



Mechanism Analysis of Digital Economy on Industrial Structure Upgrading

Haixia Wang*

School of Finance, Harbin University of Commerce, Harbin 150028 China

*Email: wanghaixiahi@126.com

Abstract. China's advancement in the economic realm has ushered in a fresh era, wherein the transformation and upgrading of its industrial structure stand as the sole pathway to attaining high-caliber economic progress. The digital economy has become the main driver to promote economic development and optimize the industrial structure. Utilizing data from 31 Chinese provinces spanning from 2011 to 2021, a dual fixed effects model has been established to investigate the impact of the digital economy on the evolution and enhancement of industry frameworks. This model accounts for both time-invariant unobserved heterogeneity at the provincial level and time-varying factors that could affect the relationship between the digital economy and industrial upgrading. A mediation effect model is employed to examine the process through which urbanization influences the advancement of industrial upgrading by utilizing intermediate mechanisms. The analysis reveals that the digital economy plays a beneficial role in shaping industrial sectors, with varying degrees of impact across regions. Specifically, the eastern part of the country experiences a more pronounced promotive effect from the digital economy, suggesting a stronger potential for this sector to drive structural improvements in the industrial landscape of the east compared to other regions. The model's findings provide insights into how policymakers can leverage the digital economy to foster more efficient and competitive industrial sectors, which is essential for sustainable economic growth in China.

Keywords: digital economy; industrial structure upgrading; urbanization level

1 Introduction

In China, the digital economy has not only greatly promoted economic growth and injected unprecedented vitality into the economic system, but also closely integrated with the national urbanization level strategy, forming a strong synergistic effect. The digital economy is profoundly changing the traditional mode of production and lifestyle with its efficient, convenient and cross-border characteristics. It breaks the constraints of time and space, making the allocation of resources more optimized and innovation activities more active. At the same time, urbanization serves as a pivotal approach to China's economic and societal growth, characterized by an unmatched velocity and magnitude. Urbanization not only brings about population concentration and urban

© The Author(s) 2024

J. Liao et al. (eds.), *Proceedings of the 2024 2nd International Conference on Digital Economy and Management Science (CDEMS 2024)*, Advances in Economics, Business and Management Research 292,

https://doi.org/10.2991/978-94-6463-488-4_37

expansion, but more importantly, it promotes industrial agglomeration and economic structure transformation. With the improvement of urbanization level, the urban economy has begun to show more diversified and high-end characteristics, and emerging industries and modern service industries have developed rapidly. The organic combination of digital economy and urbanization level has injected a strong impetus into the transformation and upgrading of China's economy.

Examining the interrelationship among the digital economy, urbanization levels, and the upgrading of industrial structures holds profound theoretical implications and carries substantial practical importance. Employing panel data encompassing all 31 provinces in China for period from 2011 to 2021, this paper systematically discusses the impact of burgeoning digital economy on upgradation of industrial structures, having crafted a composite index to gauge the advancement of digital economy's development level. Additionally, we incorporate the pivotal variable of urbanization level to scrutinize its moderating influence on the nexus between the digital economy and the transformation of industrial structures. This study endeavors to offer insightful guidance for policymakers and enrich the academic discourse with novel viewpoints and conceptual frameworks regarding the interplay between the digital economy, urbanization, and industrial upgrading.

2 Literature Review

The first is to establish a clear definition of the digital economy. Marcin (2017) believes that the digital economy refers to a series of economic activities generated by the use of information and communication technologies to onlineize transactions such as merchant services^[1]. Moulton (2010) interpreted the digital economy as information technology and e-commerce, that is, the digital economy is an economic form of information technology and information-enabled economy^[2]. Goldfarb and Tucker (2019) posited that the digital economy has the capability to diminish costs at every stage of production and distribution. They delineated the digital economy by highlighting its distinctive feature: its potential to mitigate the five principal economic costs.^[3] Tong Jiadong and Zhang Qian (2022) pointed out the four characteristics of digital economy, data, network, intelligence and sharing^[7]. Secondly, it links the digital economy with the development of information technology. Digital economy is not a synonym for the concepts of Internet economy and new technology economy. In China, most scholars calculate the comprehensive index of digital economic development level by establishing the index system of digital economic development and using principal component analysis, entropy method and so on. Dingchuan (2020) constructs a provincial digital economic development index system from five aspects: economic development, industrial development, human capital, informatization and green development^[8].

The second is the research on industrial structure upgrading by digital economy. Information and communication technology (ICT) supports the financial industry and will fundamentally change the process and structure within the industry and change the industrial structure. Banga (2022) highlighted that the digital economy serves as a catalyst for the modernization of conventional industrial infrastructure, facilitating the

development of digital infrastructure which, in turn, propels the digitization of traditional industries ^[4]. Through this digital transformation, industries are able to adapt more effectively to the changing demands of the marketplace, embrace innovative technologies, and optimize their production processes and supply chains. The analysis of Wu and Shao (2022) regarding the mechanism underlying the digital economy's impact reveals that it fosters the advancement of industrial structure through the enhancement of labor productivity and the elevation of the technological sophistication ^[5]. Based on the analysis of spatial lag model, Li Feng and Wu Yanhua (2023) discovered that the influence of the digital economy on the evolution of industrial structure varies across different contexts. ^[9].

The third is the study of digital economy on the level of urbanization. As an emerging economy, the digital economy, with its technical characteristics of permeability, substitutability and synergy, penetrates into all aspects and fields of economic and social operation, thus empowering regional innovation capabilities and providing necessary technical support for urbanization construction (Li Lin et al., 2024 ^[10]). Zhang (2019) pointed out that the platform effect of the digital economy provides a ' technology pool ' for the innovation activities of many enterprises. Furthermore, the digital economy can facilitate the restructuring of employment opportunities and enhance the level of human capital, which is more attractive to the floating population with high education, technical positions and high-tech industries^[11]. Non-agricultural employment is the key to urbanization. The digital economy exerts a positive influence on the non-agricultural employment of rural labor force. The development of the Internet has broadened the learning channels of rural residents, further improved the human capital level of rural labor force, and increased rural innovation and entrepreneurship opportunities (Han Gang et al., 2024^[6]).

3 Theoretical Mechanism and Hypothesis

3.1 The Impact of Digital Economy on the Upgrading of Industrial Structure

The primary mechanisms involve the following aspects: First, the technological innovation-driven mechanism. The digital economy has promoted the technological innovation and model innovation of traditional industries through the application of cutting-edge technologies such as big data, cloud computing and artificial intelligence. The second is the industrial integration mechanism. The digital economy has promoted the deep integration of information technology and various industries, broken the boundaries of traditional industries, and formed cross-industry and cross-domain industrial chain integration. This integration helps to achieve the optimal allocation of resources and promote the development of the industry to a more intelligent and networked direction. Third, the market demand pull mechanism. The development of digital economy has changed the structure of consumer behavior and market demand, and consumers ' demand for personalized and customized products and services is increasing. In order to meet this demand, enterprises must adjust the industrial structure and improve the quality and level of products and services.

Based on the above analysis, Hypothesis 1 is proposed: the advancement of digital economy can propel the upgrading of industrial structure.

3.2 The Impact of Digital Economy and Urbanization Level on the Upgrading of Industrial Structure

The digital economy represents a predominant technological element that, when synergized with the degree of urbanization, can catalyze significant transformations. The development of digital economy attracts high-skilled talents and enterprises to converge in urban areas. This agglomeration increases the population density of the city, but also improves the economic vitality and innovation ability of the city and promotes the process of urbanization. As urbanization progresses, labor resources have gradually shifted from rural to cities, and the reallocation of labor resources has provided sufficient labor supply for cities, promoted the development of the secondary industry and the tertiary industry, and then promoted the industrial structure to tilt to the service industry and high-tech industries. In addition, during urbanization process, there has been ongoing enhancement of urban infrastructure, and the construction and improvement of transportation, communication, energy and other infrastructure have provided good material conditions for industrial development. These infrastructures serve as foundational pillars that facilitate the clustering and dissemination of various industries, thereby propelling the structural evolution of the industrial landscape towards a more sophisticated and advanced state.

Based on the appeal analysis, Hypothesis 2 is proposed: the digital economy positively influence upgrading of industrial structure by promoting the level of urbanization.

4 Research Design

4.1 Model Construction

To empirically assess the impact of digital economy on the upgrading of industrial structure, this paper sets the following benchmark model.

$$ISR_{it} = \gamma_0 + \gamma_1 digEco_{it} + \gamma_2 X_{it} + \mu_i + \delta_t + \xi_{it} \quad (1)$$

In Equation (1), ISR represents the upgrading of industrial structure, $digEco$ serves as an indicator of digital economy, and X constitutes a series of control variables. It is an individual fixed effect, a time fixed effect, and a disturbance term. According to the above theoretical analysis, to investigate the indirect effect of digital economy on the upgrading of industrial structure, referring to the existing intermediary effect test methods, on the basis of the benchmark regression model, the intermediary effect model is constructed to test the intermediary effect of urbanization level. The model is set as follows:

$$City_{it} = \beta_0 + \beta_1 digEco_{it} + \beta_2 X_{it} + \mu_i + \delta_t + \xi_{it} \quad (2)$$

$$ISR_{it} = \alpha_0 + \alpha_1 digEco_{it} + \alpha_2 City + \alpha_3 X_{it} + \mu_i + \delta_t + \xi_{it} \tag{3}$$

In formula (2) and Formula (3), City represents urbanization level.

4.2 Variables Selection

Explained Variable

Industrial structure upgrading (ISR) refers to the transformation of the industry from the initial form of low added value and high pollution to the advanced stage of high added value and low pollution through technological innovation and optimization of resource allocation in the process of economic development. This paper will use a single index to measure the upgrading of industrial structure, that is, (secondary industry value-added + tertiary industrial value-added)/GDP.

Core explanatory Variable: Digital Economy Development Level (digEco)

This paper constructs a measurement system of digital economy development level. The second-level indicators include Internet penetration rate, number of Internet-related practitioners, Internet-related output, number of mobile Internet users, and inclusive development of digital finance. The detailed indicator system is shown in Table 1. In the process of index weight allocation, the chosen technique is the entropy weighting approach.

Table 1. Construction of digital economy development level index

first index	second grade indexes	third grade indexes	attribute
Digital Economy	Internet penetration rate	Number of Internet users per 100 people	+
	Internet-related practitioners	Percentage of computer services and software practitioners	+
	Internet-related output	Total telecommunications business per capita	+
	Number of mobile Internet users	Number of mobile phone users per 100 people	+
	Digital Inclusive Finance Development	China Digital Inclusive Finance Index	+

Control Variable

This paper draws on relevant research and adds relevant control variables to the regression model to improve the accuracy of the regression model : (1) foreign investment (fi) is quantified by the percentage of utilized foreign capital relative to region’s gross domestic product(GDP). (2) Population size (pop) is represented by logarithm of the year-end resident population count. (3) The level of economic development (gdp) is expressed by the logarithm of regional per capita GDP.

Mediator Variable: Urbanization Level

Regarding the assessment of the urbanization rate (City), it is typically gauged by the proportion of the urban permanent resident population to the overall regional population.

4.3 Data Sources

The dataset comprises panel data collected from 31 provinces in China, spanning the years 2011 to 2021. The data of each index are derived from the statistical yearbook of each province, the official website of the government and the digital financial research center of Peking University. To address missing data points on an individual basis, the technique of interpolation is employed for their estimation and inclusion.

5 Authentic Proof Analysis**5.1 Benchmark Regression Analysis**

The two-way fixed effect model is utilized to analyze the impact of the development level of digital economy on the upgrading of industrial structure, and the finds from this analysis are shown in Table 2. Column (1) considers the control variables, and column (2) adds the control variables. It can be seen from the results that regardless of whether the control variables are added, the estimated coefficient of the impact of the digital economy on the upgrading of the industrial structure is significantly positive at the level of 5 %, indicating that the improvement of the development level of the digital economy can indeed promote the upgrading of the industrial structure. The estimated value of the digital economy in column (2) is 0.040, is less than 0.098 in column (1), indicating that the control variables have a certain influence on the estimation results.

Table 2. Benchmark regression results

	(1)	(2)
variables	ISR	ISR
digEco	0.098***	0.040**
fi		0.003**
pop		0.110***
gdp		0.038***
_cons	0.871***	-0.406***
individual fixed effect	Yes	Yes
time-fixed effect	Yes	Yes
N	341	341
Adj. R ²	0.227	0.449

Note : *** p < 0.01, ** p < 0.05, * p < 0.1,

5.2 Mediating Effect Test

To corroborate the indirect effect exerted by the digital economy on the advancement of industrial structure, it is imperative to undertake a rigorous analysis to ascertain the mediatory function of the urbanization level. This entails scrutinizing the relationship between the variables involved, where one must establish if the digital economy's influence on industrial upgrading is partially or fully transmitted through changes in the urbanization level. The process entails an examination of the nexus between the digital economy and industrial upgrading, with urbanization factored in as a potential mediator that could affect the final outcome. The outcomes of the intermediary effect is displayed in Table 3. Column (1) is the total effect of the digital economy on the upgrading of industrial structure obtained according to the benchmark regression model. Column (2) shows the impact of digital economy on the level of urbanization, with a coefficient of 0.103 and significant at the level of 1 %, indicating that digital economy can significantly promote the level of urbanization. Column (3) considers the impact of digital economy and urbanization level on the upgrading of industrial structure. The coefficients of the two are 0.034 and 0.054 respectively, both of which are significant at the level of 10 %. At the same time, the regression coefficient of the digital economy is less than 0.040, suggesting that the intermediary role of urbanization level is indeed present.

Table 3. Mediation effect test results

	(1)	(2)	(3)
	ISR	City	ISR
digEco	0.040**	0.103***	0.034*
City			0.054*
control	Yes	Yes	Yes
cons	-0.406***	0.427	-0.429***
Individual fixed effect	Yes	Yes	Yes
time-fixed effect	Yes	Yes	Yes
N	341	341	341
Adj. R ²	0.45	0.81	0.45

5.3 Heterogeneity Test

Given the disparities in the development of China's digital economy across different regions, this study has chosen the central, eastern, and western areas as its primary subjects of investigation. Furthermore, a heterogeneity test will be conducted to explore the varying relationships between the digital economy and industrial structure upgrading across these distinct geographical segments. This approach will allow for a more nuanced understanding of the differential impacts that the digital economy has on industrial transformation in diverse regions of China, taking into account localized conditions, infrastructure, policy environments, and levels of technological adoption that may influence the nature and extent of the digital economy's influence on industrial

upgrading efforts. The digital economy has a significant impact on the upgrading of industrial structure in the eastern region. The digital economy in the western region has no significant impact on the upgrading of industrial structure. The digital economy in the central region has an inhibitory effect on the upgrading of industrial structure. This shows that the impact of digital economy on industrial upgrading is limited by geographical location, economic development level and various resource endowments. The eastern region has a more developed economy, better institutional conditions and coordination, and has a deeper impact on the upgrading of regional industrial structure.

6 Conclusions

6.1 Main Results

Based on the panel data of 31 provinces (autonomous regions and municipalities directly under the central government) in China from 2011 to 2021, this paper empirically tests the relationship between digital economy and industrial structure upgrading. The specific conclusions are as follows: first, the development of data economy is conducive to the upgrading of industrial structure; however, the process of urbanization plays an important role in the upgrading of industrial structure, and the improvement of urbanization level has a promoting effect on the upgrading of regional industrial structure.

6.2 Policy Implications

First of all, we must advance the digital industrialization process, concentrating on the key areas and core industries that define this sector. A proactive approach should be taken to nurture and expand burgeoning industries such as big data and artificial intelligence. Concurrently, efforts should be made to enhance the overall proficiency of the digital economy, ensuring that it remains at the forefront of technological advancement and economic growth. Secondly, the government should strengthen policy guidance, create an institutional mechanism, policies and regulations environment for the in-depth integration of digital economy and traditional industries, advanced manufacturing and other industries, and provide policy guarantee for enterprises to promote transformation and upgrading. Implementing targeted strategies to facilitate the integration of the digital economy within businesses is imperative. This entails incentivizing traditional companies to undertake the transition towards digital intelligence. By doing so, we can unlock the potential value inherent in the digital economy, mobilize its constituent elements effectively, and foster innovative business models, products, and services. Such initiatives will subsequently propel the transformation and upgrading of the real economy, ensuring it remains competitive and responsive to the evolving demands of the digital age.

References

1. Kotarba M. Digital Transformation of Business Models[J]. *Foundations of Management*, 2018, 10(1):123-142.DOI:10.2478
2. Moulton B R. GDP and the digital economy: Keeping up with the changes[J]. *Understanding the Digital Economy data*, 1999.DOI:http://dx.doi.org/.
3. Goldfarb A, Tucker C. Digital Economics[J]. *Journal of Economic Literature*, 2019, 57(1):3-43. DOI: 10.1257/jel.20171452.
4. Banga K. Impact of global value chains on total factor productivity: The case of Indian manufacturing[J]. *Review of Development Economics*, 2022, 26(2):704-735.DOI:10.1111/rode.12867.
5. Wu T, Shao W. How does digital economy drive industrial structure upgrading: An empirical study based on 249 prefecture-level cities in China. *PLoS One*. 202217(11): e0277787. DOI: 10.1371/journal.pone.0277787.
6. Han G, Li R. Digital economy and new urbanization: mechanism and threshold effect [J].*Industrial technology economy*, 2024, 43(1):21-30.DOI:10.3969/j.issn.
7. Tong J, Zhang Qian. The connotation of digital economy and its extraordinary contribution to future economic development [J]. *Nankai Journal (Philosophy and Social Sciences Edition)*,2022(03):19-33.
8. Ding C. Research on the measurement and influencing factors of China 's provincial digital economy development [J]. *Marketing industry* 2020(33):90-91.
9. Li Feng, Wu Yanhua. The research on the impact of digital economy development on industrial structure upgrading should be based on the empirical analysis of spatial lag model [J]. *Technology and management*,2023,25(03):13-2
10. Li Lin, Guo Dong, Qiao Lu. How digital economy affects new urbanization: mechanism and test [J]. *Exploration of economic issues*,2024(03):17-36.
11. Zhang Xinwei. Research on the evolution of innovation model under the condition of digital economy [J]. *Economists*, 2019(07):32-39.

Open Access This chapter is licensed under the terms of the Creative Commons Attribution-NonCommercial 4.0 International License (<http://creativecommons.org/licenses/by-nc/4.0/>), which permits any noncommercial use, sharing, adaptation, distribution and reproduction in any medium or format, as long as you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons license and indicate if changes were made.

The images or other third party material in this chapter are included in the chapter's Creative Commons license, unless indicated otherwise in a credit line to the material. If material is not included in the chapter's Creative Commons license and your intended use is not permitted by statutory regulation or exceeds the permitted use, you will need to obtain permission directly from the copyright holder.

