



# Analysis on Spatial Characteristics and Influencing Factors of Inter-provincial Population Migration Based on Multiple Linear Regression Model

Fei Su, Xiaoqian Zhu, Lei Tong, Yuhua Zhong, and Liangmin Cheng<sup>(✉)</sup>

School of Tourism and Urban-Rural Planning Zhejiang Gongshang University, Zhejiang, China  
18856565993@163.com

**Abstract.** Using the concept of migration preference index, this paper first calculates the comprehensive out-migration indexes, the migration preference indexes of outside Anhui province from 2014 to 2018, then conducts a multiple linear regression to model the migration preference indexes, and puts forward the relevant policy suggestions. Research shows that: 1) The proportion of secondary industry in GDP, per capita urban road area and per capita years of education have a negative impact on the comprehensive population emigration index in Anhui Province, while the population urbanization rate and per capita GDP have a positive impact; 2) Local government departments should increase support for the local secondary industry, strengthen infrastructure construction, ensure the overall improvement of the development level of urbanization, and increase investment in education in order to fundamentally reduce the massive outflow of labor force.

**Keywords:** Spatial Patterns · Determining Factor · Anhui Province · Multiple Linear Regression

## 1 Introduction

Population migration not only is the result of social and economic function, but also affects social and economic development. At present, China's urbanization process is continuously advancing, the scale of population flow is very large [2], and the influence of population migration on economy and society is also increasing. Exploring the temporal and spatial law of population migration and its influencing factors is of great significance to promote China's new urbanization and urban-rural integration development.

A large number of scholars have conducted in-depth research on population migration and achieved rich research results. The research of foreign scholars mainly focuses on the spatial distribution pattern and flow characteristics of population [4] and the causes of population migration [1]. Since the 1980s, domestic scholars have begun to pay attention to the study of floating population, mainly on the law and influencing factors of inter-provincial population migration [8]; some scholars study on the law and influencing factors of intra-provincial population migration [7]; and the comprehensive

law and influencing factors of intra-provincial and inter-provincial population migration [2]. Most of the above studies have laid a foundation for the exploration of the spatial law of population migration in China, but most of them are explained from the overall perspective of intra provincial or inter provincial, and there are few studies on the migration law of a single province in multiple areas such as the whole country and regions.

Anhui is a major province of population migration, but there is a lack of a comprehensive and systematic analysis on “the direction of population migration of various prefecture-level cities”, “the flow of the whole province’s population to the whole country”, “the direction of population migration to the Yangtze River Delta” and “the reasons for migration”. Relevant studies have been unable to reflect the spatial characteristics of different regional areas of inter-provincial population migration in Anhui Province in the new era. Therefore, taking Anhui Province as the study area, this paper makes an in-depth analysis of the spatial characteristics and influencing factors of inter-provincial population migration, in order to provide decision-making reference for predicting the trend of population migration and provide corresponding suggestions for Anhui Province to solve the problem of mass labor outflow.

## 2 The General Situation and Research Methods of the Study Area

### 2.1 The General Situation of the Study Area

Anhui Province, located in the west of the Yangtze River Delta, is a large province with a net outflow of population from the Yangtze River Delta. Since the reform and opening up, Anhui Province has become an important labor supply place in the southeast coastal areas. As a traditional populous province, it has the characteristics of large number of floating population and rich migration culture. At the end of 2018, 70 million 830 thousand registered residence population in Anhui Province, 10 million 480 thousand migrant workers outside the province, a large number of out flow caused the problem of farmland resources being abandoned and the two or three industry development blocked, which impeded its sustainable economic and social development.

### 2.2 The Research Method

Migration Preference Index represents the ratio of the actual number of people to the expected number of people who have moved from the place of departure to the place of migration [3]. Its formula is as follows:

$$I_{ij} = \frac{M_{ij}}{(P_i/P_t)[P_j/(P_t - P_i)] \sum_{ij} M_{ij}} K \tag{1}$$

Formula (1):  $I_{ij}$  is the migration selection index;  $M_{ij}$  is the number of people moving from  $i$  to  $j$ ;  $P_i$  is the population of  $i$ ;  $P_j$  is the population of moving in;  $P_t$  is the total population of all regions;  $K$  is constant. The comprehensive emigration selection index

(formula 2) and the comprehensive immigration selection index (formula 3) of a region can be derived from formula (1):

$$I_i = \frac{M_i}{(P_i/P_t) \sum_i M_i} K \quad (2)$$

$$I_j = \frac{M_j}{(P_j/P_t) \sum_j M_j} K \quad (3)$$

In formula (2) and (3):  $I_i$  and  $I_j$  represent the comprehensive emigration selection index of region I and the comprehensive immigration selection index of region j, respectively;  $M_i$  is the total migration population of region i to all other regions,  $M_j$  is the total migration population of region j from all other regions. The net migration index of a region is equal to the difference between the comprehensive migration index and the comprehensive migration index of the region [5].

The basic cartographic data used in this paper are from the National basic Geographic Information system database; the population migration data are from Anhui Statistical Yearbook (2015–2019) and Anhui Prefecture-level cities Statistical Yearbook (2015–2019) (Anhui Bureau of Statistics, 2015–2019).

### 3 Spatial Distribution Characteristics of Population Migration Outside Anhui Province

#### 3.1 Spatial Distribution of Emigration in Anhui Province

By using the method of migration preference index, the comprehensive emigration index of population migration from Anhui Province to other cities in prefecture level is calculated, and the obtained comprehensive emigration index is ranked as follows from large to small, Huangshan City (5081.66), Fuyang City (3463.83), Huainan City (3206.98), Maanshan City (3069.47), Chizhou City (2900.37), Xuancheng City (2874.23), Lu'an City (2734.40), Bengbu City (2400), Bozhou (1750.50), Chuzhou (1604.92), Wuhu (1263.14), Huaibei (873.28) and Hefei (778.63). It can be seen from the above data, the main cities at the prefectural level are Huangshan, Fuyang, Huainan and Maanshan, and their 5-year comprehensive relocation index averages of 5081.66, 3463.83, 3206.98 and 3069.47 respectively, all exceeding 3000. According to the comprehensive migration index of the emigration sites, the four emigration sites are divided into strong emigration centers and secondary emigration centers: the strong emigration centers are Huangshan, and the secondary emigration centers are Fuyang, Huainan and Maanshan. Among them, the strong emigration center (Huangshan) is distributed in the south of Anhui province, and the secondary emigration center is distributed in the northwest (Fuyang and Huainan) and east (Ma'anshan) of Anhui province.

#### 3.2 Migration Stream

1) The situation of population Migration from Anhui Province to the whole country: The migration areas with the strongest attraction to the population of Anhui Province

are Shanghai, Zhejiang and Jiangsu, that is, the “Yangtze River Delta migration area”. The average selection index of population migration in the past five years is 506386.6, 266572.20 and 170776.03 respectively. The second is the “Beijing-Tianjin immigration area” in the north, that is, Beijing and Tianjin, with an average of 92835.10 and 32310.56 respectively in 5 years. The average value of the southern “Fujian-Guangdong immigration area”, that is, Fujian and Guangdong, is 24400.26 and 21985.65 respectively in 5 years. The average values of Xinjiang (10887), Shandong (7014.15), Shaanxi (7009.11), Hubei (6162.23), Liaoning (5882.23), Hebei (4449.3), Henan (3611.62) and other provinces (3409.48) are all much smaller than those of the three immigrant provinces. Therefore, the areas of inter-provincial migration in Anhui Province are mainly “Yangtze River Delta migration area”, “Beijing-Tianjin migration area” and “Fujian-Guangdong migration area”.

2) Spatial characteristics of population migration from prefecture-level cities in Anhui Province to the Yangtze River Delta:

From the above analysis, it can be seen that the most attractive area for the migrant population in Anhui Province is mainly the cities in the Yangtze River Delta. Therefore, it will be more representative to explore the population migration law of the population flow from various cities in Anhui Province to the Yangtze River Delta (Shanghai, Zhejiang and Jiangsu). According to Table 1, Jiangsu Province is the most attractive area for Suzhou’s migrant population. The average value of population migration selection index between Suzhou City and Jiangsu Province in the past five years is 14457.99, which is greater than that of Zhejiang and Shanghai. For Huangshan City, Zhejiang Province is the main attraction area for migrant population. The average value of population migration selection index between Huangshan City and Zhejiang Province in the past five years is 73932.09, which is greater than that of Jiangsu and Shanghai. In addition, Shanghai is the most attractive area for the 14 prefecture level cities of Hefei, Huaibei, Mazhou, Bengbu, Fuyang, Huainan, Chuzhou, Lu’an, Ma’anshan, Wuhu, Xuancheng, Tongling, Chizhou and Anqing. It can be seen that Shanghai is the main convergence of outflow population in Anhui Province, and Zhejiang Province and Jiangsu Province are the secondary convergence of outflow population.

By selecting the migration flow whose population migration choice index is greater than 10000 in 5 years, it can be obtained that the population migration selection index of Maanshan, Liu’an, Tongling, Suzhou, Huainan, Chuzhou and Bengbu to Jiangsu Province is all greater than 10000. The population radiation range of Jiangsu Province is the center of northern Anhui and Maanshan. The selection indexes of population migration from Huangshan, Fuyang, Chizhou, Bengbu, Xuancheng, Anqing, Bozhou, Suzhou, Lu’an to Zhejiang Province are all more than 10000. The main areas attracting population in Zhejiang Province are near Zhejiang in Southeast Anhui and the main emigration areas in Northwest Anhui. Except for Huaibei City, the selection index of population migration from the other 15 prefecture-level cities in Anhui Province to Shanghai is greater than 10000, and the radiation range of Shanghai is the whole province of Anhui Province.

To sum up, Shanghai is the most important convergence place for the outflow population of Anhui Province, and the radiation range is the whole province of Anhui. Zhejiang

**Table 1.** AVERAGE SELECTION INDEX OF POPULATION MIGRATION FROM PREFECTURE-LEVEL CITIES IN ANHUI PROVINCE TO JIANGSU, ZHEJIANG AND SHANGHAI FROM 2014 TO 2018

| Prefecture-level city | Five-year average |                 |                 |
|-----------------------|-------------------|-----------------|-----------------|
|                       | <i>Jiangsu</i>    | <i>Zhejiang</i> | <i>Shanghai</i> |
| Hefei city            | 4403.38           | 2758.55         | 11030.38        |
| Huaibei city          | 4517.02           | 5563.80         | 9126.98         |
| Bozhou city           | 7779.85           | 13486.31        | 14897.90        |
| Suzhou city           | 14457.99          | 12187.03        | 14201.28        |
| Bengbu City           | 11134.24          | 20318.81        | 32376.58        |
| Fuyang City           | 9376.26           | 31463.95        | 33960.61        |
| Huainan City          | 13210.44          | 9944.65         | 90166.93        |
| Chuzhou City          | 13186.61          | 7813.78         | 20171.54        |
| Luan City             | 18285.80          | 11907.76        | 51778.55        |
| Maanshan City         | 22462.53          | 7164.74         | 22812.60        |
| Wuhu City             | 6107.39           | 2416.65         | 24708.21        |
| Xuancheng City        | 9618.54           | 18947.80        | 67621.27        |
| Tongling City         | 14716.31          | 9338.13         | 26562.14        |
| Chizhou City          | 9822.33           | 26459.73        | 35029.19        |
| Anqing City           | 7019.14           | 14488.19        | 19045.58        |
| Huangshan City        | 9708.95           | 73932.09        | 43816.86        |

Province and Jiangsu Province are the convergence areas of secondary floating population. Zhejiang Province mainly radiates the main emigration areas of southeastern Anhui and northwest Anhui, while Jiangsu Province mainly radiates the emigration centers of northern Anhui and Maanshan.

## 4 Analysis on the Influencing Factors of Population Migration Outside Anhui Province

### 4.1 Push-Pull Theory

The “push-pull” theoretical model was first put forward by R Herberle, and then a large number of scholars improved and expanded it. According to the “push-pull” theory, population migration is completed under the action of both push and pull [6].

### 4.2 Index Selection and Model Construction

The research shows that the main factors affecting the migration of people inside and outside the province are the level of urban development, education and employment

opportunities, as well as the living standards of residents [8]. In the level of urban development, this paper selects seven indicators: fixed assets investment (X1), the proportion of secondary industry to GDP (X2), the proportion of tertiary industry to GDP (X3), per capita GDP (X4), per capita park green space area (X5), per capita urban road area (X6) and population urbanization rate (X7). In terms of education level and employment opportunities, this paper selects six indicators: the proportion of employees in the first industry (X8), the proportion of employees in the second industry (X9), the proportion of employees in the third industry (X10), the registered unemployment rate in cities and towns (X11), the number of graduates from colleges and universities (X12) and the number of years of education per capita (X13). In the living standards of residents, four indicators are selected: per capita annual consumption expenditure of rural residents (X14), per capita annual consumption expenditure of urban households (X15), per capita disposable income of rural residents (X16) and per capita disposable income of urban households (X17). Based on the above analysis, the multiple linear regression model of Anhui inter-provincial population comprehensive emigration index (Z) is constructed through 17 independent variables selected from three aspects.

### 4.3 Analysis on the Influencing Factors and Countermeasures of Population Emigration of Prefecture-Level Cities in Anhui Province

According to the results of regression analysis (Table 2), in terms of social economy ( $a = -202.590$ ,  $P < 0.05$ ) and urban development ( $a = -50.402$ ,  $P < 0.05$ ), there is a significant negative correlation between the proportion of secondary industry in GDP and per capita urban road area and the comprehensive population emigration index among provinces. The proportion of secondary industry in GDP and per capita GDP represents the local economic development level to a large extent. The lower the value of this index is, the lower the local economic development level is. The migrant population is more likely to obtain higher wages from cities with higher economic development level, and the greater the thrust generated by the region to the population, the more likely it is to become the main emigration place for inter-provincial migration. The per capita urban road area reflects the level of urban infrastructure construction, and the lower the value of this index, the lower the level of local infrastructure construction, the smaller the guarantee of local production and life, and the worse the convenience of residents' life. The greater the thrust on the population, the more likely it is to become the main place for inter-provincial migration. The regression coefficients of urbanization rate and per capita GDP were 161.589 ( $P < 0.05$ ) and 0.076 ( $P < 0.05$ ) respectively, which were positively correlated with the comprehensive emigration index. The population urbanization rate represents the stage of urban development. The higher the population urbanization rate, the higher the degree of urbanization development, the higher the overall development level, and the level of infrastructure provided for the production and life of the population. The higher the level of economic income, the greater the pulling force on the population. At the same time, the higher the per capita GDP, the higher the economic income level of the population, the greater the pulling force on the population, and the fewer people who move out of the province. Therefore, in order to reduce the outflow of population, the government should increase support for the local secondary industry, strengthen infrastructure construction, and ensure the overall

**Table 2.** REGRESSION COEFFICIENTS INFLUENCING FACTORS OF POPULATION MIGRATION OUTSIDE ANHUI PROVINCE

| Model |          | unstandardized coefficients |                   | Beta   | T      | Sig. |
|-------|----------|-----------------------------|-------------------|--------|--------|------|
|       |          | <i>B</i>                    | <i>Std. Error</i> |        |        |      |
|       | Constant | 31838.904                   | 8236.206          |        | 3.866  | .000 |
| UDL   | X1       | 5.719E-5                    | .000              | .615   | .903   | .370 |
|       | X2       | -202.590                    | 84.946            | -1.260 | -2.385 | .020 |
|       | X3       | -.877                       | 73.498            | -.004  | -.012  | .991 |
|       | X4       | .076                        | .033              | 1.272  | 2.303  | .025 |
|       | X5       | -63.899                     | 83.182            | -.086  | -.768  | .445 |
|       | X6       | -50.402                     | 17.935            | -.351  | -2.810 | .007 |
|       | X7       | 161.589                     | 65.295            | 1.363  | 2.475  | .016 |
| EL&EO | X8       | -51.774                     | 37.507            | -.313  | -1.380 | .172 |
|       | X9       | -93.470                     | 56.663            | -.326  | -1.650 | .104 |
|       | X10      | .466                        | 4.190             | .013   | .111   | .912 |
|       | X11      | -135.967                    | 286.542           | -.056  | -.475  | .637 |
|       | X12      | -.037                       | .026              | -.948  | -1.458 | .150 |
|       | X13      | -2010.987                   | 562.783           | -1.102 | -3.573 | .001 |
| LSOR  | X14      | .104                        | .127              | .178   | .819   | .416 |
|       | X15      | .029                        | .076              | .093   | .379   | .706 |
|       | X16      | -.512                       | .336              | -1.271 | -1.524 | .133 |
|       | X17      | -.052                       | .057              | -.236  | -.920  | .361 |

Note: regression equation  $\overline{R^2} = 0.455$ ,  $F = 4.883$ ,  $p = .000$ .

improvement of the development level of urbanization in order to truly retain people. In addition, the influence of the proportion of tertiary industry in GDP ( $P > 0.05$ ) and per capita park green space area ( $P > 0.05$ ) was not significant.

In terms of education level and employment situation, there is a significant negative correlation between the number of years of education per capita ( $P < 0.05$ ) and the comprehensive index of population emigration, indicating that the lower the index of years of education per capita, the lower the level of education of the local population, the more likely they are to be attracted by the higher wages of migrant workers in relatively developed cities, so as to increase the “push” to the migrant population. The more likely it is to become a major exodus. Therefore, the government should increase investment in education and improve the overall education level of local residents, while driving local productivity through the level of science and education, it can also enable local residents to increase their likelihood of higher income through a higher level of education. However, there was no significant relationship between the number of graduates from colleges and universities ( $0.037$ ,  $P > 0.05$ ), the number of years of education per capita

(2010.987,  $P > 0.05$ ), the proportion of employees in the primary industry (51.774,  $P > 0.05$ ) and the proportion of employees in the secondary industry (93.470,  $P > 0.05$ ).

In terms of living standards, the per capita annual consumption expenditure of rural residents, the per capita annual living expenditure of urban households, the disposable income of rural residents ( $P > 0.05$ ) and the per capita disposable income of urban households are all more than 0.05. Therefore, the above four indicators have no significant impact on the comprehensive population emigration index.

To sum up, the five indicators of the proportion of the secondary industry in GDP, per capita urban road area, per capita years of education, population urbanization rate and per capita GDP have a great impact on the inter provincial comprehensive migration index. Among them, the proportion of secondary industry in GDP, per capita urban road area and per capita years of education have a significant negative impact on the comprehensive population migration index, while the population urbanization rate and per capita GDP have a significant positive impact.

## 5 Conclusion and Discussion

According to the selection index of population migration, this paper calculates the comprehensive migration index and migration choice index of Anhui province from 2014 to 2018, and establishes the linear regression equation of the comprehensive migration index of inter-provincial population. The main influencing factors of population migration in Anhui Province are revealed, and the following conclusions are drawn.

First, the main areas of inter-provincial migration in Anhui Province are Huangshan City, Fuyang City, Huainan City and Maanshan City; the migration areas with powerful attraction to the population of Anhui Province are the Yangtze River Delta Migration area (Shanghai, Zhejiang and Jiangsu Province), followed by the “Beijing-Tianjin Urban area” in the north (Beijing and Tianjin), and the “Fujian-Guangdong Migration area” in the south (Fujian Province and Guangdong Province). In the Yangtze River Delta, Shanghai is the main convergence area of population in Anhui Province, while Zhejiang Province and Jiangsu Province are the convergence areas of secondary population migration.

Second, the proportion of secondary industry in GDP, per capita urban road area, per capita years of education, population urbanization rate and per capita GDP have a great impact on the comprehensive inter-provincial population migration index. Among them, the proportion of secondary industry in GDP, per capita urban road area and per capita years of education have a negative impact on the comprehensive population migration index, while the population urbanization rate and per capita GDP have a positive impact.

Third, local government departments should increase support for the local secondary industry, strengthen infrastructure construction, ensure the overall improvement of the development level of urbanization, increase investment in education, and improve the overall educational level of local residents. Only by driving the local productivity through the level of science and education can we fundamentally reduce the massive outflow of labor force and help the sustainable development of Anhui Province.



This paper preliminarily reveals the spatial distribution characteristics of inter provincial population migration in Anhui Province, and explores the influencing factors of population migration from three aspects: urban development level, education level, employment opportunity and residents' living standard. The article needs to be improved in the following aspects: first, in the research period, the data from 2014 to 2018 are mainly selected for analysis, which lacks a complete and continuous change process for a long time; second, in terms of research data, it mainly focuses on statistical yearbook data, and lacks the combination with the most effective big data; third, in terms of influencing factors, there is a lack of analysis of individual factors obtained through social research, which needs further follow-up research.

**Acknowledgments.** Project supported by the National Natural Science Foundation of China (No. 42071159 and No. 59891908498).

## References

1. Clark C (1951) Urban population densities. *J Roy Stat Soc* 114(4):490
2. Dong H (2018) Differences in the Spatial Distribution and Its Mechanism of the Intra- and Inter-Provincial Floating Population in Hebei Province. Shijiazhuang: Hebei Normal University
3. Graham DJ, Kim HY (2008) An empirical analytical framework for agglomeration economies. *Ann Reg Sci* 42(2):267–289
4. Bague DJ (1959) *The study of population: an inventory appraisal*. University of Chicago Press, Chicago
5. Wang G (2000) The regional model of inter-provincial migration and its changes since China's economic reform. *Popul Econ* 3:8–22
6. Li Q (2003) An analysis of the driving force and pulling force factors affecting China's urban and rural floating population. *Soc Sci China* 01:125–136+207
7. Zhang S, Zhu Y, Jin X (2013) The spatial patterns of intra-provincial migration and their determinants in Anhui Province. *Econ Geogr* 33(05):24–30+23
8. Yu W, Pu Y, Chen G (2012) Spatial analysis of the patterns and mechanism of inter-provincial migration flows in China. *Geogr Geo-Inf Sci* 28(02):44–49

**Open Access** This chapter is licensed under the terms of the Creative Commons Attribution-NonCommercial 4.0 International License (<http://creativecommons.org/licenses/by-nc/4.0/>), which permits any noncommercial use, sharing, adaptation, distribution and reproduction in any medium or format, as long as you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons license and indicate if changes were made.

The images or other third party material in this chapter are included in the chapter's Creative Commons license, unless indicated otherwise in a credit line to the material. If material is not included in the chapter's Creative Commons license and your intended use is not permitted by statutory regulation or exceeds the permitted use, you will need to obtain permission directly from the copyright holder.

