

NEW URBANISATION AND REGIONAL ECONOMIC DEVELOPMENT: SPATIOTEMPORAL CHARACTERISTICS OF COUNTY TOWNS

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Annotation. Inevitably, the Chinese path aims to modernise and integrate urban and rural development to promote the construction of new urbanisation with county towns as important carriers. Using inter-provincial panel data from China from 2006 to 2022, this study employs the “vertical and horizontal segmentation entropy weight method” to scale new urbanisation, with county towns as important carriers. Further, the spatiotemporal characteristics of Chinese new urbanisation, with county towns as important carriers, were analysed using kernel density estimation, the Dagum Gini coefficient, a Markov chain, and a convergence model. The key conclusions are drawn as follows: (i) The new urbanisation with county towns as important carriers has realised rapid and sustained growth, with a clear spatial pattern of “high in the east, followed by the middle, and low in the west” from the middle and low levels to the middle and high levels; (ii) a certain degree of convergence in the central, western, and national regions exists, whereas the differentiation phenomenon is more pronounced in the eastern region; provinces at low and high levels exhibit a relatively high probability of maintaining their original level; the phenomenon of low-level convergence and high-level convergence clubs is more prominent; (iii) the spatial differences have eased, and the regional differences constitute the core portion of the overall differences, but their contribution is gradually diminishing; (iv) the new urbanisation, with county towns as an important carrier, demonstrates a certain degree of σ convergence; there are absolute β convergence and β conditional convergence, however, their speed is relatively slow.

Keywords: county urbanisation, urbanisation of county towns, spatial-temporal features, convergence.

JEL classification: O18, N93, C23, C33.

Introduction

Along the Chinese path to modernisation, the urban-rural dual structure has consistently been a pivotal factor in restricting economic and social development. General Secretary Xi Jinping explicitly pointed out that “to comprehensively build a socialist modernised country, we need to build prosperous cities as well as prosperous rural areas”. This notable discourse points out the direction for the integrated development of urban and rural areas in the new era. At present, China still faces significant challenges, including imbalanced urban-rural development and insufficient development of rural and agricultural areas, with

both “rural diseases” and “urban diseases” coexisting (Fang, 2022). Specifically, Liu (2018) proposes that “rural diseases” are mainly reflected in the “five modernisations” problem in rural areas, while Wei (2024) highlights a polarisation tendency in the growth of urban scale in China. As key nodes in the “tail of the city and the head of the township”, county towns have special value in breaking the urban-rural dual structure. Therefore, the construction of new urbanisation with county towns as carriers constitutes an effective path to alleviate urban polarisation.

Reportedly, new urbanisation and the use of county towns as important carriers have become core topics of academic concern as imperative means to promote integrated urban-rural development. According to Chen *et al.* (2019), the value concept of new urbanisation has undergone a paradigm shift from structuralism to humanism, with its core characteristics manifested as: ensuring inclusive urban-rural integration development, solving the issue of urban-rural factor imbalance through synergy, and building a spatial development model that is compatible with resource and environmental carrying capacity based on sustainability principles. Furthermore, Yang *et al.* (2025) indicated that the new urbanisation exerts a substantial impact on narrowing the income gap by promoting the integration of urban and rural factors. Subsequently, Gao *et al.* (2022) advocated that the new urbanisation with county towns as an important carrier essentially refers to fully respecting the development laws of urbanization while adhering to the overall notion of people-centered urbanisation, based on the endowment of county factors, making up for the weaknesses of county town development, promoting urban-rural integration development with county towns as the basic unit, and supporting the overall planning of spatial layout, industrial development, infrastructure and other county-level areas. Likewise, Wang & Luo (2025) demonstrated that the construction of new urbanisation, with county towns as an important carrier, not only promotes regional industrial development but also optimises county towns’ financial capacity, thereby fostering high-quality development of the county economy. Parallel to this, Liu (2025) stressed that the new urbanisation, with county towns as an important carrier, can substantially enhance the common prosperity of rural regions. There is plenty of research in the academic community on the use of county towns as notable carriers of new urbanisation. Thus, there is a relative lack of quantitative analysis, especially at the inter-provincial level, where the measurement of new urbanisation using county towns as important carriers urgently needs to be supplemented.

In this study, an indicator system is built for new urbanisation, with county towns as important carriers, to enable an in-depth analysis. Key marginal contributions of this study can be summed up as follows. This study builds an indicator system for new urbanisation with the county town as an important carrier. Further, this indicator system is measured at the interprovincial level. Besides, to precisely grasp the evaluation laws and trends of new urbanisation, a thorough analysis is undertaken of the spatiotemporal evolution characteristics and the convergence of new urbanisation with county towns, which serve as important carriers at the interprovincial level in China.

1. Research Design

Using the inter-provincial Chinese panel data for the time period from 2006 to 2022, the “vertical and horizontal segmentation entropy weight method” (VHSD-EM) has been adopted to scale the new urbanisation with county towns as important carriers. Furthermore, the spatiotemporal characteristics of China’s new urbanisation, with county towns as important carriers, were investigated using the Markov chain, the Dagum Gini coefficient, kernel density estimation, and a convergence model. Meanwhile, the data on the new urbanisation index with county towns as important carriers are sourced from the “China County Statistical Yearbook”, “China Urban Statistical Yearbook”, “China Urban and Rural Construction Statistical Yearbook”, the website of the National Bureau of Statistics, and statistical yearbooks of

different provinces (cities & districts). Similarly, the individual missing values in the sample are supplemented using linear interpolation or nearest neighbour assignment methods. Details of the methodological approaches used in this study are given below.

1.1 Construction of an Indicator System

The new urbanisation requires the establishment of a coordination mechanism among industries, the population, and the urban scale, encompassing three aspects: population, land, and industrial urbanisation (Fang & Zhang, 2017).

Table 1. Indicator System of New Urbanisation (XCCZH)

Primary Indicators	Secondary Indicators	Secondary Indicator Meaning	Indicator Attribute
Population Urbanisation	County Population Concentration	Total county population / Total county area population	Positive
	County Population Density	Total county population / Total county built-up area	Positive
Land Urbanisation	County Infrastructure Level	Average county road area per capita	Positive
	County Public Facilities Level	County built-up area sewage pipe density	Positive
	County Ecological Management Level	The county's built-up area green coverage rate	Positive
Industrial Urbanisation	County Industrial Structure Upgrading	County secondary and tertiary industry GDP ratio	Positive
	County Service Industry Development Level	Average county tertiary industry output per capita	Positive
	County Industrial Development Level	County industrial land area / Total county built-up area	Positive

Source: created by the author.

Ying *et al.* (2019) studied the coordinated evolution mechanism of China's urbanisation of "population, land, and industry". High-quality urbanisation of county towns is subject to the coordinated development of land, population, and industrial urbanisation (Guo, Zeng, 2022). Thus, this paper builds an indicator system for the new urbanisation (XCCZH) with county towns as key carriers (Table 1).

1.2 Measurement Method of New Urbanisation Index

The "vertical and horizontal" hierarchical entropy-weighted method (VHSD-EM) is adopted to determine the weights of each indicator (Tang *et al.*, 2020). The time factor and the amount of information in the indicators are simultaneously incorporated into the weight determination, enabling effective measurement of new urbanisation with county towns as key carriers. The VHSD-EM method requires consistency testing of the correlation coefficients between the VHSD-EM and the entropy weight method.

Table 2. Consistency Test Results of Spearman Correlation Coefficients

Year	2006	2007	2008	2009	2010	2011	2012	2013	2014
Spearman's Correlation Coefficient	0.868***	0.870***	0.942***	0.938***	0.929***	0.914***	0.991***	0.983***	0.972***
Year	2015	2016	2017	2018	2019	2020	2021	2022	
Spearman's Correlation Coefficient	0.970***	0.968***	0.928***	0.821***	0.878***	0.927***	0.921***	0.917***	

Note: *** indicates significance at the 1% level. Spearman correlation coefficients are used for consistency testing (Table 2). The overall Spearman correlation coefficient is 0.8295. The “longitudinal and transverse” level entropy weight (VHSD-EM) method can be adopted based on the Spearman's correlation coefficient consistency test results.

Source: created by the author.

1.3 Analysis Method of New Urbanisation Index

Kernel Density Estimation. This is a non-parametric estimation method that can intuitively display the distribution pattern of new urbanisation with county towns as important carriers. The changes in the kernel density curve reflect the dynamic evolution of new urbanisation with county towns as important carriers (Eq. 1).

$$f(x) = \frac{1}{nh} \sum_{i=1}^n K\left(\frac{\mu - X_i}{h}\right) \quad (1)$$

$K(\cdot)$ denotes the kernel function, h represents the bandwidth, n stands for the number of observed values, X_i connotes the observed value, and μ shows the mean of the observed values. Kernel density is used to determine whether the relevant indicators display overall improvement or convergence in different periods.

Dagum Gini Coefficient and Decomposition. This paper employs the Dagum Gini coefficient and decomposition method to analyse the interval differences and sources of new urbanisation with county towns as important carriers (Eq. 2).

$$G = \sum_{j=1}^k \sum_{h=1}^k \sum_{i=1}^{n_j} \sum_{r=1}^{n_h} |y_{ji} - y_{hr}| / 2n^2 \mu \quad (2)$$

Among them, n shows the number of provinces, k denotes the number of regions, y_{ji} (y_{hr}) means the XCCZH of $i(r)$ th the province within the $j(h)$ th region, and μ indicates the mean XCCZH of each province. The Gini coefficient can also be decomposed into the contribution of intra-regional differences (G_w , reflecting the differences in levels within each region), the contribution of net inter-regional differences (G_{nb} , reflecting the differences in levels between regions), as well as the contribution of inter-

regional hypervariable density (G_t , reflecting the phenomenon of cross-regional overlap and relative differences), i.e., $G = G_w + G_{nb} + G_t$.

Markov Chain. The Markov chains (traditional & spatial) offer an in-depth analysis of the spatiotemporal evolution characteristics of China's new urbanisation, with county towns as important carriers. The traditional Markov chain model is a mathematical model used to describe the random transition of system states. This method discretises the data of new urbanisation with county towns as important carriers at different time stages. The level of new urbanisation with county towns as important carriers is divided into k types based on quantiles. Its evolution process is approximated as a Markov process by calculating the probability distributions and transition probabilities for each type (Chen, Tu, 2025). The spatial Markov chain model posits that regional interconnection and interaction give rise to spatial spillover effects. In particular, revealing the spatial spillover effects between regions is vital for understanding regional development. Notably, spatial Markov chains can effectively characterise the spatial spillover patterns of regions. This method improves on the traditional Markov chain's neglect of spatiality by introducing a "spatial lag" to capture the domain state of a region (Wang, Huang, 2019).

Convergence Model. Convergence analysis is a prominent method for evaluating the dynamic evolution trend of new urbanisation with county towns as important carriers. From the perspective of convergence research of new urbanisation with county towns as important carriers, this study mainly incorporates the following two convergence models: σ convergence model and β convergence model. The former represents the convergence of the level of new urbanisation with county towns as important carriers, while the latter represents the convergence of the growth rate of new urbanisation with county towns as important carriers. In addition, the β convergence models are further categorised into absolute β and conditional β convergence models based on the presence or absence of control variables.

The σ convergence of new urbanisation with county towns as an important carrier refers to the gradual reduction of the dispersion of XCCZH in various provinces within the region. Several indicators can scale the degree of dispersion of XCCZH. Different methods such as the Theil index, Gini coefficient, and coefficient of variation (σ) are used to measure the σ convergence of XCCZH (Eq. 3-5):

$$\sigma_t = \sqrt{\frac{1}{N} \sum_{i=1}^N \left[\ln(d_{it}) - \frac{1}{N} \sum_{i=1}^N \ln(d_{it}) \right]^2} \quad (3)$$

$$Theil = \frac{1}{N} \sum_{i=1}^N \left(\frac{d_{it}}{\bar{d}_t} \ln \frac{d_{it}}{\bar{d}_t} \right) \quad (4)$$

$$Gini = \frac{-(N+1)}{N} + \frac{2}{N^2 \bar{d}_t} \sum_{i=1}^N i d_{it} \quad (5)$$

Among them, d_{it} represents the XCCZH of the i th province in the t th year, \bar{d}_t represents the mean XCCZH of each province in the t th year, and N represents the number of provinces within the region.

The absolute β and conditional β convergence models of the new urbanisation model with county towns as important carriers constitute the fixed utility model, Eq. 6 and 7, respectively:

$$\ln\left(\frac{d_{i,t+1}}{d_{it}}\right) = \alpha + \beta \ln(d_{it}) + \phi_i + \gamma_t + \varepsilon_{it} \quad (6)$$

$$\ln\left(\frac{d_{i,t+1}}{d_{it}}\right) = \alpha + \beta \ln(d_{it}) + \sum_{k=1}^n \psi_k X_{k,it} + \phi_i + \gamma_t + \varepsilon_{it} \quad (7)$$

d_{it} stands for the XCCZH of the i th province in the t th year, α shows the intercept term, β implies the convergence coefficient, ϕ_i represents the province effect, γ_t shows the time effect, X_k means the k th control variable, ψ_k captures the regression coefficient of the control variable, and ε_{it} shows the random error.

The convergence rate λ and half-life τ of convergence during the investigation period T are computed from the β convergence coefficient (Eq. 8):

$$\lambda = -\frac{\ln(1-|\beta|)}{T}, \quad \tau = \frac{\ln 2}{\lambda} \quad (8)$$

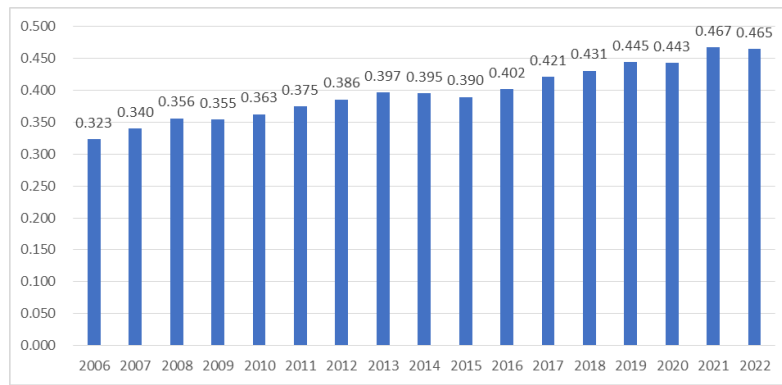
The control variables for the conditional β the convergence of new urbanisation with county towns as important carriers is set as follows: per capita material capital level, human capital level, financial development level, government intervention level, degree of opening up to the outside world, and the innovation level.

2. Results

2.1 Measurement of New Urbanisation

2.1.1 Time Series Characteristics of China's New Urbanisation

Figure 1 depicts the evolution trend of the mean value of new urbanisation with county towns as important carriers in various Chinese provinces.



Source: created by the author.

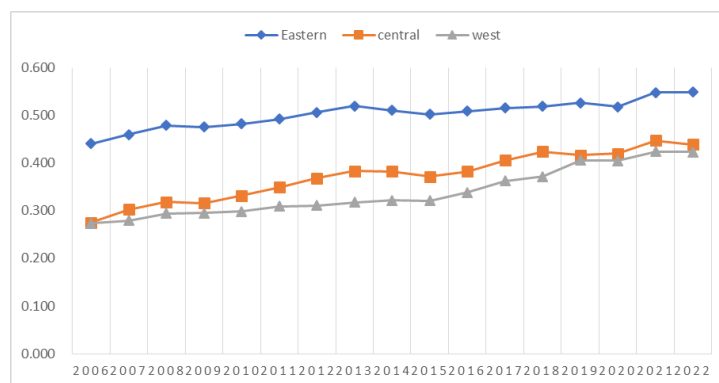
Figure 1. Evolution Trend of the Mean Value of New Urbanisation (XCCZH)

With county towns as important carriers, China's new urbanisation has shown a clear upward trend, rising from 0.323 in 2006 to 0.465 in 2022, with a growth rate of 43.9% (Figure 1).

2.1.2 Block Characteristics of China's New Urbanisation

Evidently, Figure 2 illustrates the evolution of new urbanisation with county towns as important carriers in the eastern, central, and western regions from 2006 to 2022.

The new urbanisation with county towns as an important carrier in the eastern, central, and western regions has steadily improved for the time period ranging from 2006 to 2022 (Figure 2). ① During the inspection period, the new urbanisation in the eastern region was significantly higher than that in the central and western regions, and the absolute gap gradually diminished. ② The new urbanisation in the central and western regions is lower than the national average level; the new urbanisation in the central region is higher than that in the western region. Meanwhile, the gap between the two first increases and then decreases, exhibiting an inverted U-shape.



Source: created by the author.

Figure 2. Evolution Trend of New Urbanisation (XCCZH)

2.1.3 Inter-Provincial Characteristics of China's New Urbanisation

Table 3 presents the rankings of new urbanisation with county towns as important carriers in major years.

Table 3. New Urbanisation (XCCZH) in Major Years

Province	2006 year	Rank	2012 year	Rank	2017 year	Rank	2022 year	Rank	Comprehensive Score	Rank	Overall Growth Rate
Zhejiang	0.661	1	0.676	1	0.709	1	0.750	1	0.698	1	13.5%
Jiangsu	0.566	2	0.673	2	0.708	2	0.705	2	0.674	2	24.6%
Shandong	0.505	3	0.551	3	0.578	3	0.585	4	0.552	3	15.9%
Fujian	0.407	5	0.543	4	0.568	4	0.620	3	0.545	4	52.5%
Chongqing	0.343	9	0.533	5	0.493	6	0.561	5	0.486	5	63.4%
Jiangxi	0.320	12	0.462	6	0.491	7	0.530	7	0.463	6	65.4%
Guangdong	0.445	4	0.453	7	0.400	15	0.552	6	0.462	7	23.9%
Hubei	0.389	6	0.434	8	0.435	11	0.522	9	0.431	8	34.2%
Anhui	0.284	18	0.347	17	0.500	5	0.529	8	0.408	9	86.3%
Shanxi	0.285	17	0.427	9	0.435	12	0.450	11	0.405	10	57.8%
Hebei	0.335	10	0.394	11	0.470	8	0.434	14	0.405	11	29.6%
Inner Mongolia	0.256	20	0.369	14	0.462	10	0.416	17	0.387	12	62.4%
Sichuan	0.319	13	0.395	10	0.359	18	0.466	10	0.382	13	46.0%
Hunan	0.298	16	0.347	18	0.432	13	0.442	12	0.379	14	48.4%
Xinjiang	0.357	7	0.339	19	0.364	17	0.418	16	0.365	15	17.1%
Hainan	0.301	15	0.376	13	0.417	14	0.420	15	0.359	16	39.8%
Ningxia	0.346	8	0.227	25	0.465	9	0.409	19	0.358	17	18.1%
Guangxi	0.322	11	0.350	16	0.357	19	0.396	21	0.350	18	22.7%
Henan	0.270	19	0.313	20	0.389	16	0.411	18	0.341	19	52.2%
Jilin	0.207	24	0.369	15	0.347	21	0.350	25	0.340	20	68.8%
Liaoning	0.304	14	0.383	12	0.273	24	0.323	26	0.330	21	6.3%
Yunnan	0.231	21	0.302	21	0.355	20	0.441	13	0.325	22	90.6%
Shaanxi	0.223	23	0.290	22	0.333	22	0.368	24	0.305	23	64.9%
Qinghai	0.204	25	0.234	24	0.301	23	0.390	22	0.274	24	90.8%
Guizhou	0.175	26	0.215	26	0.271	25	0.408	20	0.250	25	133.0%
Gansu	0.227	22	0.163	27	0.228	26	0.382	23	0.238	26	68.4%
Heilongjiang	0.144	27	0.242	23	0.217	27	0.277	27	0.214	27	92.3%

Source: created by the author.

Table 3 shows that four eastern provinces: Zhejiang, Jiangsu, Shandong, and Fujian consistently ranked in the top five (2006 to 2022). On the one hand, Zhejiang, Jiangsu, Shandong, Fujian, and Chongqing are the top five provinces in 2022, while Heilongjiang, Gansu, Guizhou, Qinghai, and Shaanxi represent the bottom five provinces. Guizhou, Heilongjiang, Qinghai, Yunnan, and Anhui had the top five growth rates, at 133.0%, 92.3%, 90.8%, 90.6%, and 86.3%, respectively (2006 to 2022). Conversely, Liaoning, Zhejiang, Shandong, Xinjiang, and Ningxia recorded the bottom five growth rates, at 6.3%, 13.5%, 15.9%, 17.1%, and 18.1%, respectively.

Using the K-means clustering method (Wang *et al.*, 2019), this study classifies the level of new urbanisation in each province into four tiers: high, medium high, medium, and low (Table 4). In 2006, the high-level tier comprised only Jiangsu and Zhejiang in the eastern region, whereas the medium- to high-level tier included Shandong and Guangdong (Table 4). Moreover, the low-level tier encompassed Anhui, Shanxi, Henan, Jilin, Heilongjiang in the central region, and Gansu, Inner Mongolia, Yunnan, Shaanxi, Qinghai, and Guizhou in the western region. In 2022, the high-level tier consists of Fujian, Zhejiang, Jiangsu, and Shandong in the eastern region, while the medium to high-level tier includes 5 provinces in the central region, 5 provinces in the western region, and 3 provinces in the eastern region. Additionally, the low-level tier includes only Heilongjiang in the central region. Evidently, the new urbanisation, with county towns as an important carrier, is gradually shifting from a medium to low level to a medium to high and advanced level across various provinces.

Table 4. Regional Distribution of Five Types of New Urbanisation (XCCZH)

Category	2006 Year			2022 Year		
	Eastern Region	Central Region	Western Region	Eastern Region	Central Region	Western Region
High Level	Zhejiang, Jiangsu			Zhejiang, Jiangsu, Fujian, Shandong		
Medium-High Level	Shandong, Guangdong			Guangdong, Hebei, Hainan	Jiangxi, Anhui, Hubei, Shanxi, Hunan	Chongqing, Sichuan, Yunnan, Xinjiang, Inner Mongolia, Ningxia, Guizhou, Guangxi, Qinghai, Gansu, Shaanxi
Medium Level	Fujian, Hebei, Liaoning, Hainan	Hubei, Jiangxi, Hunan	Xinjiang, Ningxia, Chongqing, Guangxi, Sichuan	Liaoning	Henan, Jilin	
Low Level		Shanxi, Anhui, Henan, Jilin, Heilongjiang	Inner Mongolia, Yunnan, Gansu, Shaanxi, Qinghai, Guizhou		Heilongjiang	

Source: created by the author.

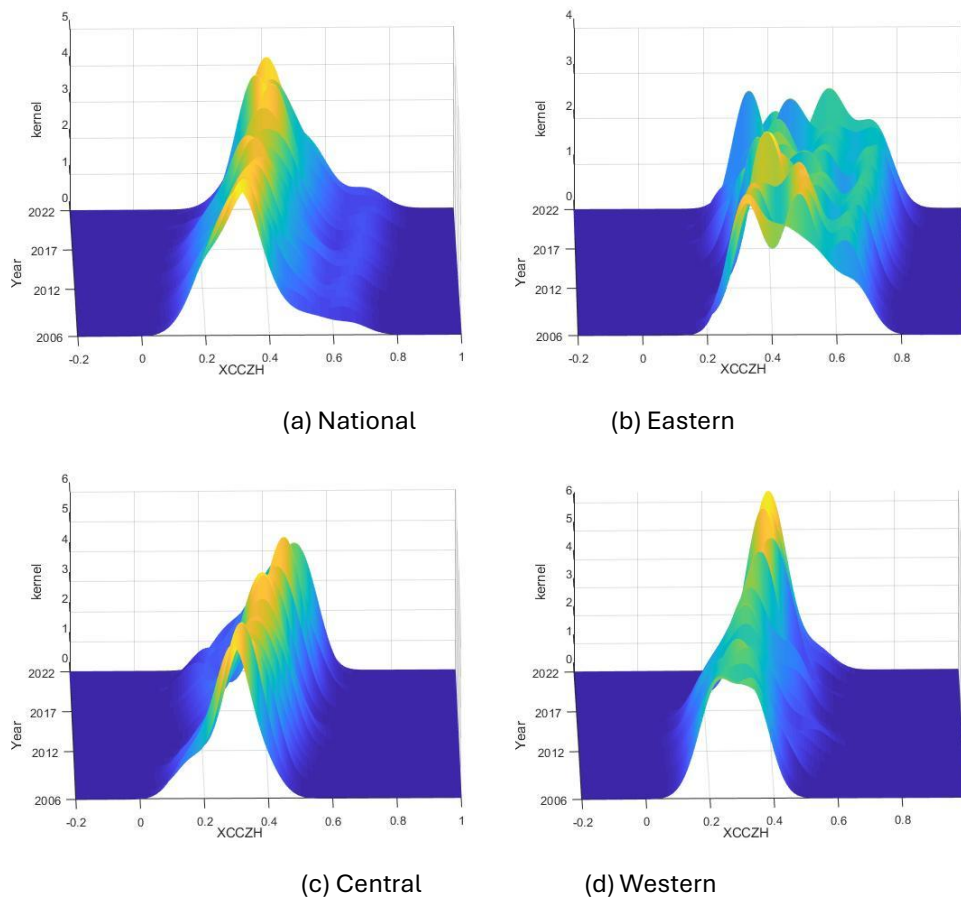
Furthermore, the eastern region has consistently been a leading area of new urbanisation, with county towns as important carriers, and the gap between the east and west is quite prominent.

2.2 The Dynamic Evolution of New Urbanisation with County Towns

2.2.1 Dynamic Distribution Evolution

This section utilises Kernel density estimation to examine the distribution of new urbanisation across different regions, with county towns as important carriers, to thoroughly analyse the dynamic evolution characteristics of China's new urbanisation. As a result, the distribution location, distribution form, and distribution extensibility of China's new urbanisation, with county towns as important carriers, are revealed in *Figure 4*.

In the context of distribution location, the centre of the Kernel density curve for new urbanisation, with county towns as important carriers at the national level, shows an explicit rightward shift (*Figure 3*). This indicates that Chinese new urbanisation, with county towns as important carriers, is persistently improving overall. Besides this, the kernel density curves of the three major regions exhibit a rightward shift, with the central region showing the largest movement amplitude, reflecting the fastest improvement pace, followed by the western region. In contrast, the eastern region demonstrates the smallest movement amplitude. From the perspective of distribution patterns, the Kernel density curves in the central, western, and national regions are unimodal, with the main peak height fluctuating upward. Meanwhile, the eastern region shows a multi-peak trend, confirming that differentiation there is reasonably severe. From the standpoint of distribution extensibility, no obvious right tail feature is witnessed in the Kernel density curves of the whole country, as well as the three major regions.



Source: created by the author.

Figure 3. Distribution and Dynamic Evolution Trend of New Urbanisation (XCCZH) with County Towns As Important Carriers in China and the Three Major Regions

Hence, there is a certain degree of convergence in the new urbanisation with county towns as important carriers in the central, western, and national regions, whereas the differentiation phenomenon is more pronounced in the eastern region.

2.2.2 Markov Chain Analysis

Markov chain analysis is adopted to deeply explore the spatiotemporal evolution characteristics of Chinese new urbanisation with county towns as important carriers.

Traditional Markov Chain. To further reflect the internal flow direction and location transfer characteristics of the new urbanisation with county towns as important carriers, this paper employs the Markov transition probability matrix (*Table 5*).

The elements on the diagonal are always greater than those on the non-diagonal. Provinces at the low, medium-high, medium-low, and high levels possess a probability of retaining their original level after one year of use of 64.3%, 78.9%, 73.3%, and 91.4%, respectively (*Table 5*). Hence, the different levels of new urbanisation with county towns as important carriers are relatively stable, leading to a “club convergence”. Additionally, the elements at both ends of the diagonal are greater than those in the middle of the diagonal. This means that provinces with county towns as important carriers of new urbanisation at low and high

levels have a relatively high probability of sustaining their original levels. Thus, the phenomenon of high-level convergence and low-level convergence is more prominent.

Table 5. Markov Transition Probability Matrix

t/(t+1)	I	II	III	IV	Observed Value
I	0.789	0.202	0.009	0	114
II	0.089	0.643	0.259	0.009	112
III	0	0.119	0.733	0.149	101
IV	0	0.019	0.067	0.914	105

Source: created by the author.

Spatial Markov Chain. Since the new urbanisation with county towns as important carriers in various provinces may display spatial positive correlations, a spatial Markov transition probability matrix is incorporated in this study (Table 6).

Table 6. Spatial Markov Transition Probability Matrix

Lag Type	t/(t+1)	I	II	III	IV	Observed Value
I	I	0.783	0.217	0	0	46
	II	0.109	0.717	0.174	0	46
	III	0	0.273	0.636	0.091	11
	IV	0	0	0	1	1
II	I	0.875	0.100	0.025	0	40
	II	0.074	0.667	0.222	0.037	27
	III	0	0.037	0.852	0.111	27
III	IV	0	0.077	0.077	0.846	13
	I	0.773	0.227	0	0	22
	II	0.032	0.548	0.419	0	31
	III	0	0.163	0.714	0.122	49
IV	IV	0	0.040	0.200	0.760	25
	I	0.333	0.667	0	0	6
	II	0.250	0.500	0.250	0	8
	III	0	0	0.643	0.357	14
	IV	0	0	0.015	0.985	66

Source: created by the author.

Firstly, the four transition probability matrices differ across spatial lag types (Table 6). The probability of a shift in the role of county towns as important carriers of new urbanisation in our province varies, owing to differences in their use in neighbouring provinces. Secondly, across different spatial lags, the diagonal elements of the transition probability matrix are not always greater than the non-diagonal elements. Moreover, the probability of “level locking” of new urbanisation with county towns as important carriers under spatial spillover effects has declined. Specifically, this phenomenon is evident under Class IV lag conditions. Further, the effects of different lag types at the same level are diverse. Under the high-level lag type, the probability of transition from low-level to medium-low level is 66.7%, which is substantially higher than the transition probability under other lag types.

2.3. Differences and Source Decomposition of New Urbanisation

In order to gain an in-depth understanding of the regional differences, this section computes the overall Gini coefficient of China’s new urbanisation with county towns as important carriers from 2006 to 2022.

Accordingly, the Dagum Gini coefficient and its decomposition method are used, yielding inter-regional, intra-regional, and contribution degrees (Table 7).

Table 7. Changes and Contribution of Gini Coefficient in Three Major Regions of New Urbanisation (XCCZH)

Annual	Regional Differences			Interregional Differences			Contribution			Super-variable Density Contribution
	Overall Difference	East	Central	West	East - Central	East - West	Central - Western	Regional Contribution	Interregional Contribution	
2006	0.189	0.155	0.134	0.128	0.243	0.247	0.141	24.7%	57.3%	17.9%
2007	0.183	0.151	0.108	0.131	0.223	0.256	0.134	24.2%	61.6%	14.2%
2008	0.186	0.135	0.122	0.152	0.216	0.252	0.151	24.9%	59.1%	16.0%
2009	0.186	0.136	0.132	0.151	0.219	0.248	0.148	25.3%	58.1%	16.6%
2010	0.179	0.130	0.122	0.146	0.202	0.246	0.145	25.1%	60.7%	14.3%
2011	0.175	0.133	0.109	0.152	0.186	0.242	0.145	25.8%	60.3%	13.9%
2012	0.181	0.127	0.102	0.174	0.177	0.255	0.161	25.7%	61.1%	13.2%
2013	0.181	0.131	0.098	0.176	0.173	0.257	0.161	25.8%	61.6%	12.6%
2014	0.175	0.149	0.094	0.153	0.177	0.246	0.149	26.0%	59.8%	14.2%
2015	0.174	0.157	0.096	0.145	0.186	0.242	0.141	26.2%	58.0%	15.8%
2016	0.173	0.158	0.105	0.148	0.184	0.232	0.142	27.2%	53.3%	19.5%
2017	0.160	0.157	0.109	0.121	0.176	0.212	0.134	27.1%	49.5%	23.4%
2018	0.149	0.155	0.096	0.100	0.164	0.199	0.131	26.1%	50.6%	23.4%
2019	0.146	0.170	0.139	0.068	0.189	0.178	0.117	27.0%	39.2%	33.8%
2020	0.139	0.173	0.118	0.064	0.181	0.178	0.106	26.7%	39.1%	34.2%
2021	0.135	0.148	0.120	0.068	0.164	0.168	0.117	26.4%	42.1%	31.5%
2022	0.126	0.142	0.107	0.059	0.163	0.164	0.098	25.7%	45.5%	28.7%

Source: created by the author.

Firstly, in the context of regional differences, the overall Dagum Gini coefficient has declined from 0.189 in 2006 to 0.126 in 2022, representing a 33.3% decline (Table 7). Therefore, the spatial differences in Chinese new urbanisation with county towns as important carriers have eased; the Dagum Gini coefficient in the eastern and central regions demonstrates a U-shaped trend of first diminishing and then increasing, whereas the Dagum Gini coefficient in the western region shows a fluctuating downward trend; overall, the eastern region exhibits the greatest regional differences, followed by the central region, while the western region has the smallest regional differences. Secondly, regional differences show that the Gini coefficients of the eastern, western, eastern central, and central western regions all display a downward trend. Thus, the regional differences in new urbanisation, with county towns as important carriers across all three major regions, show varying degrees of narrowing; overall, there are substantial differences between the eastern and western regions, while those between the central western regions are relatively small. Lastly, the contribution of inter-regional differences is the largest, showing a downward fluctuating trend. The contribution of intra-regional differences is relatively stable, whereas the contribution of super variable density fluctuates upward. Therefore, the potential differences in Chinese new urbanisation, with county towns as important carriers, predominantly stem from inter-regional differences; however, their contribution is gradually diminishing.

2.4 Convergence Analysis of New Urbanisation

2.4.1 σ Convergence Test

Table 8 populates the absolute convergence indicators, such as σ , Theil and GINI, for new urbanisation with county towns as important carriers (2006 to 2022).

Table 8. Absolute Convergence Test of New Urbanisation (XCCZH)

Annual	σ	Theil	GINI
2006	0.506	0.059	0.189
2007	0.497	0.055	0.183
2008	0.512	0.056	0.186
2009	0.509	0.055	0.186
2010	0.497	0.052	0.179
2011	0.492	0.050	0.175
2012	0.506	0.053	0.181
2013	0.510	0.053	0.181
2014	0.492	0.050	0.175
2015	0.498	0.050	0.174
2016	0.500	0.048	0.173
2017	0.481	0.041	0.160
2018	0.458	0.036	0.149
2019	0.444	0.037	0.146
2020	0.445	0.032	0.139
2021	0.434	0.030	0.135
2022	0.422	0.026	0.126

Source: created by the author.

Reportedly, there is a certain degree of σ convergence in the new urbanisation with county towns as important carriers (Table 8). Particularly, the σ convergence coefficient decreased from 0.506 in 2006 to 0.422 in 2022, showing a downfall of 16.6%; the convergence coefficient of GINI declined from 0.189 in 2006 to 0.126 in 2022, displaying a downfall of 50.0%; lastly, the Theil convergence coefficient decreased from 0.059 in 2006 to 0.026 in 2022, with a decline of 55.9%.

2.4.2 β Convergence Test

A fixed effects model is used to perform an absolute β and conditional β convergence tests on new urbanisation with county towns as key carriers (Table 9).

Table 9. β Convergence Test Results of New Urbanisation (XCCZH)

Variable	Absolute β Convergence	Conditional β Convergence
β	-0.171*** (3.50)	-0.335*** (4.50)
λ	1.17%	2.55%
τ (year)	59.137	27.184
Constant Term	-0.144*** (2.99)	-0.578** (2.46)
In-groupR ²	0.0952	0.1914
Control Variable	No	Year
Individual Fixation	Year	Year
Sample Size	432	432

Source: created by the author.

The regression coefficients for absolute β convergence and conditional β convergence are both negative at a 1% level of statistical significance, confirming the existence of conditional β convergence and absolute β convergence in the new urbanization with county towns as important carriers (Table 9). However, both convergence rates are slow, especially the convergence rate for absolute β convergence is 1.17%, with a half-life cycle of 59.137 years; the convergence rate of the conditional β convergence is 2.55%, with a half-life cycle of 27.184 years.

3. Discussion

This study elucidates various important patterns in the evolution of Chinese new urbanisation with county towns as important carriers. Firstly, the temporal dimension indicates that new urbanisation has maintained an upward trend (2006 to 2022), with the national mean rising over the period. This growth confirms the policy-driven and institutional impetus of the Chinese urbanisation strategy, specifically since the launch of the New-Type Urbanisation Plan. Nevertheless, urbanisation is extremely sensitive to infrastructure investments, regional economic cycles, and national policy adjustments. Furthermore, the pace of change varies substantially across macro-regions and provinces despite the general improvement, producing a differentiated convergence pattern. Secondly, the block and inter-provincial characteristics emphasise the enduring east-central-west division. Although the eastern provinces, especially Jiangsu and Zhejiang, have consistently maintained leading positions, the western and central regions have historically lagged behind. Remarkably, the potential gap between the central/western and eastern regions is narrowing, suggesting the need for policy interventions to support balanced regional development. Moreover, the inverted U-shaped trajectory between the western and central regions further indicates that disparities do not evolve linearly but respond dynamically to resource endowments, policy support, and other factors. For instance, the accelerated growth in provinces such as Yunnan, Anhui, and Guizhou demonstrates the capacity of lagging zones to catch up when driven by targeted strategies and infrastructure investments. Contrarily, provinces such as Shandong and Liaoning experience relatively low growth, highlighting industrial decline and structural rigidities. This divergence reflects that, though there exists spatial convergence, it is highly path-dependent.

Thirdly, the dynamic distribution analysis indicates an overall rightward shift, reflecting steady improvement. Nonetheless, the persistence of multimodal distributions in the eastern zone confirms uneven urbanisation and internal differentiation within provinces that are otherwise categorised as high-level. This internal heterogeneity highlights the coexistence of underdeveloped and advanced metropolitan areas, suggesting that intraprovincial divergence remains a critical concern. Such patterns call into question the adequacy of utilising provincial averages to detect the nuanced geography of urbanisation. Meanwhile, the provinces are inclined to remain within their respective development tiers, with especially strong persistence at the low and high ends, reinforcing the narrative of club convergence. This uncovers the benefits of both structural traps in lagging areas and cumulative causation in leading areas. The importance of neighbourhood effects is also highlighted, as a province's probability of downgrading or upgrading its urbanisation level is influenced by its neighbours. For instance, the reduced likelihood of level locking under spatial spillover effects suggests that cross-provincial collaboration, regional clustering, and the diffusion of best practices may facilitate mobility. However, the stability of both low- and high-level groups signals entrenched structural divides, conforming with theories of spatial dependence and polarisation in regional economies.

Fourthly, this study also confirms a trend of spatial convergence, driven by the dominant role of inter-regional differences, especially between the east and the other regions, underscoring that regional inequality remains the pivotal challenge. Interestingly, though macro-regional gaps are shrinking, disparities within regions and across individual provinces are becoming more prominent. This implication resonates with the new regionalism notion, which holds that the core axis of inequality is shifting from large-scale east-west divides to micro-scale intra-regional fragmentation. Lastly, both conditional and absolute convergence are confirmed in this study, as lagging provinces are gradually catching up. However, the convergence speed remains slow, as convergence is driven more by targeted interventions and structural adjustments than by market-driven processes. This is in line with the notion that conditional convergence progresses (where institutional and socioeconomic factors are controlled) more rapidly than absolute convergence. Hence, provincial characteristics such as industrial structures, governance capacity, and infrastructure quality play an imperative role in forming outcomes of urbanisation.

To sum up, the Chinese urbanisation strategy has succeeded in narrowing large-scale disparities and achieving overall progress, but it experiences persistent challenges in resolving intra-regional inequality, low-level traps, and slow convergence dynamics. Thus, a differentiated policy design is needed to enhance spatial spillovers through interprovincial collaboration, address the distinct constraints of lagging provinces, and strengthen country-level institutions to reduce within-province heterogeneity. Further, the persistence of club convergence underscores the value of moving beyond aggregate measures toward robust governance of county towns.

Conclusions

The main conclusions of this study are as follows: in the context of temporal evolution characteristics, China's new urbanisation, with county towns as an important carrier, achieved sustained rapid growth from 2006 to 2022, with an increase of 43.9%; there is a clear spatial pattern of "high in the east, followed by the middle, and low in the west"; each province has gradually shifted its focus from low to medium levels to high and advanced levels of new urbanization, with county towns as an important carrier. The eastern region has been a leading area of new urbanisation, with county towns as important carriers, and the gap between the east and the west is quite obvious. From the perspective of dynamic evolution, there is a degree of convergence in the new urbanisation, with county towns as important carriers in the national, central, and western regions, while differentiation is more pronounced in the eastern region. Furthermore, provinces with county towns at low and high levels have a relatively high probability of maintaining their original levels, and the phenomenon of "club convergence" between low and high levels of convergence is more pronounced. Meanwhile, the spatial differences in China's new urbanisation with county towns as important carriers have eased, with the regional differences constituting the key part of overall differences, but their contribution is gradually diminishing. Lastly, China's new urbanisation with county towns as important carriers has a certain degree of σ convergence, with absolute β convergence and conditional β convergence, though their pace is relatively slow.

The policy implications of this study are as follows: First, the spatial imbalance of new urbanisation, with county towns as important carriers, calls for differentiated regional development strategies. Relevant policies should extend essential support for the western and central regions through fiscal transfers, infrastructure investment, and industrial guidance to narrow the development gap with the eastern region. Secondly, the government should emphasise improving public services to support sustainable and high-quality new urbanisation, thereby consolidating the role of county towns as hubs of integrated rural-urban development. Thirdly, given the observed "club convergence", policymakers should promote cross-

regional cooperation and the diffusion of advanced experiences from leading to lagging areas. Finally, essential measures must be taken to reduce excessive reliance on purely economic indicators and to incorporate the social, digital, and ecological dimensions of urbanisation to build more balanced and inclusive development pathways.

There are different limitations related to this study. Firstly, though the employed measurement methods are scientifically rigorous, they may not fully capture the multidimensional complexity of new urbanisation with county towns as important carriers. Therefore, future studies may enrich the existing indicator system by adopting diverse dimensions such as social equity, ecological sustainability, and digital transformation. Secondly, the reliance on provincial-level panel data may potentially obscure intra-provincial disparities. Hence, future studies could incorporate prefecture- or county-level data to not only uncover enriched spatial heterogeneity but also effectively reflect local policy impacts. Thirdly, the researchers should extend the study period to thoroughly examine potential structural changes, as this study may not fully capture the latest effects of rural revitalisation policies, ecological transition strategies, and digital economy development. Lastly, this paper focuses on the Chinese context, limiting the broader generalizability of the study's findings. Further studies could conduct comparative analyses with other countries undergoing similar urban-rural integration to place China in a global perspective.

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NAUJOJI URBANIZACIJA IR REGIONINĖ EKONOMINĖ PLĖTRA: APSKRIČIŲ MIESTŲ ERDVINĖS IR LAIKO CHARAKTERISTIKOS

Liu Hanhui

Santrauka. Kinijos siekis yra modernizuoti ir integruoti miestų ir kaimo plėtrą, siekiant skatinti naujosios urbanizacijos kūrimą, kurioje itin reikšmingi apskričių centrai. Pasitelkus 2006–2022 m. Kinijos provincijų duomenų rinkinį, šiame tyrime taikytas vertikalaus ir horizontalaus segmentavimo entropijos svorio metodas. Pritaikius branduolio tankio įvertinimą, Dagum Gini koeficientą, Markovo grandinę ir konvergencijos modelį, buvo analizuojama naujoji Kinijos urbanizacija, kurioje itin reikšmingi apskričių miestai, jų erdvės ir laiko charakteristikos. Nuspręsta, kad naujoji urbanizacija pasiekė spartų ir tvarų augimą, o jos erdvės struktūra aiškiai atspindi tendenciją nuo vidutinio ir žemo lygio iki vidutinio ir aukšto lygio. Centriniam ir vakariniame regionuose nustatytas tam tikras konvergencijos laipsnis. Rytiniame regione labiau išryškėjo diferenciacija. Žemo ir aukšto lygio provincijos labiau linkusios išlaikyti savo pradinį lygį. Labiau išryškėjo žemo lygio ir aukšto lygio konvergencijos klubų reiškinys. Erdviniai skirtumai sumažėjo, o regioniniai skirtumai sudaro pagrindinę bendrų skirtumų dalį, tačiau jų įtaka palaipsniui mažėja. Naujoji urbanizacija, kurioje apskričių miestai veikia kaip svarbūs vystymosi centrai, rodo tam tikrą σ -konvergencijos lygį. Nustatyta tiek absoliuti β -konvergencija, tiek sąlyginė β -konvergencija, tačiau jų tempas yra palyginti lėtas.

Reikšminiai žodžiai: apskričių urbanizacija; apskričių miestų urbanizacija; erdvinės ir laiko charakteristikos; konvergencija.