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An Investigation into the Spatial Disparities in Development Quality and the Influence Mechanism of the Private Economy in Hunan Province, China

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Abstract: ***The private economy, as a cornerstone of economic development, plays a crucial role in addressing the economic challenges faced by Hunan Province, China. Investigating the impact of innovation investments and human capital on the development of the private sector is essential for fostering the growth of the private economy in Hunan Province. This paper examines the spatial disparities in the quality of private economic development within Hunan Province and explores the underlying mechanisms using the spatial Durbin model. The findings indicate that: First, there are significant differences in the development of the private economy between the eastern and western regions of Hunan, with the western region developing at a slower pace compared to the eastern region. Second, both innovation investment and human capital significantly influence the development of the private economy; however, innovation investment exhibits a negative spillover effect. In conclusion, increasing investment in innovation and human capital, reducing regional disparities, and enhancing coordinated development among cities will contribute to the stable and sustainable development of the private economy in Hunan Province.***

Keywords: Private economy; Space spillover effect; Spatial differences.

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1. Introduction

The private economy, as a part of socialist economy in China, plays an important role in enhancing industrial competitiveness. Promoting the innovative development of private economy is an important way to enhance the virtual economy, a driving force to promote economic transformation and development, an important means to overcome the shortcomings of regional economic development and a long-term need to cultivate leading private enterprises.

Nowadays, the private economy has gradually changed the way of the development from high speed to high quality. In this critical period of the private economic development, it is necessary to enhance technological and talent innovation, so as to transform and upgrade the traditional private economy in Hunan Province. In summary, it is necessary to research the influence mechanism of private economy. The theoretical analysis of the issue is important and urgent.

The existing literature usually focuses on the importance, policy suggestions and influencing factors of private economy, but lacks in-depth research on the spatial difference in the quality of the private economic development. When analyzing the factors affecting the development of private economy, we cannot ignore the spatial differences and spatial correlations. Ignoring the influence of spatial factors on the influence mechanism of private economy may affect the accuracy of the empirical result. Taking into account the shortcomings of the existing research, this article will analyze the spatial differences in the development of private economy in Hunan Province, and then

introduce the spatial factors into the research of the influence mechanism of the quality of the private economic development.

2. Literature Review

The private economy is an economic form with Chinese characteristics. Many domestic scholars have made large contribution to the private economy, which has left us abundant achievement. The research results are mainly focused on the importance of the private economic development, influencing factors, transition paths and countermeasures. Yinxing Hong (2012) [1] proposed that the private economic development is the key to reforming the market. Xiqin Hu (2019) [2] further demonstrated this view, proposed that the private economy, as an important market participant, plays a significant role in promoting employment, diversifying market players and upgrading the industrial structure. In addition, Huang Qian (2018) [3] suggested that the development of private economy will help us curb the further widening of the income gap between urban and rural residents. At present, private enterprises are facing many changes in the domestic and foreign environments: the huge market space, "Internet+" and the change of the consumption have created huge opportunities for private enterprises, but the transformation of economic development has also brought serious challenges in China.

A sea of studies has discussed the influence mechanism of the private economic development, and have concluded that it has been affected in many ways. Innovation is not only the key to urbanization, but also one of the important factors for the private economy. Economist Schumpeter (1990) [4] proposed the concept of the innovation firstly. He believed that innovation is the focus of modern economic development. Innovative economy can create new supply, provide new services, cultivate new consumption, and meet new demand, thereby resolving the contradiction between the supply and the demand (Xueyan Zhu, 2019) [5]. Innovation investments can affect the private economic development both in direct and indirect ways. The private economy is promoted directly through personnel training or technological improvement, and indirectly by the spillover of knowledge. Through the innovative development of private economy, innovating the technology and managerial model will improve the quality and efficiency of final products, which will ultimately upgrade economic structure (Chen Liming, 2017) [6].

The human resource is also one of the important factors influencing the development of private economy. Uzawa (1965) [7] introduced the human resource into the theory of the economic growth at first. Since then, Lucas (1988) [8], Romer (1990) [9], Barro (1997) [10], and many other scholars regarded the human resource as an important factor in their research, which can influence the economic growth. Thomas (2011) [11] concluded that the abundance of human resources is one of the main reasons for sustaining economic growth in China through cross-country and cross-regional comparative analysis. The human resource can directly affect the final product as an input to develop the economy, and it can also indirectly affect it by increasing the total factor productivity (Engelbrecht, 2001) [12]. Yunfei Bai (2019) [13] pointed out that the effect of the human resource on the private economy is more significant than the non-private economy, so the impact of the human resource on the private economic development cannot be ignored. Especially, in the process of the development of innovative private economy, knowledge and talents are more important. Jianbo Li (2011) [14] further demonstrated that the importance of the human resource in the development of economy.

A large number of domestic scholars have analyzed the influencing factors of the development of private economy from different perspectives, including the influence of the government (Qing Xu, 2019) [15], the financial environment (Hengjin Cai & Zhen Guo, 2019) [16], the entrepreneurship (Xuanchong Ge , 2019) [17], the ownership structure(Jiejiao Liu & Dehua Wang, 2019) [18], the institutional changes (Binlong Jiao, 2003) [19], analysis of social support (Guoxian Bao, 2012) [20] and so on.

In addition, different regions have different levels of economic development, and the spacial spillover effect is one of the significant characteristics of economic growth in China (Ying, 2003) [21]. Other scholars have researched the spatial spillover effect of economic growth in different regions and proved the regional relevance of the economic growth in China (Groenewold et al., 2008; Jing Li et al., 2014) [22]-[23]. Therefore, the analysis of the development of private economy cannot ignore the influence of spatial factors. Based on this, this article will introduce spatial factors to research the influence mechanism of the development of private economy and enrich related theories.

3. Spatial Differences of Private Economy in Hunan Province, China

The Hunan Government attaches great importance to the development of private economy, and earnestly implements a series of guidelines and policies of the Party Central Committee and the State Council on supporting the development of private economy. They continuously introduced support policies for private enterprises. And the government attracts enterprises for investments, which makes the private economy to a higher stage in Hunan Province. They have fostered many outstanding private enterprises, such as Sanyi Group, Macrolink Group and Dahan Group. The figure provides data about the list of top 100 private enterprises in Hunan Province in 2018. As show in the figure 1, there are 50 private enterprises in Changsha, which accounts for half of the total. There are 8 private enterprises in Xiangtan, Hengyang and Chenzhou in the top 100 list. Zhuzhou, Shaoyang, Yueyang, Yiyang, Changde, Loudi, Huaihua, and Jishou respectively have 6, 2, 5, 2, 2, 3, 1 and 1. In addition, there are 2 private enterprises in Zhangjiajie and Yongzhou in the top 100 list, and two private enterprises are not belong to any city. In short, it can be seen that the development of private economy is very uneven in Hunan Province.

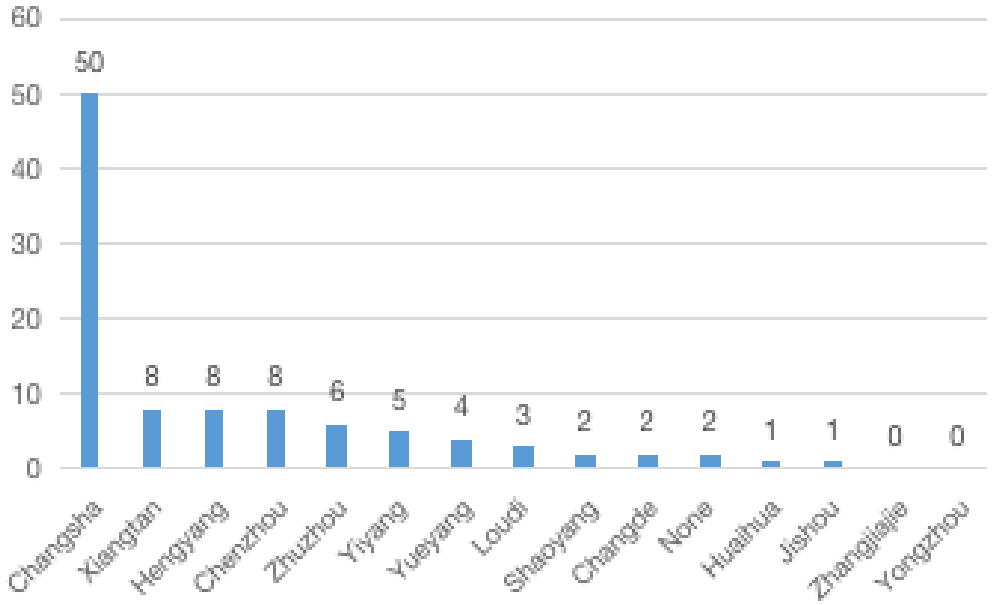

Figure 1: The distribution of top 100 private enterprises in Hunan Province in 2018

The private economy is developing with a high speed in Hunan Province, but there is still a gap compared with developed regions. Under the background of economic globalization, the lack of innovation, unbalanced development, and untight school-enterprise integration, which have seriously restricted the private economic development in Hunan Province. The figure 2 presents information about the differences in terms of the development of private economy in Hunan between 2010 and 2018.

As shown in the Figure 2, the development of private economy in Hunan Province is outstanding in Changsha, and the development of the eastern region and western region is clearly unbalanced. The gap of the development of private economy among cities—including Zhuzhou, Chenzhou, Yongzhou, Shaoyang and Yiyang, and Changsha shows a further widening trend. There is a large regional spatial difference in the development of private economy in Hunan Province, which is consistent with the regional economic development in China.

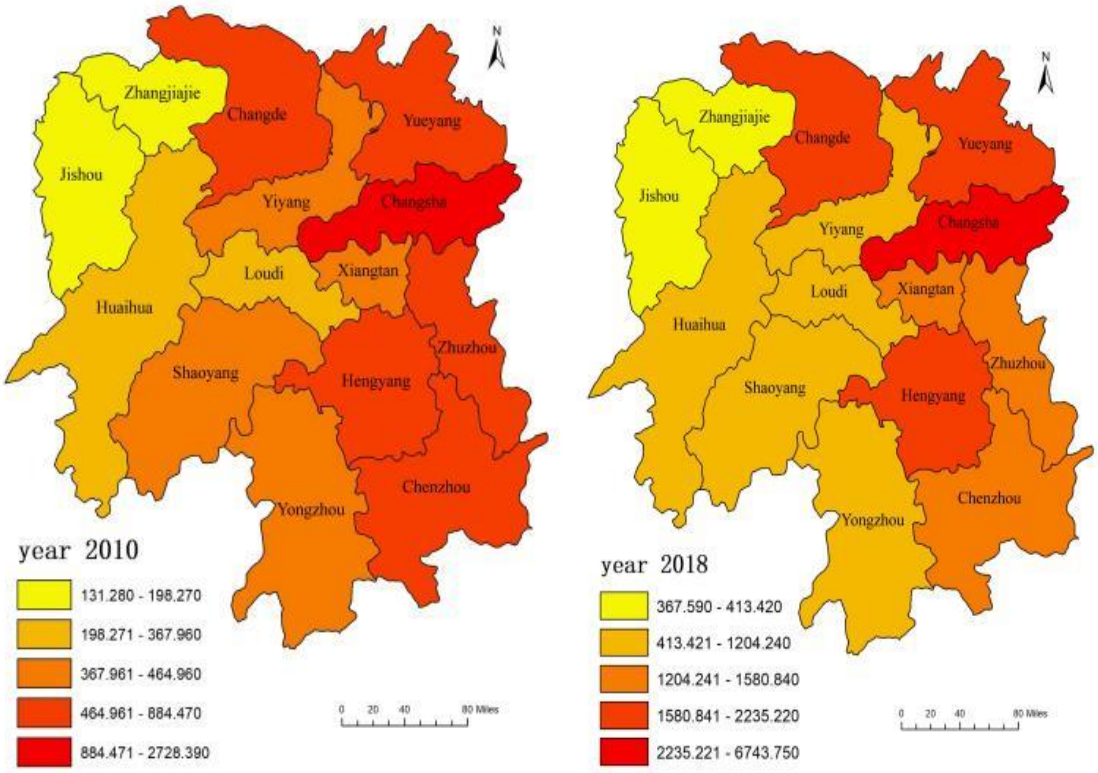

Figure 2: The evolution of the development of private economy in Hunan Province

In order to further analyze the impact and connection of the private economic development in Hunan Province, we calculated the Getis-Ord Gi* in 2010 and 2018 with the help of the hot spot analysis function of the software Arcgis 10.4 , which can be used to identify the spatial distribution of hot spots of the private economic development in Hunan Province. Based on the method of natural break point, cities are divided into five categories according to the value of Getis-Ord Gi*, named successively from high to low as: hot spot, sub-hot spot, general area, sub-cold spot and cold spot. The figure 3 compares the number of hot spots of private economy between 2010 and 2018. Compared with 2010, there is one more hot spot, Changsha, added in 2018. This means that the development of private economy is more active in Changsha. Specifically, the characteristics of migration of private economy are not obvious in Hunan Province, and the number of hot spots remained basically same during the study period. As shown in the figure 3, these hot spots are mainly concentrated in the eastern region, including Changsha, Yueyang and Zhuzhou; sub-hot spots include Yiyang and Loudi; the general area is mainly concentrated in the south of Hunan, including Yongzhou, Hengyang and Chenzhou; the sub-cold spots include Zhangjiajie, Huaihua, Changde, Loudi and Shaoyang; the cold spot only includes Jishou. From the above analysis, preliminary conclusions can be drawn. Although the development of private economy is getting better, the pattern of differences between the eastern and the western region is gradually solidifying in Hunan Province. The cities with a high speed of the private economic development are mainly concentrated in the eastern region, while the western region, especially in Jishou and Huaihua, has developed slowly. In addition, the eastern and western region exhibited spatial dependence and agglomeration characteristics in Hunan province. Therefore, we use the spatial econometric model to analyze the influence mechanism of private economy.

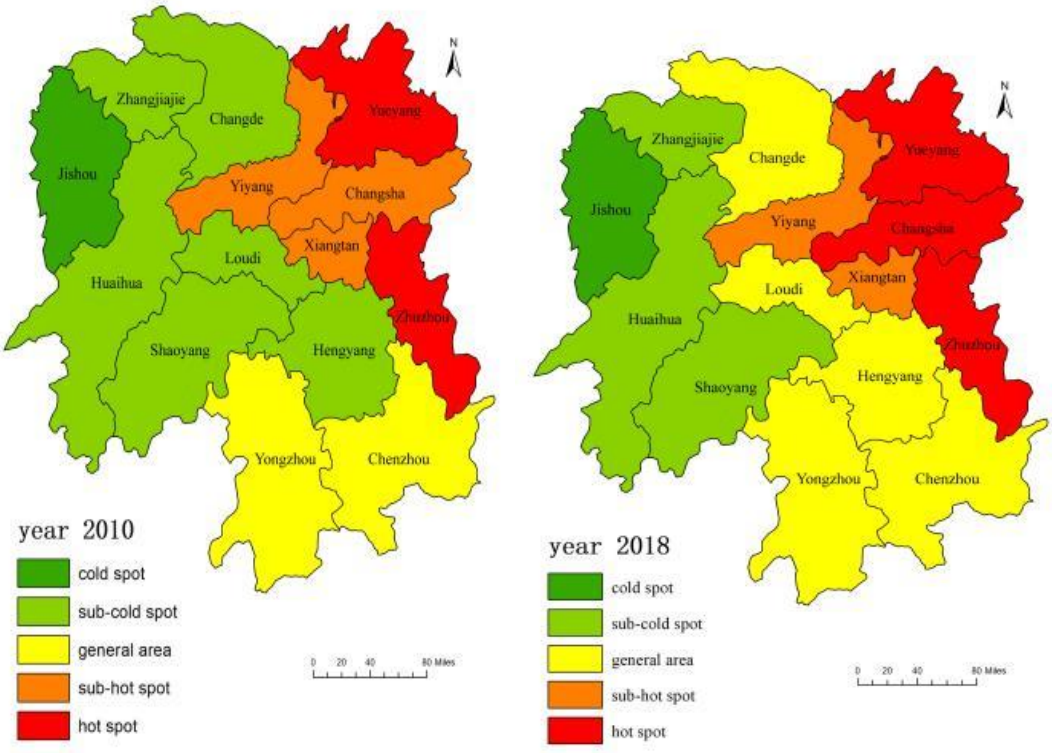

Figure 3: The evolution of Hot Spots in the Development of Private Economy in Hunan Province

4. Influence Mechanism of the Development of Private Economy

4.1 Variable Selection and Data Source

This paper selects the panel data of 14 cities in Hunan Province from 2010 to 2018. The data are mainly derived from "Hunan Province Statistical Yearbook", "China City Statistical Yearbook" and "China Regional Economic Statistical Yearbook" and Hunan Province Statistical Bulletin. The distance data come from the Baidu map. This article uses the interpolation method to supplement the missing data, and adjusts the outliers for individual years according to the Hunan Statistical Annual Report. The relevant variables in this article are described as follows.

4.1.1 Explained variables

In the economic growth model, it is extensive of researchers to use the economic growth as an indicator of economic development. Based on this, this article selects the private economy added value in Hunan Province (*pe*) as the explained variable to measure the quality of private economic development in Hunan Province.

4.1.2 Explanatory variable

This article sets up two explanatory variables. (1) The innovation investment is the core driving force of modern economy and the core foundation of the development private economy. Therefore, it is reasonable to select R&D internal expenditures as a measure of the innovation investment (*rd*). (2) The amount of employee is also another important input in the economic growth model, which has a significant impact on the development of economy. Based on the above analysis, we choose the number of employees in the private economy as an indicator of human resource *(employ*).

4.1.3 Control variables

This article sets up three control variables. (1) The level of the economic development (*pergdp*): the GDP per

capita. (2) The level of foreign trade (*trade*). This article selects the import and export trade volume and converts the dollar into RMB according to the current RMB exchange rate, as a measure of the level of foreign trade in Hunan Province (Jing Li & Yu Nan, 2019) [24]. (3) The level of education(*edu*). This article selects the number of students in the college and university as a variable to measure the level of education. Relevant statistical descriptions are showed in Table 1.

Table 1: Descriptive statistical analysis

Variable	*Obs*	*Mean*	*Std*	*Min*	*Max*
pe	126	1219.68	1203.26	131.28	6811.30
employ	126	53.48	35.20	0.20	180.00
rd	126	27.93	45.87	0.10	265.86
pergdp	126	3.73	2.59	0.92	13.69
trade	126	135.82	205.73	1.78	1323.27
edu	126	827.69	1371.489	119.38	6359.50

4.2 Model Setting

Based on above analysis, innovation investments and human resources are important factors affecting the development of private economy. At the same time, the level of the development of economy, education, and foreign trade also have a significant impact on the development of private economy. Of course, in addition, the impact of the level of urbanization, industrial structure, and marketization on the development of private economy cannot be ignored. In order to facilitate the analysis, factors except the innovation investment, the human resource, the level of the development of economy, the level of education, and the level of foreign trade are classified as other factors (ε). Generally speaking, ignoring the spatial correlation when dealing with regional economic growth issues will affect the accuracy of estimated results (Rey, 1999) [25].

The spatial econometric model introduces spatial factors on the basis of the traditional econometric model, which makes up for shortcomings of the traditional econometric model. Therefore, we chose a spatial econometric model for further research.

At present, the commonly used Spatial econometric model are Spatial Durbin Model (*SDM*), Spatial Autoregressive Model (*SAR*), and Spatial Error Model (*SEM*). The SDM model, SAR model and SEM model are as follows:

$$y = /Wy + Xb + dWX + e \tag{1}$$

$$y = /Wy + Xb + e \tag{2}$$

$$y = Xb + u,\ u = rWu + e \tag{3}$$

Among them, y is the dependent variable, X is the $n \times k$ matrix of independent variables, and W is the spatial weight matrix, λ is represents the spatial autoregressive coefficient, β is the estimated coefficient, μ is the random error term vector, and ε is a random error term vector that follows the normal distribution. σWX represents the effects of independent variables other than core explanatory variables.

According to the spatial econometric model and the relevant variables, the specific *SDM* model is as follows.

$$pe_{it} = \lambda \sum_{j=1}^{N} w_{ij} pe_{jt} + \beta_1 rd_{it} + \beta_2 employ_{it} + \beta_3 pergdp_{it} + \beta_4 trade_{it} + \beta_5 edu_{it} + \delta \sum_{j=1}^{N} w_{ij} X_{it} + \alpha_i + \gamma_t + u_{it} \tag{4}$$

In the above formula, pe_{it} represents the growth of private economy of the city i in the year t; $\beta_1 - \beta_5$ are the parameter to be estimated; α_i and γ_t respectively represents space and time effects; u_{it} represents the random error term that follows the normal distribution. The rest is the same as above.

4.3 Spacial Weight Matrices

The spatial weight matrix can represent the way of interaction between the spatial units in the spatial econometric model, which is an indispensable part in the spatial econometric model. We have chosen the geographic adjacency spacial weight matrix (W_1), the geographic distance spacial weight matrix (W_2) and the economic distance spacial weight matrix (W_3) in the study.

The geographical adjacency spatial weight matrix is based on the adjacency of each spatial unit as a criterion. It is considered that there is a spatial correlation between adjacent spatial units, otherwise it is considered non-existent. Based on the principle of post-adjacent, if the cities are adjacent, it is counted as 1, otherwise is 0, and the elements on the main diagonal are 0, constructing the geographically adjacent spatial weight matrix W_1. The formula is as follows.

$$w_{ij} = \begin{cases} 0, & i \text{ is adjacent to } j \\ 1, & i \text{ is not adjacent to } j \end{cases} \tag{5}$$

The geographic distance is the other way to define the relationship between spatial units. The geographical distance can measure how difficult the relationship is between cities. Cities are more likely to have economic interactions when they are closer than others, because they may spend lower costs on economic transactions. Based on this, we selected the optimal driving distance between cities, and then constructed the geographic distance spatial weight matrix. The distance between each spatial unit is d_{ij}, and the elements on the main diagonal are 0. The formula is as follows.

$$w_{ij} = \begin{cases} 0, & i = j \\ \dfrac{1}{d_{ij}}, & i \neq j \end{cases} \tag{6}$$

The economic connections between neighboring cities are not the same, because the same geographical distance may means different economic interactions. The closer the economic level is, the easier the trade transactions happen. Therefore, we constructed the economic distance spatial weight matrix, in order to more intuitively describe the differences in the economic interaction between the spatial units, and explore the impact of economic distance on the private economic growth. Based on this, we selected the difference in GDP per capital between spatial units as a measure of "economic relations". Among them, there is a larger weight between two cities when they have a smaller economic gap. Therefore, the main diagonal elements of the spacial weight matrix are 0, and the non-diagonal elements are the absolute value of the difference in real GDP per capita between cities, as follows.

$$w_{ij} = \begin{cases} 0, & i = j \\ \dfrac{1}{|\overline{Y_i} - \overline{Y_j}|}, & i \neq j \end{cases} \tag{7}$$

4.4 Analysis of Regression Results

Regression results of the spatial Durbin model under different spatial weight matrices are shown in Table 2. According to the result in the Table 2, based on the different spacial matrices, the sign and significance of coefficients are basically the same and there are only slight differences in the coefficients, which means the result is robust. Considering the significance of the regression result and the fixed-effect model can better control the non-observable individual heterogeneous effects that do not change with time than the random-effect model, which means the fixed-effect model can reduce the endogenous problems better. The fixed-effect model under the geographic distance special weight matrix is analyzed in detail.

The result is analyzed as follows: First, the regression coefficients of the innovation investment (*rd*) and the human resource (*employ*) are significant positive, which indicates that the investment of innovation and human resource significantly promoted the development of private economy. This is because that the innovation investment (*rd*) can not only make innovations in production technology, but also promote the specialization and advanced of human resource, which can improve production technology. In addition, the investment of human resource (*employ*) can not only directly deepen the human resource (*rd*) of private economy, but also indirectly work on the technology of production. In another words, it can realize the improvement of production technology, and then promote the development of private economy. However, it is worth mentioning that the spatial effect of innovation investment is significantly negative. The innovation investment (*rd*) will promote the development of local private economy and produce a negative spacial spillover effect. This is also an important reason for the outstanding pattern in Changsha, Hunan Province. Second, the coefficient of the level of education (*edu*) and the level of economic development (*pergdp*) are significant positive. The level of local education has a significant promotion effect on the growth of private economy, because local employees can support the transfer of more employees for

private enterprises. The spatial spillover effect of the level of economic development (*pergdp*) is significant negative except the result based on the economic distance spatial weight matrix, which indicates that developed cities have a talent for the development of private economy, while they also suppressing it in surrounding areas at the same time. Finally, the regression coefficient of the level of foreign trade (*trade*) is positive, but it is not pass the significance test, which means that the impact of import and export trade (*trade*) on private economic growth is not obvious in Hunan Province.

Table 2: Results of spatial durbin model

	W_1	W_2	W_3
employ	2.6299***	2.4171***	2.0685**
	(3.0359)	(2.7242)	(2.4114)
rd	10.3385***	10.5943***	12.4802***
	(4.8456)	(4.7701)	(5.9722)
edu	1.0248***	1.0956***	0.7952***
	(3.8238)	(3.9782)	(3.1810)
pergdp	72.3105***	57.4676***	65.2959***
	(5.5175)	(3.9443)	(4.5352)
trade	0.2849	0.3939	0.2617
	(1.1455)	(1.6339)	(1.0958)
*employ*W*	3.6913*	11.3534***	7.3591***
	(1.8399)	(3.0438)	(3.9024)
*rd*W*	0.1742	-16.1830*	-5.7490
	(0.0414)	(-1.7272)	(-1.2647)
*edu*W*	-0.7702	0.7306	0.2163
	(-1.6205)	(0.6247)	(0.2610)
*pergdp*W*	-58.6904**	-91.7551**	-19.4557
	(-2.1715)	(-2.1313)	(-1.2051)
*trade*W*	-0.6116	0.1034	-1.1217*
	(-1.5841)	(0.1344)	(-1.7274)
rho	0.4173***	0.3902***	0.3245***
	(5.1512)	(3.1650)	(2.7993)
$sigma^2$	0.0000***	0.0000***	0.0000***
	(7.8254)	(7.8882)	(7.8312)
Log-likelyhood	-762.4429	-756.7814	-760.4860
N	126	126	126
R^2	0.889	0.900	0.915

Note: ***, ** and * mean significant at the level of 1%, 5% and 10% respectively.

5. Conclusions and Countermeasures

5.1 Conclusions

Based on the panel data of 14 cities in Hunan Province from 2010 to 2018, this paper analyzed the spatial differences of private economy, and then researched the influence mechanism of private economy through the Spatial Durbin Model (*SDM*). The research shows: first, the development of private economy shows a clear pattern of east-west differentiation in Hunan Province. It shows a good momentum of private economic development in the eastern region, while a slow speed of development in the western region. Second, the development of private economy is dynamic and continuous in Hunan Province. It is uneven and the gap shows a trend of expansion in Hunan Province. Changsha, as the capital city, with advantages of the economy and the politic, which determines the pattern of private economy in Hunan Province. Last but not least, the innovation investment (*rd*) and the level of economic development (*pergdp*) has a significant positive effect on the development of private economy, but the spacial spillover effect of innovation investment (*rd*) is significant negative. In other words, these two indicators play an important role in promoting the development of local private economic, but they have a significant inhibitory effect in the surrounding areas. Based on this, the following policy countermeasures are proposed.

In addition, although we have done our best in the study, considering that the development of private economy is very complicated, further research will be needed in the future.

5.2 Policy Countermeasures

First, we should enhance the ability of independent innovation to increase the competitiveness. The key to the development of private economy is technological innovation and talent innovation. For the technological innovation, private enterprises have to strengthen the development of high-tech products to break through the core technical bottlenecks, so that they can independently develop high-tech, high-value-added products. For the talent innovation, we should increase the training of scientific researchers, the intensity of the introduction of talent, and the investment in scientific research.

Second, we should introduce more supporting policies to help the development of private economy. Government department should pay more attention to the development of innovative private economy and emphasize to people the importance of private economy in economic development. On the one hand, under the principal of safety and environmental protection, we should introduce relevant policy, including improving the business and financing environment of private enterprises, to support private enterprises, so as to expand the space of private economic development. On the other hand, we should support the promotion of local products. The government should support the promotion of local R&D products and subsidize enterprises, who employ the local talent and serve local customers. In addition, we should listen more to the demand of local start-up small and medium-sized enterprises, strengthen publicity and promotion, so as to help local enterprises to launch their products.

Third, we need to encourage the integration of schools and enterprises to train local talents for the private economy. Accelerating the integration of schools and enterprises not only helps to nurture professional employees, but also help to transform the achievement of scientists. We can build a platform through the government to achieve the goal of jointly training talents by enterprises and schools. In addition, we can also solve the ownership problem of achievement and reduce disputes in cooperation by realizing the shareholding of enterprises, schools and scientists. In the process, we need to adhere to the principle of marketization. And companies can express market demand to scientists, which can improve the conversion rate of scientists' achievements.

Last but not least, we should coordinate the development of private economy and narrow the development gap among different cities. We should take the principle of co-construction and sharing as a basis to achieve collaborative planning in a larger region. On the one hand, we can achieve information exchange by establishing an information sharing mechanism, and achieve economic exchanges by improving transportation infrastructure at the same time; on the other hand, we can seize the talented person by separating technical team from administrative teams.

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