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The Impact of Spatial Structure of Public Investment on Economic Growth in Anhui Province

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Abstract

Since the Reform and Opening-up, the rapid economic growth of all regions in China has been closely related to public investment. Firstly, the regional structure of Anhui public investment is analyzed from two angles, that is, the comparative analysis of per capita GDP and per capita public investment of 16 cities in Anhui, and the regional differences of public investment in the three regions of central Anhui, southern Anhui and northern Anhui; Then, based on the Cobb-Douglas production function,an empirical study on the effect of economic growth of Anhui Public Investment, and it is found that Anhui public investment promotes economic growth, but this promotion is less than that of private investment. Finally, we proposes to optimize regional structure of Anhui public investment to promote countermeasures for coordinated economic development.

Keywords

Public investment; regional differences; economic growth.

1. INTRODUCTION

Over the years, China has focused on public investment, including infrastructure construction. Since the Chinese government implemented the expansionary fiscal policy in 1998 to the strategy of developing the western region, since the revitalization of the old industrial bases in the northeast and the rise of the central region, and then the “Belt and Road” Initiative to expand and deepen the Opening-up in 2015, investment is constantly increasing in China. As an important part of government spending, public investment has always been the focus of people’s attention. After the adjustment of the relationship of powers and responsibilities between the central and the local, and the establishment of the status of local interests, the status of local investment has gradually promoted and becomes the highlight of national public investment. Especially since the implementation of the positive fiscal policy, all provinces and cities in China have increased the intensity of public investment, and public investment has become a particularly important part of the economic development. Therefore, under today's rapid economic development, studying the trends of public investment, the public investment structure of various provinces, the efficiency of public investment, and the problems that the government has in the process of public investment are all important issues related to economic life and people.

In the study of the correlation between public investment and economic growth, most scholars believe that there is a positive correlation between public investment and economic growth, but some scholars in the academia have different conclusions. They think there is a negative correlation between public investment and economic growth. In the analysis of public investment structure, scholars believe that the public investment structure in China is inexpedient and there is still room for optimization. Li Yuanyuan (2012) pointed out that

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government investment expenditure has a pulling effect on Anhui's national economy [1]; Xiao Yanfei (2017) thinks that public investment in many provinces in China is positively correlated with regional economic growth and affects the regional economic development of each province [2] ;Wang Guihu (2016) argues that the relationship between public investment by the government and the private investment is not a complementary and mutually beneficial relationship between the two, and the public investment allocation has not reached the optimal state [3]; Hong Teng, He Yuxin, Wen Chunhui (2017) found that the economic efficiency of public investment in the central regions is declining, and the allocation of resources in these regions is not reasonable[4]; Li Yujuan and Li Qiyun (2013) believe that China's infrastructure growth rate lags behind the average growth rate of other industries and it shows that the east is developed first and the west follows behind[5].

The above theses clearly point out the close relationship between public investment and the economy, and confirm the importance of public investment for the economic growth and regional differences in domestic public investment, but did not specifically study whether local public investment structure is inexpedient or not. In view of the above deficiencies, this paper will take Anhui Province as an example to analyze the basic situation of public investment from the aspects of regional differences in public investment, spatial structure, public investment and economic growth, and give suggestions to the problems of public investment.

2. ANALYSIS OF THE DEVELOPMENT STATUS OF ANHUI PUBLIC INVESTMENT REGION

Based on the analysis of the basic conditions of public investment in 16 cities, we obtain the scale of public investment in each city , and divide these cities into northern Anhui, central Anhui and southern Anhui according to their geographical location. We further compare the differences in public investment in Anhui Province from the total amount of public investment, per capita, and spatial distribution.

2.1. Public Investment Status in Various Cities and Cities in Anhui

In order to study the development of public investment in 16 cities in Anhui Province,We standardized the GDP and public investment of 16 cities, constructed a regional public investment structure map of 16 cities, and conducted a basic analysis of per capita public investment and per capita GDP in 16 cities. First, we calculate the per capita GDP and per capita public investment of 16 cities in Anhui Province from 2007 to 2016, and then compare it with the province's per capita GDP and per capita public investment. After standardizing the data, the standardized value of GDP per capita is the horizontal axis, and the normalized value of per capita public investment is the vertical axis. The regional public investment structure map of 16 cities in Anhui Province is obtained, as shown in Figure 1.

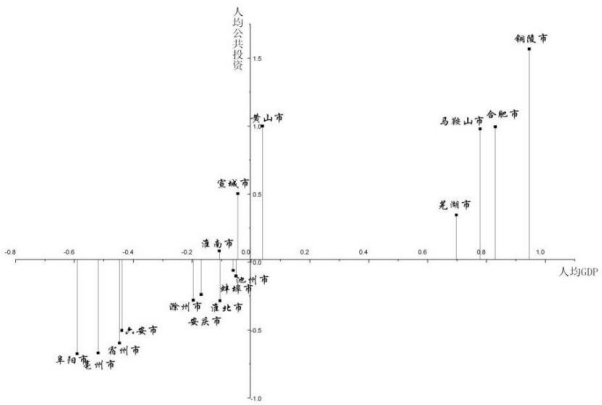

Fig 1. Regional public investment structure of 16 cities in Anhui Province

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From Figure 1, we can tell the per capita GDP and per capita public investment in the first quadrant are higher than the provincial average. Such as Huangshan, Wuhu, Maanshan, Hefei and Tongling. These cities are located in the southern Anhui except Hefei. They are close to the Yangtze River Economic Belt and are close to Jiangsu Province and Zhejiang besides Anhui Province. They have good location and well-developed economy, so the public investment in these cities is relatively big. The per capita public investment of cities in the second quadrant is higher than the provincial average, and the per capita GDP is lower than the provincial average. For example, Huainan have a population of about 800,000 more than Xuancheng and the total amount of public investment of Xuancheng is higher than that of Huainan. Therefore, the per capita public investment of Xuancheng is much higher than that of Huainan. The per capita public investment and GDP of cities in the third quadrant is lower than the provincial average. Such as Fuyang, Zhangzhou, Lu'an and other cities, most of these are located in the north and central of Anhui Privince, where the economy is underdeveloped, the public infrastructure is not perfect, the population base is large and the per capita public investment is far lower than the provincial average. Chizhou in southern Anhui Province is located in the third quadrant, indicating that not all cities in southern Anhui are located in the first quadrant. The strategy for building the Yangtze River Economic Belt is not fully popularized. In the future construction, public investment in Chizhou should be increased. The fourth quadrant indicates that the per capita investment of the city is higher than the provincial average, and the per capita public investment is lower. None of the 16 cities in Anhui Province is in the fourth quadrant.

We can know that the average per capita public investment of these 16 cities fluctuates on the average per capita public investment in Anhui Province. There is a huge difference in per capita public investment between cities. The per capita public investment in the southern city-level regions is higher than the provincial average. Due to the large population and small amount of public investment, the per capita public investment is generally lower than the provincial average. Being in municipal districts, Hefei is the political and economic center of Anhui Province with developed economy and a large population. It has a huge the amount of public investment and its per capita public investment level is much higher than the provincial average, and other central cities in the central region are slightly lower than the provincial average. It also shows that the issue of the balance of public investment distribution in Anhui Province needs to be improved.

2.2. Status of public investment in Southern Anhui, Northern Anhui and Central Anhui

In order to analyze the regional differences in public investment in Anhui Province, Anhui Province is divided into southern Anhui (including Huangshan, Xuancheng, Wuhu, Chizhou, Maanshan and Tongling) and central Anhui (including Hefei and Lu'an, the three areas of Zhangzhou and Anqing), and northern Anhui (including Suzhou, Huainan, Huaibei, Bengbu, Fuyang and Bozhou).

2.2.1 Comparison of total public investment and per capita public investment between the three major regions

The total public investment and per capita public investment in the three regions from 2007 to 2016 are shown in Table 1.

It can be seen from Table 1 that the total amount of public investment in northern Anhui, southern Anhui and central Anhui in 2007-2016 is increasing year by year. In terms of the total amount, the total amount of the central Anhui region is the largest each year, followed by the southern Anhui and northern Anhui regions. In 2007, the total amount of public investment in the three regions of northern Anhui, central Anhui and southern Anhui was still relatively small. In 2007, the difference in the total amount of public investment in the three regions began to increase. However, the differences in the proportion of public investment between these three regions have gradually decreased. In 2007, public investment in central Anhui accounted for

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45.1% of the province's public investment, and in 2016 it was reduced to 40.05%. Public investment in southern Anhui accounted for the public in the province rose from26.5% in 2007 to 32.4% in 2016. In 2007, public investment in Northern Anhui accounted for 28.4% of the province. In 2016, it accounted for 27.7% of the province's public investment. Although the proportion has slightly decreased, the fluctuation is relatively stable.

Tab 1. List of public investment and per capita investment

	Public investment			Per capita public investment		
	north Anhui	central Anhui	south Anhui	north	central Anhui	south
2007	3239765	5158205	3035094	1213.40	2280.18	2545.85
2008	3537157	6572062	5176702	1324.28	2889.84	4327.71
2009	4732583	10764887	9207306	1777.16	4729.20	7685.07
2010	6231292	13203929	10508883	2447.48	5894.61	8928.53
2011	5472359	11380690	8386581	2146.02	5080.67	7107.27
2012	8079155	14869029	11021695	3160.86	6611.40	9332.51
2013	9805116	15900271	13926768	3797.49	7038.63	11713.01
2014	11851941	22043575	17028502	4539.23	9668.23	14249.80
2015	14302015	24687787	21216592	5221.45	11681.60	16432.58
2016	20951253	30262220	24531529	7566.63	14209.62	18899.48

To make a more direct comparison of the total public investment allocation and the changing trends in these three regions, We make radar maps,as shown in Figure 2.

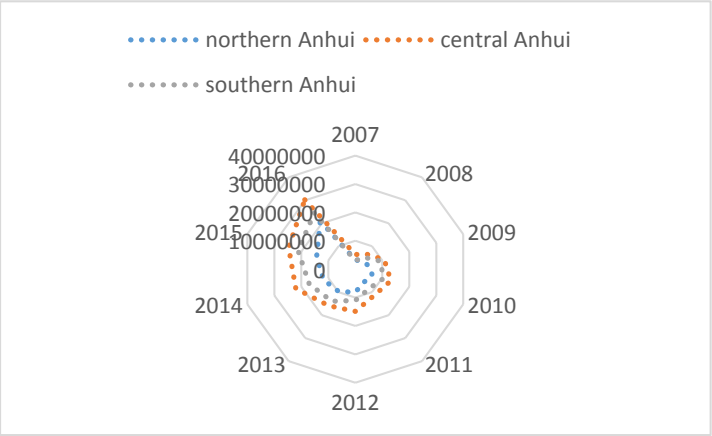

Fig 2. Comparison of the total allocation of public investment in the three major regions

From the average per capita public investment, we can see the per capita public investment in northern Anhui, central Anhui and southern Anhui all continue to rise in 2007-2016. The per capita public investment in northern Anhui increased slowly and the increasing rate was small. Per capita public investment in central Anhui and southern Anhui was overall rising and the rate of increase is large. The per capita public investment difference in the three regions has been expanding. In 2007, the per capita public investment in southern Anhui was 2.09 times that of the northern part of the country, and it rose to 2.50 times in 2016. The reasons behind are as following: in 2004, the country first proposed the plan of the rise of the central region, upgraded the industrial level of the central region of China, promoted industrialization and urbanization, and enabled the central region to be the connection between the east and the west

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regions and industrial development advantages. In the plan of the rise of the central part of China, Anhui Province invested a large amount of construction funds and increased investment in public investment fields such as railways, energy, electricity and construction. In the development of Anhui in recent years, the southern Anhui has accelerated the construction of the Yangtze River Economic Belt and undertaken industrial transfer in the Yangtze River Delta region. As the base of commodity and grain production in Anhui, the northern region has invested more in agriculture. As a city which is close to the Northern Anhui, the development of Hefei has attracted a large amount of labor and capital, which has restrained public investment in the northern part of the country to some extent. On the other hand, the total population of northern Anhui is twice that of southern Anhui.

2.2.2 Analysis of the Spatial Characteristics of Per Capita Public Investment in Anhui

The above is the analysis of the total public investment allocation and per capita public investment changes in the northern, central and southern Anhui, and to further analyze the regional differences in public investment in Anhui Province, the per capita public investment of 16 cities is divided into several intervals from small to large, as shown in Figure 3.

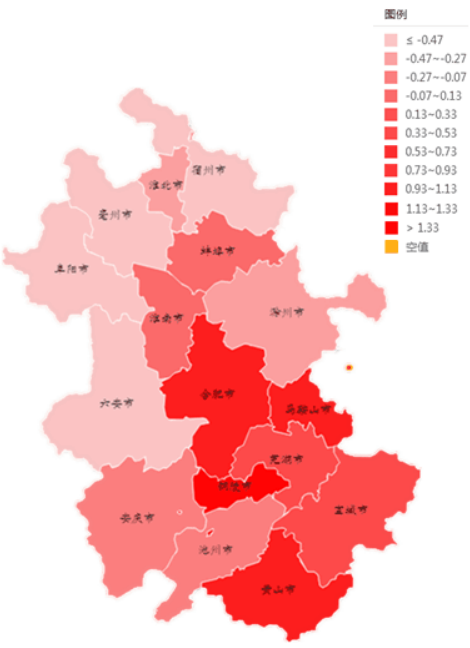

Fig 3. Spatial structure of per capita public investment in Anhui Province

It can be seen from Figure 3 that the spatial structure characteristics of per capita public investment in Anhui Province are similar to those of regional economy, mainly showing "point-axis" distribution or "line" distribution. The per capita public investment level along the Yangtze River is continuously distributed, and the locations of the regions where the per capita public investment is higher are distributed as "point-axis"; the Hefei-Ma'anshan-Nanjing line and Hefei-Wuhu-Tongling line have linear spatial structure characteristics. The per capita public investment level in the west of Hefei is low and the economy is underdeveloped, while the per capita public investment level in Hefei is significantly higher than that in the surrounding areas. In addition, the per capita public investment in Anhui Province also presents the spatial structure characteristics of the north and west are low whereas the south and east are high.

In summary, the public investment areas in northern, central and southern Anhui Province are quite different, and there is an unreasonable allocation of public investment among regions.

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The per capita public investment varies greatly, and the difference is gradually expanding. The per capita public investment in the north and south of Anhui Province is unevenly distributed.

3. THE ANALYSIS OF THE ROLE OF ANHUI PUBLIC INVESTMENT IN ECONOMIC GROWTH

The proposal of the rise of central China has a milestone significance for the development of regional economy in Anhui Province. Under the background of the rise of Central China, Anhui built a series of infrastructures such as roads, railways and water conservancy, which have been continuously improved. The volume of public investment has been increasing and the speed of economic development has accelerated. In order to study the role of economic growth for public investment, the following is based on the Cobb-Douglas production function to construct a multivariate regression model to empirically study the role of public investment in Anhui Province in economic growth.

3.1. Current Condition of Public Investment and Economic Growth

In 2007-2016, the total GDP of Anhui Province has maintained an upward trend. Among them, the growth rate of 2007-2010 slowed down; after 2010, the growth rate of GDP maintained at a medium-high level. Although the total amount of public investment in Anhui Province fluctuated in 2010-2011, the overall trend still showed an upward trend. In 2007-2010, the total growth rate of public investment was slow, and the total public investment volume accelerated in 2011-2016. By 2016, the total public investment in Anhui Province reached 605.687 billion yuan. We can see that Anhui's economic and public investment scale have maintained a certain growth rate and the growth trends are similar, indicating that there is a high correlation between these two.

3.2. Construction of An Empirical Model

The neoclassical economic growth theory is that economic growth is caused by the increase of population, the increase in capital and the development of technology. Taking into account the elasticity of the elements, this paper uses the most widely used production function in economics: Cobb-Douglas production function.

$$Y = F(L, K) = AK^{\alpha} L^{\beta} \tag{1}$$

The capitalized letter “A” indicates the technical level (In a short period of time, the progress of technology remains slow, so in this equation we assume the technical level is unchanged.), the capitalized letter “K” represents capital investment, the capitalized letter “L” represents labor input, and α and β represent the output elasticity of capital and labor. We dismantle capital investment K into government public investment (KG) and private public investment (KP), and formula (1) is converted into:

$$Y = A(KG)^{\lambda} L^{\beta(} KP)^{\varepsilon} \tag{2}$$

In the empirical study, the logarithmic form is taken on both sides of the formula (2) to obtain the formula (3):

$$\ln Y = A + \lambda \ln KG + \beta \ln L + \varepsilon \ln KP \tag{3}$$

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3.3. Variable Selection and Data Source

The main variables selected by the empirical research are as follows: (1) Public investment. Public investment is divided into two major methods in academia. The first is the government's production and supply of electricity, gas and water, transportation and warehousing, postal services, construction, water environment and public facilities management, residential services and other services, health and social security and social welfare, cultural and sports. Investments in the entertainment industry, scientific research technology services, geological exploration, information transmission computer services and software, education, public administration and social organizations are considered public investments. The second is to use the fixed assets in the state budget as public investment in terms of the source of funds for fixed asset investment. Here we take the first method. (2) Economic growth. The use of Anhui's GDP to reflect economic growth is representative. (3) Labor capital. The number of employed people in Anhui Province each year reflects the labor capital. (4) Private investment. Take self-raised funds and other funds in fixed investment as proxy variables for private capital. All data are collected from the Anhui Statistical Yearbook and the sample interval is 2007-2016.

3.4. Empirical Results and Analysis

3.4.1 Stationarity test

Considering that the selected GDP, total public investment and other data are time series data, this paper needs to test the time series for stationarity. The commonly used time series stationarity test includes the graph test method and the unit root test method. The unit root test is a method for checking the stationarity of the quantitative test time series, and has an intuitive analysis result. Therefore, this paper tests the time series stationarity by unit root test, and performs ADF test on four time series of lnY, lnKG, lnL and lnKP. The test results are detailed in Table 2.

Tab 2. Unit Root Test of Sequence lnY, lnKG, lnL and lnKP

variable	Inspection type (C,T,L)	ADF statistic	Prob.	Threshold			conclusion
				1%	5%	10%	
lnY	(0,0,1)	0.983	0.8953	-2.886	-1.996	-1.599	unstable
lnKG	(0,0,1)	0.457	0.9981	-2.847	-1.988	-1.600	unstable
lnL	(0,0,1)	0.357	0.7655	-2.847	-1.989	-1.602	unstable
lnKP	(0,0,1)	0.579	0.8184	-2.880	-1.995	-1.591	unstable
DlnY	(C,0,1)	-1.378	0.5383	-4.555	-3.321	-2.801	unstable
DlnKG	(C,0,1)	-2.768	0.1046	-4.583	-3.323	-2.845	unstable
DlnL	(C,0,1)	-1.957	0.2955	-4.585	-3.321	-2.801	unstable
DlnKP	(C,0,1)	-1.154	0.6353	-4.583	-3.390	-2.888	unstable
D2lnY	(0,0,0)	-3.116	0.0074	-2.937	-2.018	-1.597	stable
D2lnKG	(0,0,0)	-3.900	0.0022	-2.969	-2.098	-1.590	stable
D2lnL	(0,0,0)	-3.840	0.0024	-2.928	-2.010	-1.597	stable
D2lnKP	(0,0,0)	-3.908	0.0105	-2.991	-2.006	-1.598	stable

Notes: DlnYP and D2lnY represent the first-order difference and second-order difference of lnGDP, respectively, and (C, T, L) represent the constant term, time trend and lag order in the unit root test equation.

The unit root test results show that the absolute values of lnY, lnKG, lnL and lnKP are less than the corresponding critical values at the three significant levels of 1%, 5%, and 10%, and the original hypothesis cannot be rejected, indicating that the original four time sequence is not a stationary sequence. The first-order difference between lnY, lnKG, lnL, and lnKP cannot reject

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the null hypothesis.We continue to make a second difference between lnY, lnKG, lnL and lnKP, and find that the absolute value of ADF statistic is greater than the critical value, then reject the null hypothesis, and the second order difference is a stationary sequence. lnY, lnKG, lnL, and lnKP are second-order single integers that satisfy the conditions of the cointegration relationship.

3.4.2 Regression analysis

In the test of the stationarity of the time series, it is found that lnY, lnKG, lnL and lnKP are second-order single integers with a cointegration relationship. In this paper, the least squares method is used to estimate the relationship equation between lnY, lnKG, lnL and lnKP. The specific equation is as follows:

$$\ln Y = -25.12 + 1.32 \ln KG + 1.7 \ln L + 0.99 \ln KP \tag{4}$$

(-0.887) (-1.967) (1.083) (7.0165)

R2=0.9917, F=239.172, DW=1.7045

Equation (4) estimates the residual sequence μt and performs a unit root test on the original sequence of the residual sequence. The test results show that the absolute value of the ADF statistic of the residual sequence is 3.43795, which is better than 1%, 5% and 10%. The critical value is large, so the original hypothesis is rejected, and the residual sequence does not have a unit root, which is a stationary sequence.

From (4), we can tell that there is a long-term equilibrium relationship between economic growth, public investment and private investment. Under the same conditions, if the public investment increases by 10,000 yuan, the economic growth will increase by 132,000 yuan; for every 10,000 people of the labor force, the economic growth will increase by 17,000 yuan; for every 10,000 yuan of private investment, the economic growth will increase by 0.99 million yuan. The reason is that the economy of Anhui Province is in a stage of rapid development, but the level of economic development is not high. The infrastructure of many cities is underdeveloped; the scale of public investment has not reached the optimal level; and the marginal production efficiency of public capital is still on the rise. Infrastructures that have a pivotal position in economic development require government-led investment, such as water conservancy, electricity, railways, etc., and private investment is difficult to exert its effects under conditions of low market economy development. After investing in the improvement of the market infrastructure and urban construction, it has a guiding role for private investment, which promotes the marginal output of private investment.

4. SUGGESTIONS

In order to promote the impact of public investment in Anhui's economic growth and coordinate the economic development of different regions, the following countermeasures are proposed:

The first is to continue to expand the scale of public investment in Anhui Province. Musgrave and Rostow used the theory of economic development stage to analyze the scale of public investment and suggested that in the early stage of economic development, increasing public investment is indispensable for countries in the economic take-off stage. Anhui is in the midst of a booming economic development. Therefore, it is necessary to increase public investment in railway transportation, transportation, law, environment, education and other aspects to help Anhui's economic take-off.

The second is to balance the amount of public investment between Anhui regions and narrow down the regional public investment differences. The public investment in northern Anhui and

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western Anhui regions is small, and the regional economy is underdeveloped. It is obvious that the public investment in northern and western areas of Anhui Province has not reached the optimal public investment scale. Therefore, the government should increase investment in infrastructure, science and technology projects in northern and western Anhui, actively use public investment to support and Build local weaker industries and balance resource allocation; while the market economy in the central and southern Anhui regions is developing at a good level and private capital is relatively abundant, the government should shift public investment more to education, medical care, science and technology.

The third is to establish a minimum public investment guarantee system in Anhui Province. The regional differences in public investment in Anhui Province are quite large. According to the economic development of each city, the minimum public investment guarantee system is established to meet the minimum demand for public investment in the economic development of each city, which compensates for the shortage of private and public investment resulting from the lack of economic development in market conditions and narrows the gap in public investment in various cities in Anhui Province to a certain extent.

The fourth is to increase public investment in strategic emerging industries. Technological progress is a key factor affecting long-term economic growth. Because of the high risk and high cost of strategic emerging industries in the early stage of development, private capital sits on its hands. Therefore, it is necessary for government departments to invest public capital to drive private capital investment to strengthen development of strategic emerging industries in Anhui.

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