ISSN: 2688-9323

Study on the Influence of Population Agglomeration on Inter-provincial Labor Productivity

-- Based on the Spatial Durbin Model

Yang Lu, Meiling Xie

School of Economics, Jiangxi University of Finance and Economics, Nanchang 330013, China

Abstract

The Yangtze River Economic Belt covers 11 provinces and cities including Shanghai and Jiangsu, and has a very important strategic position in the country's economic development. Based on combing the researches on population agglomeration at home and abroad, this paper focuses on the analysis of relevant literature on the impact of population agglomeration on labor productivity, and specifically explores the impact of population agglomeration on labor productivity in the Yangtze River Economic Zone. Research shows that population agglomeration has a significant negative spatial spillover effect. The reason may be that high population agglomeration in some developed provinces and cities in the Yangtze River Economic Belt may have an impact on the efficiency of urban operation, while the population density of underdeveloped provinces and cities is too low. Conducive to the improvement of labor productivity. The level of human capital has no significant impact on labor productivity. Further test the impact of foreign trade level, foreign investment, fiscal decentralization and other control variables on labor productivity. The empirical results show that foreign trade has a significant positive impact on regional labor productivity; foreign investment, fiscal decentralization and other factors have a significant impact on regional labor productivity. Significant negative impact.

Keywords

Population Agglomeration; Labor Productivity; Spatial Dubin Model; Yangtze River Economic Belt.

1. Introduction

High-quality development has become a new theme of economic development. High-quality development is mainly reflected in high labor productivity, which reflects the efficiency of laborers in production. It is an important economic benefit indicator. There is an interaction between labor productivity and its influencing factors. Many factors affect labor productivity. Conversely, changes in labor productivity will also affect these factors. Demographic factors are an important factor affecting labor productivity. In recent years, research on the impact of population agglomeration on economic development has gradually deepened, mainly including the impact on innovation, industrial structure upgrading, and regional economic growth. With the rapid development of central cities, more people have flowed to economically developed areas, and population agglomeration has brought a large amount of labor to these areas and increased labor productivity.

The Yangtze River Economic Belt is one of the major strategies affecting China's economic development. It spans the three major regions of the East, Central and West. It is a giant river basin economic belt with a large economic scale and a large population. The construction of the Yangtze River Economic Belt is conducive to coordinating the economic development of the

ISSN: 2688-9323

three major regions of China's east, middle and west, and realizing the free flow of production factors within the region; at the same time, it is also conducive to promoting the implementation of the new urbanization strategy. This paper takes the Inter-provincial data of the Yangtze River Economic Zone as a sample, conducts empirical analysis by establishing a Spatial Durbin Model, summarizes the research conclusions and proposes corresponding policy recommendations, which is conducive to promoting the high-quality development of the Yangtze River Economic Zone.

2. Literature Review

2.1. Research on Population Agglomeration

Population agglomeration is specifically manifested as a non-uniform state of population distribution in space. Scholars at home and abroad have different degrees of research on the causes of population agglomeration and the effects of population agglomeration. Among them, the economic impact of population agglomeration is in the mainstream of research.

Faberman (2016) found when some environmental factors are controlled, the specific coefficient value of population density on labor income is 3%. Wang Shengjin and Wang Zhichu (2017) argued that population agglomeration and economic agglomeration have significant spatial consistency. Chen Shuyun and Yang Jiankun (2017) studied the impact of population agglomeration on regional technological innovation, and differentiated population agglomeration at different levels. They believed that there is a “positive U -shaped curve relationship” between population agglomeration and the level of technological innovation. The accumulation of talents promotes technological innovation. Xu Weiping (2018) and Yang Suchang et al. (2020) studied the impact of population agglomeration and industrial agglomeration on the environment, and found that there was a " U -shaped" trend between population agglomeration and environmental pollution. Jie Shen et al. (2019) studied the impact of urban scale and urban population concentration on urban productivity. The study found that population concentration within a certain range could promote the development of urban productivity, and it would hinder the development of urban productivity if it exceeded a certain value.

Generally speaking, population agglomeration has a positive effect on economic development. Wang Zhiyong (2018) confirmed that the Williamson Hypothesis was also applicable to China. There was an "inverted U -shaped" curve between population agglomeration and economic growth. Due to the differences in regional growth patterns, all regions should adopt reasonable development based on the development status. Yang Dongliang and Li Pengyu (2019) selected the number of primary school teachers and the number of health and medical staff as instrumental variables. The study found that population agglomeration had a significant growth effect on the economy. Song Baolin et al. (2020) found that both long-term and short-term fiscal revenue and population agglomeration had a positive effect on regional economic growth. Based on data from the Yangtze River Delta, Li Xiaoyang (2020) believed that the labor sharing effect was the main influence channel of population agglomeration on economic development.

2.2. Research on the Impact of Population Agglomeration on Labor Productivity

Ciccone & Hall (1996) used the non-agricultural employment population of counties in the United States to study the impact of employment population agglomeration on labor productivity, and found that population agglomeration had a positive impact on labor productivity. Wu Hao and Zhao Yang (2019) found that the promotion of population agglomeration on labor productivity had a significant threshold effect, that is, when the value

ISSN: 2688-9323

of factors such as the population dependency ratio exceeded the threshold, the promotion of population agglomeration would have a significantly enhanced effect. Both Yang Dongliang et al. (2020) and Wu Hao et al. (2020) showed that the agglomeration of highly skilled population had a positive impact on labor productivity with regional differences.

From the current research, the impact of population agglomeration on labor productivity has both advantages and disadvantages. Wang Jia and Chen Hao (2016) analyzed the synergistic mechanism of urban transportation facilities and population density affecting urban productivity. Research showed that urban population density and urban productivity presented an inverted U -shaped change. Zhang Xianfeng et al. (2018) analyzed the impact mechanism of population agglomeration on urban productivity. On the whole, population agglomeration has the effect of real estate prices, which leads to an increase in the cost of living, which is not beneficial for improving urban productivity.

In summary, by reading and combing the existing literature, it can be known that labor productivity, as an important indicator for measuring high-quality economic development, has very important research significance. On the one hand, population agglomeration can promote the growth of regional economic scale, and on the other hand, it can increase the efficiency of economic growth by increasing labor productivity. Population agglomeration and labor productivity may show an inverted U -shaped change. At the same time, there are more content in the existing research on the impact of population agglomeration on innovation and regional economic growth, while the literature on the specific research of population agglomeration on labor productivity is relatively small. In addition, most of the existing literature uses traditional panel data to conduct empirical analysis on the economic impact of population agglomeration. However, because the population density data of population agglomeration has significant spatial agglomeration characteristics, and economic and social activities have a certain spatial correlation, it is obvious that Spatial Dubin Model (SDM) is more suitable for the research of this paper.

3. The Mechanism of Population Agglomeration Affecting Labor Productivity

3.1. Population Agglomeration and Human Capital

According to Marshall's micro-mechanism of the formation of agglomeration economy, population agglomeration can also promote the improvement of human capital through learning and matching effects. Since much knowledge has the nature of partial spillover and silence, face-to-face communication is the most effective way to promote the dissemination of this type of knowledge. Population agglomeration increases the number of people in a certain time and space, increases the opportunities for contact between individuals, broadens the ways of communication, promotes the dissemination of knowledge and the efficiency of learning, and thus improves the level of human capital. It is worth noting that population agglomeration will also bring about a large number of substitutable low-skilled population concentration. Although this can bring about an increase in the total economic level, the congestion effect that follows will lead to a decline in the average human capital level. Increasing the difficulty of matching enterprises with suitable labor force, lowering the overall wage level, and reducing labor productivity.

3.2. Population Agglomeration and Urbanization

The process of urbanization can actually be simply seen as the process of population concentration from rural areas to cities. According to the Lewis dual economic development model and the thrust-pull mechanism of urbanization development, economic development is a process of continuous expansion of modern industrial sectors. With technological progress,

ISSN: 2688-9323

the increase in productivity has caused agriculture to release a large amount of surplus labor. This part of the labor is attracted by the employment opportunities and high income provided by the city, leading to the large-scale flow of labor to the city and becoming a city construction force.

The process of urbanization is always synchronized with the state of population agglomeration. It can be said that population agglomeration is one of the characteristics of urbanization. The promotion of urbanization can accelerate the realization of high-quality economic development by digesting excess capacity and excess social capital, and bringing a lot of investment opportunities to promote coordinated development in multiple fields. Therefore, expanding the scale of cities and promoting urbanization is conducive to achieving a new round of sustained economic growth in China. Therefore, it can be considered that population agglomeration can have an impact on the level of regional economic development through the mechanism of urbanization.

4. Empirical Analysis of the Impact of Population Agglomeration on Labor Productivity

4.1. Model Setting

According to research needs, establish the following empirical model:

$$Y_{it} = \alpha X_{it} + \sum_k \beta_k Z_{it} + C + \varepsilon_{it} \quad (1)$$

In formula 1 , Y_{it} is the explained variable, which refers to labor productivity (lap); X_{it} is the core explanatory variable, which refers to the degree of population agglomeration (mp), $Z_{it}$is a control variable that may affect labor productivity; C is a constant term; ε_{it} is a random disturbance error term; and i, t represent individual and time effects, respectively; α represents the degree of impact of population agglomeration on labor productivity, and correspondingly, β_k represents the impact of each control variable on labor productivity degree.

4.2. Research Variable Description and Data Processing

4.2.1. Explained Variables

Labor productivity (lap). As mentioned above, labor productivity (lap) is an important indicator to measure production efficiency and production quality. This paper chooses to use the per capita GDP of the labor force, that is, to use the ratio of the GDP to the number of labors to measure labor productivity. Calculated as follows:

$$\text{labor production (lap)} = \frac{\text{GDP}}{\text{number of labors}} \quad (2)$$

This study collected the regional GDP of 9 provinces and 2 cities in the Yangtze River Economic Belt, as well as the total number of labors in each year, and calculated the labor productivity (lap) of the provinces and cities in the Yangtze River Economic Belt in each year according to the above formula.

4.2.2. Explanatory Variables

(1) Core explanatory variables

Population agglomeration (mp) is the core explanatory variable of this study. There are many ways to measure population agglomeration indicators. In view of the diversity of China's urban

ISSN: 2688-9323

population classification and urban area classification, different combinations of indicators will result in different population density indicators. Therefore, this paper chooses to measure the degree of population agglomeration based on the ratio of the number of permanent residents to the geographic area of each province and city. The calculation formula is as follows:

$$\text{Population agglomeration (mp)} = \frac{\text{number of permanent residents}}{\text{geographic area of each province and city}} \quad (3)$$

(2) Other control variables

In view of the complexity of the economic system, in addition to the core variable of population agglomeration, there are many other factors that may affect labor productivity. Therefore, it is necessary to select other factors that may affect urban labor productivity on the basis of theoretical analysis. Based on previous research results and theoretical analysis, this paper summarizes and extracts the following four control variables:

Foreign investment (fdi). In a certain sense, foreign investment reflects the introduction and learning of advanced production technology from abroad. Technical factors are one of the important factors affecting labor production, so technology has a certain impact on labor productivity. Therefore, this paper chooses to measure foreign investment based on the actual use of foreign investment.

Human capital expenditure (edu). The level of human capital reflects the quality of the labor force in the region, which is an important factor influencing labor productivity. Considering that the imbalance of regional economic development in the Yangtze River Economic Zone may lead to distortions in the traditional measurement of human capital levels, based on Yang Dongliang and Li Pengyu (2020), the paper chooses to measure human capital as the proportion of education expenditures in fiscal expenditures.

The level of foreign trade (tra). Foreign trade is an important indicator reflecting the degree of opening to the outside world, which can reflect the degree of opening to the outside world of different cities, and the development level of an export-oriented economy will have an important impact on labor productivity. The paper measures the level of foreign trade based on the total import and export of each province and city.

Fiscal decentralization (fis). Fiscal decentralization reflects the level of regional fiscal capacity and economic development. This indicator also reflects the government's ability to drive economic development and progress to a certain extent, and also affects labor productivity. By learning from the research of Chen Shuo and Gao Lin (2012), we choose to measure this indicator by the proportion of government fiscal deficit in fiscal expenditure.

4.3. Data Sources and Descriptive Statistical Analysis

This paper selects 9 provinces and 2 municipal cities within the Yangtze River Economic Belt as relevant data from 2000 to 2019. Most of the data obtained comes from the "China Statistical Yearbook", and some missing data come from the statistical yearbooks of the provinces and cities in the Yangtze River Economic Belt. And in the analysis process, taking into account the influence of heteroscedasticity, choose to logarithmize indicators such as labor productivity, population agglomeration, and foreign investment.

Before performing quantitative analysis, perform a simple descriptive statistical analysis of each indicator data. The results are shown in the following Table 1:

ISSN: 2688-9323

Table 1. Descriptive statistical analysis

variable name	meaning	average value	Standard deviation	Minimum	Max
lap	labor productivity	6.0	5.2	0.5	27.7
mp	population agglomeration	621.1	902.4	108.8	3829.0
edu	human capital expenditure	16.3	2.2	11.0	21.8
fis	fiscal decentralization	45.8	18.3	4.9	70.3
tra	foreign trade expenditure	1008.4	1592.1	6.5	6639.1
fdi	foreign investment	76.4	74.8	0.65	357.6

It can be seen from Table 4.1 that there is a large gap between the maximum (27.7) and minimum (0.5) of labor productivity. Therefore, it can be considered that there is still a large development gap between the provinces and cities in the Yangtze River Economic Belt. In addition, the maximum and minimum of population density (mp) values are 3829.0 and 108.8, respectively, indicating that there is a large gap in the degree of population agglomeration in various regions. The maximum and minimum of human capital expenditures (edu) are 21.8% and 11%. The maximum and minimum of fiscal decentralization (fis) are 70.3 and 4.9, and the maximum and minimum foreign of trade(tra)are 6639.1 and 6.5, respectively. The maximum and minimum of foreign investment (fdi) are 357.6 and 0.65, respectively, indicating that there are large regional gaps in human capital expenditures, fiscal decentralization, foreign trade expenditures, and foreign investment in the provinces and cities of the Yangtze River Economic Belt.

4.4. Empirical Research on the Impact of Population Agglomeration on Labor Productivity

4.4.1. Constructing the Spatial Weight Matrix

Import the latitude and longitude data of 9 provinces and 2 cities in the Yangtze River Economic Belt to obtain the corresponding 11 × 11 main diagonal elements of 0 after the normalized spatial adjacency weight matrix.

4.4.2. Spatial Autocorrelation Test

The Moran Index is an indicator of spatial correlation. Taking into account the specific measurement of the spatial correlation existing in the Yangtze River Economic Zone, this paper uses the adjacent weight matrix constructed to perform local spatial autocorrelation analysis, and calculates the local Moran index of 9 provinces and 2 cities in the Yangtze River Economic Belt from 2000 to 2019.

Moran index can also draw Moran scatter plots in a visual form. The Moran scatter plot can be divided into four quadrants. The first quadrant represents high - high aggregation, and the third quadrant represents low - low aggregation, which means that there is a strong positive spatial correlation between regions; the second quadrant represents low-high aggregation. Clustering, the fourth quadrant represents high - low clustering, indicating that there is a strong negative spatial correlation between regions. Figure 1 and Figure 2 were labor productivity Moran scatter plot and population agglomeration scatter plot.

ISSN: 2688-9323

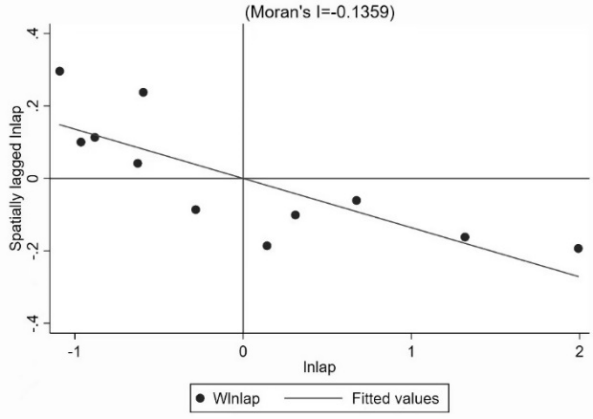

Figure 1. Moran's I for lap

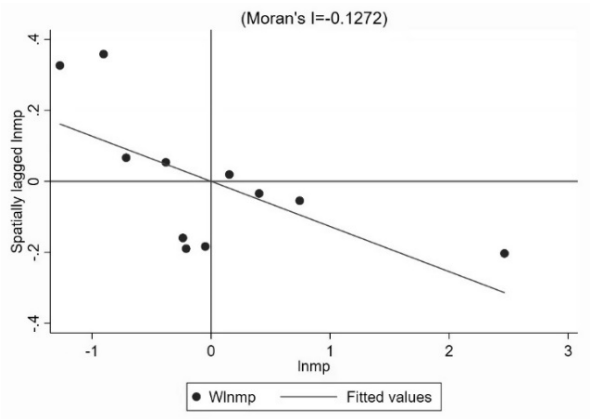

Figure 2. Moran's I for mp

It can be seen from Figure 1 and Figure 2 that there are more areas of " high-low " and " low-high" types. This shows that the spatial difference at this time is large, that is, the provinces and cities within the Yangtze River Economic Belt have large spatial differences in labor productivity and population agglomeration, and there is a strong negative spatial correlation. At the same time, some points in the two figures are located in the third quadrant, that is, there is a low-low agglomeration mode to a certain extent, that is, the areas with lower economic development and lower population concentration in the Yangtze River Economic Belt are more likely to accumulate spatially.

4.4.3. Model Selection

When the research object involves multiple provinces and cities, the spatial correlation cannot be ignored. It can be seen from the above spatial correlation test that there is a spatial correlation between the 9 provinces and 2 cities in the Yangtze River Economic Zone, so the Spatial Dubin Model (SDM) is chosen for analysis.

(1) Hausmann test

When choosing a model, we first need to use Hausman's test to choose between random effects and fixed effects. If the result rejects the null hypothesis, it indicates that it is more reasonable to choose a fixed effects model. The fixed effects analysis, random effects analysis and Hausman test are shown in Table 2.

Table 2. Analysis of model results and Hausman test

variable	Model (dependent variable: lnlap)	
	Fixed effects model	Random effects model
R^2	0.942	0.944
Log-likelihood	247.5	184.8
Hausman test	-2.82	

From the value point of view, the goodness of fit of the spatial individual fixed-effects model and the spatial individual random-effects model are 0.942 and 0.944, respectively, and the difference is not large. The log-likelihood value of the fixed-effects model is 247.5 greater than the value of the random-effects model 184.8, and the Hausman test statistic is -2.82, when the Hausman statistic is negative, the situation is more complicated, but in this case, the fixed effect model is generally selected by default.

(2) Optimal model selection

After determining the choice of fixed effects model between fixed effects and random effects, we further test the suitability of individual fixed effects, time fixed effects, and double fixed

ISSN: 2688-9323

effects with this study. We also introduce AIC and BIC criteria for individual fixed effects and time fixes. Model evaluation of effects, as well as individual and time double fixed effects. Table 3 shows the regression results of each model:

Table 3. Model evaluation analysis

model	AIC value	BIC value	Log-likelihood
Individual Fixed Effects Model	-479.0	-451.9	247.5
Time Fixed Effect Model	-123.4	-96.2	69.7
Double fixed effects model	-588.2	-561.0	302.1

From the perspective of model evaluation, the AIC and BIC values of the double fixed effects are -588.2 and -561.0, respectively, which are the smallest among all models. When choosing a model, generally choose the model with the smaller AIC and BIC values. At the same time, the log likelihood value is 302.1. The larger the value, the better the fit and the higher the credibility of the model. Therefore, it can be considered that the double fixed effects model is the optimal choice.

4.4.4. Analysis of Spatial Dubin Model

The Spatial Durbin Model reflects the relative influences between spatial units. For example, the explained variable in this area is not only affected by the independent variables in this area, but may also be affected by the independent variables in the surrounding area. According to the calculation results of the Moran Index above, we can find that there are big differences in the 9 provinces and 2 cities in the Yangtze River Economic Belt, but it is undeniable that there are spatial agglomerations such as low - low agglomeration forms, given the characteristics of the Yangtze River Economic Belt, and the spatial characteristics of population mobility must be spatially closely related between regions. Therefore, we can think that the labor productivity of the region is not only affected by the explanatory variables of the region, but may also be affected by the explanatory variables of the surrounding regions. Use the Spatial Durbin Model to perform regression analysis, and the regression results are shown in Table 4.

(1) Analysis of model regression results

According to the results of Stata analysis, the spatial autoregressive coefficient of the dual fixed effects model is -0.4324, which is a negative value, indicating that the labor productivity of the explained variable has a negative spatial spillover effect on itself. The reason may be the existence of labor population between provinces and cities. Regional competition between foreign investment, which to a certain extent manifests itself as a negative spillover effect of labor productivity. Judging from the coefficient values of the various variables in the above table, population agglomeration (lnmp), foreign investment (lnfdi), foreign trade level (lntra), and fiscal decentralization (lnfis) all reached the 1% level of significance.

The coefficient of population agglomeration (lnmp) is -2.84, indicating that population agglomeration has a negative impact on labor productivity. Regarding the impact of population agglomeration on the economy, existing studies believe that there are pros and cons. There may be an inverted U -shaped relationship between population agglomeration and economic development. As the degree of population agglomeration increases, economic growth may first increase and then decline. The reason is that the high concentration of population means a large concentration of labor, which may reduce the per capita capital level of labor, thereby reducing labor productivity; another explanation is that the concentration of population will also bring certain negative effects on the regional environmental impact and urban operation efficiency. Impacts, such as high-cost housing prices and urban pollution, will also reduce labor

ISSN: 2688-9323

productivity in the region to a certain extent; for the Yangtze River Economic Belt, Shanghai, Chongqing, Zhejiang and other developed regions are more attractive to the population in more developed regions After a high degree of population agglomeration, it may bring about a decline in overall labor productivity. For areas with less developed economies such as Yunnan and Guizhou, due to the low degree of population agglomeration, the population density that promotes labor productivity may not be reached, thus there is the problem of excessive supply of production materials.

Table 4. Regression results of Spatial Durbin Model

	variable	Individual fixed effects model	Time fixed effect model	Double fixed effects model
Main	lnmp	-2.68 ***	-0.19 ***	-2.84 ***
		(-23.45)	(-2.61)	(-29.06)
	lnfdi	-0.03 **	0.06 *	-0.04 ***
		(-2.42)	(1.79)	(-2.99)
	lntra	0.11 ***	0.25 ***	0.19 ***
		(6.08)	(8.32)	(9.84)
	lnedu	0.15 **	-0.25 *	0.04
		(2.03)	(-1.73)	(0.61)
	lnfis	-0.15 ***	-0.28 ***	-0.20 ***
		(-4.60)	(-3.45)	(-6.10)
W*	lnmp	2.50 ***	-1.99 ***	-2.88 ***
		(6.56)	(-4.16)	(-3.99)
	lnfdi	0.07 *	0.44 ***	-0.05
		(1.70)	(3.01)	(-0.85)
	lntra	-0.00	0.38 ***	0.52 ***
		(-0.01)	(2.87)	(6.36)
	lnedu	-0.10	1.87 ***	-0.54 *
		(-0.82)	(2.91)	(-1.93)
	lnfis	0.34 ***	0.15	-0.32 *
		(5.36)	(0.35)	(-1.82)
Note: " * ", " ** " and " *** " indicate that they have passed the test at the significance levels of 10% , 5% and 1% , respectively .				

The coefficient of foreign investment (lnfdi) is -0.04, which shows that it has a minor negative impact on labor productivity. This is contrary to the general perception of using foreign investment to promote regional labor productivity. The reason may be that the use of foreign capital means introducing and learning foreign production technology, but the role of foreign technology in improving labor productivity is steadily weakening, and it may even hinder local enterprises from technological innovation due to dependence on foreign technology, thereby hindering the improvement of labor productivity. The coefficient of the level of foreign trade (lntra) is 0.19, indicating that foreign trade is conducive to improving labor productivity, and foreign trade means the circulation of goods and technologies, which enhances inter-regional economic exchanges, promotes economic growth, and foreign trade can increase regional labor. It is consistent with the general perception of productivity. The coefficient of the degree of fiscal decentralization (lnfis) is -0.2, and the value of the fiscal decentralization index is inversely related to the local government's fiscal self-sufficiency rate. The stronger the self-sufficiency, the stronger the development capacity, so the negative correlation means that a good government fiscal capacity is positively correlated with a high level of regional labor productivity. The level of human capital (lnedu), which is measured by the proportion of

ISSN: 2688-9323

education expenditure in fiscal expenditure, shows an insignificant positive effect on labor productivity.

The W* term coefficient can better explain the spatial conduction effect. From the above table, we can see that population agglomeration (W*lnmp) and foreign trade (W*lntra) are significant at the 1% level, and the coefficients are -2.88 and 0.52, respectively. It can be explained that foreign trade (W*lntra) has a positive spatial spillover effect, that is, the level of foreign trade in the surrounding area has a positive transmission effect on the explained variable of the region, namely labor productivity. The higher the level of foreign trade in the surrounding areas, the corresponding in-depth exchanges of goods and technologies with the region, thereby mutually promoting the increase of local labor productivity. While population agglomeration (W*lnmp) has a negative spatial spillover effect, the degree of population agglomeration in surrounding areas has a negative transmission effect on the local explained variable, namely labor productivity. The possible explanation is that because the total population is relatively stable and the population flows between regions, the high population concentration in the surrounding areas also means to a certain extent that the population density of the region is low, thereby inhibiting the increase in labor productivity in the region. The level of human capital (W*lnedu) and the level of fiscal decentralization (W*lnfis) are significant at the 10% level, and the coefficients are -0.54 and -0.32, respectively, which can indicate the level of human capital (W*lnedu) and the level of fiscal decentralization (W*lnfis). Both have negative spatial spillover effects. Both the level of human capital and the level of fiscal decentralization reflect the regional competitiveness of the surrounding areas to a certain extent. Therefore, these two factors may have a negative impact on the region through inter-regional competition. influences. To foreign investment in the surrounding area to measure the actual use of foreign investment showed a spillover effect on the region's labor productivity is not significant and positive space.

(2) Analysis of direct and indirect effects and total effects of the model:

In order to better analyze the relationship between each explanatory variable and labor productivity, the total effect is decomposed, and the direct effect and spillover effect are used to express the influence of each explanatory variable on the labor productivity of the region and the labor productivity of neighboring regions. The analysis is as follows:

Table 5. Analysis of direct and indirect effects and total effects

Explanatory variables	Direct effect	Indirect effect	Total effect
lnmp	-2.76 ***	-1.21 ***	-3.97 ***
	(-27.15)	(-3.42)	(-11.33)
lnfdi	-0.04 ***	-0.03	-0.06
	(-3.43)	(-0.58)	(-1.27)
lntra	0.17 ***	0.32 ***	0.50 ***
	(9.95)	(6.30)	(8.66)
lnedu	0.07	-0.39 *	-0.33
	(1.01)	(-1.94)	(-1.57)
lnfis	-0.18 ***	-0.17	-0.36 ***
	(-6.07)	(-1.36)	(-2.65)
Note: " * ", " ** " and " *** " indicate that they have passed the test at the significance levels of 10%, 5% and 1%, respectively.			

ISSN: 2688-9323

From Table 5 it can be seen population agglomeration (lnmp), foreign trade level (lntra) on the direct effects, and indirect effects are very significant overall effect, coefficients are -2.76, -1.21, -3.97, indicating population agglomeration (lnmp) has a negative effect on the labor productivity of the region and surrounding regions. On the one hand, the gathering of population in the region leads to a decline in labor productivity in the region; on the other hand, the gathering of population in the region leads to a lower population density in the surrounding areas, which makes labor productivity in the surrounding areas decline. The level of foreign trade (lntra) has a significant positive impact on the region and surrounding areas, with coefficients of 0.17, 0.32, and 0.50, respectively, indicating that the circulation of goods and technologies brought about by foreign trade allows the economic development of various regions to interact with each other. The actual use of foreign investment (lnfdi) has a significant negative effect on the labor productivity of the region; the level of human capital (lnedu) has a significant negative spillover effect on the surrounding areas; the level of fiscal decentralization (lnfis) has a significant negative effect on the region and the other regions.

5. Conclusion

This paper mainly studies the impact of explanatory variables such as population agglomeration in the Yangtze River Economic Zone on labor productivity by constructing a SDM. Moreover, there are large differences in economic development between regions in the Yangtze River Economic Zone, and there are large spatial differences in labor productivity and population agglomeration among provinces and cities. There is a strong negative spatial correlation. The empirical analysis results show that population agglomeration and fiscal decentralization have a negative spatial spillover effect on labor productivity in the Yangtze River Economic Zone. The level of foreign trade has a positive spatial spillover effect on labor productivity, but the level of human capital of the impact on labor productivity is not significant. Considering that the population of some developed provinces and cities in the Yangtze River Economic Belt is highly agglomerated, this will inevitably have an impact on the efficiency of urban operation, while the population density of underdeveloped provinces and cities is also not conducive to improving labor productivity. Therefore, population agglomeration has a negative effect on labor productivity. The level of foreign trade measured by the volume of foreign trade has a positive effect on labor productivity. Foreign trade means the circulation of goods, labor, and technology among countries, which will promote the iteration of technology and the generation of new technologies, thereby increasing labor productivity. From the empirical results, foreign investment will reduce the labor productivity of the provinces and cities in the Yangtze River Economic Belt to a certain extent. The reason may be that it is over-reliant on foreign investment and the endogenous motivation for technological innovation is insufficient. To government fiscal deficit of financial expenditure to measure the stronger the self-sufficiency of local governments, regional development capacity of the stronger, it means that the stronger regional competitiveness, which has a negative spillover effect on labor productivity in the surrounding area.

References

[1] Chen Shuyun, Yang Jiankun . Can population agglomeration promote regional technological innovation--An empirical study of provincial panel data from 2005 to 2014 [J]. Science and Technology Progress and Policy, 2017, 34(5): 45-51.

[2] Chen Shuo, Gao Lin. The relationship between central and local governments: Fiscal decentralization measurement and reassessment of the mechanism [J]. Management World, 2012 (06): 43-59.

[3] Li Xiaoyang , Yan Xiaofeng , Xiaosang dream . Concentration of population heterogeneity and its mechanisms of economic development: evidence of the Yangtze River Delta. [J]. Northwest population, 2020,41 (06): 25-39.

[4] Song Baolin , Zhou Guofu , Zhang Chunhong , Chen Hanbin . An Empirical Study on the Relationship between Fiscal Revenue, Population Agglomeration and Regional Economic Growth [J]. Statistics and Decision, 2020, 36(03): 100-103.

[5] Wang Jia, Chen Hao. The impact of transportation facilities and population density on urban productivity: An analysis based on panel data of prefecture-level cities in China [J]. Urban Issues, 2016(11): 53-60.

[6] Wang Zhiyong . Population Agglomeration and Regional Economic Growth--A Test of Williamson Hypothesis [J]. Nanjing Social Sciences, 2018, (3): 60-69.

[7] Wang Shengjin, Wang Zhichu. Research on the Spatial Consistency of China's Population Agglomeration and Economic Agglomeration [J]. Journal of Demography, 2017, 39(6): 43-50.

[8] Wu Hao, Zhao Yang. Research on the Nonlinear Impact of China's Population Agglomeration on Labor Productivity [J]. Journal of Demography, 2019, 41(06): 78-88.

[9] Wu Hao, Zhao Yang. Research on the Differences in the Impact of Population Agglomeration on China's Inter-provincial Labor Productivity [J]. Seeking Truth Journal, 2020, 47(03): 63-72.

[10] Xu Weiping, Jiang Hong, Li Yi stable. Differences in the concentration of population and environmental effects of China's economic concentration - Based on Provincial Panel Data Analysis [J]. Ecological economy, 2018,34 (01): 123-127.

[11] Yang Dongliang, Li Chunfeng . The impact of high-skilled population agglomeration on China's Inter-provincial labor productivity [J]. Social Science Front, 2020(01):254-258.

[12] Yang Dongliang , Li Penggao . The impact of population agglomeration on labor productivity in the Guangdong-Hong Kong-Macao Greater Bay Area [J]. Social Sciences Journal of Jilin University, 2020, 60(2): 85-97, 221.

[13] Yang Dongliang , Li Pengyu . The economic effects of population agglomeration: an empirical study based on instrumental variables [J]. Journal of Demography, 2019, 41(3): 28-37.

[14] Yang Suchang , Kong Qing , Xu Lijun . The impact of industry and population agglomeration on environmental pollution: Based on empirical evidence at the provincial level [J]. Statistics and Decision, 2020, 36(14): 55-60.

[15] Zhang Xianfeng , Ye Chen , Chen Yongan . The impact of population agglomeration on urban productivity [J]. Urban Issues, 2018, 272(3): 57-65.

[16] Zhao Yang. Research on the influence of China's population agglomeration on regional labor productivity [D]. Jilin University, 2020.

[17] A Ciccone, Hall R & lt. Productivity and the density of economic activity. Economic Review American, 1996, 86 (1): 54 -70.

[18] Faberman R, Freedman M. The urban density premium across establishment. Journal of Urban Economics, 2016, 93: 71-84.

[19] Jie Shen, Chunlai Chen,Mengyu Yang,Keyun Zhang. City Size, Population Concentration and Productivity: Evidence from China[J]. China & World Economy,2019,27(1).