	0.032
GI	Degree of government intervention	217	0.289	1.354	0.105
FD	Financial development level	217	5.457	61.694	0.268
Tertiary industry	Rationalization of the structure of the tertiary industry	217	0.521	0.837	0.399

VII. EMPIRICAL RESULTS ANALYSIS

According to the Hausman test result, this article uses a fixed effects model for empirical research. Regression coefficient of Dig\_index is significantly given by regression result of the model (1)–model (6), indicating that the development of the digital economy has a significant positive promoting effect on the development of new urbanization as the result shown in Table 5. Specifically, from model (2)–model (6), as control variables are added one by one, the impact of digital economy development on the development of new urbanization is always positive and significant at the 1% level. Model (6) represents the result of adding all control variables to the model. Therefore, hypothesis H1 is validated. Additionally, to ensure validate hypothesis H1 and the reliability of the results, this paper adopts the method of changing the construction of the new urbanization development level index for further validation. After standardizing the relevant indicators of the constructed new urbanization development level index, principal component analysis is performed. The detailed regression results are shown in column (7) of the table below, the regression coefficient of the digital economy development index is significant at the 1% level, which proves the robustness of the conclusion.

Table 5. Benchmark regression model results

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Dig_index	0.831** (20.227)	0.711** (13.567)	0.611** (11.323)	0.606** (11.267)	0.527** (11.891)	0.527** (11.860)	4.704** (11.796)
Crea		0.000** (3.548)	0.000** (2.961)	0.000** (3.071)	0.000** (3.989)	0.000** (3.987)	0.000* (2.526)
Techinvest			5.552** (4.704)	5.745** (4.858)	5.420** (5.659)	5.429** (5.656)	50.752** (5.889)
Opening_level				-0.000 (-1.546)	-0.000 (-0.851)	-0.000 (-0.862)	-0.000 (-0.806)
GI					-0.572** (-9.837)	-0.563** (-9.352)	-5.341** (-9.880)
FD						-0.000 (-0.603)	-0.002 (-0.636)
Constant	0.148** (19.324)	0.155** (20.203)	0.070** (3.608)	0.078** (3.897)	0.257** (10.547)	0.255** (10.415)	-0.260 (-1.184)
R <sup>2</sup>	0.952	0.955	0.960	0.961	0.974	0.975	0.975
N	217	217	217	217	217	217	217

\* p < 0.05 \*\* p < 0.01 The values in brackets are t value

Table 6. Results of mediating effect mechanism

	City_index	Tertiary industry	City_index
Constant	0.079** (5.605)	0.342** (33.433)	-0.047 (-1.367)
Crea	0.000* (2.345)	-0.000** (-4.763)	0.000** (3.557)
Techinvest	5.588** (12.363)	6.268** (19.146)	3.277** (4.530)
GI	-0.024 (-0.929)	0.130** (6.816)	-0.072* (-2.575)
FD	0.000 (0.670)	0.001** (2.725)	-0.000 (-0.058)
Opening_level	0.000 (0.616)	-0.000** (-3.290)	0.000 (1.508)
Dig_index	0.570** (7.464)	0.328** (5.934)	0.449** (5.633)
Tertiary industry			0.369** (4.005)
R <sup>2</sup>	0.849	0.733	0.86
Adjustment R <sup>2</sup>	0.845	0.726	0.855
F-value	F (6,210) =197.019, p=0.000	F (6,210) =96.154, p=0.000	F (7,209) =183.262, p=0.000
Total effect		0.57	
Mediating effect		0.121	
Direct effect		0.449	
Effect proportion		21.226%	

\* p < 0.05 \*\* p < 0.01 The values in brackets are t value

Table 7. Analysis of regional differences quantile regression results

	Quantile 0.10	Quantile 0.20	Quantile 0.30	Quantile 0.40	Quantile 0.50	Quantile 0.60	Quantile 0.70	Quantile 0.80	Quantile 0.90
Constant	0.070** (5.144)	0.059** (5.083)	0.063** (6.309)	0.075** (7.613)	0.076** (7.651)	0.072** (7.034)	0.065** (5.825)	0.058** (4.120)	0.099** (6.357)
Dig_index	0.781** (10.772)	0.963** (16.460)	1.055** (21.081)	1.076** (22.237)	1.144** (23.902)	1.282** (26.746)	1.448** (27.930)	1.668** (25.598)	1.703** (24.983)
Sample	217	217	217	217	217	217	217	217	217
Constant	0.120* (2.314)	0.120** (2.776)	0.126** (3.099)	0.157** (4.256)	0.188** (5.329)	0.217** (6.133)	0.214** (6.351)	0.205** (6.487)	0.196** (8.450)
East_dig_index	0.707** (3.530)	0.846** (5.226)	0.917** (6.169)	0.890** (6.759)	0.875** (7.154)	0.896** (7.449)	1.109** (10.056)	1.290** (12.747)	1.401** (19.441)
Sample	77	77	77	77	77	77	77	77	77
Constant	0.067** (2.745)	0.073** (3.238)	0.083** (4.797)	0.086** (5.306)	0.086** (5.423)	0.087** (5.776)	0.087** (5.832)	0.079** (5.033)	0.068** (3.983)
Mid_dig_index	0.837** (5.108)	0.860** (5.798)	0.941** (8.217)	0.972** (9.270)	0.998** (9.723)	1.036** (10.741)	1.096** (11.625)	1.228** (12.567)	1.387** (12.925)
Sample	56	56	56	56	56	56	56	56	56
Constant	0.057 (1.829)	0.066* (2.472)	0.064* (2.594)	0.074** (3.259)	0.099** (4.599)	0.123** (5.886)	0.133** (5.587)	0.134** (6.580)	0.138** (6.478)
West_dig_index	0.750** (3.210)	0.807** (4.076)	0.865** (4.776)	0.907** (5.565)	0.855** (5.610)	0.760** (5.210)	0.890** (5.468)	0.987** (7.305)	1.273** (9.906)
Sample	84	84	84	84	84	84	84	84	84

\* p < 0.05 \*\* p < 0.01 The values in brackets are t value

The results obtained from mediation effect model indicate that the coefficient of the variable of rationalization of the tertiary industry structure added to the model is significant at the 1% level, which shows that digital economy has an indirect effect on promoting new urbanization development. Additionally, the total effect of the development level of the digital economy on the development of new urbanization is 0.57, and the direct effect is 0.449. It is generally believed that the direct effect is smaller than the total effect and significant, indicating that the mediating effect is effective. This also indicates that the improvement of the development level of the digital economy will enhance the service efficiency of the service industry, improve the efficiency of resource allocation, promote the rationalization of industrial structure, and thus enhance the development of new urbanization. The rationalization of the tertiary industry structure has a partial mediating effect between the digital economy and the development of new urbanization. Therefore, hypothesis H2 is used to verify this. The result as shown in Table 6.

The impact coefficients of the digital economy on the development of new urbanization at various quantiles are significantly positive, which once again confirms that the H1 digital economy has a positive effect on the development of new urbanization as shown in Table 7. Overall, the quantile regression coefficients of the digital economy development level index in the eastern, central, and western regions show an upward trend with the increase of quantiles (1/10–9/10) respectively, indicating that the impact of digital economy level on urbanization development has increased, that is, the improvement of digital economy level will have an increased impact on urbanization development.

The quantile regression coefficient of the East\_dig\_index shows a trend of first decreasing and then increasing with the increase of quantiles (3/10–4/10–5/10–6/10) (0.917–0.890–0.875–0.896), indicating that digitalization has a greater impact on the distribution of new urbanization conditions at both ends than in the central stage, indicating that the improvement of digitalization level has a smaller impact on cities in the middle stage of development in the eastern region. For the central region, from the increase of quantiles (1/10–

9/10), the quantile regression coefficient of Mid\_dig\_index increases with the increase of quantiles (0.837–1.387), indicating that for the central region, the improvement of digital economy development level promotes the development of new urbanization. For the western region, in terms of quantiles (3/10–4/10–5/10–6/10), the quantile regression coefficient of West\_dig\_index shows a trend of first rise and then fall (0.865–0.907–0.855–0.760), indicating that the impact of the development level of the digital economy on the distribution of new urbanization conditions is smaller at both ends than at the middle part. Overall, the development of new urbanization in various regions is driven by the level of digital economy. The development situation in each region is different, which is based on the different economic development situations in each region.

### VIII. CONCLUSION

Based on panel data from 2015–2021 in 31 provinces in China, this article uses the entropy method to construct a digital economic development index and a new urbanization index to measure the level of digital economic development and new urbanization development. A benchmark regression model is constructed. Mediation model and quantile regression analysis are used to study the impact mechanism of digital economy development level on new urbanization. The results indicate that the level of digital economy development has a positive impact on new urbanization. The rationalization of the tertiary industry structure plays a partial mediating role in the impact of digital economy development on the level of new urbanization, that is, the development of the digital economy indirectly affects new urbanization through the path of rationalization of the tertiary industry structure. In addition, through quantile regression analysis of the relationship between regional digital development level and new urbanization development level. Overall, the development level of the digital economy has a promoting effect on the development level of new urbanization, but the roles of the eastern, central, and western regions are different.

#### CONFLICT OF INTEREST

The authors declare no conflict of interest.

#### AUTHOR CONTRIBUTIONS

Yi Chen and Eva Khong conducted the research, analyzed the data and wrote the paper; all authors had approved the final version.

#### REFERENCES

- Chen, L., Zhong, C., & Li, C. 2022. Research on the impact of the digital economy on China's new-type urbanization: Based on spatial and mediation models. *Sustainability*, 14(22), 14843.
- Feng, Y. 2018. Research on the industrial structure upgrading effect of population aging-Empirical analysis based on panel data of western provinces. *Journal of Guizhou Business University*, 03: 29–35.
- Guo, Q., & Ma, X. 2023. How does the digital economy affect sustainable urban development? Empirical evidence from Chinese cities. *Sustainability*, 15(5): 4098. <https://doi.org/10.3390/su15054098>
- Liu, J., Yang, Y., Zhang, S. 2020. Research on the measurement and driving factors of China's digital economy. *Shanghai Economic Research*, 6: 81–96.
- Peng, Z., Feng, Z. 2023. The impact and heterogeneity analysis of digital economy on new urbanization—an empirical study based on quantile regression. *Journal of Shenyang Institute of Technology (Social Science Edition)*, 03: 44–51.
- Qian, H. 2023. Research on the impact of digital economy on farmers' income-Empirical analysis based on intermediary effect and threshold effect. *China Prices*, 11: 85–88.
- Zhu, L., Sun, G. 2023. Research on the impact of digital economy on manufacturing export trade competitiveness-analysis of intermediary effects based on manufacturing structure upgrading. *Modern Business*, 21.

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