An analysis of the factors influencing the district migration and evaluation of amenity in Guizhou Province in China

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1. Introduction

Guizhou Province, one of the western provinces in China, connects Hunan Province, Guangxi Province, Yunnan Province, Qinghai Province and Sichuan Province. As a transportation hub area in western China, it has great potential for development [1]. The purpose of this study is to estimate the quality of life in each district in Guizhou province, in 2005, 2010 and 2015, to find out the factors of population migration in each district of Guizhou province, especially to use Roback's model to clarify the conditions affecting population migration in Guizhou province, and to calculate the value of amenity and the spatial distribution characteristics of amenity.

2. Amenity model

This study is based on Rosen-Roback's general equilibrium model [2),3)]. The research area is Guizhou Province, China, and the spatial unit is the district. Using the living environment data of the region, the model of amenity evaluation is specified as follows. The type of convenience facilities is set to m. The amount of convenience facilities in the district i in period t is represented as an m-dimensional vector s (the element is s), and the wage is set to w. The inflow migration rate of the district i is assumed to be determined by wage difference from the regional average and the amenity difference from the regional average.

$$MR_t^i = \frac{MP_t^i}{P_t^i} = A^1(w^i - \overline{w}) + \sum_{m=1}^{M} A_m^2(s_m^i - \overline{s}_m)\} + \mu_2 \tag{1}$$

$$\left(A^1 = \mu_1 \frac{\partial u}{\partial w} \quad , \quad A_m^2 = \mu_1 \frac{\partial u}{\partial s_m} \right)$$

where MR_t^i is the inflow migration rate of i district in period t ; MP_t^i is the inflow migration people of i district in period t ; P_t^i is the population of i district in period t ; μ_1 is adjustment speed, $0<\mu_1<\infty$, μ_2 is the constant term. In the equation (1), the migration rate is expressed as a linear function of amenities. Taking this equation as a deduction, the coefficients Am ($m = 1,...,M$) of the facilities can be calculated.

The ultimate monetary value of amenity is derived by using the obtained coefficient of the amenity and wage. This represents the evaluation amount of each amenity level when the living environment changes by 1% on average.

$$P_{m,t}^* = \frac{\partial u/\partial s_{m,t}}{\partial u/\partial w_t} = \frac{A_{m,t}}{A_{w,t}} \tag{2}$$

where P_m^* is the value (price) of amenity m.

In addition, the total amenity value of each district is calculated as follows.

$$QoL_t^{\,i} = \sum_l P_{m,t}^* s_{m,t}^i \tag{3}$$

where QoL is the sum of the amenities in the given district.

3. Estimation analysis

3.1 Research area

In this study, all 87 districts in Guizhou Province were studied. Guizhou Province is located on the Yunnan-Guizhou Plateau in southwestern China. It covers an area of 176,167 km^2 and the permanent population is approximately 34.75 million.

According to the administrative division of Guizhou Province, it is divided into the 9 cities of Guiyang, Zunyi, Anshun, Liupanshui, Bijie, Tongren, Qiannan, Qiandongnan and Qianxinan. These 9 cities are divided into 87 districts (Figure 1). The main areas of Guizhou Province in terms of population has a population density of more than 200 people / km^2, especially the capital of Guiyang City, which has reached 598 people / km^2. Figure 1 shows the map of the 87 districts of Guizhou Province.

Figure 1. Map of 87 districts in Guizhou Province

3.2 Summary of Data

This paper used the panel data of the 87 districts in Guizhou Province in 2005, 2010 and 2015. Data comes from Guizhou Statistical Yearbook, Guizhou Province City National Economic Statistics Bulletin and 1% sample census survey of Guizhou Province. In addition, this study used Python software to obtain 11 types of POI (Point of interest)[1] data through Baidu map (http://map.baidu.com/), such as hotels, restaurants, supermarkets, hospitals, drugstores, gas stations, bus stations and banks.

Taking 87 districts in Guizhou Province as the object, the 57 kinds of amenity variables, such as Demographic (ex. nonagricultural population ratio), Living condition(ex. per capita housing area), Facility (ex. natural parks, bus stops), Employment (ex. employment rate of the second industry), Income, Finance (ex. expenditure and revenue), Health care (ex. hospitals, hospital beds and doctors), Education (ex. kindergartens, schools, and teachers), Industrial enterprises (ex. national owned enterprises and limited liability corporations' enterprises) and Cultural entertainment (ex. libraries), are used.

3.3 Presumption of Results

For this analysis, multivariate regression analysis was performed using statistical analysis software R Language. The stepwise regression analysis is to used delete or add variables based on the AIC information statistics. The results are shown in Table 1.

Table 1. The results of regression analysis

Independent variable	Dependent variable		
	$MR^i_{(2015)}$	$MR^i_{(2010)}$	$MR^i_{(2005)}$
x2 Nonagricultural population ratio		1.299e-03*** (5.812)	
x4 Proportion of population over 65	-8.211e-03*** (-4.622)		
x6 Years of Education	1.396e-02* (2.264)		
x7 Employment ratio in the secondary industry			3.507e-03*** (4.497)
x8 Employment ratio in the third industry	3.633e-03*** (9.618)		
x10 Employment rate			2.254e-01** (2.740)
x20 Per capita annual disposable income	4.488e-06. (1.668)	2.656e-06* (2.066)	8.858e-06** (3.042)
x31 Number of Natural Parks per 100 people	1.814e-03* (2.536)		
x45 Number of hospital beds Per 100 people	5.135e-03* (2.133)		
x53 Number of national owned industrial enterprises above designated size			2.723e-04*** (5.721)
x54 Number of limited liability corporations' industrial enterprises above designated size		7.924e-05*** (4.395)	
R^2	0.9356	0.8521	0.8464
Adj.R^2	0.9308	0.8467	0.8389
AIC	-225.65	-159.28	-153.97
n	87	87	87
	0.001: '***', 0.01: '**', 0.05: '*', 0.1: '.' , ( ) is the value of t		

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[1] Point of interest (POI) is a term in geographic information system. Each POI contains four aspects of information: name, category, longitude and latitude.

(1) The results of year 2005: In this analysis, first, the results of 2005 are shown in the fourth column of Table 1. As for the immigration rate in 2005, the adjusted R^2 is 0.8389 and the four variables were statistically significant. The significance of "Employment ratio in the secondary industry (x7)" and "Number of national owned industrial enterprises above designed size (x53)" is 0.1%, and that of "Employment rate (x10)" and "Per capita annual disposable income (x20)" is 1%. The above results have a positive correlation with the migration rate. "Employment ratio in the secondary industry (x7)" is positively correlated with the immigration rate in this model, that is, the more attractive the more industrialized areas are to the immigrant population. Because of the characteristics of Chinese people with industry, especially in a province with underdeveloped transportation like Guizhou. In this context, "Number of national owned industrial enterprises above designed size (x53)" has attracted a large immigrant population.

(2) The results of year 2010: The second is about the regression results in 2010, which is in the third column of Table 1. The adjusted R^2 is 0.8467. Compared with 2005, "Employment ratio in the secondary industry (x7)", "Employment rate (x10)" and "Number of national owned industrial enterprises above designed size (x53)" have disappeared, and have been replaced by "Nonagricultural population ratio (x2)" and "Number of limited liability Companies Industrial Enterprises above designed size (x54)". Due to the reform of national owned enterprises and collective enterprises, while the proportion of non-national-owned economic units in absorbing labor force is increasing, which leads to the emergence of "Number of limited liability corporations Industrial Enterprises above designed size (x54)". In addition, as the economic efficiency of urban areas is higher, it is more attractive to the immigrant population. "Nonagricultural population ratio (x2)" appeared in the regression results in 2010, and it had strong significance.

(3)The results of year 2015: The third is the results of 2015 in the second column of Table 1. The adjusted R^2 is 0.9308. Compare with 2010, "Nonagricultural population ratio (x2)" and "Number of limited liability corporations Industrial Enterprises above designed size (x54)" disappeared, but appeared "Proportion of population over 65 (x4)", "Years of education (x6)", "Employment ratio in the third industry (x8)", "Number of natural parks per 100 people (x31)" and "Number of hospital beds per 100 people (x45)". The results showed that the factors affecting the migrant have gradually shifted from the employment rate, the employment ratio of the secondary industry and the number of national-owned enterprises in 2005 to the demand for the natural environment, educational background and medical facilities, and the dominant mode also shifted from the primary and secondary industries to the third industry. The mode of production has also changed from intensive to capital and technology intensive. At the same time, it can be seen from the influencing factors that the attractiveness of income to the migrant population is gradually weakened.

3.4 Amenity Total Value

The equation (3) is used to calculate the total amenity values of the 87 districts in Guizhou Province. The denominator in the equation (2) is taking "Per capita annual disposable income (x20)" as an amenity is the basis of value calculation, and the union representing the total amenity value is "Yuan".

According to equation (3), calculated the total amenity values of each area, and assigned values to each area by using GIS, and finally got Figures 2, 3 and 4. From the perspective of space and time, the amenity values were depicted in map in Figures 2, 3 and 4. In 2005, high amenity value areas only appeared in the central area of Guizhou provincial capital city. Low amenity value areas mainly appeared in the northeast and southwest of Guizhou Province. With the change of time, the areas of high amenity value gradually expanded to the north. The reason was that the northern part of Guizhou Province has a relatively rich Sichuan Province, so it developed rapidly. From Figure 4, the amenity values in 2015 is gradually expanding the scope of growth and has formed the characteristics of multi-regional and multi center distribution. Urban and rural public resources can improve the quality of life of urban and rural residents, provide more quality public services, and facilitate people's lives. This result showed that with the continuous investment and improvement of the construction of Guizhou Province, the urban-rural gap would be further narrowed.

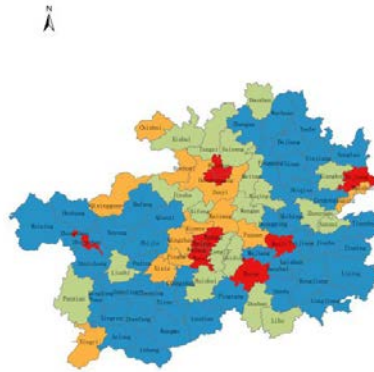Figure 2. Spatial distribution of amenity
values in 2005

Figure 3. Spatial distribution of amenity
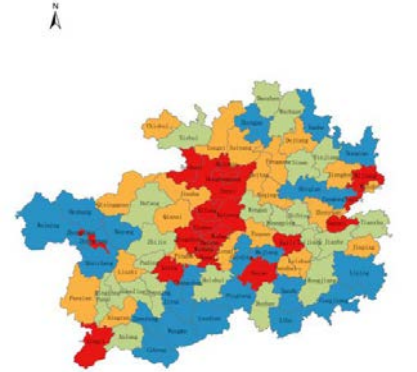values in 2010

Figure 4. Spatial distribution of amenity
values in 2015

4. Conclusion

In this study, based on Roback's model, a model is constructed to explain the relationship between migration and amenity in the 87 districts of Guizhou Province in china, and the amenity values are calculated. The results show that: the factors affecting the migrant have gradually changed from wages to the pursuit of a higher quality of life. Secondly, there are still many differences and imbalances in the distribution of amenity value. However, with the development, the high amenity value gradually extended from the central area to the multi center development. Through the development of the past ten years from 2005 to 2015, Guizhou Province has gradually shifted from a purely labor-intensive and national policy-oriented population migration to a model of improving the quality of life to meet people's needs for quality of life in terms of attracting migration population.

This paper also has some limitations. First, as Guizhou Province is a backward region in China, many data are missing. Therefore, in the next step of research, using the updated micro database to build a more reasonable index to quantitatively analyze the level of urban infrastructure and its differences among different types of residents will be the focus of the author.

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