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Spatiotemporal Characteristics of Rural Labor Migration in China: Evidence from the Migration Stability under New-type Urbanization

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Abstract: Although the factors affecting rural-to-urban migration have been discussed and analyzed in detail, few studies have examined the spatiotemporal dynamic characteristics of rural migrants' employment and working-cities in the post-immigrate era, which is essential for the citizenization and social integration of new-type urbanization in China. This study uses survey data from rural migration laborers across the eastern, central, and western China to construct a comprehensive labor migration stability index, and compares the determinants of the migration stability of rural labor among cities and industries using Geodetector. The results are as follows: 1) Compared with the midwestern cities, eastern cities have attracted younger and more skilled rural labor, and industries with higher technical content have higher migration stability among rural laborers. 2) Rural laborers more often adapt to changes by changing employment instead of changing working-cities. 3) The individual experiences of rural laborers and urban characteristics have significant impacts on the stability of migration, and family and societal guanxi (Chinese interpersonal relationships) enhance migration stability. 4) A unified labor market and convenient transportation have somewhat slowed industrial transfers and labor backflow. This study enhances our understanding of the roles of industrial transfer and new-type urbanization in shaping the labor geography landscape and provides policy implications for the promotion of people-oriented urbanization.

Keywords: migration stability; rural labor; Geodetector; spatiotemporal characteristics; new-type urbanization

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1 Introduction

New-type urbanization aimed at promoting the citizenization of rural migrations and thus achieving social integration has become the core of China's urbanization strategy (Zhang et al., 2018; Chen et al., 2019). To achieve high-quality, sustainable new-type urbanization, it is necessary to achieve stable employment and settlement of rural migrants to promote urbanization of their livelihoods, lifestyles and societal guanxi and ultimately achieve citizenization (Wang and Weaver, 2013). Stable employment and working-cities show that current industrial and urban development can meet the individual and family needs and lay the foundation for future citi-

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zenization (Zhang and Lu, 2018). The migration motivations of rural residents are related to education, employment, business, marriage and visiting, although employment is the main reason for rural migration (Liu et al., 2015; Morley, 2017; Duda et al., 2018). Therefore, the migration of rural labor is the main way to achieve people-oriented urbanization (Chen et al., 2010; Morley, 2017). However, due to poor skills, limited education, high housing prices, and an unstable job market, labor migration is flexible and floating; thus, agricultural production materials (cultivated land, housing, *etc*.) are retained when rural laborers return to the countryside (Chen et al., 2010; Xu et al., 2019; Zhang et al., 2019). Furthermore, the diversified migration options of rural laborers, as well as the difficulty in obtaining urban employment and the increase in housing costs, *etc*., contribute to unstable migration of rural laborers in specific working-cities. The stability of working-cities is directly related to the effects of citizenization, and frequent changes of working-cities not only increase the burden of urban management but also reduce the dependence on specific cities and the intention to settle therein (Liu et al., 2018). Despite these issues, rural laborers still hope to obtain stable employment and settle in an ideal city, although they will encounter the instability of migration. Therefore, accurately assessing and understanding the migration stability of rural labor is pivotal to promoting new-type urbanization and the citizenization of rural labor.

Recent studies continue to focus on the motivations, obstacles, and influences of rural labor migration (Liu, 2013; Duda et al., 2018; Ge et al., 2018; Wan et al., 2018). At present, relevant research can be divided into two categories. The first category focuses on the composition and expression of labor employment stability, such as employability, employment challenges, employment equality and employment stability (Cortès-Franch et al., 2018; Kaplan and Herbst-Debby, 2018; Su et al., 2018; Umkehrer, 2019; Wang and Fu, 2019). Employment stability reflects the ability to become employed and the intentions and expectations of sustainable employment through agency variables rather than an assessment of the actual retrospective migration process (Su et al., 2018). The steady migration of labor is both an objective experience and subjective intentional behavior. Employability represents the optimal choice under fully rational assumptions and does not consider the impacts of subjective variables, such as family, individual experience, and social guanxi, but the effects of these variables are a component of the process of labor migration. Only a complete retrospective study of the entire migration process can accurately assess migration stability. Therefore, these studies are evaluations based on the possibility of rational indicators rather than objective experiences.

Due to influences of land property rights, the labor market, borders, seasons, culture, society and family (Hu et al., 2011; Kępińska and Stark, 2013; Chen and Fan, 2018), labor migration shows temporary, cyclical and seasonal characteristics (Strauss and McGrath, 2017; Meng and Zhao, 2018; Rai, 2018). Although this type of immature and unstable migration reflects the volatility of rural migrants, the flow of rural labor among different cities is not included in the stability considerations. Additionally, temporary and cyclical migration does not entirely reflect employment purposes; for example, people migrate for holidays or festivals (Xu et al., 2017). Thus, only changes in working-cities for employment purposes can be regarded as real labor migration. In short, current studies of migration stability need to be further explored and a more comprehensive and objective research method is needed to quantitatively assess the migration stability of labor.

The second category of research focuses on the factors that influence labor migration stability. From the perspective of the labor geography landscape, these studies demonstrate the influence of institutional flexibility and employment structure elasticity on employers and laborers and highlight the negative impact of flexible accumulation reform on labor employment stability and livelihood robustness, which has exacerbated regional differences, the marginalization of weak groups, and social fragmentation (Bellmann and Möller, 2010; Cammett and Posusney, 2010; Roseman, 2013; Rebollo-Sanz and García-Pérez, 2015). Furthermore, employment security for rural labor will reduce urban-rural migration and mobility (Basu, 2013). Rural labor migration is affected by the employment market, and the floating and stability of rural labor depend on sustainable jobs and livelihood (Aure et al., 2018). The built-up area characteristics of cities and neighborhoods, social participation and social integration also have a significant impact on the settlement intention of rural migrants (Aure et al., 2018; Huang et al., 2018; Liu et al., 2018).

Moreover, hukou (China's household registration system) and its related social security, housing and education are key in this regard (Fang and Zhang, 2016; Wu and Zhang, 2018). However, little quantitative and specialized research has been conducted on the migration stability of rural labor, especially focusing on previous real migration experience, and specific mathematical methods to assess migration stability are lacking. Additionally, a comprehensive understanding of how systematic cognitive industrial transfer and new-type urbanization affect migration stability and the role of individual stability in shaping the labor geography landscape is also lacking.

2 Theoretical and Analytical Framework

Rural labor migration includes two types of migration: employment migration and region migration (Fig. 1). Employment migration involves rural labor gradually replacing agricultural employment with nonagricultural employment, and region migration is the migration of labor from the countryside to a city or from the midwest to the east (Wang and Weaver, 2013; Chen et al., 2018; Duda et al., 2018; Zhang et al., 2019). However, the previous inflow of rural labor into eastern cities was too high and caused a series of urban management problems, and major eastern cities had to raise the threshold for settlement (Aure et al., 2018; Chen et al., 2018). The industrial upgrades of eastern cities also required high-quality and highly skilled labor as backward industries were gradually phased out (Liu et al., 2013). Moreover, midwestern cities are actively undertaking industrial transfers, with the hope that eastern labor will return and promote local urbanization (Wang and Weaver, 2013; Chen and Zhao, 2017). However, the frequent flow of labor has caused two nonideal consequences: first, it is difficult for large cities to retain skilled rural labor; second, there remains a large surplus of rural labor in midwestern rural areas, which increases the difficulty of achieving stable employment and settlement in cities and ultimately drives rural laborers to return to the countryside (Knight et al., 2011). Therefore, the following questions are raised. Is rural labor willing to return and why? Why do these laborers not settle in major cities? What are the challenges of settling in these cities? What are the determinants of stable employment and settlement? How should we formulate policies to promote the stable employment and settlement of rural labor (Fig. 1)? To answer these questions, we need to quantitatively describe the migration stability of rural labor and grasp the differences and trends of its determinants.

Eastern cities have the highest level of urbanization in China, as its three major urban agglomerations (Beijing-Tianjin-Hebei, the Yangtze River Delta and the Pearl River Delta) represent China's superlarge agglomeration areas and the preferred migration destinations for most rural laborers. In the context of the new-type urbanization, rural migrant labor faces a wider choice of migration destinations, especially major cities outside the three major agglomerations, and other central cities in mid-western China. These cities have become the main choice for the migration changes and backflow of rural labor. Therefore, this study selects Fuzhou and

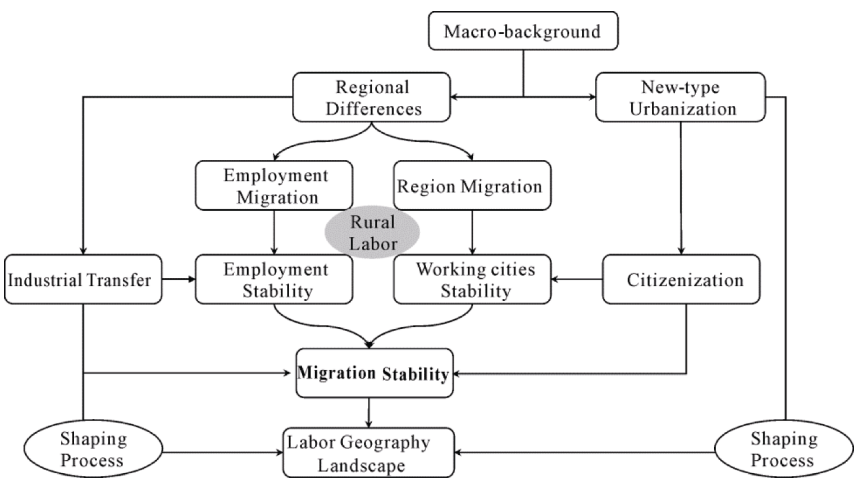

Fig. 1 Theoretical framework of the research design

Xiamen, two major cities outside of the three metropolitan areas in the east as representative eastern cities, and Wuhan and Chengdu, two central cities, to represent the midwestern cities. In addition to the three major urban agglomerations in the east, these four cities, as representatives of migration choices under the backflow of labor, provide differentiated case studies for discussing the migration stability of rural labor and industrial transfer. This study takes rural migrant laborers in cities as the study population, and survey data from sample cities are used to comprehensively assess the migration stability of rural labor. Through an analysis of the characteristics of migration stability in different cities and industries, we can assess the trends and patterns of rural labor migration under the background of industrial transfer and new-type urbanization and provide policy suggestions for promoting people-oriented urbanization (Fig. 1).

Based on the discussed analyses, this study aims to address the following key scientific issues:

(1) Build a comprehensive labor migration stability index to determine whether rural labor prefers to change employment or change cities in the post-immigrate era;

(2) Answer the following questions: What are the determinants of labor migration stability? Are these effects different in different cities and industries? If so, how do these differences affect the labor geography landscape in China?

3 Sampling, Index and Methods

3.1 Sampling and investigation

According to the main migration routes of rural labor, the survey data used in this study were derived from a structured questionnaire survey conducted in four sample cities in eastern (Fuzhou, Xiamen), central (Wuhan) and western (Chengdu) China from April to September 2018 (Fig. 2). The investigation targets were rural laborers who were born in rural areas and later migrated to the sample cities for employment purposes, but the nonlabor population and the other migrant populations, such as children, aged parents of the respondents, and business and education migrants, were excluded. The survey area encompassed the Chengzhongcun (which comprises villages surrounded by urban communities, although collective land ownership is maintained) and

Fig. 2 Regionalism and urban agglomerations in China and the location of sampling cities

other immigration communities based on stratified sampling in the various functional zones of the cities, where rural migrant laborers live and work in concentrated areas (Tian et al., 2018). Among our investigated samples, 83.27% were surveyed in the Chengzhongcun, and the remainder was in other small immigrant communities. The investigation was conducted by face-to-face structured interviews with households as basic units, and the average survey time was approximately 30 min for a single sample conducted by professionally trained college students. According to the migrant scale in different cities, 1574 questionnaires were distributed, and 1489 valid samples were recovered, including 530 samples (35.6%) in the east, 448 (30.1%) in the central region, and 511 (34.3%) in the west. In the structured investigation, we focused on each interviewee's history of changes in employment and working-cities and the corresponding reasons throughout the entire migration stage. Additionally, we obtained basic demographic, living, social guanxi and settlement information, which was used to analyze the determinants of labor migration stability.

3.2 Concept and index construction of migration stability

3.2.1 Composition of migration stability

Stable labor migration should mean that workers can obtain stable employment in specific cities and achieve sustainable development for a long period. Namely, employment and working-cities should be changed close to simultaneously and as few times as possible during the migration stage of a worker. Therefore, the starting year of the current occupation (T_e, such as 2012) minus the year of migration to the current city (T_c, such as 2008) provides the migration stability index ($S_c = T_e - T_c$, such as 2012–2008) of the current city. If $S_c>0$, then this laborer has changed at least one occupation in the current city, and this value represents employment instability. If $S_c<0$, then this laborer has changed at least one city while performing the same occupation, and this value represents instability in working-cities. The larger the absolute value is, the greater the instability. If $S_c=0$, then the laborer has been continuously working with a fixed occupation in the current city.

The relationship between the migration stability index of a particular city (S_c, X-axis) and the working duration (Y-axis) is shown in Fig. 3. Laborers who maintain stable employment and stable working-cities account for 66% of the total surveyed sample, whereas workers who changed at least one occupation in the current city represented 23% of respondents, while those who changed at least one city while performing the current occupation represented only 11% of respondents. These results suggest that maintaining employment and stability in working-cities is the priority of rural labor. When faced with changes, laborers tend to change their occupations and enter another industry rather than change working-cities. As the number of working years

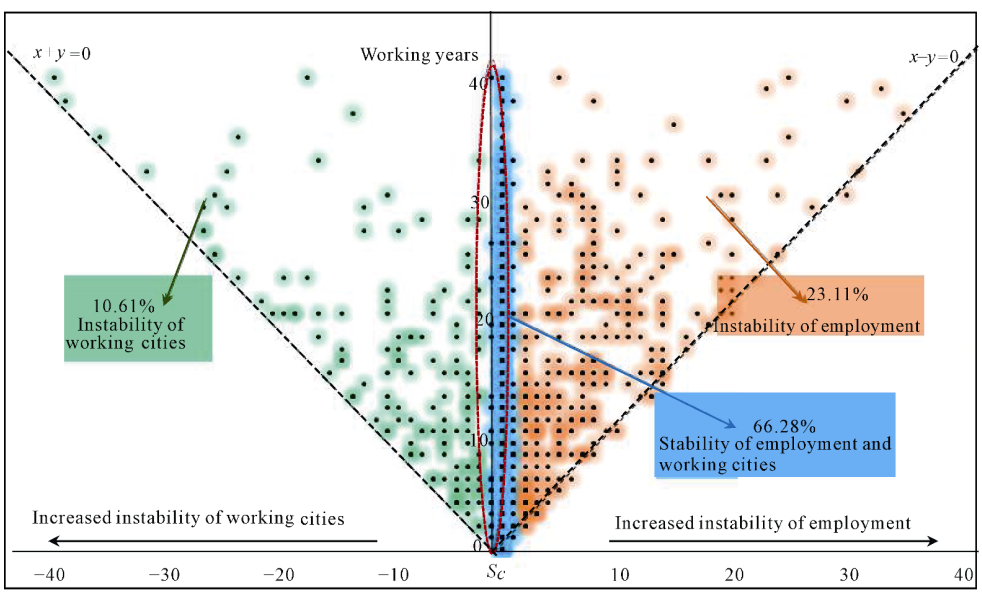

Fig. 3 Decomposition diagram of rural labor migration stability

of rural migrants increases, some rural laborers try their best to maintain stable employment and remain in stable working-cities, although other laborers (34%) frequently change employment and working-cities, and their stability worsens as a result. However, the migration stability index (S_c) of the current city considers only the specific cities, and any corresponding evaluation of migration stability is incomplete.

3.2.2 Comprehensive migration stability index

Since workers may change employment and working-cities in a complicated manner many times, a more comprehensive evaluation method of transfer stability is needed and therefore constructed in this study. The specific method of characterization is as follows. The frequency of changing employment/cities is expressed according to both the number of times the occupation/city changed (only for employment purposes) and the number of working years in the entire migration stage. We calculate the ratio of the number of changes of occupation/city to the total number of migration years to characterize the stability index, i.e., the number of changes in the occupations/working-cities per year. The migration stability of labor is composed of employment stability and working-cities stability, but changes in employment and working-cities are not always synchronized. Thus, the migration stability index is constructed by multiplying the employment stability index by the working-cities stability index. This index is negative: the higher the migration stability index, the more frequent the changes in occupation or working-cities and the worse the migration stability of labor.

Therefore, the migration stability index defined in this study uses the comprehensive evaluation index of the frequency of occupation and working-cities changes during a workers' migration stage, and this index is used to represent the stable state of laborers in out-migration. According to its definition, the formula of the labor migration stability index is as follows (1):

$$T_s = E_s \times W_s,\ E_s = \left(\frac{E_c}{Y_t - Y_e}\right),\ W_s = \left(\frac{W_c}{Y_t - Y_e}\right) \quad (1)$$

where T_s represents the labor migration stability index; E_c represents the number of changes in occupation; W_c represents the number of changes in working-cities or migration destination; Y_t represents the starting year of the initial migration, such as 2004; Y_e = 2018 indicates the survey year; E_s is the employment stability index; and W_s is the working-cities stability index. In subscript, s indicates stability; c indicates counter of changing migration; t indicates starting year and e means ending year.

3.3 Variables and model

3.3.1 Selection and definition of the variables

Based on the key scientific issues, the literature review, and the theoretical framework, this article selected the variables that influence rural labor migration stability considering five classes, namely, demographics, employment, mobility, settlement and migration, which were subdivided into 14 quantitative indicators (Table 1). The working duration was obtained by subtracting the initial labor migration year from the survey year (2018), and the migration distance was obtained by measuring the geographical distance between the working city and the hometown. All variables are organized into discrete variables and assigned values, such as *City* (x_4), where 1=Fuzhou; 2=Xiamen; 3=Wuhan; and 4=Chengdu.

3.3.2 Geodetector

Traditional humanistic empirical analysis uses regression and thus involves various analysis models, such as multiple linear regression, logistic regression, and structural equation models. However, for regression analysis, the variables are ideally continuous and independent of an identical distribution, and they should have either a positive or a negative direction; additionally, there should be no global or local collinearity among variables. If a regression analysis is applied to discrete survey data, then the data must be transformed or restructured. In this process, we must consider the loss of data accuracy and the reduction in information entropy. Geodetector, however, analyzes the influencing factors of dependent variables (y) based on the spatial distribution of independent and dependent variables and can be effectively applied to analyze discrete data, such as type and nominal variables. Geodetector is widely used in spatial factor analysis, does not require the independent codistribution of variables and is immune to collinearity (Wang et al., 2016).

Spatial heterogeneity is the core concept of Geodetector but exists beyond the geospace. In the abstract social space, the individual is the basic analysis unit, which is equivalent to the grids and administrative units in geospace. Different individual attributes (e.g., age,

Table 1 Name, designation and interpretation of the influential variables

Category	Variable	X	Definition and interpretation	Source
Demographics	Gender	x_1	Male; Female	Ask
	Age	x_2	<20; 20–30; 31–40; 41–50; 51–60; >60	Ask
	Education	x_3	Illiterate; Primary school; Junior high school; High school; Junior college; Undergraduate; Graduate	Ask
	City	x_4	Fuzhou; Xiamen; Wuhan; Chengdu	Ask
Employment	Occupation	x_5	Life service; Basic business; Light industry; Cons&Trans (Construction & Transportation); Heavy industry; High-Tech; Knowledge service; Others	Ask
	Working duration (yr)	x_6	<3; 3–6; 6–9; 9–12; 12–15; 15–18; 18–21; 21–24; 24–27; 27–30; >30	Calculation
Mobility	Reason for changing occupation	x_7	Resign & Dismissal; Salary & Environment; Project or work end; Family; Better job; Others;	Ask
	Reason for changing working-cities	x_8	Family & Friends; Better job or income; Self-employment; Dispatch & Send; Inertia; Others	Ask
	Backflow intention	x_9	Willingness; Not clear; Unwillingness because of more opportunities to out-migrate; Unwillingness because the hometown is fading away	Ask
Settlement	Settlement challenge	x_{10}	Housing price; Living cost; Employment; Hukou & Education; Environment pollution; Nostalgia complex; No challenge	Ask
	Settlement intention	x_{11}	Back to village; Back to town; Back to county; Back to another city; Hesitation; Fight to settle; Have settled	Ask
Migration	Migration distance (km)	x_{12}	<150; 150–300; 300–450; 450–600; 600–1000; 1000–2000; >2000	Calculation
	Migration type	x_{13}	Provincial migration; Been to Jing-Jin-Ji; Been to Yangtze River Delta; Been to Pearl River Delta; Been to Sinkiang; Others	Ask
	Employment Experiences before migration	x_{14}	Farming; Studying in school; Business; Working in town; Job-waiting; Official work; Others	Ask

gender, occupation, and income) are the element layers of the social space, such as temperature, precipitation, land use, *etc*., in geospace. Our questionnaire comprises structured fixed options, thus the survey data include the type and nominal variables. The classes (options) of individual attributes (questions) are abstracted into different subareas in social space, and the explanatory power of the dependent variables for the independent variables is analyzed by calculating the variance among the different subareas and the variance within divisions. Therefore, Geodetector is used for factor analysis in the social space. Using the labor migration stability index as the dependent variable, x_1–x_{14} are independent variables in Table 1 and the explanatory power (q) and significance (P) of the variables relative to different cities and industries are analyzed. The formula for Geodetector is as follows (2) (Wang et al., 2016) (http://geodetector.org/):

$$q = 1 - \frac{\sum_{h=1}^{L} N_h \sigma_h^2}{N\sigma^2} \tag{2}$$

where N and σ^2 represent the number of units and the variance of the individual attributes Y, respectively; the population Y is composed of L strata (options) (h = 1, 2, …, L); and N_h and σ_h^2 are the number of units and the variance of Y in stratum h, respectively.

4 Results

4.1 Spatiotemporal characteristics of rural labor migration

4.1.1 Demographics of survey samples

An overview and the basic information of the sample data are shown in Table 2. In the survey, the majority of respondents were male, most were of Han nationality, and the age range was concentrated between 20 and 50. The education level was mainly in junior high school and below, and employment was mainly in *life services* and *basic business*. Regionally, rural labor in the eastern cities is more often male and younger than that in the midwest, which is especially visible in the proportion of laborers aged 18–20. In addition, eastern labor is generally more educated and skilled than midwestern labor. In terms of hukou, only 8.87% of rural laborers moved their hukou to cities.

Table 2 Descriptive demographic statistics of survey samples

Variables	Value	Number of samples	Ratio			
			Total (%)	East (%)	Central (%)	West (%)
Gender	Male	878	58.97	62.08	57.59	56.95
	Female	611	41.03	37.92	42.41	43.05
Age	18–20	47	3.16	5.28	0.67	3.13
	20–30	385	25.86	36.23	25.00	15.85
	31–40	300	20.15	24.53	17.63	17.81
	41–50	424	28.48	21.13	26.12	38.16
	51–60	246	16.52	10.57	22.99	17.03
	>60	87	5.84	2.26	7.59	8.02
Ethnic	Han	1474	98.99	98.87	99.11	99.02
	Other	15	1.01	1.13	0.89	0.98
Education	Illiteracy	111	7.45	4.72	8.71	9.2
	Primary school	396	26.60	17.17	24.11	38.55
	Junior High school	548	36.80	43.58	32.81	33.27
	High school	269	18.07	23.02	16.74	14.09
	Junior college	61	4.10	5.66	4.91	1.76
	Undergraduate	93	6.25	5.47	10.94	2.94
	Graduate	11	0.74	0.38	1.79	2.00
Occupation	Life service	455	30.60	30.19	33.48	28.38
	Basic business	450	30.20	15.09	37.28	39.73
	Cons&Trans	231	15.50	23.77	10.49	11.35
	Light industry	89	6.00	9.25	3.79	4.50
	Heavy industry	136	9.10	11.51	3.79	11.35
	High-Tech	56	3.80	4.15	4.02	3.13
	Knowledge service	40	2.70	1.32	6.47	0.78
	Others	32	2.10	4.72	0.67	0.78
Now Hukou	Rural	1357	91.13	91.13	86.83	94.91
	Urban	132	8.87	8.87	13.17	5.09

4.1.2 Spatiotemporal characteristics of rural labor migration routes

By connecting and visualizing the birthplaces and current working-cities of laborers (Fig. 4a), the sources of rural labor are shown along with the statistical transprovincial migration ratio of rural labor in each city. The average transprovincial migration ratio of the full sample is 62.46%, and that of the east (Fuzhou, Xiamen) was found to be much higher than that in Wuhan and Chengdu; notably, 73.76% of the rural labor in Fuzhou comes from other provinces while only 16.83% of that in Chengdu is from other provinces. Sichuan, Henan, Hubei, Hunan, Anhui, and Jiangxi provinces are the main rural labor-exporting areas, and the northeastern and northwestern regions have less labor migration to the four studied cities than other regions.

A retrospective analysis of the laborers' initial migration experience showed that 29.01% of the laborers traveled to the three major urban agglomerations and then migrated to the current working-cities (Fig. 4b). The ratio of workers that had been to the three major urban agglomerations was highest in Xiamen (41.39%), and the ratio was lowest for Chengdu (25.96%). Most of the respondents in Fuzhou and Xiamen initially migrated to these cities and obtained stable employment, and 55.74% of the respondents in Wuhan and Chengdu

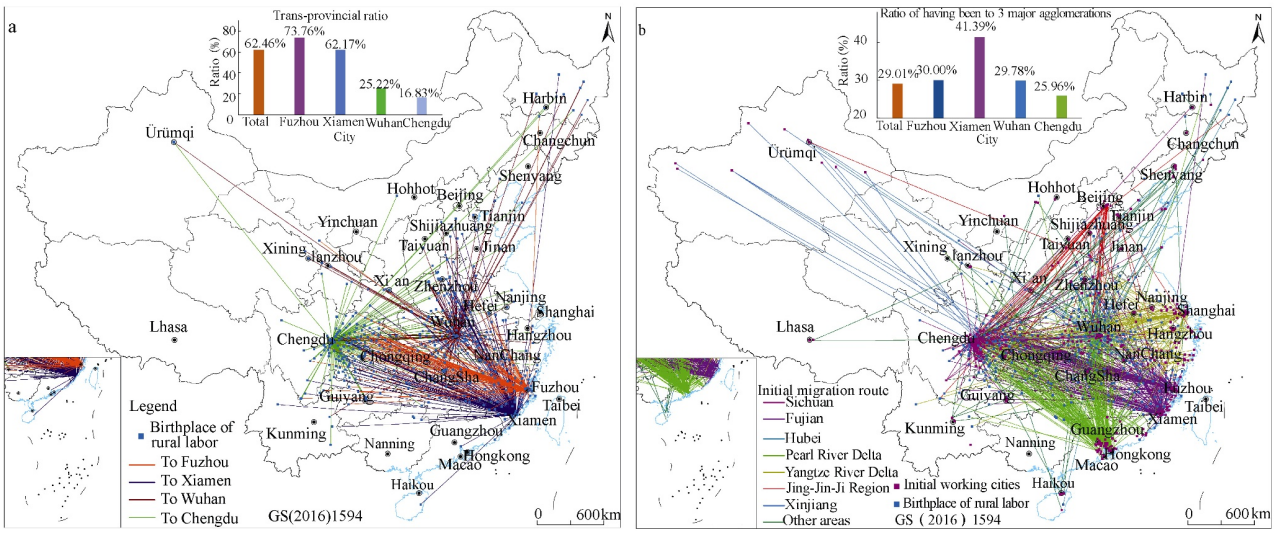

Fig. 4 Rural labor migration source (a) and initial migration routes (b) of the respondents in sampling cities

migrated to the 3 major urban agglomerations before migrating to Wuhan or Chengdu (Fig. 4b). Although the corresponding intraprovincial migration rate was higher than that in the eastern cities (Fig. 4a), migration to the east still dominated, and midwestern cities were often the second choice for rural labor. The eastern cities can attract rural labor from a greater distance, and the midwestern cities mainly attract intraprovincial labor and regurgitant labor migration. Additionally, the survey found that 32% of the respondents indicated that they would be willing to return to their hometown or a city closer to home. In comparison, labor in Chengdu had the highest backflow willingness (37%) while labor in Fuzhou had the lowest willingness (22%), which further confirms that the economic development of eastern cities is more attractive to young and skilled rural labor migrants due to the greater employment opportunities and higher rewards. In the midwestern cities, the proportion of intraprovincial migration was high, there was relatively low migration distance and the willingness to return was high, which may be due to nostalgia, the culture or personal desire. In summary, spatiotemporal characteristics of rural labor migration reflect the dynamic process and changing trends of migration, and also serve as the spatial expression of migration stability in the regional pattern.

4.2 Migration stability of rural labor

Fig. 5a shows that the average labor migration stability index is 0.10, and the average working-cities stability index (0.20) is lower than the average employment stability index (0.23). Overall, the migration stability of rural labor is still low in the context of new-type urbanization. In comparison, the stability index of Xiamen is significantly higher than that of the other cities and the differences among the stability indexes of Fuzhou, Wuhan and Chengdu are small. A comparison of industries (Fig. 5b) showed that *Cons&Trans* (*Construction & Transportation*) has the highest stability index, followed by *Light Industry*, *Basic Business*, *Heavy Industry*, *Life Services*, *Others*, *High-Tech*, and *Knowledge Services*. The more technical the content of employment, the higher the migration stability of rural labor. Employment within *Cons&Trans*, *Light Industry*, and *Basic Business* is highly flexible and highly replaceable; therefore, these industries are characterized by relatively high labor mobility and poor stability. Among these industries, the laborers engaged in *Cons&Trans* often change jobs because projects end. The division of labor in *Cons&Trans* is at a low level, and strong interoperability occurs among roles, which leads to more frequent changes in employment and working-cities in *Cons&Trans* than in other industries. Furthermore, except for *Basic Business*, the employment stability indexes of the other industries are higher than the working-cities stability index, indicating that most rural laborers change employment more often than they change working-cities; that is, maintaining a stable working city is more important than maintaining stable employment.

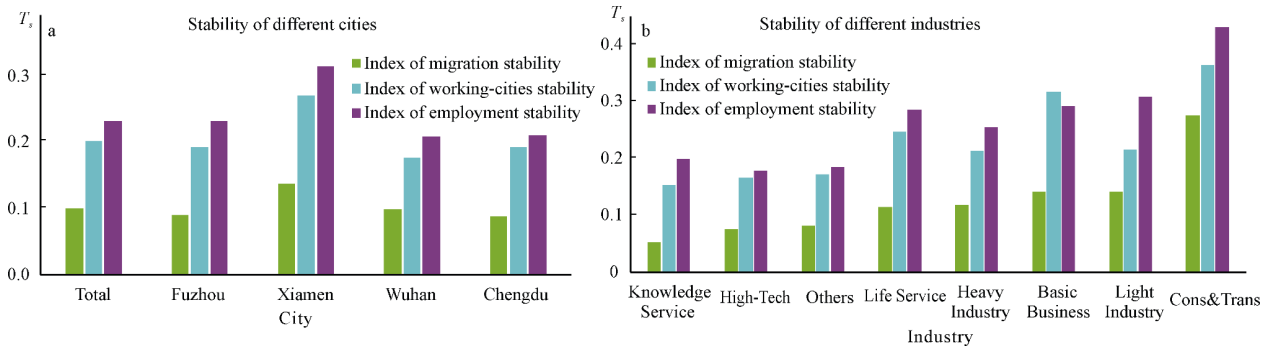

Fig. 5 Migration stability indexes of rural labor in different cities (a) and industries (b). T_s represents the labor migration stability index

4.3 Determinants of labor migration stability

4.3.1 Comprehensive analysis of determinants

Geodetector was used to obtain the explanatory power (q) and significance (P) of each variable associated with the migration stability of rural labor (Table 3). The results show that *Age*, *Education*, *City*, *Employment*, *Working Duration*, *Reasons for Changing Occupation*, *Settlement Challenges*, *Settlement Intentions,* and *Employment Experience before Migration* have a significant impact on migration stability. The strongest explanatory variable is *Working Duration*. The migration stability of different working durations was calculated, and the results showed that a longer duration of the migration corresponds to stronger stability. At the beginning of their migration, rural laborers have more courage to try different employments and explore various working-cities, and then rural migrants gradually choose stable employment and working-cities as their working duration increases. This finding is supported by the labor migration stabilities of different age brackets. The stability index of 18- to 20-year-old laborers reaches as high as 0.58, while the stability index of 51- to 60-year-old laborers is only 0.039.

Upon comparing the variables, the employment and settlement variables have the greatest impact on labor migration stability and should be considered in migration decisions. *Occupation*, *City* and *Working Duration* have relatively direct impacts on decision-making regarding changes in employment. A change in working-cities is affected by the settlement variables, and different settlement challenges and intentions affect the decision-making related to maintaining stable working-cities. Laborers with the worst migration stability consider hukou and education to be their greatest settlement challenges, and those with the highest migration stability consider housing prices and living costs to be their greatest challenges (Fig. 6a). Hukou and education are institutional barriers, whereas concerns about housing prices and living costs indicate that rural laborers intend to settle in the city, thereby increasing their migration stability (Chen et al., 2019), although more than 50% of rural laborers believe that housing prices constitute their biggest settlement challenge. Considering settlement intentions, laborers who want to return to other cities have the highest stability index, and this index is significantly higher than those of other options (Fig. 6b). Laborers that have settled and fought to settle (30%) are the most stable. In short, these laborers have stronger settlement intentions and less of a settlement challenge, so they also have high migration stability and are willing to obtain urban hukou.

Table 3 Explanatory power and confidence of determinants for the migration stability

Variables	Demography			Employment			Mobility			Settlement		Migration		
	x_1	x_2	x_3	x_4	x_5	x_6	x_7	x_8	x_9	x_{10}	x_{11}	x_{12}	x_{13}	x_{14}
q	0.000	0.164	0.048	0.007	0.018	0.420	0.002	0.015	0.000	0.010	0.027	0.008	0.006	0.043
P	0.615	0.000*	0.000*	0.014*	0.000*	0.000*	0.823	0.000*	0.792	0.028*	0.000*	0.081	0.150	0.000*

Note: * Significant at 95%; Variables of x_1–x_{14} listed in Table 1

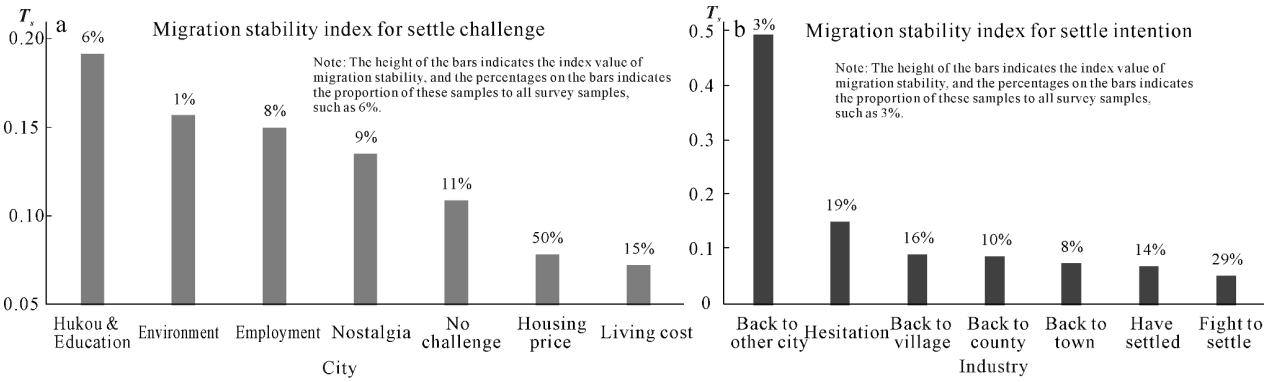

Fig. 6 Migration stability index for settlement challenge (a) and settlement intention (b)

4.3.2 Analysis of determinants in different cities

Cities are used as a control variable to detect differences in the determinants of rural labor migration stability between regions (Table 4). The results show that *Age*, *Education*, *Working Duration*, *Settlement Intention*, and *Employment Experience before Migration* have overall significant effects on migration stability and represent the commonalities affecting labor migration. The regional differences are reflected in *Gender*, *Occupation*, *Reasons for Changing Occupation*, and *Migration Distance*.

The average male has a labor migration stability index (0.11) that is approximately twice that of the average female in Chengdu (0.06). The intraprovincial migration ratio of Chengdu is much higher than that of other cities. A portion of the labor has flowed back to Chengdu from the eastern urban agglomerations, and the long-distance migrants are mostly male: thus, the rich migration experience reduces the migration stability of rural laborers (Xie et al., 2015). The average migration distance of labor in Chengdu is the shortest (256 km), whereas that in Fuzhou is the longest (839 km). A statistical analysis of the migration stability indexes of different migration distance segments in different cities (Fig. 7a) shows that rural labor in Fuzhou, Xiamen, and Wuhan has the highest stability in the 450–600 km segment, whereas rural labor in Chengdu has the lowest stability in this distance segment. Because laborers with a migration distance of more than 600 km are mostly from other provinces in Chengdu, this segment of the labor force has not migrated to the eastern developed coastal cities but rather has migrated to the western cities, reflecting the workers' intentions to obtain long-term employment and settle in Chengdu, thereby increasing their migration stability.

In total, 57.35% of rural laborers changed occupations because of family and friends, which was followed by changed occupations to obtain increased income (24.98%) (Fig. 7b). Family and friends are crucial factors in the decision-making process associated with changing working-cities, and laborers who migrate due to family and friends have the strongest stability. The eastern cities mainly attract long-distance and transprovincial migrants seeking high risk and reward opportunities. In recent years, many families have sent pioneering laborers and their families and friends later follow when conditions are ideal. The social space of this floating population is formed based on this interpersonal guanxi. These findings show that family and social guanxi help to enhance labor migration stability.

Table 4 Explanatory power and confidence of variables affecting the migration stability in different regions

Region (N)		Demography			Employment		Mobility		Settlement			Migration		
		x_1	x_2	x_3	x_5	x_6	x_7	x_8	x_9	x_{10}	x_{11}	x_{12}	x_{13}	x_{14}
East (530)	q	0.000	0.169	0.033	0.016	0.350	0.005	0.015	0.004	0.026	0.036	0.007	0.010	0.041
	P	0.987	0.000*	0.017*	0.315	0.000*	0.781	0.005*	0.542	0.056	0.000*	0.755	0.407	0.005*
Central (448)	q	0.005	0.114	0.090	0.055	0.499	0.008	0.015	0.007	0.018	0.055	0.032	0.0185	0.075
	P	0.152	0.000*	0.000*	0.004*	0.000*	0.656	0.297	0.367	0.261	0.017*	0.111	0.166	0.000*
West (511)	q	0.008	0.206	0.065	0.037	0.473	0.006	0.039	0.005	0.012	0.039	0.046	0.014	0.059
	P	0.041*	0.000*	0.000*	0.012*	0.000*	0.726	0.032*	0.501	0.534	0.008*	0.005*	0.293	0.002*

Note: * Significant at 95%

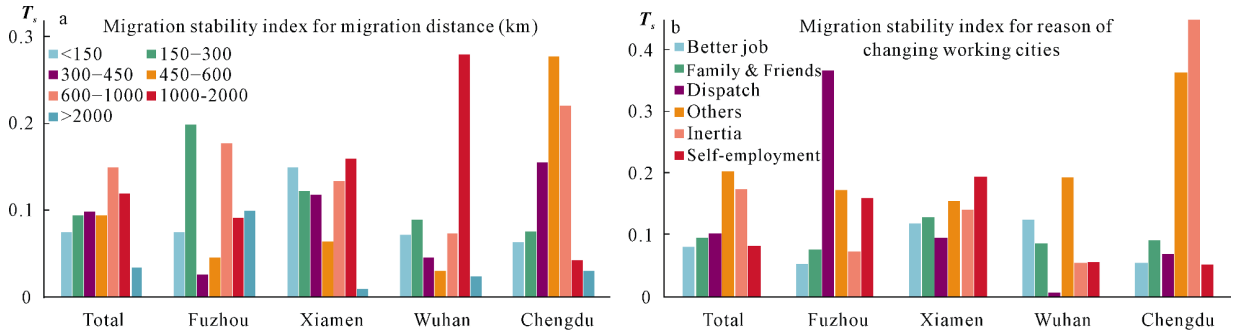

Fig. 7 Migration stability index for the migration distance (a) and reasons for changing working-cities (b)

4.3.3 Analysis of determinants in different industries

Industry was used as a control variable to analyze the differences in labor migration stability (Table 5). Because the sample sizes for *High-Tech*, *Knowledge Service*, and *Others* were less than 60, which resulted in low significance, we focused on the determinant differences in *Life Services*, *Basic Business*, *Cons&Trans*, *Light Industry*, and *Heavy Industry*. The results show that *Age* and *Working Duration* are the factors that most commonly affect the labor migration stability in different industries. Thus, the migration duration of rural labor plays a vital role in the stability of migration. A longer migration duration helps migrants obtain stable employment and working-cities and residences, which further indicates that migration stability is gradually forming over the course of the migration spatiotemporal process.

Among the industries, *Basic Business* has the nine most significant explanatory variables, including *Demographics*, *Employment,* and *Migration* class variables. *Life Services* is significantly affected by six variables. The labor migration stability within *Life Services* and *Basic Business* fluctuates greatly and is comprehensively affected by many variables. Although *Cons&Trans* has the worst labor migration stability, it is affected by only three variables, namely, *Age*, *Working Duration* and *Settlement Intention*. The significant variables of *Light Industry* and *Heavy Industry* are relatively similar, with the only difference being the *Migration Type*; that is, employment experience and the region of migration influence only the migration stability of *Heavy Industry*, indicating that the impact of industrial transfer on *Heavy Industry* is greater than the impact on *Light Industry*.

Table 5 Explanatory power and confidence of the variables affecting the migration stability in different industries

Industry (N)		Demography			Employment		Mobility			Settlement		Migration		
		x_1	x_2	x_3	x_4	x_6	x_7	x_8	x_9	x_{10}	x_{11}	x_{12}	x_{13}	x_{14}
Life Service (455)	q	0.000	0.145	0.037	0.008	0.431	0.005	0.045	0.008	0.036	0.021	0.030	0.010	0.075
	P	0.886	0.000*	0.040*	0.292	0.000*	0.823	0.011*	0.360	0.039*	0.188	0.056	0.490	0.000*
Basic Business (450)	q	0.009	0.176	0.118	0.078	0.435	0.002	0.003	0.008	0.004	0.068	0.081	0.068	0.106
	P	0.042*	0.000*	0.000*	0.000*	0.000*	0.955	0.958	0.308	0.953	0.000*	0.000*	0.000*	0.000*
Cons&Trans (231)	q	0.000	0.204	0.048	0.003	0.342	0.049	0.062	0.017	0.041	0.129	0.020	0.018	0.044
	P	0.975	0.038*	0.114	0.866	0.000*	0.088	0.060	0.364	0.185	0.000*	0.657	0.551	0.156
Light Industry (89)	q	0.012	0.959	0.025	0.023	0.970	0.015	0.008	0.008	0.171	0.014	0.033	0.026	0.025
	P	0.312	0.000*	0.748	0.589	0.000*	0.943	0.984	0.872	0.052	0.976	0.838	0.843	0.840
Heavy Industry (136)	q	0.001	0.182	0.109	0.029	0.545	0.045	0.014	0.001	0.039	0.041	0.052	0.119	0.059
	P	0.682	0.000*	0.066	0.287	0.000*	0.313	0.883	0.983	0.627	0.522	0.353	0.039*	0.433
High-Tech (56)	q	0.000	0.107	0.067	0.016	0.385	0.063	0.012	0.040	0.065	0.136	0.125	0.035	0.040
	P	0.986	0.394	0.638	0.839	0.020*	0.712	0.989	0.646	0.777	0.334	0.365	0.641	0.723
Knowledge Service (40)	q	0.018	0.063	0.072	0.021	0.315	0.222	0.117	0.026	0.011	0.037	0.074	0.026	0.191
	P	0.407	0.771	0.793	0.856	0.076	0.368	0.487	0.816	0.985	0.979	0.617	0.971	0.299
Others (32)	q	0.020	0.283	0.088	0.042	0.325	0.225	0.006	0.039	0.197	0.109	0.027	0.151	0.015
	P	0.443	0.220	0.762	0.757	0.342	0.620	0.984	0.770	0.554	0.694	0.984	0.479	0.938

Note: * Significant at 95%.

5 Discussion

5.1 Dynamic characteristics of rural migrants under industrial transfer

Many scholars have shown that China is undergoing industrial transfer, and labor-intensive industries are gradually transferring from the eastern to the midwestern cities (Wang and Weaver, 2013). Thus, a large number of rural laborers who originally migrated to the eastern cities are now following the industrial transfer trend and returning. Which is resulting that rural labor intraprovincial migration ratio is greater than the transprovincial migration ratio in midwestern regions, such as Sichuan (Liu et al., 2013). However, the labor backflow trends are not as significant and sustainable as expected (Knight et al., 2011). Changing employment or working-cities is a comprehensive trade-off process that is both subjective and objective; that is, these changes may be due to the pursuit of progress or forced by social pressure. In recent years, industrial transfer and upgrades have caused changes in the labor market and employment structure, which has led to changes in labor migration stability. Thus, rural labor faces two options: changing working-cities or employment. The former is considered to be the main cause of rural labor backflow, whereas the latter leads to changes in employment to adapt to industrial upgrades and labor market adjust.

According to the results of this study, rural laborers prefer to change employment and to maintain stable working-cities when they have to make changes; therefore, the backflow trend is not significant as expected. In the context of industrial transfer, the laborers returning to the midwest are likely already closer to hometown, so the convenience of the proximity to hometown can offset some losses from long-distance migration due to migration costs, risks and interpersonal guanxi. It should be pointed out that, rural labor still needs to make trade-offs in selecting potential migration destination when changing working-cities. Social investigation found that in eastern cities, industrial transfer tended to be characterized by transfer through diffusion rather than jump transfer to the midwest. Although many labor-intensive industries are transferred to the suburbs of eastern center cities, rural laborers choose long-distance commuting to maintain stable working-cities or settle in suburbs closer to their place of employment (Tian et al., 2018). Migrating laborers believe that changing working-cities would face additional migration costs and risks, leaving them to confront an uncertain employment market and causing them to lose their mature and stable interpersonal guanxi. Therefore, due to the familiar social space and employment market, most rural laborers of eastern cities still tend to maintain stable working-cities.

5.2 Dynamic characteristics of rural migrants under the unified labor market

Some studies have argued that industrial transfer will gradually promote rural labor to return from the eastern to the midwestern cities in China (Knight et al., 2011; Liu et al., 2013). However, this argument ignores a key factor in China, namely, the soft borders (provincial borders) between different regions rather than hard borders (e.g., national borders). Additionally, China has a unified labor market, employment market and industrial market. When labor costs rise in the eastern cities, there is still ample and relatively cheap labor from midwestern rural areas that can migrate to the east, and the cost of transprovincial migration is much smaller than that of cross-border migration. Although major eastern cities are undergoing industrial upgrades, there are still sufficient small cities and suburbs around center cities to support industrial transfer by offering comparative advantages in infrastructure and industrial support in the east.

The role of traffic in the unified labor market cannot be ignored (Thorsen and Thorsen, 2017). In recent years, the rapid construction of China's railways, airports, and highways, particularly the construction of high-speed railways, has reduced the travel time from the midwest to the east to one day. The Geodetector analysis shows that the migration distance has little effect on the labor backflow in western cities. Respondents said that the convenience of high-speed trains has gradually narrowed the differences in migration costs between moving to midwestern cities and moving to eastern cities; therefore, laborers are willing to migrate to eastern cities due to high incomes and abundant opportunities. For industry, the improvement of transportation convenience has resulted in a decline in logistical costs. Therefore, the unified labor market has enhanced the mobility and fluidity of labor, which has somewhat delayed labor backflow and industrial transfers. It is undeniable that with the deepening development of in-

dustrial transfer, the trends of rural labor backflow will be more obvious.

6 Conclusions and Implications

Based on the survey data for rural migrants across eastern, central and western China, this paper presents the current migration routes and the spatiotemporal characteristics of rural labor migration, assesses the migration stability of rural labor under industrial transfer and analyzes its determinants in different cities and industries. This research presents two main innovations: First, a comprehensive labor migration stability index is built based on changes in employment and working-cities to quantitatively depict the labor migration stability in different cities and industries. Second, Geodetector is applied for social attribution analysis, and the importance of individual experiences and urban characteristics in maintaining migration stability is analyzed. Based on these innovations, the main conclusions of this study can be stated:

(1) Compared with the midwestern ratio, the eastern transprovincial migration ratio is higher, suggesting that the eastern cities can attract younger and more skilled rural laborers migrating from a greater distance while central and western cities mainly attract intraprovincial rural migrating and backflow rural labor.

(2) The migration stability analysis shows that the working-cities stability of rural migrating labor is higher than the employment stability, and that rural labor prefers to change employment in the post-immigrate era. Among industries, the higher the technical content of the occupation is, the higher the migration stability of rural labor.

(3) The Geodetector results show that *Demographics*, *Employment*, *Mobility*, *Settlement*, and *Migration Experience* have significant impacts on the migration stability of rural labor, especially *Working Duration*, *Settlement Challenge,* and *Settlement Intention*. Taking the city and industry separately as control variables, the labor migration stability displays significant differences among different economic regions, which indicates that industrial transfer and labor markets shape the labor geography landscape.

China's significant regional differences result in the domestic industrial transfer being characterized by diversity and complexity, and the unified labor market and convenience of transportation have increased the mobility of rural migrants, thereby delaying labor backflow and industrial transfers to some extent; thus, the scenario involving China's rural migrants differs from that under a single market or small regions. Empirical analyses and social surveys indicate that rural migrating laborers have strong settlement intentions, although migrants face livehood and institutional challenges, including hukou, housing and social security in the post-immigrate era. This study found that family and social guanxi help to enhance labor migration stability and hedge the stability risks associated with industrial transfer and upgrades. Therefore, lowering the threshold for the citizenization of rural labor, providing adequate public services, and reducing the challenges of settling and building families (high housing prices), especially for major cities in midwest, are the key solutions to promoting people-oriented urbanization, citizenization and gradually stabilize cities migrants.

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