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# Characteristics of Regional Differentiation of Urbanization Development in Anhui Province

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Abstract On the basis of connotation of urbanization, by using SPSS factor analysis and cluster analysis, we establish index system of urbanization development level and conduct quantitative analysis on development level of urbanization in 17 prefecture-level city of Anhui Province, in order to find out the differentiation pattern of regional space of urbanization development in Anhui Province based on these. The results show that Anhui's difference of urbanization gradient is prominent. Classification of three clusters shows that the pattern of status quo of urbanization development in Anhui Province is "dual-nucleus" and "two-stretches"; classification of five clusters show that the pattern of status quo of urbanization development in Anhui Province is "one-core", "one-strip" and "three-region". From five aspects, namely natural geography, transportation location, resources distribution, economic development and administrative system, we analyze the reason and influencing factors of differentiation of urbanization development in the region. The results of three clusters and five clusters show that there is great possibility that "dual-nucleus" changes into "individual-nucleus"; "one-core" and "one-strip" may evolve into "one-group". We should foster the urban agglomeration in central Anhui; perfect structure system in the perspective of integration and fostering; strengthen infrastructure construction and regional coordination system; elevate comprehensive competitiveness and guide holistic development of regional economy; promote industrialization process and promote development level of urbanization.

Key words Urbanization level, Regional differentiation, Spatial pattern, Anhui Province, China

Urbanization is the result of social and economic development and the inevitable trend of history. It is not only the process of transfer of population from rural areas to urban areas, but also the indicator reflecting quality and level of regional socio-economic development, and comprehensive progress of economy, society, culture and ecological environment<sup>[1-2]</sup>. Using the single index of proportion of urban population in total population to measure the level of urbanization is far from enough, and we must build "composite indices" in order to fully reflect the quality of urban development quality [3-5]. Urbanization development in Anhui Province shows regional imbalance, and the differences among cities is very prominent. On the basis of connotation of urbanization, by using SPSS factor analysis and cluster analysis, we establish index system of urbanization development level and conduct quantitative analysis on development level of urbanization in 17 prefecture-level city of Anhui Province, in order to find out the differentiation pattern of regional space of urbanization development in Anhui Province based on these. We further scope out the cause and influencing factors of regional disparity, in order to provide decisionmaking basis for promoting coordinated development of regional urbanization in Anhui Province.

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## 1 Index selection, data source and research method

1.1 Establishment of index system and data source Based on the content of urbanization, considering the principles of representativeness of indicators, possibility of quantification and the availability of data, combined with urbanization status of Anhui Province, and environmental features, from 4 aspects, namely urbanization of economy, urbanization of population, urbanization of life, and urbanization of landscape, we put forward 15 indicators to establish index system of development level of urbanization in prefecture-level cities of Anhui Province (Table 1).

Data are from Statistical Yearbook of Anhui Province  $(2009)^{[6]}$ , and Statistical Yearbook of Construction in Anhui Province<sup>[7]</sup>.

**1.2 Research method** Because the dimension of selected indices is different, which will exert impact on the analysis results, so we first need to standardize the data, and then use SPSS to conduct factor analysis on index data of development level of urbanization in prefecture-level cities of Anhui province after standardization of data. After extracting the main factor, we get rotated factor matrix of principal factors by maximization of variance and orthogonal rotation on initial factor matrix, and conduct classification and comparison of principal factors on indices, calculation of total scores and ordering<sup>[8]</sup>.

In order to make the results of factor analysis further clear, we use SPSS to conduct cluster analysis on factors of total scores of all cities, and try to winkle out the difference of regional urbanization development by agglomerating these samples according to similarity and comparing these clusters.

Table 1 The index system of development level of urbanization in 17 prefecture-level cities in Anhui Province

Objective	Type of index	Specific index
Development level of urbanization	Urbanization of economy	Per capita GDP//yuan
		Per capita gross industrial output value//yuan
		The proportion of output value of the tertiary industry in GDP // %
		Per capita local fiscal revenue // yuan
	Urbanization of population	The proportion of non-agricultural population in total population //%
		The proportion of employees in the secondary industry and the tertiary industry $/\!/\!\%$
		Amount of people who receive junior college education per 0.1 million people // people
		Population density // people/km <sup>2</sup>
	Urbanization of life	Public transportation vehicles per 10 thousand people // amount
		Per capita throughput of post and telecommunications//yuan
		Disposal rate of urban sewage // %
		Disposal rate of household garbage // %
	Urbanization of landscape	Per capita area of urban road // m <sup>2</sup>
		Per capita area of green space and garden // m <sup>2</sup>
		Coverage rate of forestation in built-up area // %

## 2 Results and analysis

**2.1 Factor analysis and cluster analysis** According to the principle of eigenvalue greater than 1, we extract 4 principal factors, and the eigenvalue of all factors is 8. 281, 2. 012, 1.663 and 1. 264 respectively, the contribution rate is 55. 209%, 13.415%, 11.089% and 8.428% respectively, and the cumulative contribution rate reaches 88.142%.

The rotated principal factor matrix is shown in Table 2. The indices of per capita GDP, per capita gross industrial output value, per capita local fiscal revenue, the proportion of non-agricultural population in total population, the proportion of employees in the secondary industry and the tertiary industry, amount of people who receive junior college education per 0.1 million people, public transportation vehicles per 10 thousand people and per capita throughput of post and telecommunications have big absolute value of load on the first principal factor ( ${\cal F}_1$ ), which can reflect the main connotation of development level of regional urbanization and can be as the comprehensive evaluation on urban economic development and residents' life quality, so the

first principal factor can be named as urban modernization level; indices of per capita area of urban road and disposal rate of household garbage have relatively big absolute value of load on the second principal factor( $F_2$ ); indices of disposal rate of urban sewage, per capita area of green space and garden and coverage rate of forestation in built-up area have relatively big absolute value of load on the third principal factor( $F_3$ ), which are the comprehensive evaluation of facility environment enjoyed by residents; indices of the proportion of output value of the tertiary industry in GDP and population density have relatively big absolute value of load on the fourth principal factor ( $F_4$ ).

The total scores and ordering of prefecture-level cities in Anhui Province can be seen in Table 3, and the total scores are plus or minus. As for the data, being that the data we analyze data are the standardized data after processing, so plus means that the urbanization development level is above the average level of whole province; minus means that the urbanization development level is below the average level of whole province.

Table 2 The rotated factor matrix of principal factors of development level of urbanization in Anhui Province

Index	F <sub>1</sub>	F <sub>2</sub>	F <sub>3</sub>	$F_4$
Per capita GDP	0.969	0.006	0.124	0.122
Per capita gross industrial output value	0.925	0.049	0.124	0.248
The proportion of output value of the tertiary industry in GDP	-0.246	-0.339	0.150	-0.670
Per capita local fiscal revenue	0.955	0	0.152	0.107
The proportion of non-agricultural population in total population	0.851	0.165	0.246	0.301
The proportion of employees in the secondary industry and the tertiary industry	0.824	0.106	0.192	0.415
Amount of people who receive junior college education per 0.1 million people	0.910	0.238	0.132	0.093
Population density	0.159	-0.063	0.101	0.917
Public transportation vehicles per 10 thousand people	0.931	0.038	0.218	0.062
Per capita throughput of post and telecommunications	0.944	0.021	0.106	-0.073
Disposal rate of urban sewage	0.060	-0.192	0.842	0.317
Disposal rate of household garbage	0.229	0.899	-0.107	0.102
Per capita area of urban road	0.069	-0.962	-0.113	-0.030
Per capita area of green space and garden	0.529	0.074	0.661	-0.197
Coverage rate of forestation in built-up area	0.444	0.240	0.737	-0.262

Table 3 The scores of four principal factors and total and ordering

City	Total	Ordering	City	Total	Ordering	City	Total	Ordering
Hefei	0.637 99	4	Huainan	0.365 41	5	Xuancheng	-0.185 74	9
Huaibei	0.098 59	6	Chuzhou	-0.330 53	12	Tongling	1.458 30	1
Bozhou	-1.002 31	17	Lu'an	-0.512 39	14	Chizhou	-0.198 23	10
Suzhou	-0.607 79	15	Ma'anshan	1.189 13	2	Anqing	-0.164 46	8
Bengbu	-0.214 50	11	Chaohu	-0.381 05	13	huangshan	-0.146 65	7
Fuyang	-0.672 64	16	Wuhu	0.666 84	3			

Table 4 The classification results of three clusters and five clusters

Amount of cluster	Type	City
Three clusters	The first type	Tongling, Ma'anshan, Wuhu, Hefei
	The second type	Huainan, Huaibei, Huangshan, Anqing, Xuancheng, Chizhou, Bengbu, Chuzhou, Chaohu
	The third type	Lu'an, Suzhou, Fuyang, Bozhou
Five clusters	The first type	Tongling, Ma'anshan
	The second type	Wuhu, Hefei, Huainan
	The third type	Huaibei, Huangshan, Anqing, Xuancheng, Chizhou, Bengbu, Chuzhou
	The fourth type	Chaohu, Lu'an, Suzhou, Fuyang
	The fifth type	Bozhou

In the analysis of clustering, we adopt two methods of three clusters and five clusters, and the result of clustering can be seen in Table 4.

## 2.2 The analysis of spatial pattern of urbanization development in prefecture-level cities of Anhui Province

Differentiation characteristics of regional development. Table 3 shows that the city with the highest total score is Tongling City, reaching 1.458 30, while the city with the lowest total score Bozhou City, only reaching - 1.002 31. They are greatly different from each other, and the difference of regional urbanization development of Anhui Province is prominent. Based on the natural conditions, Anhui Province is divided into northern, central and southern regions (Fig. 1). In the light of results of three types of clusters (Table 4), the south includes 3 first-type cities and 4 second-type cities; the central region includes 1 first-type city, 4 second-type cities and 1 third-type cities; the north includes 1 second-type city and 3 second-type cities. In the light of results of five types of clusters (Table 4), the south includes 2 first-type cities, 1 second-type city and 4 third-type cities; the central region includes 2 first-type cities, 2 second-type cities and 2 third-type cities; the north includes 1 third-type city, 2 fourth-type cities and 1 fifth-type city.

According to the results of factor analysis and cluster analysis, we analyze the regional difference of urbanization development in Anhui Province, which indicates that the urbanization development of the southern, central and northern Anhui Province takes on gradient difference; the urbanization development of the south excels that of the central regions prominently, while the urbanization development of central regions excels that of the north, taking on gradient difference. Meanwhile, there is a gap between Wuhu, and Ma'anshan and Tongling; Chaohu, located beween Hefei, and Ma'anshan, Wuhu and Tongling, as one link, will have advantageous location in the future development. In the analysis of three clusters and five clusters, some cities are steady, at the same level. For instance, four cities of Anqing, Chizhou, Huangshan and Xuancheng, and three cities of Huaibei, Bengbu and Chuzhou in

two kinds of classification methods, are at the same level. From the level of whole province, they are at the medium level; Lu'an and Fuyang are at the same level in two kinds of classification methods, but at the low level.



Fig. 1 The regions of the north, the middle and the south

**2.2.2** Spatial pattern of regional development. In the light of the three clusters (Fig. 2), the "dual-nucleus", namely the center of Hefei and the center of Ma'anshan, Wuhu and Tongling as the radiation point, coupled with the "two-strips", promotes the holistic economic development in the region. If we raise the level of Chaohu City, it will connect two nuclei and form big "single-nucleus" within Anhui Province. In the light of the five clusters (Fig. 3), it forms two high-level regions,

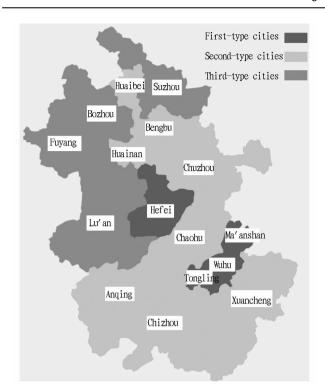


Fig. 2 Classification of three clusters

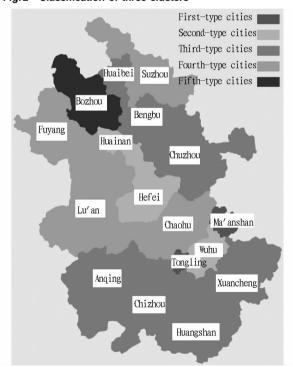


Fig. 3 Classification of five clusters

namely the central circle of Hefei and Huainan, regions along river of Ma'anshan, Wuhu and Tongling, which have become the important development polar of Anhui Province. If we raise the level of Chaohu City, then the foregoing two regions will become the biggest core of Anhui Province. If we consider the city cluster along the river, then Hefei, Huainan, Bengbu, Ma'anshan, Wuhu, Tongling, Anqing, Chizhou and Xuancheng

will become the most important city cluster of Anhui Province. The key development regions of province in the short run (2004 – 2010) are T-shape urban dense development regions integrating Ma'anshan, Wuhu, Tongling, Hefei, Chaohu and Wuhu; the key development regions of province in the long run (2010 – 2020) are the golden delta which takes urban strip along river as focus and takes Hefei, Ma'anshan, and Anqing as vertex. In the comparative analysis of results of two clusters, we can demonstrate the overall development strategy of three big urban clusters.

In three clusters, there is great possibility that "dual-nucleus" changes into "individual-nucleus" and the pattern of status quo of urbanization development in Anhui Province is "dual-nucleus" and "two-stretches"; in five clusters, the pattern of status quo of urbanization development in Anhui Province is "onecore", "one-strip" and "three-region", the difference among cities is clear and the evolution tendency of regional pattern of urbanization development is prominent; "one-core", "onestrip" can evolve into "one-cluster", namely the central urban cluster of Anhui Province; in three regions, the south and the west of Anhui Province show clear pattern of status quo, and the cities in the northeastern Anhui Province have big difference.

2.2.3 Analysis of reason of difference. Urbanization not only means that the number of cities and population increase, but also means that the urban modernization level is elevated. It represents the high-level stage of urbanization development [9]. In terms of total score, the top six cities are Tongling, Ma'anshan, Wuhu, Hefei, Huainan and Huaibei. In the factor analysis, the first principal factor has high scores, namely the level of urban economic development and quality of residents' life is high; at the same time, as the weight of the first principal factor (contribution rate) is biggest, so their total score tops the list.

Ma'anshan, Wuhu, and Tongling, along the river, leading to sea, in the central and central China, connected with Yangtze River Delta, are geographically adjacent, with outstanding location advantage. The steel production of Ma'anshan, the copper processing of Tongling, and the construction materials and automobile manufacturing of Wuhu, promote development of industrialization and accelerate the urbanization process, which is obvious in five clusters. However, there is still a gap between Wuhu, and Ma'anshan and Tongling, the five cluster reflected obvious.

Hefei, located in central Anhui, the political, economic, scientific, educational and cultural center and transportation hub, has the important geographical advantage of connecting the east and the west, the north and the south, and linking the Central Plains. Meanwhile, Hefei is also an important comprehensive industrial city in whole province, and a "technology city". Therefore, Hefei has great appeal to attracting the accumulation of population, and its urbanization level is increasingly promoted<sup>[10]</sup>.

In terms of total scores, Hefei ranks No. 4, and there may be several reasons as follows: firstly, in comparison with Ma'anshan, Wuhu and Tongling, the geographic location of Hefei is relatively poor and the area of Hefei is relatively big; secondly, in comparison with Ma'anshan, Wuhu and Tongling,

the advantage of Hefei is the political and cultural center of whole province. The choice of indicators is weak in this regard, for example, the volume of books per hundred people own is not listed, due to the statistical reason.

Huainan and Huaibei are important energy bases of coal energy in east China, their urbanization level is relatively high [10]. In addition, the role of the transportation hub of Bengbu, tourism of Huangshan, convenient transportation of Chuzhou convenience and so on make the development potential of urbanization in these regions immense.

Four cities with composite score at the bottom of list are Lu'an, Fuyang, Suzhou, and Bozhou. Due to slow development of economy and low level of development, the first principal factor of them scores little.

Although they have relatively high scores on several individual factors, they trail other cities on the list. As for the central region, particularly the northern city, although they develop significantly, it has not yet fundamentally changed the pattern of underdevelopment.

- 2.2.4 Analysis of influencing factors
- 2.2.4.1 Difference of natural geographic conditions. The natural geographical condition of one city is the prime condition of urban development which we must consider. The central and eastern Anhui Province are in plains, while the western Anhui Province is in mountains and hills, and we clearly know that the former is more beneficial to foreign exchange and development as against the latter; the east and the southeast borders Jiangsu and Zhejiang, adjacent to the Xuzhou city circle, Nanjing city circle, city circle of Suzhou, Changzhou and Wuxi, and Hangzhou city circle, which is beneficial to promoting urbanization level. In addition, some cities boast the unique landscape and culture, which have brought considerable development potential for city. For example, Huangshan City is a famous tourist city, and tourism industry becomes an important pillar for urban development.
- **2.2.4.2** Difference of transportation location conditions. Traffic location plays an irreplaceable role in regional development, and almost the planning of all productive forces is carried out along the lines of communication, which strengthens the city's internal and external contact. For example, Ma'anshan, located in southeastern Anhui Province, close to the "Yangtze River Delta", driven by "Yangtze River Delta", near the "Golden Waterway" of Yangtze River, associated with the rail and highway along river, has outstanding advantage of traffic location; driven by "Yangtze River Delta", its economic exchange and cooperation are strengthened and its urbanization level is rapidly promoted. In contrast, inland areas of Anhui Province, such as Fuyang and Lu'an, have relatively poor advantage.
- 2.2.4.3 Difference of mineral resources distribution. Abundant mineral resources offer great power for the development of urban construction and industrial development, which is conducive to the concentration of population, and elevation of urbanization level. For example, Ma'anshan is the new steel industrial city rising from the late 20th century; Tongling is one of the birthplaces of Chinese bronze culture, and so far the largest China's famous ancient copper mining and smelting base found in southern areas.

- **2.2.4.4** Difference of economic development level. Different basis of the urban economy, leads to the different industrial structure of city, different degrees of population concentration, and clear difference of urban construction and development. For example, Hefei has good economic foundation, and its proportion of secondary industry and tertiary industry is significantly higher than that of Bozhou, Suzhou and other cities. As the degree of population concentration and urban attractiveness are prominently different, so the direction of urban development diverges and there is a big gap of the level of urbanization.
- **2.2.4.5** "Small horse drags big cart" in administrative system. In city, it universally practises system of using city to drive county, and most of the counties have low-level economic develop, forming the phenomenon of "small horse drags big cart" in administrative system. It makes the overall level of urbanization low, and thereby causes inter-city differences on the level of urbanization [10].

## 3 Conclusion and suggestions

The research on characteristics of regional differentiation of urbanization development in Anhui Province shows that the regional pattern of urbanization development of Anhui Province is that the development of the northern, central, southern Anhui Province is uneven, the southern region better than the central region, and the central region better than the northern region; the spatial pattern in three clusters is the state of "dual-nucleus" and "two-strip", and the spatial pattern in five clusters is the state of "one-core", "one-strip" and "three-region". No matter the "dual-nucleus" in three clusters or "one-core", "one-strip" in five clusters, they tend to integrate; there is obvious great gradient difference of urbanization development level of all cities within regions.

In order to promote the development level of urbanization in Anhui Province, we should scope out their own conditions and the problems they confront, and put forward corresponding countermeasures and measures, so as to eliminate internal differences and achieve regional harmony.

The fostering and development of city group is the main form of promoting urbanization development. In three clusters, there is great possibility that "dual-nucleus" changes into "individual-nucleus" and the pattern of status quo of urbanization development in Anhui Province is "dual-nucleus" and "two-stretches"; in five clusters, the pattern of status quo of urbanization development in Anhui Province is "one-core", "one-strip" and "three-region", the difference among cities is clear and the evolution tendency of regional pattern of urbanization development is prominent; "one-core", "one-strip" can evolve into "one-cluster", namely the central urban cluster of Anhui Province; in three regions, the south and the west of Anhui Province show clear pattern of status quo, and the cities in the northeastern Anhui Province have big difference.

We should foster the urban agglomeration in central Anhui; perfect structure system in the perspective of integration and fostering; strengthen infrastructure construction and regional coordination system; elevate comprehensive competitiveness and guide holistic development of regional economy; promote (To page 116)

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industrialization process and promote development level of urbanization. In addition, we should consider the difference of natural geographic conditions, transportation location conditions and resources conditions and different urban economic basis; select different development modes; establish industrial spatial structure; foster development axis; elevate rapidly the economic development level and life standard of city so as to elevate the urbanization level comprehensively.

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