

A Spatial Statistical Analysis on Intra-Country Economy in Chongqing From Inputs Point of View

GAO Yuandong^{[a],*}; ZHANG Na^[b]; ZHAO Xiaoming^[b]

^[a]Associate Professor, College of Economics and Management, Southwest University, Chongqing, China.

^[b]College of Economics and Management, Southwest University, Chongqing, China.

*Corresponding author.

Supported by the Major Program of National Social Science Foundation of China (12&ZD100); the National Social Science Foundation of China (14BJY125); the Social Science Foundation of Ministry of Education of China (12YJC790041); the China Postdoctoral Science Foundation (2013M540687); the Key Program of Humanities and Social Science Key Research Bases in Chongqing (13SKB020); the Key Program of Higher Education Teaching Reform Research in Chongqing (132061).

Received 18 September 2014; accepted 25 November 2014
Published online 16 December 2014

Abstract

In order to analyze the region difference and the dynamic changes of intra-country economy in Chongqing since the implementation of coordinating urban and rural development, the paper analyze quantitatively the spatial distribution of economic growth level, capital investment, human capital investment and credit investment in countries of Chongqing by spatial statistical analysis method taking 35 countries of Chongqing as spatial units. Then we compare the spatial clustering of three inputs with it of economic growth level in the county of Chongqing. The results show that there exist positive spatial autocorrelation of economic growth level, capital investment and credit investment except human capital investment between countries; it reflects the significant improvement of inputs on economic growth in country that the spatial clustering state of inputs and economic growth level are similar.

Key words: Intra-country economy; Spatial statistical analysis; Inputs

Gao, Y. D., Zhang, N., & Zhao, X. M. (2014). A Spatial Statistical Analysis on Intra-Country Economy in Chongqing From Inputs Point of View. *Management Science and Engineering*, 8(4), 1-7. Available from: URL: <http://www.cscanada.net/index.php/mse/article/view/6127>
DOI: <http://dx.doi.org/10.3968/6127>

INTRODUCTION

Since Chongqing became the municipality in 2007, its economic comprehensive strength has increased a lot. From 1997 to 2011, Chongqing's nominal GDP has increased from 150.975 billion to 1001.137 billion, the economic aggregate has expanded by 6.63 times, its average annual growth rate has reached to 14.66%, which is 1.1% higher than the average annual growth rate of national nominal GDP (the annual growth rate of national nominal GDP from 1997 to 2011 is 13.56%). If carrying on the smoothing processing of GDP index which the base year is 1997, we can get that the real average annual growth rate of Chongqing is about 12.12%¹. However, the development of the districts and counties of Chongqing is uneven because of its urban-rural dual economic structure. In 1997, the GDP of Yuzhong District, whose GDP is the largest in Chongqing, is 24.89 times more than the GDP of Chengkou County, whose GDP is the smallest in Chongqing. In 2011, the GDP of Yubei District, whose GDP is the largest in Chongqing, is 20.65 times more than the GDP of Chengkou County, whose GDP is the smallest in Chongqing. Though the absolute difference of economic aggregate between different districts and counties in Chongqing has been diminished since Chongqing has become the municipality, but the gap is still wide. As a very important part of the regional

¹ The data is from The Tenth Anniversary of Chongqing Municipality, Chongqing Statistical Yearbook, 2012.

economy, the gap between county economy determines the gap of the economic development between different regions. As shown in Table, Chongqing can be divided into a total of 6 regions. Nominal per capita GDP of the nine districts of Chongqing City is the highest, and then followed by the eight districts of Western Chongqing, the five districts of the Middle Area of Chongqing, the two districts of Southern Chongqing, the five districts of Southeast Chongqing and the nine districts of Northern Chongqing. Among them, the speed of economic growth of The nine districts of Chongqing City is far above the citywide average level. The economic difference between different region is very outstanding, and the development is very uneven. Besides, it can be seen from Figure1 that the five districts of the Middle Area of Chongqing has developed rapidly, the growth of the west and the South of Chongqing has been reduced, and the economic growth of each region has changed significantly in recent years.

Table1
Nominal per capita GDP in each region of Chongqing (Unit: RMB)

Per capita GDP	Chongqing city	Middle area of Chongqing	Western Chongqing	Southern Chongqing	Northern Chongqing	Southeast Chongqing
2007	27577.89	12113	14793.69	13092.25	7505.667	8515.4
2008	34531.67	14872.4	20113.06	16160.25	9493.222	10712.2
2009	44280.78	18694.6	22485.13	18558.25	11708.67	13394.00
2010	50292.53	22816.28	27129.97	23469.81	14390.73	16100.95
2011	59707.44	29724.00	28663.19	21947.00	18402.89	19981.20

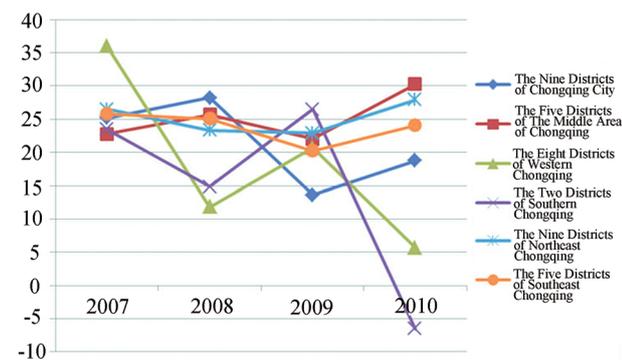


Figure 1
Growth Rate of Nominal Per Capita GDP in Each Region of Chongqing (Unit: %)

1. THE RESEARCH SCOPE AND DATA SOURCES

The sample of this paper is the whole area of Chongqing, including 38 districts and counties². Limited by digital map, this paper excludes Chengkou County, Wushan

² October 27th, 2011, Chongqing had an administrative divisions adjustment which involved reversing Yuzhong District, Shuanqiao District, Qijiang county and establishing Qijiang District and Dazu District.

Then the economic growth between Chongqing’s districts and counties is mutually independent or spatially correlated? Is there a significant spatial aggregation in regional economic growth? According to the economic growth theory, in addition to the economic base and geographic location, physical capital, human capital and other input factors also play important roles in the process of regional economic development. If there is a spatial aggregation in the economic growth of districts and counties, then is there a necessary link between the spatial aggregation state of the economic growth and the input of the physical capital and human capital in districts and counties? Therefore, this paper does the spatial correlation test to economic growth level, capital input, educational input and credit input of the districts and counties of Chongqing, analyzes the spatial aggregation state of input elements and economic growth, finally gets a series of results and put forward policy suggestions for the economic growth of Chongqing’s regions.

County and Wuxi County. And considering the availability of statistics, Yuzhong and Yubei are combined as one county, the corresponding data is merged. The digital map is provided by national fundamental geography information center, and adjusted based on the requirements of the study.

The sample data for this paper comes from “Statistical Yearbook of Chongqing (2008, 2011)”, “Chinese counties (cities) Social and Economic Statistical Yearbook(2011)”. And, we adopt the adjacent standard to build spatial weight matrix which is used in spatial statistical analysis. Concretely, each element w_{ij} of W is constructed as the following principle. Finally, The spatial weight matrix is row standardized.

$$W = \begin{cases} 1 & \text{region(county)}i \text{ is adjacent to region(county)}j \\ 0 & \text{region(county)}i \text{ is not adjacent to region(county)}j \end{cases}$$

2. A SPATIAL STATISTICAL ANALYSIS ON THE DYNAMIC CHANGE OF ECONOMIC GROWTH OF COUNTRIES AND DISTRICTS IN HONGQING

First of all, we use per capita GDP as the economic growth index, analyzing the spatial distribution of

economic growth of Chongqing's districts and counties by quartile graph. Comparing the distribution of per capita GDP between different region, we know that Chongqing economic growth is characterized by core-periphery structure that per capita GDP decrease gradually from the inside out to the edge. Districts and counties develop spatial aggregation naturally according to different economic growth. Concretel, the per capita GDP of The nine districts of Chongqing City is the highest, and then followed by the Middle Area of Chongqing which is around the main city, part of counties of Western Chongqing, and part of counties of Western and Southern Chongqing, per capita GDP of the remote counties of Southeast Chongqing and Northeast Chongqing is the lowest.

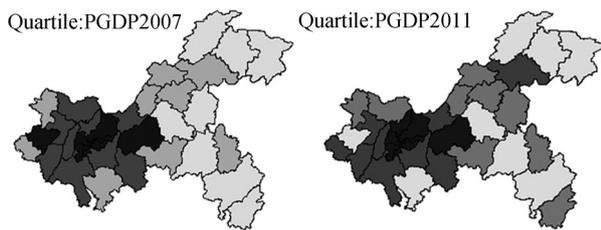


Figure 2
Quartile Graph of Per Capita GDP of Chongqing³

To further test whether the spatial aggregation of the economic growth in Chongqing's districts and counties is caused by the significant spatial autocorrelation, we further measure the spatial autocorrelation of economic growth in Chongqing's districts and counties. The results are shown in table2 as follows: the Moran' I of per capita GDP of counties in Chongqing is positive and significant, that varied from 0.3879 in 2007 to 0.3047 in 2011. It suggests that the spatial distribution of per capita GDP of counties in Chongqing presents positive autocorrelation, which

means the economic growth of counties is not completely random, but expresses the spatial aggregation among similarity values. Positive spatial correlation represents neighboring counties have similar spatial structures which mean there is spatial agglomeration distribution among which has similar per capita GDP level, in other words, richer counties and poorer counties aggregate respectively.

Table 2
Estimation results of Moran'I

	2007		2011	
	Moran'I	Z	Moran'I	Z
per capita GDP	0.3879	3.0982	0.3047	4.5797
investment in fixed assets per capita.	0.4924	4.0986	0.2165	2.4449
Fiscal expenditure on Education	0.1603	1.6678	0.1659	1.7662
balance of financial credit	0.0985	2.8550	0.1480	3.6539

Further consulting the Moran'I scatter plot of per capita GDP in Chongqing districts and counties, we can see that spatial differentiation of economic growth in Chongqing districts and counties is stable. Among them, the first quadrant is the H-H aggregation area whose economic growth is high, which includes 10 counties from 2007 to 2011 and have never been changed; the third quadrant is the L-L areas whose economic growth is low, as well, the corresponding counties has added from 18 in 2007 to 20 in 2011, Rongchang County and Dazu District are added. The amount of Counties in the second quadrant and the fourth quadrant is less. Obviously, the change of overall spatial difference of economic growth in Chongqing's counties is not obvious since 2007, but it has formed different spatial agglomeration regions according to economic development level.

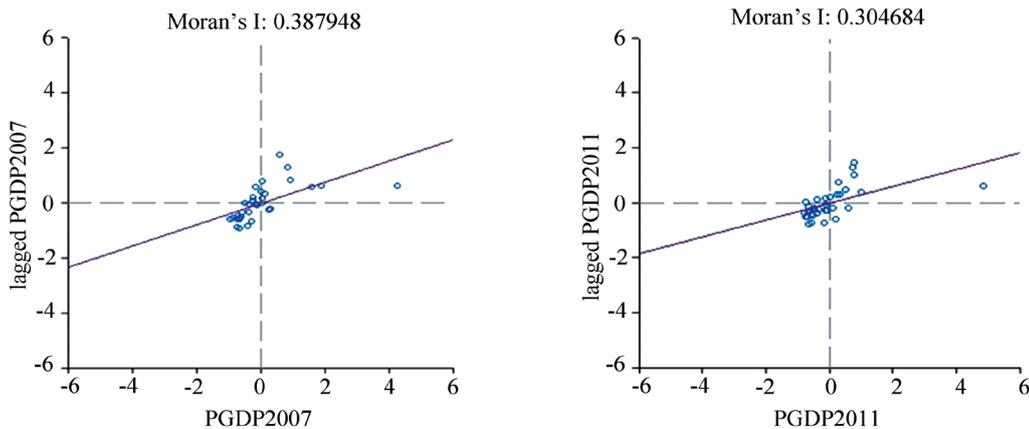


Figure 3
Moran Scatter Plot on Per Capita GDP of Counties in Chongqing

³ The gray color which varies from shallow to deep reflects indexes vary from low to high, the same below.

Finally, we test the significance of spatial agglomeration among counties in Chongqing with LISA cluster method. From Figure 4, we can see that Yubei District, Banan District, Shapingba District, Yuzhong District, Jiangbei District and Banan District whose per capita GDP is high, forming significant agglomeration(H-H). Zhong County, Shizhu, Fengdu, Qianjiang, Pengshui, Youyang, Xiushan and Wanzhou whose per capita GDP is low, forming agglomeration(L-L), which covers the whole southeast Chongqing and the part of northeast Chongqing, reflecting that relative poor counties possess a large region. Compared with spatial aggregation state of per capita GDP in 2007, it shows in 2011 that H-H areas have not changed while L-L areas are dwindling, reflecting that balanced urban-rural development has promoted Economic development of Chongqing's districts and counties since 2007.

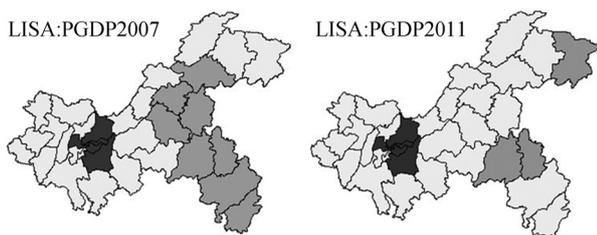


Figure 4
LISA on Per Capita GDP of Counties in Chongqing⁴

3. A SPATIAL STATISTICAL ANALYSIS ON AREA COUNTY ECONOMY GROWTH OF INPUT ELEMENTS IN CHONGQING

3.1 Spatial Statistical Analysis of Capital Investment

In the initial stage of economic growth, capital is one of the most important factors to promote economic growth, that has gradually become the consensus of scholars. Moreover, overall Chinese economy is promoted mainly by factor accumulation especially high investment. for instance, from 1979 to 2008 China's capital

accumulation average growth rate of 10% which contributes as high as 70.4% to economic growth; and from output elasticity point of view, capital output elasticity is generally in the range of 0.48-0.63, it shows the great promotion of capital on Chinese economic growth. Therefore, we will first analyze the spatial distribution of capital investment in Chongqing's districts and counties from the capital point of view. Analyzing the data of investment in fixed assets per capita in Chongqing's districts and counties by spatial statistical method, in 2007 2011, we acquire that spatial aggregation of capital investment is significant statistically, and Moran'I index is 0.4924 in 2007 and 0.2165 in 2011 respectively, as shown in Table 2.

As following quartile graph implies (Figure5), per capita investment in fixed assets in Chongqing's districts and counties exhibits the shifting tendency from the Chongqing City to the Middle Area of Chongqing from 2007 to 2011, that is to say Chongqing increased the investment to the Middle Area of Chongqing during this period, the results are as shown in Table 1. Per capita GDP of the Middle Area of Chongqing increases to 29724 yuan in 2011 from 12113 yuan in 2007, which has become the region with the highest average growth rate in Chongqing since Chongqing became the municipality city. According to LISA diagram to further analyze the significant of spatial aggregation, we know that the spatial aggregation state of capital investment in 2011 is similar to it in 2007. Higher capital investment districts of Chongqing City, including Yubei District, Banan District, Shapingba District, Yuzhong District, Jiangbei District and Nan'an District, significantly form H-H aggregation area which is consistent with the aggregation state of per capita GDP. The similarity of capital aggregation state of factor input and economic growth level reveal, Chongqing's districts and county with higher level of economic growth are often the counties with higher capital investment. Capital investment has a significant key influence on economic growth in Chongqing districts and counties. The changes of spatial layout of capital input will lead to the relative changes of economic growth level among districts and counties.

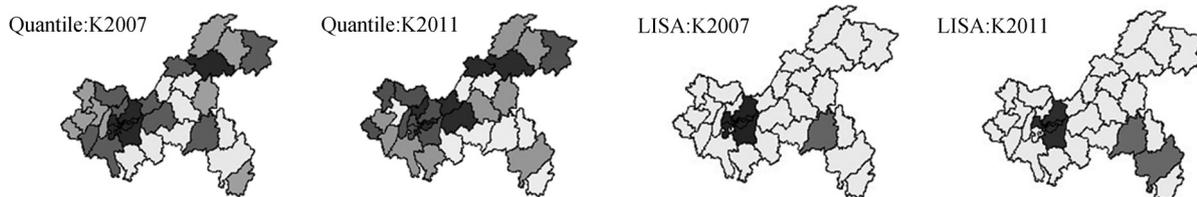


Figure 5
Per Capita Fixed Asset Investment of District on Space Aggregation Morphology

⁴ Dark gray indicates the H-H aggregation area, light gray indicates L-L accumulation area, white indicates no significant regional, the same as below.

3.2 Spatial Statistics of Human Capital Investment

Modern economic growth theory suggests that technological progress is a decisive factor in economic growth. The source of technological advance has come from the investment of human capital and knowledge innovation. As the most significant investment in human capital, education has a significant impact on economic growth, however, its role is still no empirical support. This paper takes the fiscal education expenditure as the index to assess the level of human capital investment in Chongqing districts and counties in order to reflect the spatial aggregation state of human capital investment. Based on the same analysis steps, the quartile graph show, the spatial layout of the districts and counties fiscal education expenditure has been significant changes from 2007 to 2011. Concretely, the districts and counties holding a large proportion of Chongqing fiscal expenditure on education in 2007 involve Shapingba, Yunyang, Kaixian, Wanzhou and Yongchuan, Jiangjin, while in 2011 the districts and

counties change to the 9 districts of Chongqing City, Yongchuan and Jiangjin. It show that Chongqing City increases the relative intensity of fiscal expenditure on education in this period, this situation is bound to make education resources more concentrated to the main city. But, Moran' I results of show, spatial autocorrelation of Education Investment in Chongqing's districts and counties are not statistically significant in both 2007 and 2011, that is the random what education input of districts and counties mainly performed, the spatial aggregation of properties of fiscal education expenditure is not significant, that is also confirmed from the education input on the LISA map. Obviously, with respect to the significant spatial aggregation of economic growth, human capital investment has not shown significant spatial autocorrelation, that is, education investment is still not enough to become the main factors explaining economic growth difference among Chongqing districts and counties. This results is consistent with the research conclusions of Benhabib and Spiegel (1994), Wan Guanghua (2005) .

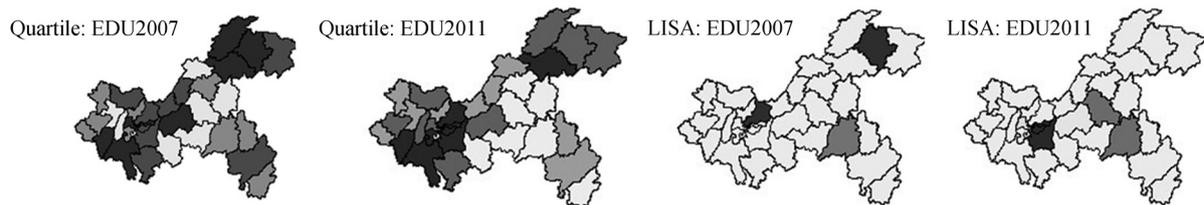


Figure 6
Education Inputs of District on Space Aggregation Morphology

3.3 Spatial Statistical Analysis of Credit Investment

In the districts and counties economic development, credit investment of financial institutions reflects the districts and counties financial support for economic development and it play a significant role in promoting economic growth of districts and counties , especially for investment in water conservancy construction, highway and other infrastructure construction. Credit investment can be seemed as “blood transfusion” for economic growth of districts and counties, which is a crucial way to solve the contradiction between the supply and demand of funds in the development of districts and counties, significantly promote the districts and counties' economy development and improve the level of per capital income as well. For the theory, enormous studies have given positive support, such as Jin Chengxiao and Ma Lijuan (2010) have approved the credit investment growth is well correlated with economic growth, especially in the high-speed economic growth. In China, positive correlation between the distribution of credit capital and economic growth is found. Meanwhile, the significant

promoting effect of credit investment on economic growth of districts and counties has also been empirical confirmed. Based on this, this paper used the loans outstanding of financial institutions to measure the credit input of districts and counties in Chongqing and do spatial analysis. The results show: from the graphs, during 5 years the relative structure in financial loans did not have obvious change in districts and counties of Chongqing. However, they surprisingly consist with the distribution state of economic growth of the districts and counties, which show the highest in the nine districts of Chongqing City, outwards gradually decreased and the lowest credit input in the periphery of the northeastern and southeastern Chongqing. Moran'I index of Loan balance of Financial show that, its are 0.0985 and 0.1480 in 2007 and 2011 respectively. It is significant statistically, but the degree of spatial aggregation is relatively low. It shows there is spatial autocorrelation of obtaining credit in districts and counties. Combining with the LISA graph, we know, that the spatial aggregation state of credit investment is basically the same in two years, mainly formed H-H aggregation area, that is, has significantly formed spatial

aggregation region including Yubei District, Yuzhong District, Jiangbei District, Nan'an District and the District of Shapingba where the credit amount is higher. All of them are located in the urban area, which is similar to the spatial clustering structure of per capita GDP index which measure economic growth. The correlation coefficient of Credit investment and economic growth in Chongqing districts and counties is calculated to be 0.62. And the

spacial aggregation state of credit investment is similar to economic growth of districts and counties, which reflects the high correlation between credit distribution and economic growth. We can see from the result that the region of higher credit investment is often the district gathered region with high levels of economic growth, which reflected a significant role made by financial credit on economic growth in districts and counties.

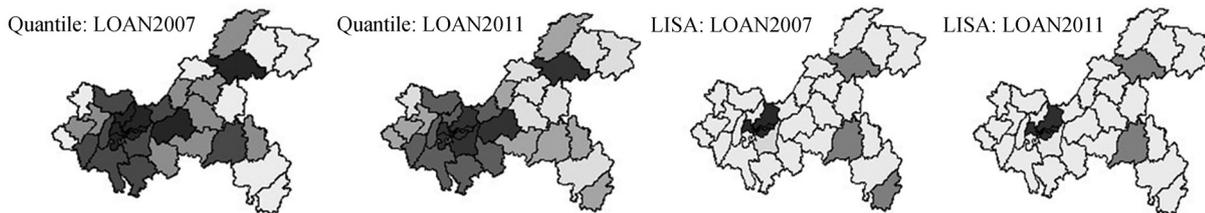


Figure 7
Financial Loan of District on Space Aggregation Morphology

4. CONCLUSIONS AND POLICY RECOMMENDATIONS

This article analyzes the dynamic change in the spatial layout and significance of regional economic growth, capital input, credit input effectively since the urban and rural co-ordination of Chongqing in 2007 and comparatively analyzes the spatial aggregation state of capital, human capital and credit and the aggregation state of regional economic growth through the spatial statistics analysis method. The results are as follows: First of all, there is a significant positive spatial autocorrelation in the regional economic growth of Chongqing. It forms a community that gathers economically fast-growing regions, including the nine districts of Chongqing City and Changshou District, and a community that gathers economic slow-growing regions which includes more than 20 counties in southeast Chongqing and northeast Chongqing. The relative spatial layout of districts and counties economic growth has been basically stable since the urban and rural co-ordination of Chongqing, but the significant degree of slow-growing community has gone down. The speed of economic growth in some regions has increased, escaping from slow-growing community. Secondly, there is an important positive spatial correlation in the capital input of districts and counties in Chongqing. We can see from the result that the degree of spatial aggregation has reduced since the urban and rural co-ordination of Chongqing. The characteristic is the case that the capital input has shifted partly from Chongqing City to the Middle Area of Chongqing. There is an aggregation state in capital input, which is similar to the aggregation state

in economic growth. It is meant that the community of higher capital accumulation is always the concentrated areas with a high level of economic growth. Thirdly, there is different from those in the distribution of human capital input in districts and counties of Chongqing, but the spatial correlation is not significant. It is shown that the regional human capital input is not the main reason for the gap of regional economic growth and the form of spatial aggregation. Fourthly, although there is a positive spatial correlation in regional credit input of Chongqing, the level is low. The degree of spatial correlation has been improved since the urban and rural co-ordination of Chongqing, developing an area where credit input level is H-H aggregation area in the nine districts of Chongqing City, which shows similar spatial aggregation state as the same as the area whose regional economic growth level is high. The result reflects the high correlation between credit and regional economic growth.

In order to promote the healthy and benign development of overall economy of Chongqing, the article suggests that based on the harmonious development of Chongqing's overall economy, from the aspects of physical capital, credit and other factor inputs, government should focus on the nine districts of Chongqing City, shift partly to Southeast Chongqing, Northeast Chongqing and other remote areas, optimize the layout of regional factor inputs, accelerate the economic growth of remote districts and counties. Meanwhile, relevant authorities are supposed to adopt preferential policies, such as educational fund, talents and other human capital factor inputs, to remote areas. In this way, we can avoid the excessive concentration of human capital inputs to the

nine districts of Chongqing city and other core areas and provide the talent for the regional sustainable economy. Furthermore, the spatial correlation of economic growth among counties should be considered when we make strategies and measures for districts and counties economy. Our apartments can formulate development strategy accurately according to the focus region which is formed by regional economic growth. Only in this way, we can promote the overall economic development of the accumulation areas which gather slow-growing districts and counties.

REFERENCE

Jin, C. X., & Ma, L. J. (2010). The asymmetric effects of credit policy/credit expansion and economic growth. *Statistical Studies*, 27(9), 9-15.

Research Group on China's Economic Growth and Macroeconomic Stability. (2010). Capitalization expansion and technological progress of catch-up economy. *Journal of Economic Studies*, (5), 4-20.

Wan, G. H., Lu, M., & Chen, Z. (2005). Globalization and regional inequality: Chinese evidence. *Chinese Social Science*, (3).

Yao, L. H. (2011). Empirical research on loan support for regional economic growth based on panel data model. *Regional Economic Research*, (10), 85-88.

Yao, X. G., & Zhang, H. F. (2008). Education, human capital and regional economic difference. *Journal of economic studies*, (5), 47-57.

Zhu, T. X., Gao, L. F., Wang, H., & Wang, Z. (2011). Empirical research on relationship between credit distribution and economic growth in China. *School of Economics, Shenyang University of Technology(Social Sciences)*, 4(4), 346-349.