

Research on the Influence Mechanism of Digital Economy on the Optimization and Upgrading of Industrial Structure in Anhui Province

Jiajia Zhang

College of International Economics and Trade, Anhui University of Finance and Economics,
Bengbu 233000, China

Abstract

Based on the data of Anhui Province from 2013 to 2020, this paper constructs the digital economy index system from the three perspectives of digital infrastructure, digital industrialization and industrial digitalization, comprehensively analyzes the development level of digital economy with the entropy method, and constructs the direct effect model for empirical research. The research results show that the development of digital economy in Anhui province has promoted the optimization and upgrading of industrial structure. At the same time, according to the empirical research results, suggestions are put forward for the optimization and upgrading of digital economy and industrial structure in Anhui Province.

Keywords

Digital Economy; Industrial Structure; Entropy Value Method.

1. Introduction

The report to the 19th National Congress of the Communist Party of China calls for accelerating the revitalization of the digital economy, accelerating the development of advanced manufacturing, and promoting the deep integration of the Internet, big data, artificial intelligence and the real economy. Subsequently, the national "14th Five-Year Plan" and the outline of 2035 vision goals pointed out that in 2035, China's digital industrialization will step to a new level, and the manufacturing industry will be more digitalized, networked and intelligent. Since 2020, China has increased investment in new digital infrastructure such as the Internet and 5G to continuously improve the development level of the digital economy. By the end of 2020, the scale of China's digital economy has reached 39.2 trillion yuan, accounting for 38.6% of GDP. The development of digital economy is the general trend. Digital economy has injected new blood into China's economic society and become an important part of economic growth, especially in the effective adjustment of industrial structure. However, there are many problems in China's traditional industries, such as high cost, low utilization rate, imbalanced informatization, different resource endowments and industrial bases in different provinces, so the industrial transformation and upgrading caused by regional digital economy development are not the same. Under the background of comprehensively constructing a new development pattern, the development of digital economy has become one of the key elements to promote the upgrading of traditional industrial structure.

2. Literature Review

2.1. The Meaning and Measurement of Digital Economy

Tapscott, an American scholar, first proposed the digital economy in the Digital Economy Era published in 1996, but did not give a clear definition of the digital economy. In 1998, the US

Department of Commerce defined the economic development model of digital economy in the Emerging Digital Economy, proposed the form of digital industry, and proposed the significant impact of digital industry on the US and even the world. The OECD Development Centre's Report "Digital Economy Governance in Developing Countries" points out that the digital economy is the convergence of a variety of common technologies and a range of economic and social activities conducted by people through the Internet and related technologies. Bukht and Heeks believe that digital economy is the part of economic output generated only or mainly by the new generation of information technology and business model based on digital goods or digital services. This kind of definition mainly emphasizes the output increase brought by the digital economy, which has a certain one-sidedness. China Academy of Information and Communications Technology defined the digital economy in the White Paper on The Development and Employment of China's Digital Economy: "Digital economy was based on the digital knowledge and information of the key factors of production, with digital technology innovation as the core driving force, with modern information network as the important carrier, by a new generation of information technology and the real economy depth fusion, constantly improve the level of the traditional industry, intelligent digital and networking, accelerate restructuring economic development and government governance mode of the new economic form". Digital economy is taking advantage of the information age to set off a huge wave in the world. Data is the basic strategic resource of the digital economy era and the fifth factor of production after land, labor, capital and technology.

With the rapid development of digital economy, many scholars at home and abroad have measured the development level of digital economy. Abroad, the U.S. Bureau of Economic Analysis (BEA) mainly uses the same value to calculate the contribution degree and added value of the digital economy. Statistics New Zealand uses OCED model for research when measuring the development level of digital economy. In China, there are mainly China Academy of Communications Digital Economy Index (DEI) and Caixin Intelligence Institute China Digital Economy Index (CDEI). Zhiguang Shan et al. used the three-dimension space theory to study the construction of China's digital economy development comprehensive evaluation system. Jun Wang et al. constructed an index system from the four dimensions of digital economy development carrier, digital industrialization, industrial digitalization and digital economy development environment, and found that with the rapid development of China's digital economy, there exists the problem of regional "digital economy gap", and this phenomenon has become obvious. According to the development course of digital economy, Xianchun Xu and Meihui Zhang analyzed the scale and products of digital economy and studied the development level of digital economy. Haiyan Qian et al. constructed an index system from the four dimensions of telecom infrastructure construction, information technology industry development, enterprise electronization level and social innovation ability to measure the development level of digital economy in cities in Zhejiang Province.

2.2. Measure and Influence Factor Analysis of Industrial Structure Optimization and Upgrading

The concept of industrial structure first began in the 1940s. With the deepening of industrial economics research, the definition and cognition of industrial structure became more mature. The advanced industrial structure means that the industrial structure gradually changes from the lower form to the higher form, from the primary industry to the secondary industry and tertiary industry. Along with the evolution law of industrial structure, advanced is also manifested as: the product changes from low value-added to high value-added, the industrial structure changes from labor intensive to capital intensive, technology and knowledge intensive; The industry changes from high energy consumption and low efficiency to low energy consumption and high efficiency. The indexes of industrial structure upgrading and

optimization calculated by scholars can be roughly divided into two measures: but indexes and multiple indexes. Aidong Wu et al. constructed industrial structure advance coefficient and Moore value when measuring the direction and rate of industrial structure upgrading. Maoxing Huang et al measured industrial structure upgrading directly according to the proportion of the added value of the secondary industry and the tertiary industry in the national economy. Deyun Xu weighted the proportion of output value of the first, second and third industries by weighting method 1,2,3 to measure the upgrading and optimization of industrial structure. Changqi Tao et al. measured the upgrading of industrial structure from two perspectives of rationalization and advanced industrial structure. Zilun Li explored the factors promoting the upgrading and optimization of industrial structure, and he concluded that technological innovation, human capital and energy utilization can promote the upgrading of industrial structure, and measured the upgrading and optimization of industrial structure from these three perspectives.

At the same time, many scholars at home and abroad have studied the factors affecting the upgrading and optimization of industrial structure. Henderson and Reeve concluded that technological progress could promote industrial structure upgrading and economic development. Through research on industrial technological innovation, Peters concluded that improving the efficiency of industrial innovation can promote the optimization and upgrading of industrial structure. Shulian Zhou and Weiguang Wang believe that technological innovation can promote the upgrading and optimization of industrial structure by improving the allocation efficiency of production factors. Yingzhi Xu et al. Trade opening can stimulate consumer demand and promote the upgrading and optimization of industrial structure.

2.3. The Influence of Digital Economy on the Upgrading and Optimization of Industrial Structure

Digital technology has penetrated into every aspect of economic life and become the core of China's innovation and technological progress. Digital economy industry has provided a powerful driving force for the optimization and upgrading of industrial structure and boosted China's economic transformation and upgrading. The promotion of digital economy industry to the optimization and upgrading of industrial structure can be seen in the upgrading and transformation of traditional industries to a large extent. Digital economy industry with high permeability, via the Internet, e-commerce, cloud computing, digital technology, digital services, digital information to infiltrate traditional industry production, management, sales of each link, improve the industry efficiency and enhance the level of digital industry and promote the traditional industry transformation, realize the optimization and upgrading of industrial structure.

As for the study of digital economy and industrial structure, Hongwei Wang concluded that digital economy has an important impact on the optimization and upgrading of industrial structure. Yawei Qi concluded that digital economy plays an obvious positive role in promoting the optimization and upgrading of industrial structure. Through his research, Yuzhe Zhang concluded that digital economy promotes the transformation of old and new driving forces and the upgrading of industrial structure. Xisan Zhao believes that digital economy promotes the integration of new and traditional industries and promotes industrial upgrading and transformation. Kim and Yongtae believe that informatization accelerates the speed of knowledge production and diffusion and promotes the positive evolution of industrial organization structure. Studies by M. Cardona, T. Kretschmer and T. Strobel show that ICT has a positive and significant effect on productivity, and there is a greater difference between the United States and Europe in the impact of ICT, but the analysis at the enterprise level shows that there is no significant difference between countries. Markillie P explained the process of industrialization and good adjustment of industrial structure with the help of the

popularization of departmental digital technology and innovation of industrial cooperation mechanism. Hongwang Cha holds that both informatization and industrial structure upgrading have spatial aggregation characteristics, and industrial structure upgrading has significant positive spatial effect. Bing Chen and Xin Pei analyzed the effect mechanism of digital economy on industrial structure from urbanization, fiscal expenditure integration and human capital. Focusing on the influence of ICT industry development on the upgrading of regional industrial structure, Dijing discusses the theoretical relationship between ICT industry and the upgrading of regional industrial structure, and further explores the specific conditions of industrial upgrading in different regions through the mediation effect model.

3. Model Construction and Index Selection

3.1. Variable Selection

3.1.1. Explained Variable: Index of Industrial Structure Optimization and Upgrading in Anhui Province

By referring to the research articles of other scholars, different scholars have different measurement methods for industrial structure. Based on the scientific nature and availability of data, this paper refers to Xu Deyun's measurement method. When designing indicators, the weight of the tertiary industry is set as 3, the weight of the secondary industry as 2, and the weight of the primary industry as 1. The specific calculation formula is as follows:

$$R = \sum_{i=1}^3 y_i * i \quad (1 \leq R \leq 3)$$

The closer R is to 1, the greater the proportion of the primary industry in the national economy, and the closer R is to 3, the greater the contribution of the tertiary industry in social development.

3.1.2. Core Explanatory Variables: Digital Economy Index Measurement System of Anhui Province

In order to effectively measure the development level of digital economy in Anhui Province, this study refers to other scholars' research literature and anhui provincial figures digital infrastructure, digital industrialization and industrial digitalization are selected to construct the index measurement system of digital economy development level in Anhui Province. Since the measurement index system of digital economy contains three first-level indicators and several second-level indicators, this study uses entropy method to process the data.

Entropy method is an objective value assignment method, which determines the weight of indicators according to the information provided by each indicator and comprehensively calculates the final indicator. Due to the different units of each variable, dimensionless processing is carried out for all data before the entropy method is used for scoring. The specific calculation process is as follows:

(1) If the data is represented in the form of matrix, and the data involved has m row record and n variables, then

$$A = \begin{bmatrix} X_{11} & \cdots & X_{1m} \\ \vdots & \ddots & \vdots \\ X_{n1} & \cdots & X_{nm} \end{bmatrix}$$

(2) Normalize the data

$$X_{ij} = \frac{X_{ij} - \min(X_{1j}, X_{2j}, \dots, X_{nj})}{\max(X_{1j}, X_{2j}, \dots, X_{nj}) - \min(X_{1j}, X_{2j}, \dots, X_{nj})} + 1, \quad i=1, 2, \dots, n; \quad j=1, 2, \dots, m$$

- (3) Calculate the proportion of the *i*th scheme in item *j* index $P_{ij} = \frac{x_{ij}}{\sum_{i=1}^n x_{ij}}$ (*j*=1, 2, ...*m*)
- (4) Calculate the entropy value *e_j* of the JTH index $e_j = -k * \sum_{i=1}^n P_{ij} \log(P_{ij})$
- (5) Calculate the difference coefficient of item *j* $g_j = 1 - e_j$
- (6) For the weight $W_j = \frac{g_j}{\sum_{j=1}^m g_j}$, *j*=1, 2...*m*
- (7) Calculate the overall score of each scheme $S_j = \sum_{i=1}^m P_{ij}$, *i*=1, 2...*n*

3.1.3. Control Variables

This paper selects the degree of government intervention in foreign trade (Open) and the Total retail sales of consumer goods (Total) as the control variables. Among them, foreign trade adopts the proportion of total import and export in total GDP of the province, government intervention degree adopts the proportion of government general budget expenditure in total GDP of the province, and retail sales of social consumer goods are measured by the retail sales of social consumer goods of Anhui Province in that year, and the data are all from the statistical yearbook of Anhui Province.

3.2. Model Specification

According to the content and significance of the study, stepwise regression method was used to carry out multicollinearity regression, thus establishing the following regression model:

$$R = \alpha + \beta_1 Dig + \beta_2 \sum X_{ij}$$

Dig represents the development level of digital economy, *X_{ij}* represents each control variable, and *R* represents the index of industrial structure optimization and upgrading.

4. Empirical Test Results and Analysis

4.1. Empirical Test Results

Table 1. Empirical results of digital economy on industrial structure optimization and upgrading in Anhui Province

variable	R0	R1	R2	R3
Dig	0.16***	0.13***	0.20***	0.23***
Open	—	-0.86***	-0.61**	-0.54**
Total	—	—	-0.06*	-0.069**
Gov	—	—	—	0.62
Constant	2.3***	2.48***	2.43***	2.3***
R ²	0.8937	0.9732	0.987	0.996

Note : * ** *** represents significance test at 10%, 5% and 1% levels respectively.

In the above table, R0 represents no control variable, R1 represents one control variable, R2 represents two control variables, R3 represents three control variables are all added based on the above empirical results. The final regression model is: $R = 2.3 + 0.23Dig + 0.62Gov - 0.54open - 0.069 Total$.

4.2. Refine Results

In the model without control variables, the influence coefficient of digital economy on the optimization and upgrading of industrial structure is 0.16, which is significant at 1% level, indicating that digital economy can promote the optimization and upgrading of industrial structure. Foreign trade and government intervention have a significant relationship, and the study found that digital economy has a significant role in promoting the optimization and upgrading of industrial structure regardless of whether control variables are added into the model. Based on this, Anhui Province should take a series of measures to improve the development quality of digital economy and promote the optimization and upgrading of industrial structure.

4.3. Robustness Test

Due to the choice of indicators may affect the results of the study, in order to ensure the reliability of the empirical study, this article will be explained variable to replace, will be explained variable into the tertiary industry output value of 2013-2020 in anhui province/output in anhui province, is replacing explained variables, the core variable coefficient of the symbols and significance are no change, It is proved that the results are relatively robust and reliable.

5. Policy Suggestion

As the foundation of digital economy, digital infrastructure is an important foundation of digital economy. Governments at all levels should attach importance to 5G Internet, cloud computing and artificial intelligence Blockchain and other digital infrastructure development, accelerate the development of new forms and models of business, promote the digital transformation of traditional industries, improve total factor productivity, and promote the optimization and upgrading of the industrial structure.

We will accelerate the cultivation and introduction of digital talents. The digital economy related industry is facing serious talent shortage problem, need to actively introduce possess a high level of information technology, digital technology, more experience of industry high-level talents from home and abroad, the special policy, in the service of such talent, and the need of digital economy or industry innovation talents classification, corresponding to different levels talents special subsidy policy, intensify service. In addition, the government should actively take the lead in encouraging universities to establish relevant research centers for advanced digital technology, strengthen the construction of relevant disciplines, and cultivate applied talents with professional skills to provide talent reserve for the development of digital economy. We will strengthen the implementation of the strategy of innovation-driven development, and promote the shift from mass entrepreneurship and mass entrepreneurship in innovation and entrepreneurship to innovation, entrepreneurship and creativity. All cities should create a sound environment for innovation, entrepreneurship and creation. Relying on the diversified innovation platform provided by the development of digital economy, we should seize the new wave of scientific and technological revolution, accelerate the independent innovation of core technologies, and promote the formation of a new industrial system. Break away from the traditional mode of thinking in pursuit of high-speed economic growth, build micro constraint mechanism and macro institutional environment, and provide a smooth channel for digital economy to promote industrial transformation and upgrading through innovation and entrepreneurship from the perspective of mechanism and system.

It is an effective way to promote the development of digital economy to adhere to the policy of opening to the outside world and learn the core technology of foreign digital economy. It is an effective way to promote the development of digital economy to adhere to the policy of opening

to the outside world, introduce advanced technology and equipment from abroad through the use of import and export and modern network, develop digital economy, and accelerate the integration of the three industries with digital technology and information technology Promote the "bring in" and "go out" strategy, improve the industrial competitiveness of Anhui province, further optimize the industrial structure.

We will develop demonstration zones for in-depth integration of the digital economy and the real economy. Encourage local governments and enterprises through the Internet platform to integrate resources, demonstration area in economic development zone set up fusion, such as artificial intelligence, deep learning, attract investment at all levels, build resource list, to promote industrial convergence results fall to the ground as soon as possible, play a demonstration zone of leading leading role, for the transformation of the region development provides the necessary technical support and direction.

Optimize the institutional environment. Establish digital economy negative list, expand access object, further enhance to the attraction of the high-tech enterprises at home and abroad, to create an atmosphere of convenient access to capital, to broaden the digital technology industry admittance threshold, set up fair market main body environment, policy environment conducive to healthy development of the digital economy, eliminate barriers to digital technology application.

Acknowledgments

Fund Item: Part of the achievement of Anhui University of Finance and Economics Graduate Scientific Research Innovation Fund Project (ACYC2021197).

References

- [1] Z.H. Bai, K. Yuan. Empirical Study on Employment Effect of Digital Economy Development and Industrial Structure Upgrading [J]. Lanzhou Journal, 2022 ,No.3,p.62-73.
- [2] J.P. Gao, L.N. Sun. The Mechanism and Path of Digital Economy Development Promoting Industrial Structure Upgrading in China [J]. Enterprise Economics,2022,No.2,p.17-25.
- [3] B.N. Guo, Y. Wang, H. Zhang Digital Economy, Green Technology Innovation and Industrial Structure Upgrading: Empirical Evidence From 282 Cities in China [J]. Lanzhou Journal, 2022 , No.2,p.58-73.
- [4] B. Z. Peng, J. Y. Yi. Research on the Impact of Digital Economy on Industrial Structure Upgrading of Yangtze River Economic Belt [J]. Hunan Social Sciences, 2021,No.6,p. 51-57.
- [5] Y.X. Cui ,X.Y. Xiong. Research on the Impact of Digital Economy Development on the Optimization and Upgrading of China's Industrial Structure [J]. Commercial Economics Research, 2021,No.21,p. 176-179.
- [6] X.J. Bai,P. Song , L. Li, LIAO Sainan. Can Digital Economy Promote The Transformation of China's Industrial Structure? Journal of Xi 'an Jiaotong University (Social Science Edition), 2021,No.6,p. 1-15.
- [7] J.Q. Qin , J.J. Zhao, W. Wang . The mediating effect of digital economy on industrial structure upgrading and empirical evidence [J]. Statistics and Decision,2022,No.11,p.99-103.
- [8] Y.Y. Ji, P.F. Zhu. Digital Economy Enabling Industrial Structure upgrading: Demand Traction and supply Optimization [J]. Academic Monthly,2022, No.4,p.63-77.
- [9] M.Y. Chi, Y.N. Shi. The influence mechanism and countermeasures of digital economy on industrial structure optimization and upgrading [J]. Economic Review,2022, No .4,p.122-128.
- [10] Z.H. Bai, K.Yuan . An empirical study on the employment effect of digital economy development and industrial structure upgrading [J]. Lanzhou Journal,2022, No3,p.62-73.
- [11] J.P. Gao, L.N. Sun. The mechanism and path of digital economy development promoting industrial structure upgrading in China [J]. Enterprise Economics,2022, No 2,p.17-25.

- [12] L.J. Zhang, L.P. Ma. Digital economy, industrial structure upgrading and total factor productivity [J]. *Statistics and Decision*, 2022, No3, p.5-10.
- [13] D.Y. Xu. From norm to positivism: On the uniqueness of Pareto optimality and the modification of the first and second Foley theorems [J]. *Finance and Trade Research*, 2018, No12, p.28-38
- [14] D.Y. Xu. Decision and measurement of industrial structure equilibrium: Theoretical Explanation and verification [J]. *Industrial Economics Research*, 2011, Nov3, p.56-63.
- [15] J.D. Tong, Q. Zhang. The Connotation of digital Economy and its Extraordinary Contribution to Future Economic Development [J]. *Journal of Nankai (Philosophy and Social Science Edition)*, 2022, Nov3, p. 19-33.
- [16] Z.J. Gao, J.F. Zhao, J. Zhang, X. Li. The mechanism and path selection of digital economy enabling consumption upgrading [J]. *Southwest Finance*, 2021, Nov10, p.44-54.
- [17] R.J. Tan, Q.Y. Lu. Does digital inclusive finance promote the optimization and upgrading of industrial structure? [J]. *Investment Research*, 2021, Nov, p.85-104.
- [18] Z.D. Zhang, Q.L. Huang. The impact of industrial agglomeration on industrial structure upgrading: An empirical analysis based on spatial econometric and panel threshold Model [J]. *Contemporary Economic Management*, 2021, Nov2, p.57-64.