

Measurement and Spatiotemporal Evolution of High-quality Development Level of New Urbanization in Anhui Province

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Abstract

This study takes 8 cities in Anhui Province from 2013 to 2022 as research objects, and through quantitative analysis of the spatial evolution characteristics of the new urbanization level, reveals the internal mechanism and dynamic process of regional urbanization development. The study adopted a multidimensional indicator system to systematically measure the level of new urbanization in Anhui Province, and deeply analyzed the development differences and evolution paths between cities. The research results indicate that the new urbanization in Anhui Province presents a clear spatial distribution characteristic of "high in the middle and low in the surrounding areas". The study ultimately proposed policy recommendations such as optimizing regional coordinated development, promoting differentiated urbanization paths, and deepening the connotation of new urbanization, providing important references for the development of new urbanization in Anhui Province and similar regions.

Keywords

New Urbanization; Spatial Evolution; Anhui Province.

1. Introduction

Since the reform and opening up, China's urbanization process has undergone profound and rapid changes, and has become an important strategy for the country's modernization construction. The connotation and extension of urbanization are constantly expanding, presenting an increasingly complex and diversified development trend. The report of the 20th National Congress of the Communist Party of China proposed to promote high-quality development of urbanization, marking a new historical stage in China's urbanization. This means that urbanization is no longer simply about population and spatial agglomeration, but rather about achieving a coordinated, sustainable, and humane development model at a higher level and broader dimension. However, there are many deep-seated challenges in the process of new urbanization, such as regional development imbalance, long-standing urban-rural dual structure, and insufficient industrial support, which seriously restrict the improvement of urbanization quality and regional coordinated development[1]. Regional development differences, uneven allocation of urban and rural resources, and bottlenecks in industrial structure transformation have become key factors limiting the high-quality development of new urbanization. Conducting research on measuring the level of new urbanization in cities is of great significance. This not only helps deepen the theoretical understanding of the laws of urbanization development, but also provides scientific methodological support for formulating precise regional development strategies. By constructing a systematic, dynamic, and multidimensional measurement index system, the quality and level of urbanization development can be comprehensively and objectively evaluated, revealing the inherent mechanism and evolutionary path of regional urbanization development. This research has

important theoretical value and practical significance for providing policy references for decision-makers, promoting regional coordinated development, and narrowing regional development gaps.

As a major national strategy, new urbanization has become a key research area in academia in recent years. Scholars have conducted in-depth research on the development level, quality, and impact mechanism of new urbanization from multiple perspectives, with increasingly rich and refined research methods. In terms of research methods, scholars generally adopt a multidimensional indicator system and use quantitative tools such as entropy weight TOPSIS and coupling coordination degree model to scientifically measure the level of new urbanization [2-3]. Unlike traditional research, these studies not only focus on quantitative indicators, but also emphasize the quality connotation, such as public services, ecological environment efficiency, and green and low-carbon development [4]. In terms of regional research, scholars select different provinces as research objects to reveal the regional differences of new urbanization. For example, Ding Renchuan et al. (2024) studied the coupling and coordination between new urbanization and public services in Anhui Province [5], Li Xinrui et al. (2024) measured the quality of new urbanization in Jiangsu Province [6], and Lu Chunyang et al. (2024) analyzed the level of human centered urbanization development in Henan Province [7]. These studies have enriched the theory of regional development and provided important references for formulating differentiated development strategies. In the field of coupling coordination research, scholars further explore the interactive relationship between new urbanization and other systems. Zhou Ying et al. (2024) studied the coupling coordination between new urbanization and agricultural ecological environment efficiency in the Chengdu Chongqing economic circle [8], while Yin Conghao (2024) focused on the coupling coordination between new urbanization and agricultural carbon productivity [9]. These studies have expanded the perspective of new urbanization research and revealed the complex interactive mechanisms between urbanization, ecology, agriculture, and other fields.

Although significant progress has been made in the study of new urbanization, there are still significant shortcomings in research methods, scale, and content. The academic community's understanding of new urbanization is still deepening, and there is an urgent need to construct a more scientific and comprehensive evaluation index system and theoretical framework. In view of this, taking 8 cities in Anhui Province as research objects, the entropy weight method is used to measure the level of new urbanization and conduct spatiotemporal evolution research. This not only helps deepen the theoretical understanding of the development laws of urbanization, but also provides scientific methodological guidance for narrowing the development gap between cities within Anhui Province.

2. Research Methods and Data Sources

2.1. Research Area

Anhui Province, as an important province in the central region, selects 8 cities including Hefei, Wuhu, Anqing, Ma'anshan, Chuzhou, Chizhou, Xuancheng, and Tongling as research objects. These cities show significant differences in location, economic development level, and urbanization process. In terms of urbanization development level, these 8 cities exhibit significant gradient differences. The imbalance of regional development not only reflects the complexity of urbanization development within Anhui Province, but also highlights the necessity of constructing a scientific, dynamic, and multidimensional measurement index system. Through in-depth analysis of the urbanization development characteristics of these 8 cities, more accurate theoretical guidance and practical paths can be provided for the high-quality development of new urbanization in Anhui Province.

2.2. Research Methods

In order to overcome the interference caused by subjective factors, this article calculates the urbanization level and urban livability level of Anhui Province based on the entropy method in the objective weighting method, and determines the comprehensive weight of each indicator. According to relevant literature, the specific calculation is as follows [10-12].

Firstly, standardize the positive and negative indicators.

$$x'_{ij} = \left[\frac{x_{ij} - \min(x_{1j}, x_{2j}, \dots, x_{nj})}{\max(x_{1j}, x_{2j}, \dots, x_{nj}) - \min(x_{1j}, x_{2j}, \dots, x_{nj})} \right] \tag{1}$$

$$x'_{ij} = \left[\frac{\max(x_{1j}, x_{2j}, \dots, x_{nj}) - x_{ij}}{\max(x_{1j}, x_{2j}, \dots, x_{nj}) - \min(x_{1j}, x_{2j}, \dots, x_{nj})} \right] \tag{2}$$

Secondly, calculate the proportion p_{ij} , entropy e_j , coefficient of difference g_j , and weight value w of the indicators.

$$p_{ij} = \frac{x_{ij}}{\sum_1^n x_{ij}} \tag{3}$$

$$e_j = -\frac{1}{\ln(n)} \sum_1^n p_{ij} \ln p_{ij} \tag{4}$$

$$g_j = \frac{1 - e_j}{m - \sum_{j=1}^m e_j} \tag{5}$$

$$w = \frac{g_j}{\sum_{j=1}^m g_j} \quad (1 \leq j \leq m) \tag{6}$$

Finally, calculate the comprehensive score.

$$U = \sum_{j=1}^n (w_j \times x_{ij}) \tag{7}$$

Among them, x_{ij} is the standardized value of the j th indicator of the i -th city ($i=1, 2, \dots, n; j=1, 2, \dots, m$), σ_j and \bar{x} are the standard deviation and mean of the j th indicator, w is the weight, and U is the score of new urbanization.

2.3. Data Sources

This study focuses on 8 cities in Anhui Province from 2013 to 2022, based on panel data. Data sources include the official statistical yearbook, which mainly covers authoritative statistical data such as the statistical yearbook of China's cities and the statistical yearbook of China's urban construction. Aiming at the problem of missing data in some years in the research process, the scientific interpolation method is used to supplement the data to ensure the overall integrity and academic reliability of the data set. Referring to the relevant literature, the new urbanization evaluation index system is designed from the three levels of population, space and economy [13-15]. See Table 1 for the specific evaluation index system.

Table 1. New urbanization evaluation index system

Level	Indicators	Unit	Weight
Population	Population density	Person/m ²	0.16
	Population urbanization rate	%	0.06
	Proportion of employees in secondary and tertiary industries in total employed population	%	0.01
Space	Air quality days ratio	%	0.02
	Proportion of construction land area in urban area	%	0.22
	Urban Road area per capita	m	0.10
	Park area per capita	m ²	0.06
Economic	Per Capita GDP	Yuan/Person	0.09
	Per capita investment in fixed assets	Yuan/Person	0.05
	Economic density	Yuan/m ²	0.19
	Proportion of output value of secondary and tertiary industries in GDP	%	0.04

3. Result Analysis

3.1. Temporal Variation Characteristics of New Urbanization

The measurement results of the level of new towns in Anhui Province are shown in Figure 1. On the whole, the level of new urbanization in Anhui Province showed a gradual upward trend from 2013 to 2022, and maintained in the range of 0.2-0.5, indicating that the urbanization construction in Anhui Province still has great potential for improvement. The level of new-type cities and towns rose from 0.2869 in 2013 to 0.4763 in 2022, a relative increase of 66.10%, with an average annual growth rate of 5.82%, indicating that Anhui Province has made remarkable achievements in the process of new-type urbanization. This growth not only reflects the acceleration of economic development, but also reflects the efforts of the government in the implementation of urbanization policies and infrastructure construction. With the improvement of the level of urbanization, the urban function and service capacity of Anhui Province are continuously enhanced, and the quality of life and economic vitality of residents are also improved accordingly. Specifically, the urbanization construction in Anhui Province was slow before 2016, and accelerated after 2016. By 2019, the urbanization level in Anhui province had reached 0.4005. The reason may be that after 2016, Anhui Province accelerated the adjustment of industrial structure, vigorously developed high-tech industry and modern service industry, especially the innovative city represented by Hefei, attracted a large number of talents and capital, and promoted the improvement of urbanization quality.

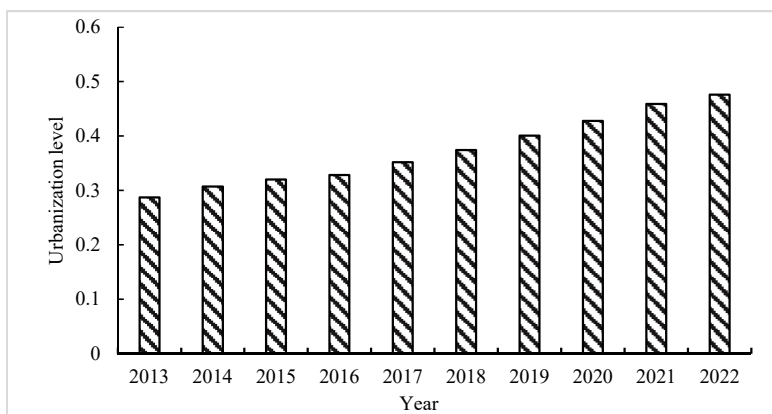


Figure 1. Development level of new urbanization in Anhui Province

3.2. Spatial Evolution Characteristics of New Urbanization

According to the evaluation results of urban ecological resilience, the natural breakpoint method is used to divide it into five types: low level [0.1191, 0.1908], low level (0.1908, 0.3001], medium level (0.3001, 0.4016], high level (0.4016, 0.5250], and high level [0.5250, 0.8205]. ArcGIS software is used to map the spatial distribution of urbanization levels of each city. The final results are shown in Table 2.

Table 2. Spatial distribution of new urbanization level in Anhui Province

Year	High	Higher	Moderate	Lower	Low
2013		Hefei, Manshan, Tongling	Wuhu		Anqing, Chuzhou, Chizhou, Xuancheng
2016	Hefei	Manshan	Wuhu, Tongling	Anqing, Chuzhou	Chizhou, Xuancheng
2019	Hefei, Manshan	Wuhu	Tongling, Anqing, Chuzhou	Xuancheng	Chizhou
2022	Hefei, Wuhu, Manshan, Tongling, Chuzhou	Anqing		Chizhou, Xuancheng	

From 2013 to 2022, the spatial evolution of new urbanization in Anhui Province showed a development trend of "high in the middle and low in the surrounding areas", which generally showed the distinctive characteristics of urban gradient differentiation and unbalanced regional coordinated development. Specifically, Hefei, as the provincial capital, has always maintained a high level of urbanization and driven the coordinated development of surrounding cities. Ma'anshan, Wuhu, Tongling and other cities have performed prominently in the process of urbanization, rising steadily from a moderate level to a high level. In contrast, the development of Chizhou, Xuancheng and other cities is relatively lagging behind, and they have not been effectively integrated into the rapid urbanization process. In 2013, the difference of urbanization level between cities was relatively small, but by 2022, the development gap between high-level and low-level cities will significantly expand. This spatial pattern reflects the complexity and imbalance of regional development in Anhui Province. It is not only the result of economic development, but also the product of multiple factors such as location, industry and infrastructure. In the future, Anhui province needs to further promote regional coordinated development, narrow the development gap between cities, and achieve a more balanced and high-quality urbanization process.

4. Conclusion and Suggestions

4.1. Conclusion

(1) The new urbanization in Anhui Province presents significant spatial gradient differentiation characteristics, forming a regional development pattern centered on Hefei with "high in the middle and low around". From 2013 to 2022, the gap in urbanization levels between cities continued to widen, and the problem of uneven regional coordinated development became increasingly prominent.

(2) Location conditions, industrial structure, infrastructure, and policy guidance are key factors driving the spatial evolution of new urbanization in Anhui Province. Hefei and surrounding cities have achieved rapid improvement in urbanization level relying on their geographical advantages and industrial innovation, while the development of peripheral cities is relatively lagging behind.

(3) The development of new urbanization in Anhui Province presents an unbalanced and differentiated trend, which reflects both the dynamic nature of regional development and the structural contradictions and development bottlenecks that exist in the urbanization process. The uneven development between cities has become an important factor restricting the overall improvement of urbanization quality.

4.2. Suggestions

Based on in-depth and systematic research results, combined with the theoretical and practical needs of the development of new urbanization, the following suggestions are proposed:

(1) Optimize the regional coordinated development strategy and build a multi center, networked urban agglomeration development model centered on Hefei. Promote the overall coordinated development of regional urbanization through industrial synergy, infrastructure interconnection, and resource sharing.

(2) Promote differentiated urbanization paths according to local conditions, and formulate precise urbanization development strategies based on the resource endowments and development stages of different cities. Key support will be given to relatively underdeveloped cities such as Chizhou and Xuancheng to enhance their industrial support capabilities and regional competitiveness.

(3) To deepen the connotation of new urbanization, we should not only focus on quantitative indicators, but also pay attention to the quality and sustainable development of urbanization. Strengthen ecological environment protection, improve public service levels, promote high-quality urbanization development centered on people, and achieve the organic unity of economic, social, and ecological benefits.

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References

- [1] Jin X, Lei Y, Ma X. Research on Quality Evaluation and Influencing Factors of New Urbanization Development in Ningxia [J]. *Journal of Xinjiang Normal University (Natural Science Edition)*, 2024, 43 (02): 52-61.
- [2] He X, Huang D, Zheng K. Measurement of New Urbanization in Zunyi City and Analysis of Its Spatiotemporal Pattern Evolution [J]. *Journal of Zunyi Normal University*, 2023, 25 (06): 56-59.
- [3] Jin C, Yang J, Jiang Y. The Coupling Coordination and Spatiotemporal Evolution of New Urbanization and Green Low Carbon Circular Development: A Case Study of Anhui Province [J]. *Journal of Hunan University of Engineering (Social Sciences Edition)*, 2024, 34 (02): 44-51.
- [4] Duan K, He J. Research on the Coordinated Development of New Urbanization and Agricultural Economy in Xi'an City [J]. *Liaoning Agricultural Science*, 2023, (06):30-35.
- [5] Ding R, Wu D. The coupling and coordinated evolution of new urbanization and public services in Anhui Province [J]. *Journal of Shenyang University (Social Sciences Edition)*, 2024, 26 (04): 19-29.
- [6] Li X, Zhang B. Discussion on Quality Measurement and Optimization Path of New Urbanization in Jiangsu Province [J]. *Gansu Finance*, 2024, (05):43-47.
- [7] Lu C, Zhang C, Wen F, etc. Research on Measuring the Development Level of New Urbanization with People as the Core in Henan Province [J]. *Journal of Henan Urban Construction College*, 2024, 33 (04): 128-132.
- [8] Zhou Y, Wan B, Fu Y, etc. Research on the Coupling and Coordination Level of New Urbanization and Agricultural Ecological Environment Efficiency in the Chengdu Chongqing Dual City Economic Circle [J]. *Decision Consulting*, 2024, (04):64-69+75.

- [9] Yin C. Coupling and Coordination Measurement of New Urbanization and Agricultural Carbon Productivity [J]. *Statistics and Decision making*, 2024, 40 (21): 69-74.
- [10] Zhang J, Shi L, Wang X, etc. Measurement of Coordinated Development between New Urbanization and Green Technology Innovation in the Yellow River Basin [J]. *China Business Review*, 2023, (19):147-151.
- [11] Li X, Chen S. Comprehensive evaluation and spatial analysis of the development level of new urbanization in Jiangsu Province based on entropy weight TOPSIS [J]. *Popular Standardization*, 2023, (18):93-96.
- [12] Wang G, Liu J, Fan T, etc. Measurement of New Urbanization Level and Analysis of Main Influencing Factors in Jiangxi Province [J]. *Journal of Social Sciences, Jiamusi University*, 2024, 42 (06): 76-81.
- [13] Yin C. Coupling and Coordination Measurement of New Urbanization and Agricultural Carbon Productivity [J]. *Statistics and Decision making*, 2024, 40 (21): 69-74.
- [14] Shen D. Research on Measuring the High Quality Development Level of New Urbanization in Xinjiang [J]. *Journal of the Party School of the Ili Prefecture Committee of the Communist Party of China*, 2024, (03):58-63.
- [15] Xu X. Multidimensional measurement, spatial differences, and dynamic evolution of high-quality development of new urbanization [J]. *Statistics and Decision making*, 2024, 40 (10): 100-1.