The Dynamic Evolution Law and Realization Path of Digitalization in Western Cities

Hongliang Zhu[1,a*],Bo Shi[2,b]

[1]School of Economics and Management, Northwestern University , Postgraduate;
[2]School of Digital Economy and Management, Nanjing University,Doctoral supervisor;
[a*]2551083680@qq.com
[b]Shibonwu@sina.com
Corresponding author: 2551083680@qq.com

Abstract. This paper analyzes the regional differences, dynamic evolution patterns and trends of the digital development level of cities in 69 cities in the western region using Dagum Gini coefficient, kernel density estimation and Markov chain methods, respectively.The digital development level of cities in the western region shows an increasing trend from 2018 to 2021, and its overall Gini coefficient decreases from 0.1728 to 0.1322. kernel density estimation The analysis shows that the digital development level of cities in the western region is gradually increasing, but the uneven development characteristics among regions are obvious. The Markov chain method analysis shows that the overall digital development level of cities in the western region is shifting to a high level, and there is less possibility of leapfrogging.

Keywords: city digitization, Gini coefficient, Markov chain

1 Introduction

As the main economic form after the agricultural and industrial economies, the digital economy takes digital knowledge and information as important factors of production, and takes digital technology as the core driving force and modern information network as the important carrier. Through the deep integration of digital technology and the real economy, it continuously improves the level of digitalization, networking and intelligence, thus accelerating the innovation of economic development and governance mode. China Digital Economy Development Report (2022）) shows that the digital economy reached a scale of 45.5 trillion yuan in 2021, with a nominal growth of 16.2% year-on-year and a proportion of 39.8% of GDP. The digital economy drives the high-quality development of urban economy by improving the industrial system of digital development, optimizing the digital development environment, and constructing the path of digital governance system (Shi-Bo, 2020) [1], which has become an important engine of China's high-quality economic development. The digital economy has been booming in recent years, and scholars have conducted statistical and measurement studies on the digital economy from various levels. Jin Xingye et al. (2020) and Xu

L. Moutinho et al. (eds.), *Proceedings of the 2023 International Conference on Management Innovation and Economy Development (MIED 2023)*, Advances in Economics, Business and Management Research 260,
https://doi.org/10.2991/978-94-6463-260-6_53

Xianchun et al. (2020) constructed and improved China's digital economy statistical accounting system by measuring the degree of contribution of digital economy to macroeconomic operation from the national level[23]. From the provincial level, Han Zhaoan et al. (2021) and Liu Chengkun et al. (2022) found that the eastern coastal provinces and cities maintain the leading position in digital economy scale all year round, and the gap between the central and western regions is obvious[45].From the perspective of major city clusters, Liu Chuanming et al. (2020) and Zhang Kexian et al. (2022) found that the difference in digital economy development of city clusters showed a gradual decline, but the polarization within city clusters was obvious[67].Other scholars have measured the digital economy from other aspects, for example, Mao Fengfu et al. (2022) studied the digital economy industry in the Yangtze River economic belt and found that digital enterprises in the Yangtze River basin were distributed in multi-core clusters[8].Song Changlin (2022) studied the digital economy of cities in the Yellow River basin and found that the gap between upstream and downstream cities increased[9].Wu Guoyong et al. (2022) found that the overall level of digital economy development in China's rural areas is low but increasing, and the "polarization phenomenon" is obvious in the whole country and the eastern region[10].Scholars have conducted in-depth measurement studies on the digital economy at various levels, but there is a lack of literature focusing on the digital development of cities in the western region. In May 2020, the Guidance Opinions of the State Council of the Central Committee of the Communist Party of China on Promoting the Development of the Western Region in a New Era to Form a New Pattern instructed that continuing to do a good job in the development of the western region in the new era is important for starting a new journey of building a comprehensive socialist modern country. Has important practical significance and far-reaching historical significance. "The 14th Five-Year Plan and the 2035 Visionary Goals also emphasize: strengthening initiatives to promote the development of the west, enhancing the construction of the Guanzhong Plain City Cluster, and promoting cooperation and interaction between the northwest and southwest regions. Based on this, this paper analyzes 69 cities in western China to explore the current situation and the realization path of urban digitalization in western China.

2 Digital Indicator System and Status of Cities in Western Region

For urban digital development indicators, Xinhuasan Group① constructs the "Urban Digital Economy Indicator System" from five aspects, including digital infrastructure, digital economy, digital society, digital government and digital ecology, for the four key areas of urban development and governance in China, including four secondary indicators, 12 tertiary indicators (as shown in Table 1) and 44 basic indicators (for details, see Xinhuasan Group①).

According to the digital development index of cities in the western region from 2018 to 2021. From the overall perspective, the digitalization level of cities in the western

① Xinhuasan Group "Digital City Development Index", http://deindex.h3c.com/

region shows a stable growth with less fluctuation. In terms of sub-dimensions, data and information technology infrastructure contribute the most to the urban digital development index, with an average index value of 58.61 from 2018 to 2021, accounting for the largest piroportion of the urban digital development index. Digitization of urban services is the second highest. Industrial integration digitization is the lowest, and its decreases to 35.48 in 2021. the index is estimated to reach 51.43 in 2022 based on the average growth rate of each sub-index, showing an overall growth trend.

To study the spatial sources of urban digitization in the western region, the dagum Gini coefficient decomposition method was used to assess the overall and inter-regional differences in the western region. From the results of the Gini coefficient measures (as in Table 1), the variance values of the digital development index for the whole region ranged from 0.1322 to 0.1728, with an overall mean Gini coefficient of 0.1505. the mean intra-regional variance of urban digitalization in the northwest region was 0.1497, and the mean intra-regional variance of urban digitalization in the southwest region was 0.1491, while the urban digital development in the southwest region was The development of urban digitalization in the southwest region is more uneven.

Table 1. Overall differences in digitization level and intra-regional and inter-regional differences in cities in the western region, 2018~2021

Year	Overall differences	Intra-regional variation		Inter-regional differences
		Northwest	Southwest	
2018	0.1728	0.1773	0.1675	0.1749
2019	0.1549	0.1573	0.1505	0.1571
2020	0.1421	0.1384	0.1430	0.1428
2021	0.1322	0.1257	0.1352	0.1324

The sources and contribution rates of digital development differences of cities in the western region are shown in Table 2. It is obvious that intra-regional variation is the main source, whose value fluctuates from 0.0676-0.0879, and its variation contribution rate is higher than 50%. The contribution rate of super-variable density variance accounts for the second proportion, more than 40%, and it is obvious that the key to solve the problem of uneven urban digital development in the western region lies in reducing the intra-regional variance.

Table 2. Sources and contribution of digital disparity in cities in the western region, 2018 to 2021

Year	In the region		Inter-regional		Super variable density	
	Source	Contribution	Source	Contribution	Source	Contribution
2018	0.0879	50.87%	0.0127	7.34%	0.0722	41.79%
2019	0.0785	50.68%	0.0062	3.99%	0.0702	45.32%
2020	0.0725	51.03%	0.0000	0.03%	0.0695	48.94%
2021	0.0676	51.11%	0.0035	2.64%	0.0611	46.25%

3 Trend analysis of digitization of cities in western region

3.1 Kernel Kernel Density Estimation for Digital Development of Cities in Western Region

Taking 2018, 2019, 2021, and 2022 as the measurement time points, the results of nuclear density in the western region show that the center of the distribution curve of urban digitization gradually moves to the right, indicating that the overall urban digitization in the western region shows a gradual upward trend. Using the same method to measure the northwest region and the southwest region, it is found that the gap between the average level of urban digitalization within the southwest region increases year by year, and the gap in the extension of the kernel density curve expands year by year, and the phenomenon of unipolarity exists obviously and will continue all the time. The digitization level of cities in the Northwest region continues to develop for the better, and the gap of digitization level of each city decreases year by year.

3.2 Markov Chain Dynamic Characterization of City Digitization Index

The cities were divided into four levels based on the quartiles of the city digital development index: low level digital city (I), medium level digital city (II), medium high level digital city (III) and high level digital city (IV). Then the probability matrix of cities in the western region shifting between different levels in one-year, two-year and three-year periods is measured. If the city rank in period t+1 is the same as the city rank in period t, the rank status of the indicated city is relatively stable; if the city rank has improved, it is shifted upward, and the results are shown in Table 3. The probability of the city rank state on the main diagonal remains high during the sample observation period, and its probability is much higher than that of the cities on the non-diagonal; with the longer time span, the value of the elements on the main diagonal gradually decreases, while the probability value on the right side of the main diagonal gradually increases, which indicates that the stability of the city rank gradually decreases with time, the probability of the city rank shifting upward rises, and the level of city digitization becomes higher.

Table 3. Overall transfer probability matrix of four types of cities in the western region

cross-period		I	II	III	IV
1	I	0.51471	0.45588	0.02941	0.00000
	II	0.00000	0.61702	0.38298	0.00000
	III	0.00000	0.00000	0.77778	0.22222
	IV	0.00000	0.00000	0.00000	1.00000
2	I	0.16949	0.77966	0.05085	0.00000
	II	0.00000	0.04545	0.95455	0.00000
	III	0.00000	0.00000	0.55172	0.44828
	IV	0.00000	0.00000	0.00000	1.00000
3	I	0.02941	1.00000	0.32353	0.00000
	II	0.00000	0.64706	1.00000	0.00000
	III	0.00000	0.00000	0.28571	0.71429
	IV	0.00000	0.00000	0.00000	1.00000

4 Conclusions

First of all, fully promoting the construction of data and information infrastructure is the beginning of the digital development of cities, which needs the support of digital infrastructure. On the one hand, to properly face the imbalance of regional digital infrastructure construction, the government should increase financial subsidies to improve the overall network coverage area in the west, so that it can fully cover remote cities and eventually penetrate into various application areas of cities. On the other hand, enhance the strong digital infrastructure investment and optimize the digital infrastructure construction structure. Second, improve the new model of digital government. On the one hand, optimize the management mode and service mode, strengthen cooperation with third-party organizations and other organizations to drive extensive social participation in the urban governance process; on the other hand, in the process of digitizing urban services, the government should tap the implicit value of big data and promote the application of information technology in the urban governance and service system, so as to improve the level of urban governance and services. Again, seize the digitalization of industrial integration. In order to strengthen the foundation of industrial integration digitalization, it is necessary to break the technical bottleneck in the process. On its part, the government needs to build a unified data element market, improve the fair competition review and supervision system, improve the digital information perfection and other related laws and regulations, and establish an all-round security system for the digital development of the city. Finally, the government should lead the optimization of talent structure, continuously promote the talent training program in the field of digitalization, and establish a city talent pool. On the one hand, it should establish a comprehensive education, medical and housing system to solve the living problems of talents; provide policy preferences and subsidies, and improve the basic public service system to solve the worries of talents. On the other hand, the government should build a think tank platform to improve the form of human resource services according to the occupational categories and characteristics needed for the future digitization of the city. At the same time, can also support key areas by setting up special funds and guiding social capital to provide project start-up and R&D funding for digital talents, so as to inject vitality into urban digitization.

References

1. Shi Bo. (2020) Mechanism and path of digital economy for high-quality development of urban economy.Journal of Xi'an University of Finance and Economics. http://dx.doi.org/10.19331/j.cnki.jxufe.2020.02.002
2. Jin Xingye,Fu Lin, Li Tao.(2020)Framework, Methodology and Characteristics of Accounting for the Size of the Digital Economy. Comparative Economic and Social Systems. http://dx.doi.org/10.3969/j.issn.1003-3947.2020.04.008
3. Xu Xianchun,Zhang Meihui.(2020)A study on the measurement of the size of China's digital economy - an international comparison-based perspective. China Industrial Economics. http://dx.doi.org/10.19581/j.cnki.ciejournal.2020. 05.013

4. Han Zhaoan,Zhao Jingfeng,Wu Haizhen.(2021)A Study of Interprovincial Digital Economy Scale Measurement, Unevenness and Regional Differences in China. Quantitative Economic and Technical Economics Research.http://dx.doi.org/10.13653/j.cnki.jqte.2021.08.009
5. Liu Chengkun,Jiang Yue,Zhang Qihui,Zhu Xingfang.(2022)Research on the statistical measurement and spatial and temporal evolution trend of the development level of digital economy.Industrial Technology Economy.http://dx.doi.org/10.3969/j.issn.1004-910X.2022.02.016
6. Liu Chuanming,Yin Xiu,Wang Linshan.(2020)Regional differences in the development of China's digital economy and the dynamic evolution of its distribution. China Science and Technology Forum. http://dx.doi.org/10.13580/j.cnki.fstc.2020.03.012
7. Kexian Zhang,Hongmei Li.(2022)Spatial differences in the level of digital economy development in urban agglomerations and convergence analysis. Economic Geography. http://dx.doi.org/10.15957/j.cnki.jjdl.2022.09.014
8. Mao Fengfu.Gao Yuchen.and Zhou Can.（2022）Evolution of the Spatial Pattern of Digital Industries in the Yangtze River Economic Belt and the Driving Factors.Geographical Studies. http://dx.doi.org/10.11821/dlyj020210609
9. Song Changlin. (2022)Analysis of Spatio-temporal Evolution and Influencing Factors of Digital Economy Development in Yellow River Basin Cities, Master's thesis, Shandong University of Finance and Economics, http://dx.doi.org/10.27274/d.cnki.gsdjc.2022.000204
10. Guoyong Wu,Guoguang Pang,Junhui Tang, and Jindan Liu.(2022)Measurement, regional differences and spatial and temporal evolution of the level of digital economy development in rural China. Journal of Hunan Agricultural University.http://dx.doi.org/10.13331/j.cnki.jhau(ss).2022.04.002