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The Economic Radiation Power of Central Cities to Surrounding Cities

-- An Empirical Study in Guangdong Province

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Abstract

In order to study the economic radiation ability of central cities to surrounding cities, this paper uses panel data of 20 cities in Guangdong Province from 2003 to 2016 to empirically analyze the impact of economic growth of Guangzhou as a central city on surrounding cities. The empirical results show that Guangzhou's economic growth has a radiation effect on the economic development of surrounding cities, and this effect is a positive radiation effect. The further research of this paper found that from the perspective of various industries, the secondary industry and tertiary industry in central cities have a radiating effect on surrounding cities, and they both promote the economic growth of surrounding cities to a certain extent; The secondary industry has a greater impact on the economic growth of surrounding cities. Finally, this article puts forward policy recommendations for further exerting the radial function of the central city.

Keywords

Central city; Surrounding cities; Economic growth; Radiation effect.

1. INTRODUCTION

A central city refers to a large-scale city that plays an important role in economy, culture, and technology within a certain area, has relatively strong comprehensive strength, and has a large radiation effect, which can drive the common development of surrounding areas [1]. After the reform and opening up, my country has formed three major economic circles represented by the Yangtze River Delta, the Pearl River Delta and the Bohai Rim with Shanghai, Guangzhou, and Beijing as its central cities. In the "11th Five-Year" and "12th Five-Year" planning outlines, the central government has successively proposed that "city agglomerations should be the main form of urbanization" and "it is necessary to rely on large cities and focus on central cities to gradually form Urban agglomerations with large radiation effects". In the "13th Five-Year Plan", it is further proposed that the construction of urban agglomerations should be stepped up to form more growth poles that support regional development. In the report of the 19th National Congress of the Communist Party of China, a judgment was made that "socialism with Chinese characteristics has entered a new era", which has important guiding value for the development of urban agglomerations in my country in the new era. One of the points is that the development of urban agglomerations should be focused on the pursuit of urban self The development is shifting to focusing on the pursuit of coordinated development of large, medium and small cities and urban-rural integration.

Since 2018, the Pearl River Delta urban agglomeration, one of the three major urban agglomerations, has "upgraded" into the Guangdong-Hong Kong-Macao Greater Bay Area.

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According to the "Guangdong-Hong Kong-Macao Greater Bay Area Development Plan Outline", the Guangdong-Hong Kong-Macao Greater Bay Area is expected to be transformed into a world-class bay area and a world-class city cluster. The continued economic growth of Guangdong and the upgrading of its economic structure are the guarantee for the continued prosperity of Hong Kong and Macau. As a core area of economic and social activities in the Guangdong-Hong Kong-Macao Greater Bay Area, Guangzhou is still an important model for promoting regional development, using it as a growth pole to drive the common development of surrounding areas. However, whether Guangzhou can exert its own radiation effect on the economic development of other surrounding areas, whether this radiation effect is positive or negative, is still lack of specific discussion. This is the question that this article will study.

This article draws on the method used by Xianbin Wang et al. (2018)[2], first explores whether Guangzhou's economic growth has a radiating effect on the development of surrounding cities, and then analyzes Guangzhou's secondary and tertiary industries from the perspective of Guangzhou's secondary and tertiary industries. The radiation effect of the secondary and tertiary industries on surrounding cities. The research in this paper finds that as a central city, Guangzhou's economic growth has a positive radiating effect on the development of surrounding cities, and that the secondary and tertiary industries in the central city also have a positive radiating effect on the economic growth of surrounding cities, but the secondary industry has a positive effect on the economic growth of surrounding cities. The economic growth of surrounding cities has a greater degree of influence.

2. LITERATURE REVIEW

Scholars mainly have the following four views on how the economic growth of central cities affects surrounding areas: The first view is that the economic growth of central cities has a "reflux effect" on the development of surrounding areas. Jingwen Li et al. (2019) examined the economic growth relationship between different cities in the Beijing-Tianjin-Hebei urban agglomeration and found that the central city suppressed the economic growth of the surrounding small cities [3]. Dachun Fang et al. (2017) believe that the first city is the central city of the region. In the process of urbanization, the larger its scale, the more unfavorable the economic growth of the region [4]. Jiating Wang (2012) believes that urban primacy has a negative effect on economic growth [5].

The second view is that the economic growth of central cities has a "diffusion effect" on the development of surrounding areas. Yaqiong Zhu et al. (2016) found that Guangzhou has strong economic radiation to the main surrounding areas [6]. Fang Luo et al. (2019) found that Shanghai's economic growth has a "back-feeding effect" on the development of surrounding cities [7]. Hong Zhu et al. (2012) compared the economic radiation power of the two central cities, Beijing and Shanghai, on surrounding cities, and found that Shanghai's influence on surrounding cities is manifested as a "diffusion effect" [8]. Bindong Sun et al. (2016) took 108 small cities in the Yangtze River Delta as an example, studied the spatial impact of different levels of large cities on the economic growth of small cities and their heterogeneity, and found that neighboring large cities contribute to the economic growth of small cities [9]. Jingwen Yu et al. (2011) believe that compared with the Beijing-Tianjin-Hebei metropolitan area, the Yangtze River Delta metropolitan area and the Pearl River Delta metropolitan area can benefit from the radiation capacity of central cities [10]. Zheng Xu et al. (2010) found that the closer it is to a large regional city, the more favorable it is for urban economic growth [11].

The third view is that the economic development of the central city has no effect on the economic development of the surrounding areas. Xin Li (2010) studied the radiation driving ability of core cities in Shandong Peninsula and found that core cities cannot drive the development of surrounding areas [12]. Hongzhen Tian et al. (2017) believe that there is no

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significant correlation between the speed of urban development and the distance of the central city, that is, the cities close to the central city have not developed very fast [13]. Henderson (2003) believes that urban primacy has no effect on economic growth [14].

The fourth point of view is that the economic development of the central city has an impact on the economic development of the surrounding areas, but it cannot be determined whether it is a pulling effect or a restraining effect. Longbin He(2014) believes that surrounding cities should accept economic radiation based on the characteristics of central cities [15]. Zhipeng Zhou(2014) and others believe that central cities will promote the economic development of surrounding areas in the short term, but in the long run, they will hinder the development of surrounding areas [16]. Zhongming Du et al. (2014) believe that the radiation effect of the central city in the metropolitan area on the surrounding areas is related to the difference in the three industrial structures of the two sides [17].

In summary, previous scholars' research mainly focused on the two urban agglomerations of the Beijing-Tianjin-Hebei and the Yangtze River Delta. Relatively speaking, there are fewer literatures on the Pearl River Delta urban agglomeration, and whether and how it affects the economic growth of central cities within the urban agglomeration The economic growth of surrounding cities mostly stays at the stage of theory and case analysis, lacking empirical analysis. This article will empirically examine the impact of the economic growth of central cities within the Pearl River Delta urban agglomeration in Guangdong on the economic growth of surrounding cities.

3. EMPIRICAL MODEL SETTING

3.1. Design Specifications

In order to examine the economic radiation of Guangzhou's economic growth to surrounding cities, this paper constructs a core variable Dist to measure the degree of economic radiation of Guangzhou to surrounding cities.

$$\mathrm{Dist}_{\mathrm{ot}} = \frac{\mathrm{Rgdp}_{\mathrm{gt}}}{\mathrm{dis}_{\mathrm{go}}} \tag{1}$$

In formula (1), the subscript g refers to Guangzhou, the subscript o refers to the surrounding cities of Guangzhou, t refers to the year, and the variable Rgdp refers to the actual per capita GDP of Guangzhou in year t. The variable dis represents the geographic distance between Guangzhou g and surrounding cities o.

3.2. Model Building

Based on the standard economic growth model and referring to Wang Xianbin's (2018) research method [2], this paper sets the following regression model:

$$I\mathrm{nRgdp}_{\mathrm{ot}} = \beta_0 + \beta_1 InDist_{o,t} + \beta_2 X_{o,t} + d_o + \mu_t + \varepsilon_{o,t} \tag{2}$$

The core explanatory variable Dist in equation (2) is the radiation variable of Guangzhou city measured by equation (1), the explained variable lnRgdp is the log value of per capita real GDP of cities around Guangzhou, and the per capita real GDP of the city is the nominal per capita GDP divided by the city The GDP deflator is obtained. Xo,t are other variables that may affect regional economic growth, such as investment intensity, which is calculated by dividing the amount of regional investment by the regional GDP, expressed in InInv; the number of employees in the city at the end of the year, expressed in InEmp; government intervention,

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expressed by regional finance Expenditure divided by regional gross product, expressed by InGov; do and are fixed regional effects and time fixed effects, respectively, and are random error terms.

3.3. Data Source

This article aims to study the actual per capita GDP growth in Guangzhou and the impact of Guangzhou's secondary and tertiary industries on the economic growth of surrounding cities. Taking Guangzhou and Guangzhou's surrounding cities from 2003 to 2016 as a sample, we specifically searched for the GDP data of each city in Guangdong Province, as well as the amount of investment, the number of employees in the unit at the end of the year, the regional fiscal expenditure, the added value of the secondary industry and the tertiary industry in Guangzhou, etc. data. Surrounding cities include: Zhuhai City, Shantou City, Foshan City, Shaoguang City, Heyuan City, Meizhou City, Huizhou City, Shanwei City, Dongguan City, Zhongshan City, Jiangmen City, Yangjiang City, Zhanjiang City, Maoming City, Zhaoqing City, Qingyuan City City, Chaozhou City, Jieyang City, Yunfu City. Since the economic aggregates of Shenzhen and Guangzhou are not much different, they are excluded. The data used are from the "Statistical Yearbook of Chinese Cities" and the "Statistical Yearbook" of cities in Guangdong Province over the years.

3.4. Data Descriptive Statistics

The descriptive statistics of the main variables are shown in Table 1. Figure 1 depicts a fitted scatter plot of Guangzhou's economic radiation power to surrounding cities.

Table 1. Descriptive statistics of main variables

Variable	Observations	Mean	Standard Deviation	Max	Min
InRgdp	294	9.989	0.725	7.109	11.748
InDist	294	6.300	1.344	4.702	11.748
InEmp	294	3.658	0.837	2.454	6.131
InInv	294	-0.955	0.423	-2.123	0.108
InGov	294	-2.206	0.392	-2.945	-0.936
InDisSec	294	3.265	1.390	1.243	8.657
InDistTer	294	3.763	1.455	1.465	9.514

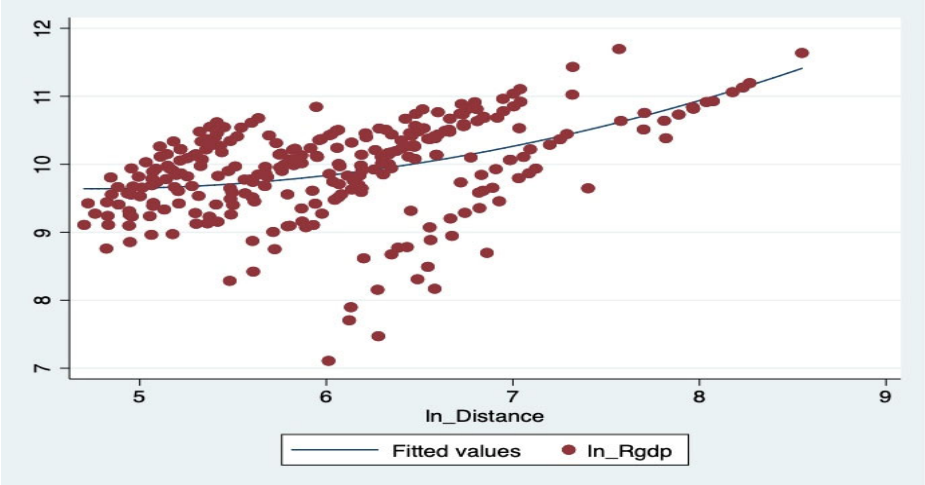

Figure 1. The fitted scatter plot of Guangzhou's economic radiation power to surrounding cities

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4. EMPIRICAL RESULT ANALYSIS

This paper uses the panel data of various cities in Guangdong Province from 2005 to 2016 to estimate the radiation effect of Guangzhou's economic growth on surrounding cities.

4.1. Basic Regression Results

4.1.1 The impact of core explanatory variables on urban economic growth

From Table 2, the coefficient of the core explanatory variable InDist is 0.781, which is significantly positive at the 1% statistical level. This shows that the economic growth of Guangzhou has significantly boosted the economic growth of surrounding cities. On the one hand, it may be because the agglomeration function of the central city is at play, and on the other hand, it may be because the diffusion function of the central city is at work, which drives the development of surrounding cities.

4.1.2 The influence of control variables on urban economic growth

For the control variables, the coefficient of InInv is 0.151 and the coefficient of InGov is 0.542, both of which are significantly positive at the 1% statistical level; and the coefficient of InGov is greater than the coefficient of InInv, which shows that the investment intensity and government intervention in the surrounding cities have The economic growth of the city has a stimulating effect, but relative to the intensity of investment, government intervention has a greater impact on surrounding cities.

This also shows that the economic growth of the surrounding cities cannot be driven solely by the central city. "Iron-strikes need to be hard by itself." The surrounding cities should tap their own potential and increase investment in local characteristic industries. At the same time, the government will provide funding and policy support to further improve Promote economic growth in surrounding cities.

Table 2. The radiation ability of Guangzhou to surrounding cities

Variable	(1) InRgdp	(2) InRgdp	(3) InRgdp	(4) InRgdp
InDist	1.446***	1.221***	1.233***	0.781***
	(0.091)	(0.100)	(0.118)	(0.145)
InInv		0.238***	0.236***	0.151***
		(0.051)	(0.053)	(0.053)
InEmp			-0.009	0.038
			(0.049)	(0.047)
InGov				0.542***
				(0.110)
Cons	1.652***	3.095***	3.056***	6.399***
	(0.525)	(0.590)	(0.065)	(0.903)
Obs	266	266	266	266
Year	yes	yes	yes	yes
Id	yes	yes	yes	yes
R2	0.901	0.910	0.910	0.918

Note: ***, **, and * indicate significant at the 1%, 5%, and 10% statistical levels; the explained variable is InRgdp, which is the value of surrounding cities Real GDP per capita.

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4.2. Robustness Test

In order to test the robustness of the results, this article sequentially changed the control variables to "Investment intensity (InInv)", "Investment intensity (InInv) and employment (InEmp)", "Investment intensity (InInv), employment (InEmp) and government intervention (InGov)" and then perform regression analysis. In Table 2, columns (2), (3), and (4) are the regression results of adjusting the control variables in turn. It is not difficult to find that the economic growth of surrounding cities (InRgdp) is used as the explained variable. Even if the control variables are changed, the coefficient of Guangzhou's economic radiation power (InDist) is significantly positive, that is, the positive radiation effect of Guangzhou's economic growth on the development of surrounding cities is robust.

4.3. Spillover Effects of Secondary and Tertiary Industries in Guangzhou

From the above analysis, it can be seen that as a central city, Guangzhou's economic growth does have a positive radiation effect on surrounding cities. Next, this article discusses the mechanism behind the positive radiation effect brought by Guangzhou from an industrial perspective. The specific method is to first set an indicator, use the added value of Guangzhou's secondary and tertiary industries divided by geographic distance as the core explanatory variable, establish a model, and perform regression analysis to analyze the underlying mechanism.

From Tables 3 and 4, it can be seen that the InDistSec coefficient is 0.746, which is significantly positive at the 1% statistical level, which indicates that the spillover effect of the secondary industry in Guangzhou has effectively promoted the economic growth of surrounding cities. The InDistTer coefficient is 0.506, which is significantly positive at the 1% statistical level, which also shows that the spillover effect of the tertiary industry in Guangzhou has effectively promoted the economic growth of surrounding cities.

Table 3. Radiation ability of Guangzhou's secondary industry value to surrounding cities

Variable	(1) InRgdp	(2) InRgdp	(3) InRgdp	(4) InRgdp
InDistSec	0.746***	0.630***	0.646***	0.403***
	(0.047)	(0.051)	(0.061)	(0.075)
InInv		0.238***	0.236***	0.151***
		(0.051)	(0.053)	(0.053)
InEmp			-0.009	0.038
			(0.049)	(0.047)
InGov				0.542***
				(0.110)
Cons	7.992***	8.450***	8.464***	9.825***
	(0.135)	(0.163)	(0.179)	(0.325)
Obs	266	266	266	266
Year	yes	yes	yes	yes
Id	yes	yes	yes	yes
R2	0.901	0.910	0.910	0.918

Note: ***, ** and * indicate significant at the statistical level of 1%, 5% and 10% respectively; the explained variable is InRgdp, which is the value of surrounding cities Real GDP per capita.

Further comparative analysis of Table 3 and Table 4, this paper found that the coefficient of the variable InDistSec is greater than the coefficient of In DistTer, which shows that although

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Guangzhou's secondary and tertiary industries have a positive radiating effect on the economic growth of surrounding cities, Guangzhou's second Industry has a great influence on the economic growth of surrounding cities. The possible explanation for the above results is that Guangzhou, as a central city, has a relatively clear and mature division of labor system in the industrial chain with surrounding cities. For example, in the manufacturing process, in the entire process of product production, companies in central cities are mainly responsible for some technical research, product design, marketing, etc., while companies in neighboring cities are responsible for some product manufacturing, so that companies in neighboring cities can pass Benefit from production cost advantage.

Table 4. The radiation capacity of Guangzhou's tertiary industry value to surrounding cities

Variable	(1) InRgdp	(2) InRgdp	(3) InRgdp	(4) InRgdp
InDistTer	0.506***	0.427***	0.432***	0.273***
	(0.032)	(0.035)	(0.041)	(0.051)
InInv		0.238***	0.236***	0.151***
		(0.051)	(0.053)	(0.053)
InEmp			-0.009	0.038
			(0.049)	(0.047)
InGov				0.542***
				(0.110)
Cons	8.340***	8.744***	8.761***	10.012***
	(0.116)	(0.141)	(0.168)	(0.300)
Obs	266	266	266	266
Year	yes	yes	yes	yes
Id	yes	yes	yes	yes
R2	0.901	0.910	0.910	0.918

Note: ***, ** and * indicate significant at the statistical level of 1%, 5% and 10% respectively; the explained variable is InRgdp, which is the value of surrounding cities Real GDP per capita.

As we can see the results, it can be seen that Guangzhou has a positive radiation effect on driving the economic growth of surrounding cities. Further research found that behind this positive radiation effect, the spillover effects of Guangzhou's secondary and tertiary industries all have a promoting effect on the economic growth of surrounding cities, and the secondary industry's role in stimulating economic growth in surrounding cities is even greater.

5. CONCLUSIONS AND POLICY RECOMMENDATIONS

The development of urban agglomerations is an important manifestation of spatial agglomeration of economic activities, and it is also an important way for China to accelerate the process of urbanization. It is generally believed that the economic growth of the central city within the urban agglomeration will have a potential impact on the economic growth of the surrounding cities. This paper uses the panel data of Guangdong Province from 2003 to 2016 to empirically examine the impact of economic growth of Guangzhou as the central city of urban agglomerations on the economic growth of surrounding cities. The study found that the economic growth of Guangzhou has a significant positive radiation effect on the economic growth of surrounding cities. This paper further studies the potential mechanism of the above-mentioned radiation effects and finds that the secondary and tertiary industries in central cities also have a positive radiation effect on the economic growth of surrounding cities. In order to

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better play the leading role of Guangzhou as a central city, the policy recommendations in this article are summarized as the central city and surrounding cities need to "two-pronged".

5.1. Promote the Development of Central Cities and Strengthen Their Leading and Exemplary Role

First, transform the structure of economic growth power. At the current stage, although Guangzhou has achieved great results in economic development, the "troika" of consumption, investment, and foreign trade has slowed down in driving economic growth. Therefore, it is necessary to further increase the driving force of labor, capital, innovation, and resources. To achieve sustained economic growth, Guangzhou must strengthen innovation drive, vigorously improve independent innovation capabilities, and take the lead in establishing a modern industrial system. At the same time, it is necessary to further promote the continuous agglomeration of capital, labor and other production factors in central cities, and increase the labor productivity of central cities by strengthening the agglomeration effect.

Second, optimize the configuration, give play to the leading role of the central city, and do a good job in industrial planning and industrial transfer. The research in this paper finds that Guangzhou's secondary and tertiary industries can effectively drive the economic growth of surrounding cities. Therefore, Guangzhou should speed up the development of advanced manufacturing, speed up the development of auto industry clusters with independent brands and independent technologies, and build an international automobile manufacturing base. At the same time, it is necessary to develop modern service industry, increase investment in competitive industries, such as increasing the international influence of other exhibition brands such as the Canton Fair, promote the construction of modern logistics parks, improve the infrastructure that matches the modern logistics industry, and drive the Pearl River Delta to build a world-class Logistics center.

Third, deepen cooperation between Guangdong, Hong Kong and Macao. Guangzhou and Hong Kong are geographically close, and they are also closely related in social and cultural aspects. We can learn from Hong Kong's successful experience. The Guangzhou-Hong Kong cooperation can encourage Hong Kong businessmen to invest and start businesses in Guangzhou. At the same time, actively guide Hong Kong creative enterprises to come to Guangzhou, promote the industrialization of Hong Kong's scientific and technological achievements in Guangzhou, and form a new growth pole in Guangzhou.

5.2. Surrounding Cities Combine Their Own Characteristics to Tap Economic Development Potential, Undertake Economic Radiation Effects, and Jointly Promote Economic Development

First, give play to the comparative advantages of the region and form its own growth pole. The regional industrial division of labor system should be improved, and regional comparative advantages should be brought into play. The industrial positioning of surrounding regions must be based on their respective comparative advantages and form their own unique economic growth poles.

Second, intensify the opening up of the economy to realize the benign interaction between the economic development of the central city and surrounding cities.

Third, the contribution of investment to economic growth determines that the local government should also increase effective investment and provide financial support. At the same time, it should also provide policy support for local characteristic industries to drive local economic growth.

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REFERENCES

[1] Longbin He, Qiang Li(2018). The economic radiation mechanism of central cities and the realization conditions of peripheral areas receiving radiation[J]. Journal of Shaanxi University of Technology (Social Science Edition), vol.36,no.5,p.7-26.

[2] Wang Xianbin, Wu Ziqian(2018). Central cities in urban agglomerations drive economic growth in peripheral cities[J]. Industrial Economics Review, vol.25,no.3,p.54-71.

[3] Jingwen Li, Shaojie Chi(2019). The impact of large cities in the new era on the economic growth of surrounding small and medium-sized cities[J]. Progress in Science and Technology, vol.36,no.14, p.31-37.

[4] Dachun Fang, Fan Zhang(2017). Urbanization, population concentration and economic growth: an empirical analysis based on the spatial dynamic panel model [J]. Economic Survey, vol.0,no.1,p. 8-13.

[5] Jiating Wang(2012). Urban primacy and regional economic growth [J]. Exploration of Economic Issues, vol.0,no.5,p.35-40.

[6] Yaqiong Zhu, Tingting Pan, Ling Hong, Lei Teng(2016). Quantitative analysis of Guangzhou's economic development and its radiation influence on the Pearl River Delta[J]. Journal of Xichang University (Natural Science Edition), vol.30,no.4,p.19-24 .

[7] Fang Luo, Yudie Kan(2019). Shanghai's Economic Radiation to Surrounding Cities: Taking the Tertiary Industry as an Example [J]. Technology and Innovation Management, vol.40,no.2,p. 231-236.

[8] Hong Zhu, Yanchao Xu, Heng Yin(2012). Empty absorption or backfeeding; Comparison of economic radiation patterns between Beijing and Shanghai[J]. World Economy, vol.0,no.3,p.111-124.

[9] Bindong Sun, Song Ding(2016). Are big cities conducive to the economic growth of small cities? — Evidence from the Yangtze River Delta City Group[J].Geographical Research,vol.35,no.9,p.1615-1625.

[10] Jingwen Yu, Chunchao Wang(2011). Analysis of the internal mechanism of urban agglomeration driving regional economic growth—taking the Beijing-Tianjin-Hebei, Yangtze River Delta and Pearl River Delta urban agglomerations as examples [J]. Economic Review, vol.0,no.1,p. 69-78.

[11] Zheng Xu, Zhao Chen, Ming Lu(2010). The "center-periphery model" of China's urban system [J]. World Economy, vol.33,no.7,p.144-160.

[12] Xin Li(2010). Research on the Radiation Driving Capacity of Regional Core Cities [D]. Shandong University of Science and Technology.

[13] Hongzhen Tian, Ling Xie, Qinping Liu, etc(2017). An empirical analysis of the impact of central cities on the development of surrounding cities[J]. Statistics and Decision, vol.0,no.6,p.141-144.

[14] Vernon Henderson(2003).The Urbanization Process and Economic Growth: The So-What Question[J]. Journal of Economic Growth,vol.8,no.1,p210-216.

[15] Longbin He(2014). A Comparative Study on the Economic Radiation Power of the Core Cities of my country's Three Economic Circles[J]. Economic Aspects, vol.0,no.8,p.50-54.

[16] Zhipeng Zhou,Changsheng Xu(2014). Or balanced development driven by the leader? A spatial measurement analysis of urban primacy and economic growth[J]. Economic Survey, vol.1,no.5,p.20-25.

[17] Zhongming Du, Jifa Tang(2012). Comparison of economic radiation intensity between Beijing and Shanghai[J]. Productivity Research, vol.0,no.1,p.123-144.