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Analysis of the Convergence of Regional Economic Growth in Beijing

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Abstract

In this article, we studied the convergence of regional economic growth in Beijing. We divided 18 districts and counties in Beijing into four economic regions, utilized the method of Gini coefficient decomposition to educe the σ-convergence didn't exist in the regional economic growth of Beijing. At the same time, we utilized the panel data model and the spatial panel data model analysis to educe that the β- absolute convergence didn't exist in the regional economic growth of Beijing, but the β-conditional convergence existed, and analyzed the reason forming that β-conditional convergence.

Keywords: Gini coefficient, β-convergence, β-conditional convergence

1. Introduction

Since the late of the last century, the macro economy of Beijing has been operating well, but the large differences of growth of various districts and counties must influence the economic booms and social stability of Beijing. So the convergence and divergence of economic growth of various districts and counties in Beijing have been noticed by people.

The new-classical theory of economic growth thinks that if the exogenous technology is identical, the degression of capital marginal reward will make the undeveloped economic region develop with quicker growth speed, catch up with the developed region and realize the convergence of economic growth, i.e. the economic convergence. But the new growth theory thinks that the scale reward increase by degrees about material capital, technology and human capital may make the economic growths of difference regions develop at different directions, i.e. the divergence of economic growth. These two sorts of theory have debated the convergence of economic growth for a long term and induced many empirical researches.

In the empirical research of the convergence of regional economy, the economic convergence is generally divided into σ-convergence, β-convergence and club convergence. The σ-convergence means that the average GDP standard deviation of economic system possesses the descending trend. The β-convergence can be divided into β-absolute convergence and β-conditional convergence, and the β-absolute convergence means that the poor economic system has quicker development speed than the rich economic system and finally achieves same stable state. The β-conditional convergence means that the growth of economic system approaches different stable states because of the difference of self initial states. The club convergence means that for the interior of the economic groups with close economic development level in the initial stage, its growth speed and development level approach convergent, but the differences among groups still exist.

About σ-convergence, it is a better method to analyze by means of the decomposition of Gini coefficient. For β-convergence, most people use the cross section data or panel data to implement regression analysis. The regression model generally adopts the convergence analysis models based on Solow-Swan, Barro J R and Sala-I-Martin X:

$$(\log Y_{i,t+T} - \log Y_{i,t})/T = X_i^* - \left[(1-e^{-\beta T})/T\right]\log(Y_i^*/Y_{i,t}) + u_{i,t} \quad (1)$$

Where, i means the economy of certain region, t denotes the time point at the certain initial observation period, T is the length of the observation period, $\log Y_{i,t+T}$ is the logarithm of average GDP at the late of the observation period, $\log Y_{i,t}$ is the logarithm of average GDP at the beginning of the observation period, X_i^* is the average output growth rate under the stable state, Y_i^* is the stable average GDP, β is the convergent speed of average GDP to stable level Y_i^*, $u_{i,t}$ denotes the random error. Obviously, when the convergent speed β is appointed, and if the economy of certain region is further from its stable level, i.e. the $\log(Y_i^*/Y_{i,t})$ is bigger, so the year average growth rate of this region in T

term will exceed the stable growth rate X_i^*. The economic growth rate of poor region will be higher than the rich region, and the regional difference will be gradually reduced from a long time, i.e. the convergence. The equation (1) can be further abbreviated as

$$\log Y_{i,t+T} - \log Y_{i,t} = A - (1 - e^{-\beta T}) \log Y_{i,t} + \varepsilon_{i,t} \quad (2).$$

Where, the intercept $A = X_i^* + \left[(1 - e^{-\beta T}) / T\right] \log Y_i^* / T$ and the random error $\varepsilon_{i,t} = u_{i,t} / T$ reflect the influences of temporary impacts. We use the nonlinear LS (NLS) to evaluate the above equation, and we can get the evaluation value of β. If β>0, it shows that β-absolute convergence exists, and β is bigger, the convergent speed is quicker, and contrarily, if β<0, it shows β-absolute convergence doesn't exist. If the control variable $\psi_{i,t}$ is joined into the equation (1) and (2), we can get the model which can test β-conditional convergence.

The above researches to the economic growth convergences of country or region all regard the economic system as mutual independent individuals. However, the regional economy theory thinks that the mechanisms such as the exterior character, technical diffusion and factor flow of economic growth all promote the convergence of regional economic growth. Therefore, the function of space factor is not ignorable in the process of regional economic growth and many scholars considered the space factor when they studied the convergence of regional economy in recent years.

The regression model with space factor has two basic forms including the spatial regressive model (SAR) and the spatial error model (SEM).

SAR: $y = \rho W y + \beta X + \varepsilon \quad (3)$

SEM: $y = \beta X + \varepsilon, \varepsilon = \lambda W \varepsilon + \mu$ and it can be described as

$$y = \beta X + (I - \lambda W)^{-1} \mu \quad \varepsilon, \mu \sim N(0, \sigma^2 I) \quad (4)$$

Where, y is the attributive variable, X is the independent variable, β is the coefficient of variable, ρ and λ are respectively spatial regressive coefficient and spatial self-relative coefficient, ε and μ are random error items. W is the spatial weight matrix of n×n (n is the number of region), and if the boundaries of region i and region j are neighbouring, and the value of $W_{i,j}$ in W is 1, or else, it is 0. β is the elasticity of regional economic growth rate to the regional initial economic level, and it is the evaluation of regional economic convergence, and if β is significant negative, it shows that the convergence exists in economic growth, and if β is significant positive, it shows that the economic growth is divergent.

For the economic convergence analysis of China, most scholars' conclusions thought that the σ-convergence didn't exist in the regional economic growth of China, and the β-absolute convergence didn't exist too, but the β-conditional convergence existed. And some scholars studied the club convergence of China regional economic growth from different views.

In this article, we will empirically analyze the regional economic convergence of Beijing.

2. The empirical analysis of Beijing regional economic convergence

The data root in Beijing Statistical Yearbook issued by China Statistics Press, and the statistical software is Eviews 5.0. First, we divide 18 districts and counties in Beijing into four economic regions including function core region, function development region, new development region and ecological conservation region. The function core region includes Dongcheng, Xicheng, Chongwen and Xuanwu, and the function development region includes Chaoyang, Haidian, Fengtai and Shijingshan, and the new development region includes Shunyi, Changping, Daxing, Tongxian and Fangshan, and the ecological conservation region includes Huairou, Miyun, Yanqing, Pinggu and Mentougou.

Supposed that k=1, 2, 3, 4 respectively denote function core region, function development region, new development region and ecological conservation region, and u_{kt} denotes the average GDP of the k'th economic region in t year, and u_t is the average GDP of Beijing in t year. The average GDP of various districts and counties in t year are denoted by $y_{it} (i = 1,2,...,18)$.

(1) σ-convergence analysis

The total Gini coefficient of t year in Beijing can be decomposed as (Rf. [7])

$$G_t = \frac{1}{2n^2 u_t} \sum_{i=1}^{n} \sum_{j=1}^{n} \left| y_{it} - y_{jt} \right| = \sum_{k=1}^{4} v_{kt}^{\ 2} w_{kt} G_{kt} + G_{bt} + O_{bt}$$

$$= v_{1t}^{\ 2} w_{1t} G_{1t} + v_{2t}^{\ 2} w_{2t} G_{2t} + v_{3t}^{\ 2} w_{3t} G_{3t} + v_{4t}^{\ 2} w_{4t} G_{4t} + G_{bt} + O_{bt} \quad (5)$$

Where, n denotes that the number of district and county which can be observed in t years, and $v_{kt} = p_{kt} / p_t (k = 1,2,3,4)$ is the ratio of the k'th economic region population p_{kt} of t years with the total population p_t of Beijing, and $w_{kt} = u_{kt} / u_t (k = 1,2,3,4)$ is the ratio of the k'th economic region average GDP u_{kt} of t years with the average GDP u_t of Beijing, and G_{kt} denotes the interior Gini coefficient of the k'th economic region of t years, and

$$G_{kt} = \frac{1}{2n_k^2 u_{kt}} \sum_{i=1}^{n_k} \sum_{j=1}^{n_k} \left| y_{kit} - y_{kjt} \right| \tag{6}$$

Where, n_k denotes the number of district and county which can be observed in the k'th economic region of Beijing, and y_{kit} denotes the average GDP of t years of the i'th district or county in the k'th economic region, and O_{bt} is a sort of Gini coefficient residue depending on average GDP cross frequency among four economic regions, and it is called as the super-change density. But

$$\begin{aligned} G_{bt} &= \frac{1}{u_t} \sum_{1 \le i < j \le 4} v_{it} v_{jt} \left| u_{it} - u_{jt} \right| \\ &= \frac{1}{u_t} (v_{1t} v_{2t} \left| u_{1t} - u_{2t} \right| + v_{1t} v_{3t} \left| u_{1t} - u_{3t} \right| + v_{1t} v_{4t} \left| u_{1t} - u_{4t} \right| \\ &\quad + v_{2t} v_{3t} \left| u_{2t} - u_{3t} \right| + v_{2t} v_{4t} \left| u_{2t} - u_{4t} \right| + v_{3t} v_{4t} \left| u_{3t} - u_{4t} \right|) \end{aligned} \tag{7}$$

denotes the Gini coefficient of average GDP difference among k economic regions, and we can get Table 1 according to equation (5), (6) and (7).

Through Table 1, we can know that the total Gini coefficient from 1994 to 2004 and the Gini coefficients of various economic regions have obviously ascending trend, which can indicate the σ-convergences don't exist in the whole Beijing and various economic regions. In addition, as viewed from the contribution rate to Gini coefficient, the contribution rates among four economic regions obviously exceed the contribution rates in group, which further shows the differences of Beijing regional economic development are mainly from the differences among four economic regions.

(2) β-convergence analysis

We utilize the panel data and spatial panel data from 1994 to 2004, and adopt following two models to implement β-convergence analysis for the Beijing regional economic growth.

a. The model without regional dummy variable

$$\log Y_{i,t+T} - \log Y_{i,t} = A - (1 - e^{-\beta T}) \log Y_{i,t} + \varepsilon_{i,t} \tag{8}$$

b. The model with regional dummy variable

$$\log Y_{i,t+T} - \log Y_{i,t} = -(1 - e^{-\beta T}) \log Y_{i,t} + \lambda D_k + \varepsilon_{i,t} \tag{9}$$

Where, D_1, D_2, D_3 and D_4 respectively denote function core region, function development region, new development region and ecological conservation region. According to above two models, we implement regression analysis to average GDP growth rates of 18 districts in Beijing from 1994 to 2004, and the result is seen in Table 2.

From Table 2, β-absolute convergence doesn't exist in regional economic growth of Beijing. But the introduction of regional dummy variable can make the regional economic growth of Beijing possess β-conditional convergence, and the convergent speed is about 2%, which indicates the factor of region is one important reason influencing the convergence of regional economic growth.

Secondly, we use the following model to analyze the convergence.

$$\log Y_{i,t+T} - \log Y_{i,t} = A - (1 - e^{-\beta T}) \log Y_{i,t} + \lambda \psi_{i,t} + \varepsilon_{i,t} \tag{10}$$

Where, $\psi_{i,t} (i = 1,2...,18)$ are control variables which mean some index variables of t years in the i'th region and these control variables mainly include finance earning proportion (the ratio of financial earning and the GDP of t years), finance payout proportion (the ratio of finance payout and the GDP of t years), industrial structure variable (the weighted average of the ratio of the logarithm growth rate of various industrial production values with GDP), and actual proportion using foreign capital amount (the ratio of actual using foreign capital amount with GDP of the same year). The computation result is seen in Table 3.

From Table 3, all control variables will validate the β-conditional convergence of Beijing regional economic growth

and the convergent speed achieves about 3%, which indicates those control variables can not be ignored to influence the β-conditional convergence.

Finally, we introduce spatial factor, consider regional dummy variable, and increase the control variable, i.e. the proportion of social consumable retail amount (the ratio of social consumable retail of t years in the i'th district with GDP of the same year, i=1,…,18) to analyze the convergence. The adopted models should be the spatial regressive model (3) and the spatial error model (4). Theoretically, we can select the spatial regressive model or the spatial error model through the test of LM statistics (Xiang, 2007). From foreign relative researches, the β convergence model of regional average GDP can be analyzed through statistical test or probing space measure and most scholars support the spatial regressive model. And some scholars thought if the spatial regressive model can be used to fit, and even if the statistic is worse than the space error model, but if the statistic test is significant, the spatial regressive model will be better, which can be explained more easily from the economic meaning. In this article, we can adopt the spatial regressive model (11), and we can get Table 4 through computation.

$$\log Y_{i,t+T} - \log Y_{i,t} = A - (1 - e^{-\beta T}) \log Y_{i,t} + \lambda \psi_{i,t} + \rho W (\log Y_{i,t+T} - \log Y_{i,t}) + \varepsilon_{i,t} \quad (11)$$

From Table 4, the regional dummy variable, social consumable retail amount proportion and spatial factor will make β-conditional convergence occur in the regional economic growth of Beijing, and the convergent speed is about 2%-3%. At the same time, the introduction of spatial factors can make the regulative R^2 obviously exceed the regulative R^2 without spatial factor, and it is obvious that the spatial factor (geographical place) is also the important factor to influence the convergence of the regional economic growth of Beijing.

3. Conclusions

Above empirical results from 1994 to 2004 indicate that the σ-convergence and the β-absolute convergence doesn't exist in the regional economic growth of Beijing, but the β-conditional convergence exists, and the differences of Beijing regional economic growth are mainly from the differences of four economic regions, and the many factors such as regional factor, average GDP in the initial stage, finance earning proportion, finance payout proportion, level of industrialization, level of serving industry, social consumable retail amount proportion, actual proportion using foreign capital and spatial factor are un-ignorable factors to influence the convergence of Beijing economy. Therefore, we put forward following policy advices as conclusions.

(1) Emphasizing the problem of economic difference of various districts or counties in Beijing

From 1994 to 2004, the differences of economic growth exist in various districts or counties of Beijing and increasingly extend. Though the economic difference of various districts or counties is inevitable, but over large economic difference will damage the distribution efficiency of resource, and it will seriously influence the development of the whole economy of Beijing. Furthermore, the efficiency only emphasized without justice will influence the social stability. Therefore, the economic difference of various districts or counties of Beijing must be emphasized.

(2) Strengthening the cooperation among economic regions and reducing the difference among economic regions

The difference among four economic regions is main reason to induce the regional economic difference of Beijing. Undeveloped districts or counties of Beijing should not develop the economy extensively, and they must intensively develop the economy depending on their own regional advantages and resource gift advantages. The administration of Beijing should harmonize and encourage the communication between undeveloped districts or counties with developed districts or counties on the layer of enterprise, and develop the economy more quickly depending on the direction, support of developed districts or counties and the enhancement of self level. At the same time, according to the principle of mutual complement of advantage, mutual benefit and mutual development, the long term cooperation and communication should be promoted among economic regions. The support degree should be strengthened for undeveloped districts or counties, and the inclined policies about talent, education, financial transfer payout and basic establishment should be implemented for these regions. The opening degree and the marketization degree of undeveloped districts or counties should be enhanced, and the economical public character and the space overflow effect of economy should be utilized to gradually reduce the difference for undeveloped economic regions.

(3) Flexibly using financial policies and promoting the transformation and update of regional industrial structure

The administration of Beijing should plan and harmonize the economic development of various districts or counties and the establishment of financial policies as a whole, and optimize the financial earning and payout structure, increase financial payout for the undeveloped districts or counties, implement measures of tax reduction, and optimize the structure of tax system. Various economic regions of Beijing have formed different industrial structures in the long term development, and the government departments should adopt strategic regulatory measures, and fully promote the generation and updating of industrial structure for various districts or counties. In the structured adjustment of the second industry, the traditional industries should be changed by high and new technologies and advanced technologies. In the structured adjustment of the third industry, we should face the production and denizen consumption, utilize modern management mode and serving technology, change and develop traditional serving industry, and promote the

marketizaiton of the servicing industry, for example, fully develop the tour industry, financial insurance and community serving. So we can enhance the economic growth speed of undeveloped districts or counties, reduce the difference among economic regions and make for the convergence of economic growth.

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Table 1. Total Gini coefficients and Gini coefficients of various economic regions from 1994 to 2004

Year	Total Gini Coefficient	Regional Gni Coefficient in Function Core Region	Gini Coefficient in Function Develop Region	Gini Coefficient in New Development Region	Gini Coefficient in Ecological Conservation Region	Contribution Ratio in Group	Contribution Ratio among Groups G_{bt}	Super-change Density O_{bt}
1994	0.1834252	0.15082	0.111687	0.055185	0.129218	0.030889	0.121576	0.030961
1995	0.18283908	0.167688	0.134076	0.063642	0.138172	0.036985	0.153587	-0.00773
1996	0.19151331	0.197634	0.167846	0.092631	0.143834	0.047014	0.16104	-0.01654
1997	0.19765901	0.21514	0.189235	0.120673	0.144803	0.05499	0.168965	-0.0263
1998	0.20230125	0.232178	0.217089	0.138843	0.140943	0.06169	0.165485	-0.02487
1999	0.21494181	0.251936	0.228472	0.171689	0.165475	0.068141	0.159833	-0.01303
2000	0.22944211	0.256257	0.256042	0.184912	0.203927	0.075261	0.166152	-0.01197
2001	0.24774248	0.260438	0.311822	0.209029	0.242958	0.091208	0.1485	0.008035
2002	0.25690959	0.273473	0.314495	0.218432	0.266249	0.094524	0.148375	0.01401
2003	0.28477092	0.304958	0.337858	0.258105	0.304879	0.103101	0.145581	0.036089
2004	0.29657848	0.330232	0.340553	0.260088	0.314554	0.107248	0.160284	0.029046

Table 2. Absolute convergence test results and the equation test results with regional dummy variables

Explanation variables	Absolute convergence test result (p-value)	The equation test result with regional dummy variable (p-value)
Average GDP in the initial stage	0.00101(0.924)	-0.018207(-0.2112)
Regional dummy variable D_1		0.131316(0.0399)
Regional dummy variable D_2		0.1283(0.0373)
Regional dummy variable D_3		0.115267(0.0515)
Regional dummy variable D_4		0.120157(0.0405)
Intercept item	0.04437(0.3156)	
Regulative R^2	0.24416	0.251286
F	58.82252	16.01913

Table 3. The regional economic growth convergence with control variables

	Equation 1 (value of p)	Equation 2 (value of p)	Equation 3 (value of p)	Equation 4 (value of p)
Average GDP in the initial stage	-0.0229 (0.2661)	-0.025726 (0.1654)	-0.044765 (0.0213)	-0.03845 (0.0577)
Intercept item	0.12862 (0.1366)	0.181645 (0.0201)	0.162989 (0.0317)	0.195075 (0.0191)
Finance earning proportion	-0.1958 (0.0017)	-0.185242 (0.0019)	-0.168747 (0.0052)	-0.20628 (0.0012)
Finance payout proportion	0.16099 (0.0046)	0.143876 (0.0085)	0.121864 (0.029)	0.191321 (0.0011)
Variable of industrial structure	0.10208 (0.3189)			
Level of industrialization		-0.093168 (0.0234)		
Level of the serving industry			0.1227 (0.0033)	
Actual proportion using foreign capital				-0.01641 (0.2568)
regulative R^2	0.182	0.234083	0.253597	0.181631
F	2.89649	3.605081	3.896035	2.891793

Table 4. The regional economic growth convergence with regional dummy variables, social consumable retail amount proportion and space factors

	Equation 1 (value of p)	Equation 2 (value of p)	Equation 3 (value of p)	Equation 4 (value of p)	Equation 5 (value of p)	Equation 6 (value of p)
Average GDP in the initial stage	-0.008116 (0.3459)	-0.016624 (0.1434)	-0.029818 (0.1075)	-0.018998 (0.2764)	-0.036793 (0.0447)	-0.023329 (0.1272)
Intercept item	0.044806 (0.2153)		0.110447 (0.1531)	0.100841 (0.1729)	0.099785 (0.1772)	
Regional dummy variable D_1		0.083185 (0.0953)				0.121789 (0.0767)
Regional dummy variable D_2		0.050099 (0.3036)				0.08779 (0.1789)
Regional dummy variable D_3		0.068764 (0.1403)				0.104271 (0.0922)
Regional dummy variable D_4		0.076077 (0.0969)				0.100857 (0.0970)
Finance earning proportion			-0.080525 (0.088)	-0.064009 (0.1295)	-0.05597 (0.203)	-0.103075 (0.0153)
Finance payout proportion			0.112068 (0.0185)	0.071376 (0.0792)	0.062986 (0.1398)	0.109894 (0.0084)
Level of industrialization				-0.080861 (0.0158)		-0.032216 (0.2166)
Level of the serving industry					0.088836 (0.0102)	
Proportion of social consumable retail amount			-0.005622 (0.1060)	-0.004743 (0.1676)	-0.005977 (0.0899)	-0.00382 (0.2514)
Actual proportion using foreign capital			-0.010915 (0.2840)			-0.007964 (0.2677)
Space factor	0.14823(0)	0.170651(0)	0.207877(0)	0.201612(0)	0.199851 (0)	0.177305(0)
Regulative R^2	0.5358	0.58502	0.6021	0.653302	0.631531	0.559895
F	104.3048	51.4692	12.77658	15.66522	14.33887	23.77208