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Research Paper

A study on fiscal policies to promote the development of digital economy – A Chinese case study

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Abstract: China's digital economy development is a strategic decision to construct a new development model for the nation's economic growth and to pave the way to fostering high-quality economic growth. Since the Chinese government first introduced its strategy for developing digital economy in 2016, the Chongqing Municipal Government has responded positively by implementing various policy initiatives. This paper examines and evaluates the overall level of Chongqing's digital economy from 2014 to 2021 and analyses the development process through a mixed research method. The results show a growth trend of continuous improvement, with the speed of digital economy development in Chongqing significantly accelerating after 2017. However, there are still some challenges, such as weak innovation capacity, lagging digital service capability, imbalance in the internal structure of digital economy, and uneven development within the region. Therefore, Chongqing must make some efforts to support the advance of digital economy by developing infrastructure, cultivating market players, and enhancing innovation capabilities, thereby forming a solid foundation for growth.

Keywords: digital economy; Chinese digital economy development; fiscal policy; digital industrialization; entropy-based TOPSIS method

1. Introduction

The Chinese government first formally proposed a development strategy for digital economy in 2016. In May the same year, the State Council issued the Guiding Opinions on Promoting Internet Plus Action, which aimed to integrate this strategy with the real economy, and – among other objectives – wished to accelerate digitalization, advance new-generation information technology, and foster the industry's growth (Hong, 2017).

In 2014, the Chinese government officially introduced a strategy for developing digital economy. This initiative aimed to integrate digital economy with the real economy, and wished to accelerate the transformation towards digitalization, promote the advancement of new-generation information technology, and foster the growth of the digital economy industry. The issuance of this document marked a significant milestone in China's digital economy development, this way signalling a new phase. Since then, the Chinese government has increasingly supported digital economy, implemented relevant policies and measures and made it a vital driver of economic growth (Central Committee of the Communist Party of China & State Council, 2014).

Chongqing Municipality is geographically located in the southwestern part of China's interior and on the upper reaches of the Yangtze River. With an area of about 82,400 square kilometres and 38 districts and counties under its jurisdiction, its population reaches 32,133,000 people, with an urbanization rate of 70.96%. As a centralized municipality and an essential megacity in the central and western regions, Chongqing plays a vital role in the country's overall development (Chung & Lam, 2009). Chongqing, an industrial town in China, boasts a well-established industrial system, a strong foundation for intelligent industries, and diverse industrial categories. These factors provide a robust supply chain guarantee for the development of digital economy.

Citation:
Cai, J., Wei, Z., & Neszmélyi, G. I. (2024). A study on fiscal policies to promote the development of digital economy – A Chinese case study. *Prosperitas*, *11*(1), Article 3. Budapest Business University. https://doi.org/10.31570/prosp_2023_0066

History:

Received:	12 Apr 2023
Revised:	31 Jul 2023
	16 Sep 2023
Accepted:	19 Sep 2023
Published:	25 Oct 2023

In 2016, the Chinese government introduced its strategy for developing digital economy, which prompted the Chongqing Municipal Government to respond positively by implementing a series of policy initiatives. These policies aim to foster the seamless integration of digital economy with the real economy, accelerate digital transformation, promote research and development of new-generation information technology, and ensure robust growth of the digital economy industry. As a result of these measures, Chongqing's digital economy has emerged as a pivotal driver of China's economic growth. This research paper aims to comprehensively investigate the development of Chongqing's digital economy from 2014 to 2021 and critically evaluate how government fiscal policies have impacted its growth trajectory. This study adopts a mixed research method to analyse the effectiveness of such policies in terms of propelling the region's digital economy. By shedding light on the success of these policies, this research intends to provide valuable insights for policymakers and stakeholders, thereby facilitating further advancements in the digital economy landscape.

Analysing the development of Chongqing's digital economy holds significant importance due to its unique status as the only directly administered municipality in China's central and western regions. A considerable gap exists in digital economy's progress within these regions. Still, Chongqing, as a representative city in this area, has experienced rapid growth through increased support and policy innovation. Other cities in the central and western regions can draw valuable lessons from Chongqing's success and can explore suitable models to develop their digital economies and thereby promote the transformation and upgrading of their respective regional economies.

Beyond its relevance to China's domestic regions, studying Chongqing as a typical case also provides crucial implications and insights for the international development of digital economy. As an essential mega-city and economic centre in China, Chongqing's process of digital economic development offers lessons to learn for other developing countries and regions. This aspect is particularly relevant for developing countries, which often face challenges such as limited resources and innovation capabilities in digital economic growth. As a successful case, Chongqing can offer a viable development path and valuable experience to help other regions achieve better outcomes in the field of digital economy.

2. Literature review

2.1. Definition of digital economy

The concept of digital economy encompasses a wide range of economic forms that leverage data directly or indirectly to allocate resources and foster product development (Bukht & Heeks, 2017). In the 1990s, the Organization for Economic Cooperation and Development (OECD) provided an initial definition of digital economy (Dahlman et al., 2016). Additionally, Brent Moulton suggested that digital economy includes e-commerce (Internet sales) and information technology, with the latter encompassing electronic equipment for processing digital information, semiconductors, software, and other electronic devices (Moulton, 2000). Moreover, e-marketing, particularly through emails, has gained significance as one of the most effective communication tools (Hudák et al., 2017).

Digital economy is commonly understood as an economic system that utilizes the digitalization of information and communication technology as a key production factor. This system creates a virtual network through modern information and communication infrastructure, thus enabling a range of economic activities. These activities include transactions and business processes across various industries, thereby driving the development of e-commerce and digitizing the entire process from production to distribution and consumption. Consequently, digital economy brings about fundamental changes to economic structures and generates economic value in novel ways.

Central to digital economy is information and communication technology, primarily relying on the internet. This employs the internet and digital technology to conduct all economic activities and replaces traditional production factors such as land and labor with digital production factors. As a result, this transforms traditional industries across multiple domains into digital industries, leading to the reconfiguration of business processes, consumption patterns, and payment methods (Jia, 2020).

Digital economy leverages modern information and digital technology to convert information and knowledge into data, which serves as a critical production factor. It heavily relies on the internet as a carrier and efficiently utilizes information and digital technology to digitize economic activities, including production, transactions, consumption, collaboration, social governance, and organizational management (Bethlendi et al., 2019). This digitalization process optimizes economic and social operating models, this way enhancing overall operational efficiency (Pan et al., 2022).

In summary, the literature indicates that digital economy encompasses diverse economic forms that leverage data and information and communication technology. It is characterized by the digitization of economic activities, the utilization of the internet as a primary platform, and the transformation of traditional industries into digital ones. By harnessing modern technology and digitalization, digital economy optimizes operational models and enhances economic efficiency. This definition provides the basis for the theory in this paper.

2.2. Characteristics of digital economy

After conducting an extensive review of various literature sources, we have gained a thorough understanding of the significant themes and viewpoints surrounding the growth of digital economy. Several key factors are crucial in driving digital economy forward. These factors include the development of digital infrastructure, integrating industries, innovation, social benefits arising from digital economy, and the role assumed by market players.

Digital infrastructure provides the foundation for the development of digital economy (Kireyeva et al., 2021; Dou & Gao, 2022). A relatively complete set of infrastructure is a cornerstone for the proper functioning of an economy, and the development of digital economy is no exception. The infrastructure of digital economy, also known as “digital infrastructure”, includes 5G networks, big data centres, industrial Internet, and other areas (Greenstein, 2019). Digital infrastructure is China’s forward-looking construction plan for future digital global competition. Digital infrastructure can collect and organize data on production and life with the help of information technology, it can build dynamic economic models for enterprises through different algorithms, gain insight into the shortcomings of digital economy development, seize the lifeline of digital economy development, and help digital economy development enter the “fast lane” (Li, 2019).

Industrial integration is the trend of the development of digital economy. Along with the technological revolution, the Internet, cloud technology, mobile communications, and other information technology industries are thriving, and digital economy has penetrated all aspects of economic activities (Zhu, 2019). Digital economy extends into different industries through digital infrastructure, creates a vast “digital information network” and changes how information is processed and analysed to be scientifically effective and timely. Digital economy has demonstrated solid industrial integration characteristics, from innovative city services to industrial “clouds”, agricultural operations, and computer interoperability. It has played a vital role in transforming and upgrading China’s industrial structure and building an ecosystem for digital economy development (Zhang et al., 2021).

The innovation drive is the source of the development of digital economy. In 2021 General Secretary Xi Jinping pointed out at the 6th Eastern Economic Forum that digital technology innovation capability is the source of power for the development of digital economy and that the innovative development of digital economy should be supported (National Research Centre for Socialist Political Economy with Chinese Characteristics, 2021). Innovation is the core of technological innovation, and the emergence and development of digital economy rely mainly on the innovation of information and communication technologies. The convergence and development of industries and the emergence of new digital businesses and industries also depend on the technology obtained through innovation (Teece, 2018). In addition, further innovation and digital empowerment of some traditional technologies and their applications can break through the bottleneck of digital economy development, “overtake” digital economy development, and “give wings” to digital economy to take off (Bukht & Heeks, 2017).

Social benefits are a reflection of the development of digital economy. With the development of digital economy, digitization has become an indispensable element of social development. Digital infrastructure and information technology brought about by digitization

have changed daily production services and means of payment, thus changing people's lifestyles and improving their living standards (Yin & Liu, 2020). The transportation industry, rooted in express delivery and other sectors, has broadened the consumption market, reduced the price of goods, and boosted consumer spending. Some new industries spawned under the development of digital integration have increased jobs, eased social employment pressure, improved the employment environment and further promoted the healthy development of the digital economy (Wang et al., 2022).

Market players are the force behind the development of digital economy. As "participants" in the economy, market players are essential in promoting economic growth. In digital economy, e-commerce is the leading force in developing digital economy. With the increasing contribution of online retail sales to the retail sales of consumer goods, e-commerce drives the formation and development of the digital economy (Yu, 2017; Zhang & Chen, 2019; Erdeiné Késmárki-Gally & Fenyvesi, 2014). In addition, cross-border e-commerce uses the internet and logistics to open up an "online silk road" to the world, thereby bringing China's digital economy in line with international developments and widening the market for digital economy development (Wang, 2020).

In conclusion, the literature review highlights the importance of various factors in the development of digital economy including digital infrastructure, industrial integration, innovation, social benefits, and the role of market players. These perspectives provide a comprehensive understanding of the key drivers and impacts of digital economy, which lay the foundation for the further analysis of Chongqing's digital economy development and its alignment with these overarching themes.

2.3. Current development of Chongqing's digital economy

By 2022, Chongqing achieved significant results in developing the municipality's digital economy, with its value-added accounting for over 30% of GDP, which has become a new driving force for high-quality economic growth. In the same year, the revenue of Chongqing's electronic information manufacturing industry exceeded RMB 730 billion. By the end of 2022, Chongqing had successfully implemented 5,578 intelligent transformation projects, establishing 127 smart factories and 734 digital workshops, which led to an average production efficiency increase of nearly 60% (Liu et al., 2022; Yu, 2023).

In 2023, Chongqing plans to continue developing its digital economy through three critical approaches. Chongqing's first step involves constructing an "Industrial Brain" that focuses on innovative application scenarios. This will promote digitization in platform management, project services, government services, enterprise digital transformation, and project investment. This will also facilitate the creation of an interconnected, resource-sharing, and efficient collaboration system within the industrial brain. Secondly, the government aims to enhance the quality of digital industrial development by formulating an action plan for the manufacturing industry's digital transformation. It will conduct eight specific activities including consultation, diagnosis, and capacity maturity assessment (CAICT, 2023).

Additionally, Chongqing will deepen the construction of the "One Chain, One Network, and One Platform" to digitally integrate large, medium, and small enterprises in the industrial chain. The plan also involves building 100 new digital workshops and ten intelligent factories. Thirdly, Chongqing intends to accelerate the pace of digital industrialization. The government will implement the "Star" action plan for the software and information industry in 2023, which aims to establish 4,000 new software and information enterprises with 80,000 employees. Furthermore, it will promote the development of "Core, Screen, End, Core & Network" digital industry clusters, targeting a revenue of RMB 1.1 trillion from the digital industry. The government will also drive scenario-driven artificial intelligence industry development actions, thereby facilitating the digitization, networking, intelligence, and platform establishment concerning various scenarios (Chongqing Municipal People's Government, 2023).

3. Methodology

3.1. Research Questions

The methodology section of this paper outlines the research questions and the research approach employed to address these questions. The paper utilizes a mixed research approach, combining a policy analysis and empirical analysis to investigate the development of digital economy in Chongqing. The research questions in this paper are as follows. How has digital economy been developing in Chongqing since 2014? What are the fiscal policies enacted by the Chongqing Municipal Government to promote the development of digital economy, and have these policies had a positive impact?

To answer the above questions, the research method used in this paper is a mixed research approach. Firstly, this paper adopts a literature review approach in which the authors systematically review the relevant literature to identify the defining characteristics of digital economy and the implications of its development for China, which provides clear theoretical support for the paper. Furthermore, we have gathered and analysed the fiscal policies the Chongqing municipal government implemented since 2014. These policies were explicitly designed to promote the growth of digital economy. We have examined the key elements of these policies to comprehend the strategies to foster the development of digital economy in Chongqing. In addition, the authors collected and analysed the fiscal policies enacted by the Chongqing municipal government since 2014 in response to the development of digital economy. Then, empirical analysis is employed to explore the development of digital economy in Chongqing from 2014 to the present. The method used in this paper is the Entropy-based TOPSIS approach. This method facilitates the comprehensive evaluation and comparison of various factors and indicators related to digital economy development in Chongqing.

3.2. Entropy-based TOPSIS method

The main idea is to determine the weight of each indicator by the entropy method and then use the TOPSIS method to make a comprehensive evaluation (Sun et al., 2017). This method uses the objective weighting idea of the entropy method and the TOPSIS method to approximate the ideal solution, which can effectively eliminate the influence of human subjective factors (Xu et al., 2021). The method in question is more effective than both the entropy method and the TOPSIS method. The primary process of the model is shown below.

Building the original matrix. First, the data on the development of digital economy in Chongqing is collected. Let a total of n years, and m indicators be selected for each year to build the original matrix.

$$X=\left(x_{ij}\right) nm(\ i=1,2,3,\ldots,n;\ j=1,2,3,\ldots,m) \quad (1)$$

The selected indicators were normalized to initially eliminate differences caused by the dimensions of the variables. As all the data selected in this study are positively oriented indicators, there is no need for either positive or reverse transformation. Therefore, this study adopts the “normalization by mean” method for data processing.

$$Y_{ij}=X/\,Mean \quad (2)$$

Determine the weights for the values of the j_{th} indicator of the i_{th} object:

$$P_{ij}=\frac{x_{ij}}{\sum_{i=1}^{n} x_{ij}} \quad (3)$$

Determine the entropy value of the j_{th} indicator:

$$e_j = -\frac{1}{\ln(n)} * \sum_{i=1}^{n} P_{ij} \ln(P_{ij}), (i = 1, \ldots, n; j = 1, \ldots, m) \quad (4)$$

Then calculate the information utility value d:

$$d_j = 1 - e_j \quad (5)$$

Determine the entropy weight of the j_{th} indicator:

$$w_j = \frac{(1 - e_j)}{\sum_{j=1}^{m} (1 - e_j)}, \quad 0 \le w_j \le 1, \sum_{i=1}^{m} w_j = 1 \quad (6)$$

Compute scores for individual indicators and overall performance level.

$$S_{ij} = w_i \times x_{ij}, \; S_i = \sum\nolimits_{j}^{n} S_{ij} \quad (7)$$

After the above steps, use the TOPSIS method for evaluation. Assuming there are m_{th} object, n_{th} indicators, the matrix $X = (x_{ij})_{mn}$ is obtained; and then the following decision matrix is generated: $Y = (y_{ij})_{mn}$ (8)

Next, compute the weighted and normalized decision matrix V:

$$V = (v_{ij})_{m \times n} = (w_j y_{ij})_{m \times n} \quad (9)$$

Using the weighted and normalized decision matrix V, calculate the positive ideal solution and negative ideal solution. In the TOPSIS method, monotonicity is usually required. The formulas for positive and negative ideal solutions are as follows:

positive ideal solution: $X^+ = (v_1^+, v_2^+, \ldots, v_n^+)$, $v_j^+ = max_{1 \le i \le m} v_{ij}$ (10)

negative ideal solution: $X^- = (v_1^-, v_2^-, \ldots, v_n^-)$, $v_j^- = min_{1 \le i \le m} v_{ij}$ (11)

For the calculation of the distances between each object and their expected and wild card future solutions, the Euclidean distance is used:

$$S_i^+ = \sqrt{\sum\nolimits_{j=1}^{n} (v_{ij} - v_j^+)^2}, \; i = 1, 2, \ldots, m$$
$$S_i^- = \sqrt{\sum\nolimits_{j=1}^{n} (v_{ij} - v_j^-)^2}, \; i = 1, 2, \ldots, m \quad (12)$$

Compute the relative closeness of each object:

$$C_i^+ = S_i^- / (S_i^+ + S_i^-) \quad (13)$$

The relative closeness measure C_i^+ of each object is its comprehensive score index, with a higher C_i^+ indicating a better object.

3.3. Data resource

The accuracy of the evaluation of the development level of digital economy depends on the understanding of the connotation of digital economy. Based on existing research results, this paper considers that digital economy is new and is based on the traditional economic system. This new economic structure is rooted in the real economy. It has the characteristics of upgrading output models and promoting industrial innovation through advanced information technology such as the Internet and artificial intelligence.

From an economic point of view, digital economy can meet the demand for digital consumption through digital products and services. In addition, digital economy should be an ecosystem in which digital service producers, digital application consumers, digital output innovators, and the digital technology environment coexist harmoniously.

Based on this and considering the principles of data availability, continuity, and operationalization, the authors cover the digital features of economic development as extensively as possible. Hence, this paper constructs a digital economy evaluation index system comprising four primary and 20 secondary indicators including digital infrastructure, digital industry income generation, digital service capacity, and digital innovation capacity, as shown in Figure 1. All initial data were collected by the authors from the official websites of the National Bureau of Statistics of China (https://data.stats.gov.cn/english/). The four indicators – breadth of digital financial coverage, depth of digital financial usage, level of digitalization of inclusive finance and level of online mobile payments – are taken from the Peking University Digital Inclusive Finance Index, which was compiled by a joint research group formed by the Peking University Digital Finance Research Centre and Ant Financial Services Group (Guo et al., 2020).

Code	*Secondary indicators*	*Primary indicators*
X1	Length of optical fiber cables (km)	Digital infrastructure
X2	Number of broadband internet access ports	
X3	Penetration rate of mobile phones (number of users per hundred people)	
X4	Number of domain names (in ten thousands)	
X5	Capacity of mobile telephone exchanges (in ten thousands)	
X6	Revenue from software business (10,000 RMB)	Revenue from the digital industry
X7	Revenue from information technology services (10,000 RMB)	
X8	Telecom business volume (100 million RMB)	
X9	E-commerce procurement volume (100 million RMB)	
X10	E-commerce sales volume (100 million RMB)	
X11	The breadth of digital financial coverage	Digital service capability
X12	The depth of digital financial usage	
X13	Level of online and mobile payments	
X14	Level of digitalization of inclusive finance	
X15	Number of employed persons in urban units engaged in information transmission, software, and information technology services (in ten thousands)	
X16	Full-time equivalent (FTE) R&D personnel in industrial enterprises above designated size (person-years)	Digital innovation capability
X17	R&D expenses in industrial enterprises above designated size (10,000 RMB)	
X18	Number of R&D projects in industrial enterprises above designated size	
X19	Technology market turnover (100 million RMB)	
X20	Number of domestic patent applications and authorizations	

Figure 1. Digital Economy Evaluation Index System. *Source: Initial data were collected by the authors from the Official websites of National Bureau of Statistics of China (https://data.stats.gov.cn/english/)*

4. Results

Based on the construction of the evaluation index system and the measurement model for the development level of Chongqing's digital economy, the information entropy (e_j), weight (w_j) and utility value (d_j) of each evaluation index in Chongqing are derived according to the above formula, as shown in Figure 2.

index	e_j	d_j	w_j	index	e_j	d_j	w_j
X1	0.98	0.02	3.6	X11	0.99	0.01	2.29
X2	0.98	0.02	3.32	X12	0.98	0.02	3.26
X3	1.00	0.00	0.55	X13	0.99	0.01	1.16
X4	0.96	0.04	6.09	X14	1.00	0.00	0.74
X5	1.00	0.00	0.62	X15	1.00	0.00	0.35
X6	0.96	0.04	6.32	X16	0.99	0.01	1.88
X7	0.97	0.03	5.27	X17	0.98	0.02	3.28
X8	0.83	0.17	29.12	X18	0.97	0.03	5.3
X9	0.94	0.06	9.27	X19	0.95	0.05	8.9
X10	0.97	0.03	4.8	X20	0.98	0.02	3.92

Figure 2. The results of the calculation of various indicators in Chongqing Municipality. *Source: Initial data were collected by the authors from the Official websites of National Bureau of Statistics of China (https://data.stats.gov.cn/english/)*

According to the results, X8 (Telecom business volume (100 million RMB)) is the most heavily weighted among the 20 indicators. X15 (Number of employed persons in urban units engaged in information transmission, software, and information technology services (in ten thousand) is the least weighted. The difference between the maximum and minimum values is 28.77. The top six in order of ranking are X8 (Telecom business volume (100 million RMB)), X9 (E-commerce procurement volume (100 million RMB)), X19 (Technology market turnover (100 million RMB), X6 (Revenue from software business (10,000 RMB)), X4 (Number of domain names (in ten thousand)), and X7 (Revenue from information technology services (10,000 RMB)).

As for the weight of each primary indicator, Digital Infrastructure obtains 14.18%, Revenue from Digital Industry takes 54.78%, Digital Service Capability obtains only 7.8%, and Digital Innovation Capability takes 23.28%. Therefore, Revenue from Digital Industry has the most significant impact on the growth of digital economy in Chongqing.

This consequence is because the Chongqing Municipal Government as one of the important cities for developing China's digital economy has adopted a series of financial policies to promote its growth. Here are some of the central policies. Since 2014, the Chongqing Municipal Government has invested several hundred million yuans annually in the Digital Economy Industry Support Fund to aid the development of digital economy-related enterprises and projects such as technology research and development, market development, and talent introduction. Secondly, the Chongqing Municipal Government has launched the Innovation Voucher Program to provide up to RMB 500,000 in subsidies to eligible small and medium-sized enterprises engaged in digital economy-related technological innovation activities, including technology development, intellectual property application, and technology transfer.

What is more, the Chongqing Municipal Government has implemented a series of tax incentives to attract more enterprises and individuals to participate in developing the digital economy industry: these tax incentives include reductions and exemptions of enterprise income tax, personal income tax, value-added tax, and other taxes. Besides, to attract more digital economy talents to Chongqing, the municipal government has launched the Talent Introduction Plan, which includes providing favorable policies –such as high salaries, housing subsidies, and education opportunities for children, as well as establishing talent apartments as well as innovation and entrepreneurship bases – to guarantee quality living and working environments.

Finally, the Chongqing Municipal Government has set up the Key Industry Development Fund to support the development of the digital economy industry, including investing in digital economy-related enterprises and supporting the construction of digital economy industrial parks. Overall, the Chongqing Municipal Government's financial policies aim to improve the development level and competitiveness of the digital economy industry through various measures, which contribute to the transformation and upgrading of Chongqing's economy.

However, the findings show that despite the recent quick growth of digital economy, there are still issues with lagging digital service capability, comparably low capacity for innovation, imbalances in internal structure, and uneven regional development. Hence, the authors suggest the government should pay more attention to further improve the digital transformation of public services directly linked to people's means of subsistence – such as health care, education, transportation, and government services – through special bonds, PPP models, and other ways, to name a few new ideas. What is more, when it comes to the procurement of services, eligible social organizations should be given the responsibility of providing public services like data processing and electronic government affairs in line with market-oriented approaches. In addition, the government should enhance management, aggressively create a framework for collaboration and incentive compatibility among government departments, provide open platforms for sharing data for governments at all levels and departments, and fully utilize big data as a decision-making tool in the hands of governance.

Then, based on the TOPSIS evaluation model the development level of Chongqing's digital economy was determined. The data results of positive (S_i^+) and negative (S_i^-) ideal solutions, the relative closeness of each object (C_i^+) and its rank are shown in Figure 3.

Year	S_i^+	S_i^-	C_i^+	ScoreC_i^+
2014	0.723	0.078	0.098	7
2015	0.694	0.045	0.061	8
2016	0.713	0.097	0.12	6
2017	0.656	0.095	0.127	5
2018	0.42	0.325	0.436	3
2019	0.198	0.566	0.741	2
2020	0.078	0.716	0.901	1
2021	0.689	0.233	0.252	4

Figure 3. Comprehensive Evaluation Results of Digital Economy Development in Chongqing Municipality from 2014 to 2021. Source: Initial data were collected by the authors from the Official websites of National Bureau of Statistics of China (https://data.stats.gov.cn/english/)

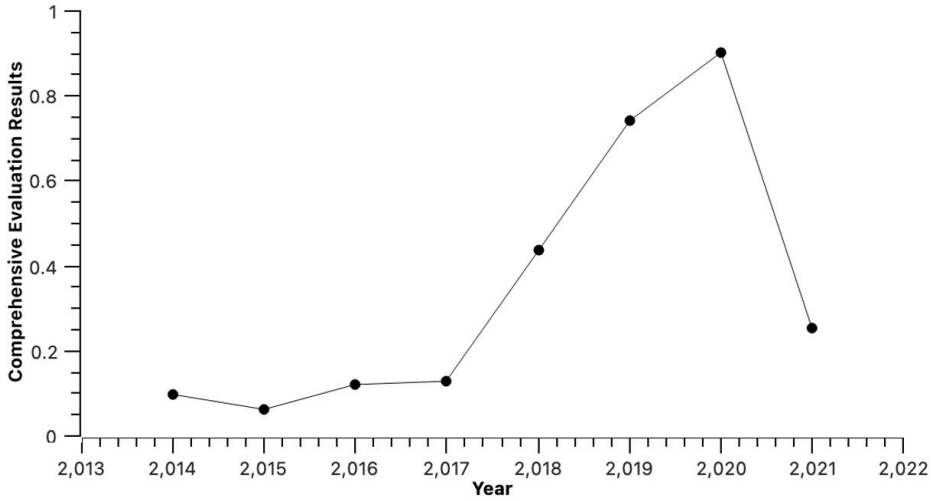

Figure 4. Comprehensive Evaluation Results of Digital Economy Development in Chongqing Municipality from 2014 to 2021. Source: Initial data were collected by the authors from the Official websites of National Bureau of Statistics of China (https://data.stats.gov.cn/english/)

In order to visualize changes in the development of Chongqing's digital economy between 2014 and 2021, the authors have made a visual chart based on the above data, as shown in Figure 4.

As shown on the figure, the level of digital economy development in Chongqing has gradually increased from 2014 to 2021, which shows a good growth trend of continuous strengthening. The speed of digital economy development in Chongqing accelerated significantly after 2017. However, after 2020, the level of digital economy development in Chongqing Municipality fell back to the level of around 2018.

Based on the timeline, the authors analysed the fiscal policies issued by the Chongqing Municipal government to promote the development of digital economy year by year. The results show that Chongqing has vigorously implemented the development strategy of "big data intelligence" since 2018 and has since accumulated a solid foundation and strong momentum for the city.

The authors of this article are of the opinion that Chongqing's adherence to this development strategy can be characterized as three "first-class". First, first-class digital infrastructure. A total of 49,000 5G base stations have been built and opened, with the most significant data centre cluster in the west. The number of registrations of the China Industrial Internet Identity Analysis national top node (Chongqing) has exceeded 100 million, and the total bandwidth of China-Singapore (Chongqing) international data dedicated channel has reached 380G. Second, expansion of first-class application scenarios. Chongqing is an essential modern manufacturing base in the country, with the wealthiest industrial categories, the best industrial application scenarios, and the broadest market space. Third, first-class social atmosphere. At present, the innovation and development of digital economy have become the consensus of the city's growth, especially with Chongqing as the permanent site of the China International Intelligent Industry Expo. "Smart Expo" has become a new beautiful business card of Chongqing: a large number of digital industry giants and heavy projects have landed, and the urban agglomeration effect has been significantly enhanced. This can also explain the rapid rise in the development of Chongqing's digital economy since 2018.

Subsequently, in May 2020, the Digital Transformation Partnership Action (2020) was officially launched, and Chongqing became one of the six provinces and cities in digital economy development Pilot Zone. Then, the 2021 China-Shanghai Cooperation Organization Digital Economy Industry Forum was held in Chongqing. These opportunities helped Chongqing to growth its digital economy development level.

In creating the pilot zone, Chongqing has accelerated the promotion of digital technologies such as big data, blockchain, and artificial intelligence in the depth of traditional industries. The local authority makes efforts to comprehensively improve the digital level of manufacturing, construction, agriculture, and service industries and help create a new business card of "smart city" for this originally old manufacturing town. The following four aspects can reflect on these measures.

Firstly, the government further advanced intelligent manufacturing. They actively guide key enterprises to implement smart transformation. Nearly 90% of Chongqing's special funds for industry and information technology are used to support the intelligent development of big data and promote the implementation of 2,780 intelligent transformation projects. These helped to accelerate the accumulation and development of industrial Internet platforms. The city gathered 197 industrial Internet service enterprises and 47 industrial Internet platforms providing third-party services. Besides, the government also vigorously promoted the application of new models of intelligent manufacturing. New models and products – such as network collaborative manufacturing and large-scale personalized customization – continued to emerge, and 393 demonstration and application projects were established.

Secondly, the integration of digital technology and the construction industry is accelerating. This means promoting the application of BIM (building information modelling) technology in nearly 1,000 projects, identifying 2,630 innovative construction sites, and building 25 municipal prefabricated construction industrial bases and six national industrial bases. Besides, this also includes exploring the establishment of a primary platform of urban information model (CIM) for mapping and managing all elements of urban three-dimensional space and taking the lead in carrying out pilot projects in the core areas of the two rivers and four banks. The construction of big data centres in the construction industry has been completed, and about 2.8 billion data assets have been formed.

Thirdly, the government has helped to accelerate smart agriculture and rural development. Chongqing has built 200 municipal smart agriculture experiment and demonstration bases, and the industrial aquaponics system of the Municipal Academy of Agricultural Sciences has been approved by the Ministry of Agriculture and Rural Affairs as the national smart agriculture new technology application model. The city's "agriculture, rural areas" big data platform has been built to integrate more than 88 million agriculture-related information resources in the city. The construction and application of big data for the whole industrial chain of a single product will be carried out in characteristic and competitive industries such as pickled mustard and citrus.

Fourthly, the digitization of the service sector is accelerating. Leading e-commerce enterprises such as Kaola Overseas Shopping and Alibaba Cainiao have settled in Chongqing, the local share of Chongqing and Europe has risen to the level of national cross-border e-commerce enterprises, and cross-border e-commerce B2B export pilots have landed. Lianglu Cuntan Bonded Port Area and other comprehensive protection areas of intelligent warehousing have been completed, construction planning has been finished and put to use, with a total area of more than 120,000 square meters. Many business districts have built innovative business district platforms to realize functions such as business district finance and intelligent parking.

However, it is important to note that digital economic growth trends can fluctuate due to factors. Some potential reasons why China's digital economy has experienced a slowdown or reverted to 2018 levels in 2020 could include the following.

Firstly, the perspective of the impact of COVID-19 to Chinese digital economy development is addressed. The pandemic had mixed effects on different sectors of China's digital economy. Lockdowns, travel restrictions, and reduced consumer spending may have affected certain digital businesses adversely. Here are some examples to explain this point.

- Ride-Hailing Services: Didi Chuxing and similar services saw reduced demand as people avoided shared transportation options.
- Shared Mobility and Bike-Sharing: Companies like Mobike and Ofo faced decreased demand as people avoided using shared bicycles and scooters.
- Online Travel Agencies (OTAs): Ctrip and Qunar experienced a significant drop in travel bookings and in revenue due to travel restrictions.
- Online Retail: E-commerce platforms like Alibaba's Taobao and JD.com saw increased demand for essential goods but reduced spending on non-essential items.
- Online Entertainment: Streaming services and online gaming platforms like Tencent Video and Honor of Kings saw increased usage, but live entertainment sectors faced setbacks due to restrictions on gatherings.
- Online Food Delivery: Meituan and Ele.me saw a surge in orders, but operational challenges arose from supply chain disruptions and safety measures.
- Government Regulations: Changes in policies or regulations impacted the growth of specific digital industries. Guidelines for platform economy regulation and investigations into big tech companies aimed to foster competition and address antitrust concerns.

Besides, from the perspective of market saturation, some sectors reached a saturation point, where growth slowed due to market maturity and intense competition. Here are some examples to explain this point.

- E-commerce: Major players like Alibaba's Taobao and JD.com dominated the market, making it challenging for new entrants to gain significant market share.
- Online Payment Services: China's mobile payment market had wide adoption, which led to incremental growth opportunities.
- Online Food Delivery: As multiple platforms competed for market share, the growth rate in the delivery market slowed down.
- Ride-Hailing Services: Didi Chuxing faced intense competition, resulting in slower growth in user acquisition and usage.

- Online Travel Agencies (OTAs): With well-established players like Ctrip and Qunar, the OTA market reached a point of slower growth.
- Understanding these factors is essential to grasp the dynamics of China's digital economy and its response to various challenges and opportunities.

Currently, following the requirements of the 14th Five-Year Plan for the development of China's national digital economy as well as the 14th Five-Year Plan for National Economic and Social Development of Chongqing Municipality and the Outline of Visionary Goals for 2035, Chongqing Municipal Government has formulated the following plan taking into account the actual situation in Chongqing. The planning period is from 2021 to 2025, with an outlook to 2035. During 2022, Chongqing Municipal Government focused on promoting the high-quality development of digital economy. The local government launched the software and information service industry's "Star in the Sky" action plan. Over 3,500 new software enterprises and over 1 million square meters of stocked buildings were revitalized, and as a consequence software business revenue increased by 10.5%. This program implemented 1,407 intelligent transformation projects and identified 22 new smart factories and 160 digital workshops. Fifteen national "double span" platforms were laid out in Chongqing, and the Industrial Internet Transformation Promotion Centre was put into operation. The government promoted the construction of 131 new industrial Internet models and applications. The top-level node for industrial Internet identity resolution (Chongqing) was connected to 9 provinces and cities and 34 secondary nodes. The 5G base stations reached 19 per 10,000 people, ranking first in the country. The 2022 Smart Expo was held successfully. The value added of core industries in digital economy exceeded 8% of GDP.

5. Limitations and conclusions

Despite the knowledge gathered from this study on the growth of Chongqing's digital economy, there are still certain issues that need to be resolved. First, other parts of China were not included in this study; it only assessed how the Chongqing's digital economy was developing. As a result, the findings' generalizability might be constrained. For providing a more complete view of the evolution of China's digital economy, future research may broaden the analysis's geographic scope to encompass the entire country or just some selected regions.

Secondly, the research covered the period from 2014 to 2021, during which the COVID-19 pandemic occurred. Although the data indicates that the pandemic significantly impacted the digital economy development of Chongqing during this period, there may still be some effects that were not captured by the data. Hence, future research could include more recent data to explore the possible impact of the pandemic on digital economy development.

Lastly, the current research used the Entropy-based TOPSIS method to evaluate the digital economy development level. In fact, other evaluation methods are also available, such as the Data Envelopment Analysis (DEA) method, which could provide different insights into sustainable development. Therefore, future research could compare different evaluation methods to gain a more comprehensive understanding of regional digital economy development in China.

In conclusion, this study adopted a mixed research method to investigate the current situation of Chongqing's digital economy development, the fiscal policies issued by the Chongqing government to promote digital economy development, and the actual effects of these policies. The study employed a literature review to provide a clear theoretical foundation for the research and analysed the fiscal policies aimed at promoting digital economy by collecting and examining data from 2014 to 2021. The study also used the Entropy-based TOPSIS method to evaluate the overall level of Chongqing's digital economy development. The results indicate that although digital economy has grown rapidly in recent years, there are still challenges in terms of poor industrial transformation, weak innovation capacity, lagging digital service capability, imbalance in the internal structure of digital economy, and uneven development within the region. However, the study also shows a growth trend with a significant acceleration of development speed after 2017, which is attributed to the implementation of targeted fiscal policies. Therefore, efforts are required on both the supply and demand sides to support the development of digital economy, with the supply side focusing on infrastructure

development, cultivating market players, enhancing innovation capabilities, strengthening the talent pool, and forming a robust support system for digital economy. Ultimately, the development of digital economy is not only a strategic choice for China but also a necessary path towards high-quality economic growth.

Funding: This research received no external funding.

Conflicts of Interest: The authors declare no conflict of interest.

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