

Research on Spatial Migration Patterns and Influencing Factors of Western Talents: Based on Data from "Double first-class" Universities in China

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Abstract. The western region's talent loss issue has received widespread attention. Promoting the construction of human resources in the west has become key to forming an important high-quality development pole in western China. This study analyzes the graduate migration data of first-class universities in western China between 2016 and 2020 and draws the following conclusions: Overall, the retention rate of college graduates in western China across seven provinces is high, with a relatively higher retention rate observed in the place of study in four southwestern provinces. The retention rate of different provinces' place of study showed different trends during the period of 2016-2020, and the retention rate of different provinces also showed different trends during the same period. In 2020, western college graduates continued to show a preference for employment in popular provinces such as Guangdong, Beijing, and Shanghai, while they showed a greater inclination towards choosing employment opportunities in the South and Central regions of China. The results based on the directed migration model show that economic factors and natural and educational resources in a city have a greater impact on employment decisions. Analysis of heterogeneity found that graduates from areas with a high sticking rate are more susceptible to population size, human resources, and economic factors, and that cultural resources and transportation resources also have a significant impact on talent migration. Policy recommendations include western provinces taking higher education as a key factor to utilizing employment retention advantages to attract and retain high-quality talents.

Keywords: western colleges; undergraduate college graduates; sticking rate; inflow rate; urban comfort.

1. Introduction

"Talent is the foundation of a rich country and a major plan for the prosperity of a nation." College graduates are important bearers of human capital and reserve army of talents. [15] In the era of knowledge economy, the cross-regional mobility of college graduates is becoming more and more frequent. The current imbalance in China's regional economic development remains a serious challenge, the essence of which lies in the lack of talent. [1] The problem of brain drain in the west has also been of great concern, and the phenomena of "peacocks flying southeast" are widely used to describe the brain drain dilemma faced by the central and western regions. [23] Especially in the regional higher education imbalance, the central and western colleges and universities education funding is less, location advantage is not prominent situation, to meet the western development for the fundamental need for talent is the formation of an important high-quality development pole in the west of the fundamental driving force of the problem. In the final analysis, the construction of talent resources in the west mainly depends on two points: The two approaches to address the talent issue in the western region are "blood-creation" and "stop the blood". The former focuses on continuously nurturing high-level talents through the establishment of western universities, while the latter aims to prevent excessive talent outflow and retain local "Double first-class" college graduates. [2]

What are the spatial migration features of employment migration of undergraduates from western China's "Double first-class" universities, and the driving factors behind these features? This issue is crucial for the strategy of building a strong talent nation.

2. Literature References

The concept of human capital was first introduced into the academic field by Thodore W. Schults in the 1960s, and the boom in talent research continues to this day. In Western countries, talent usually refers to a population with a bachelor's degree or higher. [4] In the West, "talent" is usually measured by the percentage of the population with a bachelor's degree or higher. [5] Talents from "Double first-class" colleges and universities should be equipped with scientific spirit and innovation ability. [6]

Numerous classical theories and research papers have explored the issue of the geographic distribution and mobility of talent. Famous theories include the human capital migration theory (Sjaastad, 1962), the "push-pull" theory (Ravenstein), the gravity model, and so on. Compared with the domestic research, scholars have carried out the migration of talents earlier, covering the migration mechanism of domestic and transnational mobility of talents. Related literature mainly involves the spatial migration pattern of various types of talents at the provincial and municipal levels and the influencing factors of their migration, and more of that focusing on the migration characteristics and driving factors of college graduates.

In terms of employment migration preferences and spatial characteristics, previous studies have shown that of Chinese graduates are consistent with the sticky effect of place of study [15] law, and there are also obvious differences in the retention of their place of study, with higher retention rates in parts of Southwest China, East China, and parts of North China, while the retention rate in Central China is at an intermediate level. [19] In fact, the choice of school already includes graduates' preference for the place of study, and the social capital that graduates have accumulated during their study and life in the place of study makes it easier for them to find a job there [10] [11] In addition, scholars investigating the willingness of talents to migrate also found that talents in the western region show no strong willingness to migrate. [12] However, due to the imbalance of regional development in China, the employment of college graduates obviously prefers the eastern region, as well as the central cities and first-tier cities. [9] [10] [15] The developed regions such as the Yangtze River Delta urban agglomeration constitute the core region of graduate mobility. [20] Since 2000-2015, there is still a steady trend of migration of highly educated talents from the west to the east, but the scale of migration from the east to the central and western parts of the country is also growing [8], the majority of graduates from western universities are willing to stay in the west, and western-born graduates and those who studied in the west are more likely to find a job in the west. [21]

In terms of migration influencing factors, scholars have found that the level of economic development and job treatment may become important factors in determining the place of employment of university graduates, while other social variables, such as demographic characteristic variables and employment opportunity, may also have a significant impact on the inter-regional mobility of university graduates. As the income level of talents is increasing, their demand for living level is also increasing day by day. Scholars such as Florida, Clark, Glaeser and Rappaport, etc. have argued that the comfort of the city can attract high level of innovative talents. It has been proved that urban comfort can attract innovative talents, which can greatly promote the economic development of the city. [17] As the economy progresses, factors such as the natural environment, social culture and policy system of each place will have an important impact on the flow of human capital. [7]

Overall, previous studies have shown that among the factors influencing the relocation of Chinese college graduates, both economic factors and urban comfort factors are attractive to graduates. [15] In addition, economic factors still play a dominant role, in addition to higher education resources, natural geographic environment, public services, etc. [13] [14] Numerous existing empirical articles have also proved the significant influence of economic factors and urban comfort on talent mobility.

In terms of research objects, the existing literature has mainly studied the spatial migration of talent groups such as college graduates, returnees, highly skilled talents and special high-end talents (such as academicians). Based on the employment quality report of graduates of "double first-class" universities, some studies have explored their employment migration. Among them, Zhou Junxu et al. (2021) used social network analysis to study the spatial flow and network characteristics of these graduates, while Wang Qiang et al. (2023) used spatial econometric interaction modeling to study the influencing factors of migration. Yet there is little literature that uses panel data for related studies.

In summary, academics have conducted exhaustive theoretical and empirical analyses of the spatial migration of talent, but there is not enough exploration of the spatial migration characteristics and influencing factors of graduates from "double first-class" colleges and universities in the western China, while much of the existing literature focuses on the study of talent mobility using cross-sectional data. Therefore, this paper will further investigate the spatial migration characteristics of the employment of highly educated talents represented by undergraduate graduates of top universities in western China and the influencing factors of the mobility of this part of talents by utilizing the panel data from 2016 to 2020.

The innovation of this paper is mainly reflected in three aspects.

(1) Regarding the research object, existing studies mainly consist of literature reviews focusing on talent in central and western China.

(2) In terms of data sources, this study utilizes panel data from 2016-2020, offering a larger sample size. This mitigates issues related to endogeneity and enhances estimation precision. It also allows for a comprehensive examination of the temporal trends in talent spatial migration.

(3) Lastly, this study investigates heterogeneity by categorizing provinces into high and low retention rates for schooling. It discusses potential reasons for variations in retention rates among educational institutions.

3. Models and data

3.1 Data sources

Since there are fewer "double first-class" universities in the western provinces than in the eastern region, "graduates of first-class universities" can be regarded as talents in the region from the perspectives of population ratio, ability and quality. Therefore, this study focuses on the employment migration flow of graduates of "double first-class" universities in the west.

This paper's data mainly comes from the provincial data of the National Bureau of Statistics and the employment quality reports published by some "double first-class" universities in seven western provinces from 2016 to 2020. Table 1 lists all the double first-class universities in the 7 western provinces. Due to some universities not publishing employment quality reports or the documents being invalid, and the caliber of statistics varying among universities, there are 11 universities' data can be used in total. The number of graduates from the 11 "first-class universities" is summarized into 7 places of study according to the provinces where the universities are located to get the data on the flow of graduates from the 7 places of employment to 31 provinces regions excluding Hong Kong, Macao and Taiwan.

Table 1 Data about universities from 7 provinces in Western China

Province	Quantities	Double First Class Colleges and Universities
Sichuan	8	Sichuan University, Chengdu University of Technology, Chengdu University of Traditional Chinese Medicine, Southwest Jiaotong University, Southwest Petroleum University, University of Electronic Science and Technology, Sichuan Agricultural University, Southwest University of Finance and Economics
Shaanxi	8	Xi'an Jiaotong University, Northwestern Polytechnical University, Northwestern Agricultural and Forestry University, Northwestern University, Shaanxi Normal University, Xi'an Electronic Science and Technology University, Chang'an University, Air Force Military Medical University
Guangxi	1	Guangxi University
Chongqing	1	Chongqing University
Guizhou	1	Guizhou University
Yunnan	1	Yunnan University
Gansu	1	Lanzhou University

3.2 Modeling

3.2.1 Measures of spatial migration characteristics

Drawing on Wang Yifan et al. (2021), this paper uses the "sticking rate" and "inflow rate" as two major indicators to measure the spatial migration patterns of undergraduate graduates from western colleges. [15]

(1) The retention rate: The retention rate is an indicator of the retention of the place of study for local graduates and is calculated as follows:

$$R_i = \frac{L_i}{T_i} \quad (1)$$

where R_i denotes the sticking rate. L_i is the number of graduates who stayed in employment in place of attendance i ; T_i is the total number of graduates in city i . The provincial sticking rate is the mean value of the sticking rate of all first-class colleges and universities included in the province.

(2) Inflow rate: The inflow rate reflects the inflow of graduates to a particular place of employment and is calculated as follows:

$$I_j = \frac{K_{ij}}{T_i} \quad (2)$$

I_j denotes the inflow rate. K_{ij} is the number of graduates who traveled from place of study i to place of employment j ; T_i is the total number of graduates from city i . The provincial inflow rate is the proportion of the total number of graduates from city i who went to city j .

3.2.2 Measures of spatial migration characteristics

This paper uses a fixed effects panel model to examine the impacts of various factors on the employment migration of western college graduates. Specifically, the effect of migration from study location i to workplace j is denoted as U_{ijl} . l denotes the utility of migration from study location i to workplace j , and utility depends on the attributes of location i and j , X_{ij} . If the utility U_{ijl} satisfies the linear assumption with the attributes of study and workplace locations, and the random perturbation term ε_{ij} satisfies independent homogeneous distribution, then is U_{ijl} denoted as:

$$U_{ijl} = \alpha X_{ij} + \varepsilon_{ijl} \quad (3)$$

The probability that graduate l travels to place j is P_{ijl} , and k denotes other alternative employment provinces that graduate l can choose. When utility maximization is satisfied:

$$P_{ijl} = \text{Prob}(U_{ij} > U_{ik}), k \neq j, k = 1, 2, \dots, 31 \quad (4)$$

Then the graduate l employment migration decision satisfies a standard conditional logit model:

$$P_{ijl} = \frac{\exp(\alpha X_{ij})}{\sum_{j=1}^{30} \exp(\alpha X_{ik})} \quad (5)$$

(Equation (5) illustrates that the probability of migration P_{ijl} is related to all the attributes of the place of employment available to graduates, and since it is difficult to estimate the parameters directly, reference is made to some scholars who have converted the model into a function that estimates the odds of migration:

$$\exp(\alpha X_{ij}) = \frac{P_{ijl}}{1 - P_{ijl}} = \frac{P_{ijl}}{P_{iil}} \quad (6)$$

P_{iil} That is, the probability that a graduate will remain employed in the place of study.

The data used in this paper are the macro-mobility data of graduates from each school, which can be converted according to the law of large numbers, and the number of migrants can be used to indicate the migration probability, with N_i to represent the total number of graduates in a provincial administrative region, i.e.

$$\frac{P_{ijl}}{P_{iil}} = \frac{N_i * P_{ijl}}{N_i * P_{iil}} = \frac{N_{ij}}{N_{ii}} \quad (7)$$

In the above equation N_{ij} is the number of graduates from province i moving to province j , and N_{ii} is the number of graduates from province i staying in their province for employment. It is obtained after logarithmization:

$$\ln\left(\frac{N_{ij}}{N_{ii}}\right) = \beta X_{ij} + \mu_{ij} \quad (8)$$

Based on this, the logit model based on utility maximization theory is transformed into a directed migration model applicable to macro data.

3.3 Definition of variables

The specific meanings of the variables involved in the above model are as follows:

(1) Explained variables: the odds of talent migration. Given the differences in employment statistics among universities, to ensure the accuracy, credibility of our findings, and consistency of the statistical methods, employment in this paper specifically refers to graduates engaging in certain social labor and obtaining corresponding labor compensation or business income. [18]. Based on this definition, the number of people who do not meet the requirements, such as domestic and foreign education preparation, conscription, non-engaged, etc., should be excluded. For cases where some university employment quality reports only provide the percentage of employment flow by province, multiply it with the actual number of employed people to get the required number of employed people.

(2) Core explanatory variables: divided into economic factors and urban comfort factors. In this paper, four indicators are selected to measure the economic factors of the province, namely, wage level, employment opportunities, cost of living, and technology level, and four indicators are selected to measure the urban comfort factors of the province, namely, natural environment, educational resources, cultural resources, and transportation resources.

(3) Control variables: geographic distance, population size and human capital. Talent agglomeration is influenced by population density, and the spillover effect of population density in the city knowledge can promote wage growth and improve the income expectations of talent, making talent willing to agglomerate. Similarly, the externality brought about by the increase in the average level of human capital in the city can also improve the wage level of low human capital and attract the agglomeration of talent. However, talent mobility across provinces is affected by geographical distance, resulting in higher migration costs, including quantifiable costs such as transportation, communication, job information search costs, as well as hidden costs due to giving up original social network relationships. In addition, there are quantifiable costs of transportation, communication, job information search, as well as implicit costs of giving up the original social network relationships. Based on the above analysis, this paper selects geographic distance, human capital and population size as the control variables of this paper's migration model.

The corresponding measures for each variable are shown in Table 2. Since we logarithmized all variables, the correlation coefficients represent elasticities. For a small amount of missing data, we fill in using linear interpolation or based on time trends.

Table 2 Description of model independent variables

Variable	Indicator	Symbol	Description
Control variable	Geographic distance	<i>DIS</i>	Euclidean distance between provincial capitals (km)
	Human capital	<i>COL</i>	Proportion of population aged 6 years and over with a college degree or higher (%)
	Size of population	<i>POP</i>	Permanent population (tens of millions)
Economic factor	Wage level	<i>WAG</i>	Salaries of active staff (thousands of dollars)
	Employment opportunities	<i>UEP</i>	Registered unemployment rate (%)
	Cost of living	<i>HOU</i>	House price to income ratio (1/m ²)
	Science&technology	<i>COP</i>	Patents granted per 10,000 persons (units)
Urban comfort factors	Environment	<i>TEM</i>	Provincial average temperature (°C)
	Educational resources	<i>TSR</i>	Ordinary Primary School Pupil Division Ratio
	Cultural resource	<i>LIB</i>	Public library holdings per capita (volumes/person)
	Transportation resources	<i>BUS</i>	Public transportation vehicles per 10,000 persons (standard units)

4. Migration Characteristics of Undergraduate Graduates from "Double First-class" Universities in Western China

4.1 Analysis of the retention rate at the place of study

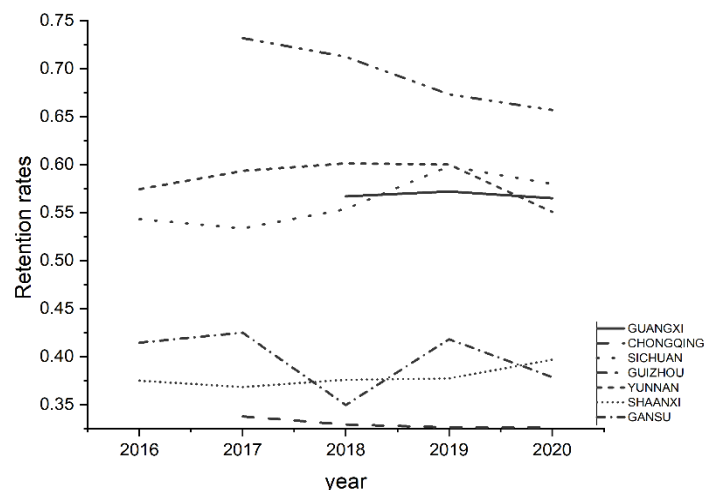


Fig. 1 Retention rates of graduates in Western-China provinces where "first-class" universities locate

According to formula (1), the paper calculates the study retention rate of undergraduate students from 11 universities. Using Originlab and Arcmap, a line chart of the retention rate over five years in different sub-provinces and distribution in 2016, 2018 and 2020 is plotted (similar to Fig. 1).

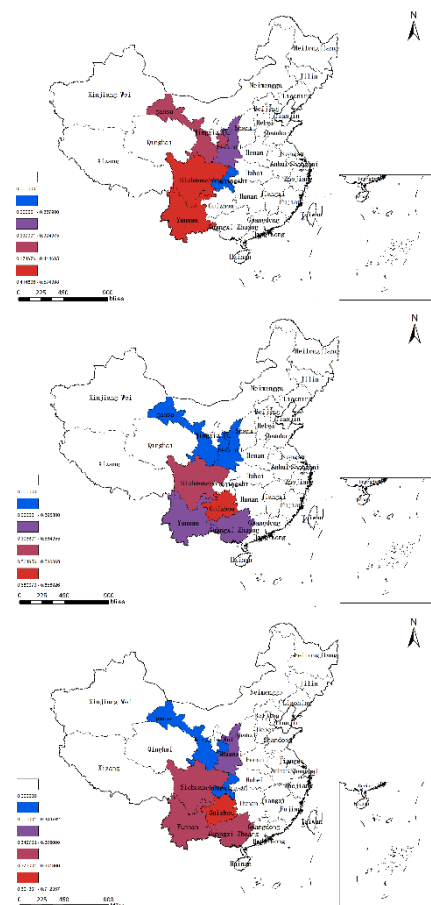


Fig. 2 Retention rates of 7 Western-China provinces where "first-class" universities locate

From a spatial perspective, the overall retention rate of graduates from universities in the 7 western regions is at a moderate level and divided into two distinct categories. With 50% as the threshold, the retention rates of Guizhou, Yunnan, Guangxi, and Sichuan provinces are all above 50%, with

Guizhou being the highest. This is consistent with previous research conclusions that the retention rates of southwestern provinces are higher, forming a "U"-shaped high-value area. The retention rates of Chongqing, Shaanxi, and Gansu provinces are significantly lower and each province/city forms a "Y"-shaped low-value area, but the retention rate remains above 30% but below 50%.

From the perspective of temporal change, there is no uniform trend of change in place-of-attendance retention rates across provinces from 2016 to 2020. In Guizhou, the downward trend is obvious; in Chongqing, there is a slight decline yet basically stable; in Sichuan and Shaanxi, the viscosity rate of the place of study fluctuates and rises; in Gansu, the retention rate decreases in 2018 to the lowest level in five years, then rises significantly in 2019, and then declines significantly in 2020, either due to the impact of the epidemic; similarly, in Yunnan, there is also a decline in retention rate in 2020; In Guangxi, the change was not significant.

Overall, during the period from 2016 to 2020, the western provinces have created a certain degree of "talent retention", the employment retention rate of graduates of the region's top universities is at a high level.

Retention rates are also affected by the level of development of its neighboring provinces, with particular attention to the "siphon effect" and "diffusion effect" of economically developed regions. [15] In addition, existing studies have shown that the phenomenon of "neighborhood interaction" between regions in China has been highlighted, and geographically neighboring regions share certain commonalities in language, culture and living customs, which makes it easy for the population to move. Therefore, it needs to be further analyzed in conjunction with the inflow rate of places of employment.

4.2 Analysis of inflow rates to places of employment

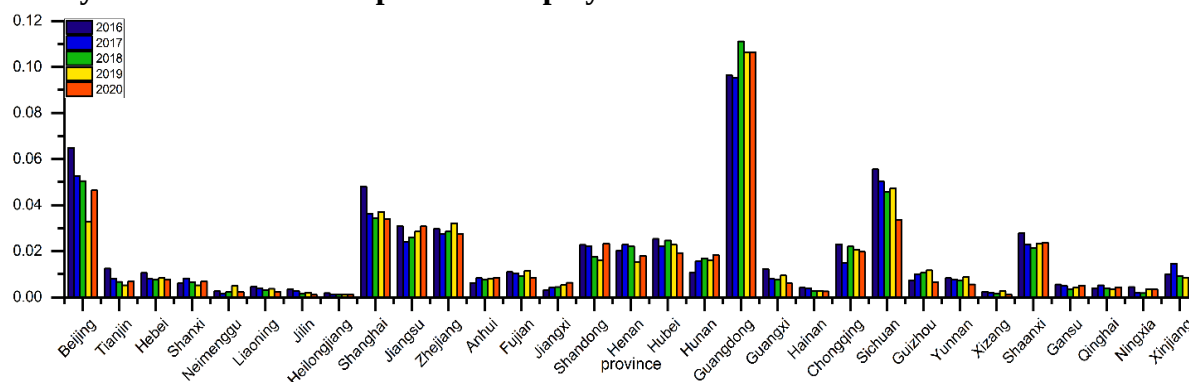


Fig. 3 Inflow rates of graduates in Western-China provinces where "first-class" universities locate

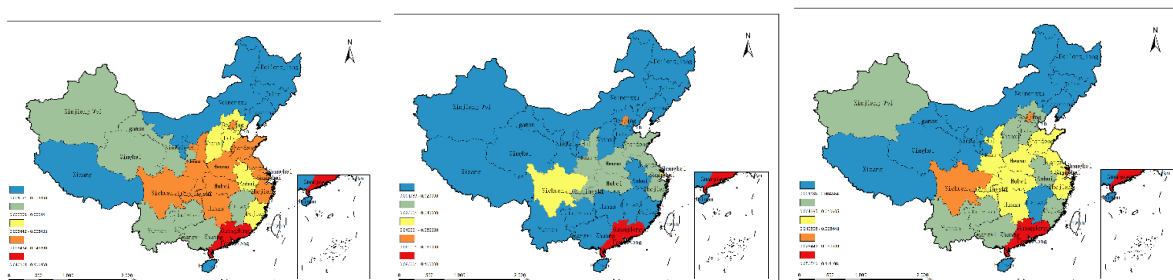


Fig. 4 Inflow rates of graduates in Western-China provinces where "first-class" universities locate

Based on formula (2), we calculate the graduate inflow rate of western "double first-class" colleges and universities in 31 provinces across China. Figure 3 focuses on the inflow rate of each province in China and the time trend. From 2016 to 2020, the trend of the graduate inflow rate of each province is not obvious, with fluctuating downward trend in the provinces of North China and Northeast China, the inflow rate of South China and Central China maintained at a high level, and the inflow rate of Northwestern China increased, which may be related to a series of western tilting policies such as "Three Supports and One Assistance" in recent years. With the in-depth

implementation of the strategy of developing the west, the economic development of the northwest region has made great progress, and the employment situation has become more stable. [22]

Generally speaking, the talent attraction of "North, Shanghai and Guangzhou" is absolutely dominant, and central and southern China are favored by graduates of western universities. On the one hand, it is self-evident that regions with higher levels of economic development are attracting talents. On the other hand, college graduates may be inclined to strengthen their relocation preference to Central and South China under the guidance of the policy.

Combined with the sticking rate in the place of study, the four western provinces of Guizhou, Yunnan, Guangxi and Gansu are characterized by a high sticking rate and a low inflow rate. This may be due to the fact that these provinces are blessed with natural resources and ethnic cultures, and people growing up here may prefer to maintain their original lifestyles rather than leave their homelands. Comparatively speaking, Sichuan, Shaanxi and Chongqing have higher inflow rates and are more attractive to talents among the western provinces, which may be due to factors such as their relatively good economic development and infrastructure.

5. Factors affecting the migration of graduates from "double first-class" universities in western China

5.1 Baseline regression

This paper analyzes the talent migration influencing factors based on economic factors and urban comfort theory using time fixed effects panel model (directed migration model).

The regression results of the benchmark model, i.e., equation (8), are as follows:

Table 3 Baseline regression results (stepwise)

Variable	(1)	(2)	(3)
<i>DIS</i>	-1.0906*** (-10.8385)	-0.8759*** (-9.6693)	-0.8642*** (-9.5053)
<i>POP_i</i>	1.1884*** (5.9682)	1.2814*** (7.0708)	-0.0980 (-0.6358)
<i>POP_j</i>	1.7612*** (12.7071)	0.4114** (2.4279)	0.5621*** (3.3669)
<i>COL_i</i>	-0.3962*** (-2.9766)	-0.3316*** (-3.3308)	-0.1458 (-1.2704)
<i>COL_j</i>	1.1359*** (17.1419)	1.0188*** (15.7275)	0.9602*** (14.8019)
<i>WAG_i</i>		-0.6353 (-0.8367)	-2.2223*** (-2.6817)
<i>WAG_j</i>		1.9988*** (5.1515)	1.8295*** (5.1191)
<i>COP_i</i>		-0.0622 (-0.5015)	0.5178*** (5.4111)
<i>COP_j</i>		0.2334*** (2.7636)	0.1751* (1.8666)
<i>HOU_i</i>		0.4585 (1.2244)	1.0079*** (2.9407)
<i>HOU_j</i>		0.0794 (0.6430)	0.0345 (0.3344)
<i>UEP_i</i>		-0.1052 (-0.4570)	0.7168** (2.5149)
<i>UEP_j</i>		-0.6618*** (-3.7034)	-0.6207*** (-3.7869)
<i>TEM_i</i>			0.7701*** (2.8973)
<i>TEM_j</i>			0.1911** (1.9847)
<i>TSR_i</i>			-6.0635*** (-7.4613)

<i>TSR_j</i>			0.3111 (0.8192)
<i>LIB_i</i>			-0.3001 (-1.5087)
<i>LIB_j</i>			-0.0425 (-0.5053)
<i>BUS_i</i>			-0.3968 (-1.1919)
<i>BUS_j</i>			0.1217 (0.5780)
constant	1.3933** (2.5969)	-5.9989 (-1.6286)	11.9305** (2.2160)
observed value	832	832	832
goodness of fit	0.6703	0.7882	0.8237

Note: * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$, t-test values in parentheses.

Model (1) includes control variables only, and the regression results show that the coefficient of Euclidean distance between the two places is significantly negative, indicating that as the geographic distance between the two places increases, the probability of talent migration decreases, consistent with existing literature findings. In terms of human capital, the larger the population size of the place of study, graduates tend to move out of the place of study, likely due to limited capacity of basic services in the place of study.

The economic factor variable is added to model (2), and the table shows that the direction of the coefficients of each control variable has not changed, and all of them pass the significance level test. None of the economic factors of the place of study has a significant effect on the probability of migration, which may be due to the fact that the level of economic development in the western region as a whole is relatively lagging behind, so that students coming to the western region do not pay much attention to the local economic environment when choosing a school. The wage level, technology level and employment opportunities in the place of employment are all significant at the 1% significance level, and the effect of cost of living on the chances of relocation fails in significance. This may be due to the fact that undergraduates from top universities in the west are not eager to consider settling down when they first choose their place of employment, especially because the cost of living is very high in the popular places of employment, so the house price to income ratio does not have a significant effect on the chances of relocation.

Model (3) adds urban comfort-related factor variables to model (2). The temperature of the place of employment and the place of study also positively contributes to the probability of migration; the poorer the basic education resources and the higher the student-teacher ratio of the place of study, the higher the probability of talent migration. In addition, after adding the urban comfort factor, the income level and employment opportunities of the place of study among the economic factor variables are significant at the 5% significance level, and the attracting ability of the income level and employment opportunities is further corroborated; the level of scientific and technological development of the place of study passes the 1% significance test, and the explanatory ability of the level of scientific and technological development of the place of employment decreases, which may be due to the fact that the scientific and technological development of the place of study improves the quality of the university in that place. This may be due to the fact that scientific and technological development in the place of study has improved the quality of talents trained by the university there, thus increasing the chances of migration to a certain extent. After adding the factor of urban comfort, the increase of house price in the place of study will also increase the probability of migration, and the house price-income ratio begins to show the "crowding out effect" on the inflow of graduates.

Overall, in the spatial migration characteristics, it is shown that the inflow rate of the more economically developed central and southern China is at a higher level in the country, showing a stronger attraction to college graduates, and the sticking rate of Sichuan among the western provinces is higher, which also has a good attraction for talents.

5.2 Heterogeneity Analysis

The analysis of spatial migration characteristics found that the seven western provinces are clearly divided into two categories according to the retention rate of college graduates, and students from provinces with high retention rates are more willing to stay in the place of study for employment. Then, what is the difference between the influencing factors of talent migration choices between regions with different viscosity ratios is an issue worth exploring: on the one hand, it reflects the talent attraction advantages of these high viscosity provinces; on the other hand, it reflects the differences in the influencing factors of graduates of the two types of regions in their choices to migrate. We re-estimated equation (8) by dividing the sample into two categories, high and low viscosity areas, and the results are shown in Table 4.

Table 4 Regression results for the grouping of groups according to the high and low values of Retention rates

Variable	(1) High retention area	(2) Low retention area
<i>DIS</i>	-0.8009*** (-7.5128)	-0.9332*** (-6.6031)
<i>POP_i</i>	0.5136** (1.9840)	-0.9152 (-1.3369)
<i>POP_j</i>	0.7049*** (4.6511)	0.4094 (1.2632)
<i>COL_i</i>	-1.0935** (-2.0231)	4.6681 (0.8980)
<i>COL_j</i>	0.9759*** (13.6211)	0.9688*** (9.6234)
<i>WAG_i</i>	-4.1773*** (-3.1921)	12.8710 (1.1178)
<i>WAG_j</i>	1.4314*** (4.3914)	2.4642*** (3.9074)
<i>COP_i</i>	0.4067 (1.2326)	-0.9737 (-0.8116)
<i>COP_j</i>	0.1506 (1.6176)	0.2016 (1.1020)
<i>HOU_i</i>	1.0789 (1.0762)	-1.7971 (-0.6202)
<i>HOU_j</i>	0.0960 (0.7728)	-0.0180 (-0.1199)
<i>UEP_i</i>	-1.3158** (-2.2598)	2.8643 (0.7272)
<i>UEP_j</i>	-0.5536*** (-3.3871)	-0.6799*** (-2.3670)
<i>TEM_i</i>	-0.3289 (-0.9657)	-0.5098 (-0.2243)
<i>TEM_j</i>	0.2880** (2.1279)	0.0743 (0.7185)
<i>TSR_i</i>	-1.1696 (-0.7713)	-11.4806 (-0.7515)
<i>TSR_j</i>	0.0731 (0.1573)	0.2171 (0.3496)
<i>LIB_i</i>	1.6579*** (3.1495)	-0.4129 (-0.1914)
<i>LIB_j</i>	-0.1621* (-1.7409)	0.0332 (0.2088)
<i>BUS_i</i>	2.4825*** (5.1136)	-1.0974 (-0.8901)
<i>BUS_j</i>	0.1972 (0.8430)	-0.0409 (-0.1166)
observed value	482	350
goodness of fit	0.8462	0.7765

Note: * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$, t-test values in parentheses

It can be seen that the parameters including permanent population in the place of study and employment, proportion of population with college degree or above in the place of study, economic

factors such as income level and employment opportunities, cultural resources in the place of study and employment, and transportation resources in the place of study in the high-retention group passed the significance test at the 1% level, while none of these parameters in the low-retention group were significant. This indicates that graduates from high-retention areas were more significantly influenced by the above factors in their migration choices.

The level of retention refers to the strength of a region's ability to retain talent. Regions with high retention rates have better talent development opportunities and living environments. However, some provinces that do not fit these characteristics remain to be explained as to why they have high talent sticking rates. According to the classical theory, more economically developed regions should be more attractive to labor inflows, but not all provinces with high sticking rates are among the western provinces with high economic levels. We note that the high retention rate provinces have more influences that pass the significance level test, which suggests that the choice of employment mobility of talents in the high retention rate provinces is more emphasized on economic factors and urban comfort factors.

In addition, in other empirical research on the willingness to migrate, it is found that the proportion of talents in the western region who are "unwilling to migrate" is actually very high. Considering the high proportion of provincial students in western universities, the high sticking rate in many provinces may come from the attachment to the homeland. Therefore, it cannot be concluded that the economic factors and urban comfort factors in the provinces with high sticking rates have an absolute advantage in retaining talents.

6. Summary

In the construction of economic development in the western China, human resources are one of the most important and scarce input factors. Based on the results of the study, this paper draws the following conclusions:

(1) As a whole, the retention rate of graduates from first-class universities in seven western provinces/regions is high, and ranks highly among national universities. It can be divided into two distinct categories: the retention rate of four provinces (Guizhou, Yunnan, Guangxi, and Sichuan) is high, while that of Chongqing, Shaanxi, and Gansu is significantly lower. In terms of time trends, from 2016 to 2020, the retention rate of each province showed diverse trends with small overall fluctuations; several provinces experienced a slight decrease in the retention rate in 2020.

Graduates from western universities still prefer popular employment provinces like Guangdong, Beijing, and Shanghai; they are more inclined to choose to move to southern and central China for employment, while the inflow rate in Northwest China is generally lower than 1%. Combining the two indicators of retention rate and inflow rate, the four provinces of Guizhou, Yunnan, Guangxi, and Gansu all feature high retention rates and low inflow rates.

(2) After analyzing, this study found that economic factors and urban comfort play a crucial role in graduates' employment mobility. Among the economic factors, income level, employment opportunities, technological development, and cost of living are important factors influencing graduates' employment decisions; among the urban comfort factors, favorable climate and basic education resources are important influences on graduates' migration, while the other factors do not have a significant impact.

(3) Graduates from high retention rate areas are more influenced by population size and human resource factors in choosing their relocation places, and income level and employment opportunities among economic factors have a significant effect on high retention rate provinces, but not on low retention rate provinces. In addition, cultural and transportation resources in the place of schooling and employment also have a significant effect on talent migration in high retention rate provinces, but the opposite is true in the low retention rate group. This maybe due to the fact that high retention rate areas usually have higher talent density, better educational and cultural resources, better

employment opportunities and income levels, and a favorable social environment, which makes the talents in the area more inclined to choose to stay in the place of study.

Western provinces should take higher education as a key to retaining, attracting and accumulating high-quality talents by taking advantage of their employment retention.

On the one hand, in order to better promote the economic development of the western region, the construction of “double first-class” colleges and universities should be strengthened to increase the possibility of students staying in the west for employment by guiding and encouraging them to study in the western region. [21] Besides it is also possible to enhance the ability to cultivate talents in a targeted manner by strengthening school-enterprise cooperation, ensuring employment opportunities in the specialized structure of local colleges and universities, increasing the possibility of employment conversion, and upgrading the overall level of local human resources;

On the other hand, the city's attractiveness to graduates should be strengthened by upgrading the city's natural environment and educational resources, and introducing more favorable housing policies. Utilizing the natural environmental advantages of the western provinces and providing more development opportunities through industrial transformation and upgrading, local talents will be retained and more talents will be attracted.

Admittedly, this paper still has some shortcomings. First, due to data availability and varying statistical programs among universities, this paper faces research limitations from data scarcity. Second, the migration model used is based on macro data from employment reports for analysis, unable to account for micro-level individual heterogeneity. Additionally, city-level migration data is unavailable as talent policies are often municipal-level, and most university stats lack city-specific migration data. Finally, this paper overlooks the migration path of graduates, not accounting for their birthplace. Therefore, future work will further investigate the mechanisms influencing western China's talent migration, refining the specific impact of each factor studied here.

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