Comparative Analysis of the Course of Rural Urbanization and Urban Modernization

——A Case Study of Jiangsu Province

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Abstract According to the relevant data in Jiangsu Province during the period 2000 -2005, this article conducts comparative analysis of the course of rural urbanization and urban modernization using factor analysis method and principal component analysis method. The results show that the factors influencing the course of rural urbanization and urban modernization in Jiangsu Province can be summarized as 3 common factors (economic urbanization, social urbanization, urbanization of life quality and environment); economic urbanization is still the main factor influencing the course of rural urbanization and urban modernization; social urbanization, urbanization of life quality and environment also have great impact on the course of rural urbanization and urban modernization. Finally this article draws the conclusion that the difference between rural urbanization and urban modernization in Jiangsu Province will be gradually reduced, and Jiangsu Province should achieve balanced development in urban and rural areas.

Key words Urbanization, Factor analysis, Principal component analysis, Jiangsu Province

The study on urbanization is one of hot issues at present, and each has his own understanding of the urbanization. In general, the meaning of urbanization should include four levels. The first is that the rural areas are constantly transformed into urban areas, and finally assimilated by the urban areas; the second is the internal urbanization of rural areas; the third is the city's development, namely the so-called "modernization of cities"; the fourth is that the urbanization is regarded as the study object by various disciplines and fields, such as population urbanization, geographical urbanization, landscape urbanization, and industrial urbanization[1]. The rural urbanization discussed in this article refers to the first level and the second level, namely the "all-round well-off rural areas"; the so-called "modernization" of cities refers to the third level, the advanced stage of urbanization[2].

Rural urbanization is the road of rural development we must follow. Since the reform and opening up, we have witnessed the dramatic economic and social development, and significant growth in the level of urban modernization. At the same time, driven by the cities, the construction of all-around well-off rural community has been in full swing, and the phenomena of using urban prosperity to drive rural development and developing industry to promote agricultural development have been better reflected[3-4], indicating that the urban modernization plays a pivotal role in rural development. Rural urbanization is closely linked to urban modernization in the course of urbanization. Rural urbanization is the basis of urban modernization, and urban modernization is the driving force of urbanization in rural areas. The interaction between the two is the final choice of China's urbanization road, and also the best way to achieve urban and rural integration. But the rural urbanization-urban modernization in real society is not so exhilarating, and there is a large gap between the course of rural urbanization and urban modernization, which can be reflected in the following aspects: first, there is a prominent gap between urban-rural residents' income and consumption level, and it is difficult to coordinate urban and rural economic development; second, the gap in the development of social undertaking between urban areas and rural areas is large, and it is difficult to plan the course of urban and rural social development as a whole; third, there is a enormous gap between urban-rural resources and the environment, and it is difficult to plan harmonious development course of human and nature as a whole[5].

Most scholars' researches of the course of rural urbanization and urban modernization only linger at the first level, but few of them take an interest at the second and third level. This study carried out simply from a side, on the one hand, is difficult for us to have a comprehensive and accurate grasp of the course of rural urbanization and urban modernization in order to facilitate assessment of course and solution to the problems; on the other hand, confines the urbanization or modernization to the cities and neglects urbanization in rural areas, which will have an adverse impact on the construction of new socialist countryside in China and balanced urban-rural development (urban and rural integrated development). Through comparative analysis of the course of rural urbanization and urban modernization in Jiangsu Province, this article can not only provide decision-making basis for path choice of rural urbanization and urban modernization in urban and rural areas, but also provide the basis for the ways to be taken in rural urbanization and urban modernization. At the same time, it is of great theoretical and practical significance, to improving and promoting the course of rural urbanization and urban modernization, in whole province and even whole country.

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1 Impact indicators of the course of rural urbanization and urban modernization

I research and determine the indicator system of rural urbanization and urban modernization, from the perspective of economy, society and environment (people's lives). And I try to weed out some indicators with small impact that cannot be compared in the course of rural urbanization and urban modernization, such as the number of lawyers per 10 thousand people. In accordance with the above principles, by integrated considerations[3-4,6-11], I select the indicators using cluster analysis method[12-13], to make the abstract concepts more concrete and visual for comparative analysis.

The economic indicator is the core indicator at present for measuring urbanization at home and abroad. The economic indicator we determine should take into account the impact of economic growth on people's lives, deal with well the relationship between the quantity and quality of economic growth, between speed and efficiency of economic growth, so that people's living standards are constantly improved with economic growth. At the same time, it should regard comprehensively promoting informatization as the basic strategy of economic development and important measure of actual urbanization[4].

Society is constituted by human, thus social urbanization is the human urbanization in a great sense. And the human urbanization should attach great importance to the progress of human ideas and improvement in the level of culture; at the same time, focus on the stable social development, social rights justice, opportunity equality, fair distribution, fairness in social security *etc.*[14]. These are the most basic conditions to ensure that the residents live in harmony. Socio-economic development is the basis of improvement in the living standards and quality, and the main objective of economic development is to continuously improve the quality of people's lives and the living environment. The quality of people's lives is the ultimate manifestation of the development of modern economy and society. The environment construction is one of the main standards of measuring the quality of development and the level of development.

2 Empirical study of the course of rural urbanization and urban modernization

2.1 Data source and research method Since some counties and cities in Jiangsu Province engage in making experiments of urban-rural integration in recent years, the comparative research of rural urbanization and urban modernization will be not prominent after implementation of urban-rural integration. Therefore, I select the data before the implementation of urban-rural integration, to facilitate horizontal comparison between different objects. Taking urban and rural areas in Jiangsu Province as the statistical unit, I conduct factor analysis and principal component analysis of the related data in the period 2000 –2005. Factor analysis is a statistical method used to describe variability among observed, correlated variables in terms of a potentially lower number of unobserved, uncorrelated variables called factors. In other words, it is possible, for example, that variations in three or four observed variables mainly reflect the variations in fewer such unobserved variables. Factor analysis searches for such joint variations in response to unobserved latent variables. The observed variables are modeled as linear combinations of the potential factors, plus "error" terms. The information gained about the interdependencies between observed variables can be used later to reduce the set of variables in a dataset. Computationally this technique is equivalent to low rank approximation of the matrix of observed variables. Factor analysis originated in psychometrics, and is used in behavioral sciences, social sciences, marketing, product management, operations research, and other applied sciences that deal with large quantities of data. Principal component analysis (PCA) is a mathematical procedure that uses an orthogonal transformation to convert a set of observations of possibly correlated variables into a set of values of linearly uncorrelated variables called principal components. The number of principal components is less than or equal to the number of original variables. This transformation is defined in such a way that the first principal component has the largest possible variance (that is, accounts for as much of the variability in the data as possible), and each succeeding component in turn has the highest variance possible under the constraint that it be orthogonal to (*i. e.*, uncorrelated with) the preceding components. Grey relational analysis is to seek the main relationship between various factors in the system by a certain method, to find out the important factors affecting the target value. The correlation degree is used to signify the size of the correlation between two factors or systems, in order to have a more thorough understanding of the relationship between the systems or factors[18].

First, I conduct standardization processing of the evaluation indicator data, and the calculation formula is as follows:

$$Z_i = \frac{X_i - \overline{X}}{S}$$

where Z_i is standardization variable; X_i is the original variable; $\overline{X}$ is the mean; S is standard deviation.

By factor analysis, I get the contribution rate of variance, the cumulative contribution rate and scores of factors. Then I conduct analysis using principal component analysis method, to establish the principal component regression model, for researching the impact of all influencing factors on urbanization after eliminating multicollinearity. The indicators include per capita investment of fixed assets (X_1), per capita disposable income (X_2), the number of phone per capita (X_3), the number of people who receive the subsistence allowance (X_4), the coverage rate of basic pension insurance (X_5), the coverage rate of basic health insurance (X_6), health technicians (X_7), the total number of post offices (including telecommunications network) (X_8), the number of schools (X_9), the Gini coefficient (X_{10}), the degree of residents' satisfaction with openness of government public affairs (X_{11}), urban residents' living consumption expenditure (X_{12}), the Engel coefficient (X_13), per capita deposits (X_14), the proportion of expenditure in family

health care (X_{15}), the proportion of expenditure in family culture, education and recreation (X_16), and the investment of environmental governance project (X_{17}).

2.2 Operation results of model and analysis

2.2.1 Operation results of urban modernization model. The operation results of urban modernization model can be seen in Table 1.

Table 1 shows that in the orthogonal solution, three common factors are extracted, and the total variance contribution rate is 97.434%. Then most of the information of the original variables can be described. In order to reasonably explain each common factor, I use the maximum variance method to conduct factor rotation (Table 1), and I get the rotated factor loading matrix and model.

Table 1 The analysis of total variance of the indicator system, the factor loading matrix and the factor loading matrix after rotation (city)

Indicator system	Initial value			Factor loading matrix			Factor loading matrix after rotation		
	Total	Contribution rate of variance	Cumulative contribution rate of variance	F_1	F_2	F_3	F_1	F_2	F_3
X_1	13.698	80.577	80.577	0.933	−0.297	0.198	0.897	0.415	−0.148
X_2	2.093	12.311	92.888	0.998	0.045	0.025	0.716	0.695	0.051
X_3	0.773	4.546	97.434	0.964	−0.219	0.082	0.822	0.536	−0.143
X_4	0.401	2.360	99.794	0.993	−0.056	−0.070	0.694	0.711	−0.085
X_5	0.035	0.206	100.000	0.955	0.111	−0.267	0.489	0.869	−0.047
X_6	1.010E−15	5.944E−15	100.000	0.998	−0.040	−0.005	0.729	0.681	−0.037
X_7	5.454E−16	3.208E−15	100.000	0.973	−0.023	0.188	0.819	0.552	0.079
X_8	3.304E−16	1.943E−15	100.000	−0.559	0.784	0.267	−0.532	−0.253	0.808
X_9	2.775E−16	1.633E−15	100.000	0.469	0.828	0.300	0.211	0.458	0.861
X_{10}	1.734E−16	1.020E−15	100.000	0.969	−0.053	−0.210	0.593	0.782	−0.157
X_{11}	1.298E−16	7.637E−16	100.000	0.990	−0.065	−0.054	0.704	0.696	−0.084
X_{12}	1.721E−17	1.013E−16	100.000	0.996	0.081	0.044	0.713	0.695	0.091
X_{13}	−1.055E−16	−6.207E−16	100.000	−0.813	0.018	0.006	−0.588	−0.562	0.019
X_{14}	−1.860E−16	−1.094E−15	100.000	0.993	−0.088	0.017	0.757	0.646	−0.066
X_{15}	−2.633E−16	−1.549E−15	100.000	0.808	0.500	−0.309	0.216	0.940	0.261
X_{16}	−2.790E−16	−1.641E−15	100.000	0.827	0.543	−0.133	0.317	0.862	0.390
X_{17}	−8.846E−16	−5.204E−15	100.000	0.796	−0.265	0.539	0.988	0.123	0.060

First, common factor F_1 is the composite indicator described by X_1, X_2, X_3, X_6, X_7, X_{11}, X_{12}, X_{13}, X_{14}, and X_{17}, mainly reflecting the direct or indirect impact of economy on modernization, including people's benefits in the process of urban economic development, impact of changes in income on people's consumer attitudes, and people's emphasis on "green economy" and the economy for the development of "harmonious society", defined as economic modernization.

Second, common factor F_2 is the composite indicator described by X_4, X_5, X_{10}, X_{15}, and X_{16}, mainly reflecting the impact of the social environment on modernization, including the operation of social security system, people's income gap and distribution of consumption, defined as the modernization of life quality and environment.

Third, common factor F_3 is the composite indicator described by X_8 and X_9, mainly reflecting the accessibility of the social information infrastructure, information environment building, and people's cultural quality and spiritual civilization, defined as social modernization. After completing the factor analysis, I conduct corresponding processing using principal component analysis method, and get composite score model of urban modernization as follows:

$$F_U = 0.743X_1 + 0.8322X_2 + 0.773X_3 + 0.811X_4 + 0.791X_5 + 0.820X_6 + 0.811X_7 - 0.352X_8 + 0.506X_9 + 0.785X_{10} + 0.808X_{11} + 0.836X_{12} - 0.670X_{13} + 0.811X_{14} + 0.717X_{15} + 0.746X_{16} + 0.650X_{17} \quad (1)$$

2.2.2 Operation results of rural urbanization model. Operation results of rural urbanization model can be seen in Table 2.

Table 2 The analysis of total variance of the indicator system, the factor loading matrix and the factor loading matrix after rotation (countryside)

Indicator system	Initial value			Factor loading matrix			Factor loading matrix after rotation		
	Total	Contribution rate of variance	Cumulative contribution rate of variance	F_1	F_2	F_3	F_1	F_2	F_3
X_1	13.305	78.263	78.263	0.914	0.366	0.100	0.959	0.189	0.158
X_2	2.265	13.323	91.587	0.967	0.083	0.179	0.846	0.303	0.410
X_3	0.775	4.561	96.148	0.978	0.157	−0.121	0.858	0.483	0.159
X_4	0.445	2.619	98.767	−0.892	0.388	0.150	−0.466	−0.740	−0.452
X_5	0.210	1.233	100.000	0.992	0.066	−0.018	0.830	0.463	0.292
X_6	6.660E−16	3.918E−15	100.000	0.912	0.340	0.045	0.935	0.240	0.137
X_7	4.470E−16	2.629E−15	100.000	0.749	−0.464	−0.282	0.290	0.802	0.358
X_8	3.200E−16	1.883E−15	100.000	−0.919	−0.287	0.159	−0.883	−0.415	−0.030
X_9	1.785E−16	1.050E−15	100.000	−0.996	0.077	0.007	−0.750	−0.530	−0.392

(Table 2)

Indicator system	Initial value			Factor loading matrix			Factor loading matrix after rotation		
	Total	Contribution rate of variance	Cumulative contribution rate of variance	F_1	F_2	F_3	F_1	F_2	F_3
X_{10}	1.468E-16	8.634E-16	100.000	0.716	-0.418	-0.525	0.259	0.935	0.149
X_{11}	2.809E-17	1.652E-16	100.000	0.997	0.062	0.036	0.838	0.429	0.334
X_{12}	-4.364E-17	-2.567E-16	100.000	0.962	0.089	0.239	0.853	0.255	0.446
X_{13}	-8.268E-17	-4.863E-16	100.000	0.270	0.885	-0.155	0.715	-0.209	-0.570
X_{14}	-1.693E-16	-9.958E-16	100.000	0.980	0.166	0.018	0.883	0.381	0.251
X_{15}	-2.615E-16	-1.538E-15	100.000	0.668	-0.502	0.455	0.299	0.260	0.866
X_{16}	-3.629E-16	-2.135E-15	100.000	0.824	-0.520	0.144	0.373	0.565	0.716
X_{17}	-1.081E-15	-6.357E-15	100.000	0.988	0.077	0.040	0.840	0.414	0.325

It can be seen from Table 2 that in the orthogonal solution, three common factors are extracted, and the total variance contribution rate is 96.148%, then most of the information of the original variables can be described. In order to reasonably explain each common factor, I use the maximum variance method to conduct factor rotation (Table 2), and I get the rotated factor loading matrix and model. From the model, we can find that the analysis process of rural urbanization is similar to that of urban modernization.

First, common factor F_1 is the composite indicator consisting of X_1, X_2, X_3, X_5, X_6, X_8, X_9, X_{11}, X_{12}, X_{13}, X_{14} and X_{17}. Here we define it as social and economic urbanization.

Second, common factor F_2 is the composite indicator consisting of X_4, X_7, and X_{10}. Here we define it as urbanization of the living environment.

Third, common factor F_3 is the composite indicator composed of X_{15} and X_{16}. Here we define it as urbanization of life quality.

I get composite score model of rural urbanization as follows:

$$F_R = 0.799X_1 + 0.807X_2 + 0.812X_3 - 0.665X_4 + 0.816X_5 + 0.792X_6 + 0.532X_7 - 0.780X_8 - 0.800X_9 + 0.500X_{10} + 0.822X_{11} + 0.807X_{12} + 0.335X_{13} + 0.822X_{14} + 0.496X_{15} + 0.605X_{16} + 0.817X_{17} \quad (2)$$

The data concerning urban and rural areas in the period 2000-2005 (after standardization) are substituted into expression (1), (2), respectively, to get the composite score of the course of rural urbanization and urban modernization in Jiangsu Province (Table 3).

Table 3 Score of rural urbanization and urban modernization in Jiangsu Province in the period 2000-2005

Year	Urban modernization	Rural urbanization	Degree of difference in the course of urbanization between urban areas and rural areas
2000	-7.432	-14.666	7.234
2001	-2.430	-9.639	7.209
2002	3.457	-3.644	7.101
2003	7.760	3.236	4.524
2004	14.162	9.816	4.346
2005	15.432	13.367	2.065

I conduct the regression analysis of the degree of differences in urban and rural urbanization and time (year) using data derived from the operation results of model, and the result can be seen in expression (3). It can be clearly seen that in the future several years of the course of rural urbanization and urban modernization in Jiangsu Province, the degree of difference will be gradually reduced, and tend to be consistent.

$$Y_1 = 2\,122.971 - 1.057X \quad (3)$$
$$(5.16) \quad (-5.14)$$

2.2.3 Comparative analysis of operation results of rural urbanization model and urban modernization model.

From operation results of rural urbanization and urban modernization model, we can find that the modernization of the economy is still the main factor affecting the course of urbanization, and the course of rural urbanization and urban modernization advances led by the modernization of the economy. It can be seen from Table 1 that in the first principal component, in addition to the load capacity of the Engel's coefficient, the load capacity of the remaining 9 indicators is all greater than 0.7, showing that these indicators play a great role in the modernization of the economy; it can be seen from Table 2 that in the first principal component, the load capacity of the 12 indicators is all greater than 0.7, showing that these indicators play a prominent role in rural economic urbanization (social urbanization).

In the course of economic modernization (including urban modernization), a noteworthy indicator is the investment in environmental governance project, which has the greatest load capacity in the indicator system of urban modernization, reaching 0.988. In recent years, the construction of "ecological province" and "green Jiangsu Province" implemented by Jiangsu Province is an important measure after realizing the importance of harmonious development of environment and economy, and the effect is also very obvious.

In the process of modernization and urbanization of urban and rural economy, the role of urbanization of life quality and environment, and social urbanization can not be ignored. The load capacity of 7 indicators concerning the second and third principal component in Table 1 is greater than 0.7, and 5 indicators concerning the second and third principal component in Table 2 is also greater than 0.7, showing the role of life quality, environment and social urbanization in the course of rural urbanization and urban modernization. The overall situation is good, but we can also find some frustrating points from the analysis results. The load capacity of the Gini coefficient of rural urbanization and urban modernization is 0.782 and 0.935, respectively, with the average annual growth rate of 4.5% and

0.88%, and the change in annual growth rate can be shown in Fig. 1. From the analysis, we can find that in recent years (2000 to 2005), the Gini coefficient in urban areas tends to rise, but the Gini coefficient in rural areas tends to decline. From changes in the growth rate of the two in Fig. 1, we can also find this change. It is likely because in recent years, the farmers' "rush of going to city" and "rush of translating from agriculture to non-agricultural industries", have inflicted pressure on the city. But the Gini coefficient in rural areas never experiences evident change, because the income of farmers is at low level, and grows slowly. The rural residents' per capita disposable income in 2005 just reaches the level of urban residents in 2005. At the same time, the annual growth rate of urban residents' per capita disposable income is 22.2%, while the annual growth rate of rural residents' per capita disposable income is only 5%, less than 25% of the annual growth rate in urban areas. Too large income gap or low level of income will affect the level of people's lives and social stability. If these problems are left unchecked, it is bound to hinder the course of rural urbanization and urban modernization to a certain extent.

On the whole, in the period 2000 – 2005, the course of rural urbanization and urban modernization in Jiangsu Province moves forward almost at the same speed, but the degree of urban modernization is still higher than that of rural urbanization, which just tests the thesis of "The urban areas drive rural areas, and rural areas promote urban areas to achieve harmonious development".

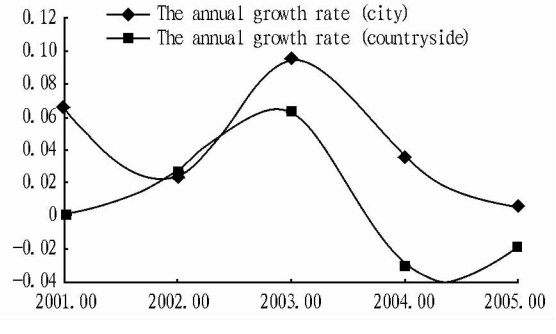

Fig.1 The annual growth rate of urban-rural Gini coefficient in Jiangsu Province in the period 2001 – 2005

3 Conclusions

The course of rural urbanization and urban modernization includes economic urbanization, social urbanization, environmental urbanization and so on, affected by a number of factors. From a comprehensive perspective, I establish multi – indicator systematic evaluation system, using factor analysis and principal component analysis to quantify the qualitative indicators, which can effectively determine the course of rural urbanization and urban modernization. In the process of evaluation, the interference of human factors with evaluation is avoided, so that the evaluation is more scientific and rational[20].

From the results of factor analysis and principal component analysis, the economic development is still the basis and primary task of modernization and urbanization, and the key link of modernization and urbanization. According to the classification criteria of World Bank, Jiangsu's economic development is at the level of the world's middle-income countries and regions, showing that the economic urbanization results of Jiangsu Province in the course of rural urbanization and urban modernization are good, achieving faster and better economic development. In the process of the modernization of the economy, Jiangsu Province also pays attention to social urbanization, and the development of people's life quality and living environment, focuses on the human development, put emphasis on the development of various social undertakings, vigorously implements the strategy of sustainable development, and accelerates advance of construction of "ecological province" and "green Jiangsu Province", so that the residents' living environment has been improved; urban and rural residents' life quality has been constantly improved; the gap between urban and rural residents' living standards has been gradually reduced in the course of rural urbanization and urban modernization.

Through analysis and evaluation of the course of rural urbanization and urban modernization in Jiangsu Province, we can see find the importance of balanced urban and rural development. But from the results of analysis, we also find the problems we must pay attention to in the future. I conduct grey relational analysis of scores of urban modernization and rural urbanization, and scores of degree of difference between urban and rural areas. The correlation value is 0.918 and 0.787, respectively, with difference of 0.131, showing that there is still a gap in correlation between the two. It indicates that there is imbalance to some extent between the pace of development of rural urbanization and urban modernization in Jiangsu Province, and urbanization in rural areas is still in a relatively backward state. Therefore, in the next period of time, Jiangsu Province should continue to maintain the rapid development of urban modernization, and strengthen investment in rural areas for construction of agricultural infrastructure, and construction of education, health, culture, and other social undertakings, so as to make farmers share the fruits of industrialization and modernization as much as possible, accelerate the pace of urbanization in rural areas, and achieve the coordinated development of urban and rural areas. This is the main direction of future development of rural urbanization and urban modernization.

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opment. If the issues concerning safety of agricultural products are prominent, the people will lose confidence in the government, thus affecting the peaceful and stable development of society. So the problem of agricultural products is not only people's problem of "shopping basket", but also related to China's unity and stability. Given that in the evaluation process of safety of agricultural products, there are certain preferences in simple determining of the weight of influencing factors, easily triggering deviation in evaluation results of safety of agricultural products, this article uses group decision-making to determine the weight of influencing factors on the basis of the actual situation of safety evaluation of the agricultural products, and offers a method of determining the weight of factors influencing safety of agricultural products having mixed group decision-making information of complementary judgment matrix and reciprocal judgment matrix, so that the evaluation results of the safety of agricultural products are closer to the actual situation, more objective, and more convincing[5].

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