

Spatial patterns, driving forces, and urbanization effects of China's internal migration: County-level analysis based on the 2000 and 2010 censuses

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Abstract: China has witnessed unprecedented urbanization over the past decades. The rapid expansion of urban population has been dominantly contributed by the floating population from rural areas, of which the spatiotemporal patterns, driving forces, and multidimensional effects are scrutinized and evaluated in this study by using the latest national censuses conducted in 2000 and 2010. Analysis based on the county-level data comes to conclusions as follows. The spatial pattern of floating population has remained stable over the first decade of the new century. The top 1% cities with the largest floating population received 45.5% of all migrants in China. As the rapid development of mega-city regions, the coastal concentration areas of floating population tended to geographically united as a whole, whereas the spatial distribution of migrants within each region varied significantly. The migrant concentration area in the Yangtze River Delta was the largest and its expansion was also the most salient. However, the floating population has growingly moved into provincial capitals and other big cities in the inland regions and its gravity center has moved northward for around 110 km during the study period. The spatial pattern of floating population has been formed jointly by the state and market forces in transitional China and the impacts of state forces have been surpassed by those of market forces in the country as a whole. The attractiveness of coastal cities and counties to the floating population comes mainly from the nonagricultural employment opportunities and public services, reflecting that long-distance and long-term migrants have moved coastward not only to gain employment but also to enjoy city life. By contrast, in the central and western regions, places with a higher economic development level and at a higher administrative level are more attractive to floating populations, demonstrating that the state remains to play an important role in allocating economic resources and promoting regional development in inland China. As the main body of new urban residents, the floating

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population has contributed substantially to the elevation of the urbanization levels of migrant-sending and -receiving places, by 20.0% and 49.5% respectively. Compared with extensively investigated interprovincial migrants, intra-provincial migrants have higher intention and ability to permanently live in cities and thus might become the main force of China's urbanization in the coming decades. The internal migration has also reshaped China's urban system in terms of its hierarchical organization and spatial structure.

Keywords: floating population; migration; urbanization; urban system; megacity region; census; China

1 Introduction

Urbanization in China is progressing at an unprecedented scale and speed and has received extensive attention of the world. In a new era in which more than half of the population resides in cities, urbanization has become a core concern for national development. Within the recent 30 years of urban development in China, the floating population (i.e., migrants) has been the primary contributor to the national urbanization, and therefore has been a research focus for numerous domestic and international scholars (Chan and Zhang, 1999; Fan, 2008; Bosker *et al.*, 2012; Fu and Gabriel, 2012; Ma and Chen, 2012; Lu *et al.*, 2013).

China is a large country possessing an immense population and vast territory; therefore, a crucial basis for studying migration and urbanization is to understand the spatial distribution patterns of the floating population in China. Relevant studies have reported that the floating population is mainly concentrated in coastal megacity regions, which are the Yangtze River Delta, Pearl River Delta, and Beijing-Tianjin-Hebei Region (Ding *et al.*, 2005; Fan, 2008; Cao and Liu, 2011; Shen, 2012; Wang *et al.*, 2012; Yu, 2012). However, since the new century, the economic development in China has shown a trend of moving toward inland regions; in other words, the central and western regions of China have played an increasingly substantial role in national urbanization (Cao and Liu, 2011). Therefore, whether the migration phenomenon has also shown the same trend of moving toward inland regions and whether the migration to inland regions has resulted in a new spatial pattern of the floating populations must be examined. Current studies on this topic have been conducted mostly at the provincial level; however, investigations regarding migration within provinces, which may exert more substantial influence on urbanization and regional development than the migration across provinces, have remained scant. Additionally, several studies on the prefecture-level cities cannot precisely depict the regional influence of migration either (Wang *et al.*, 2012; Yu, 2012). Therefore, studies at the county level can not only efficiently portray the spatial distribution of the floating population, but also facilitate the understanding of the spatial pattern of migration and its influence on urbanization.

Numerous scholars have explored the formation of the spatial patterns of floating populations (Fan, 2008; Wang *et al.*, 2012; Yu, 2012) and primarily focused on two aspects: (a) individual decisions were examined by conducting questionnaire surveys, and (b) regional comparisons were conducted based on census data. The results have shown that the scale and spatial distribution of migrants are substantially influenced by numerous factors, including the income gap between urban and rural areas, nonagricultural employment opportunities, household registration deregulation, the rural land system, and the tax system (Zhao, 1999; Zhu, 2002; Mullan *et al.*, 2011; Bosker *et al.*, 2012). These factors reflect that the state and market forces coexist and exert interactive effects that prompt large-scale internal mi-

gration in transitional China (Liang and White, 1997; Fan, 2005; Shen, 2013). For example, the deregulation of household registration and migration restriction is a process of marketization, but it has been continuously affected by governmental policies related to household registration, land, and social security. Moreover, the government's influence on internal migration is not limited to the direct effect of public policies; its influence on the economic resource distribution through market mechanisms, which is reflected on industrial distribution and the construction of infrastructures and public service systems, also have substantial indirect effects on the spatial distribution of the floating population. Therefore, the driving mechanisms of state and market forces behind the internal migration in transitional China require a thorough comparison and analysis.

The floating population is a central topic in urbanization and is the primary contributor to urban growth in China; therefore, changes in the spatial patterns of the floating population may generate fundamental influences on the urbanization and urban system in China. However, a large number of migration studies in China have rarely systematically analyzed the spatial distribution of the floating population, although they typically emphasize the crucial influence of the floating population on socioeconomic development (Du and Chen, 2010; Fan, 2011). Some essential issues have remained vague in existing literature. To what extent has internal migration facilitated the elevation of urbanization levels in migrant-sending and -receiving places? How have migrants' choices among cities at various levels and in different regions influenced the alteration of the urban system in China?

In this study, the most current national census conducted in 2010 is the basis for the exploration of the questions raised above. By using the county-level data gathered from the fifth and sixth national censuses, which were conducted in 2000 and 2010 respectively, statistical and spatial analyses are carried out and an econometric model is then developed to identify and explain the major characteristics of the changes in the spatial patterns of the floating population in China during the first decade of the 21st century. This study attempts to elucidate the driving mechanisms of the state and market forces that influenced the internal migration and to systematically evaluate the effects of migration on the Chinese urbanization and the transformation of the urban system in China.

2 Data and methodology

2.1 Data

The data used in this study were derived from the fifth and sixth national censuses conducted at a county level in 2000 and 2010, which were integrated into the administrative division system in 2010. In this study, the floating population was defined as intra-provincial (inter-county) and interprovincial migrants, referring to people who currently reside in one county but have their registered residence in another county (city or district) and have left their registered residence for more than 6 months. In addition, migration within counties was also examined as a supplement in some parts of the paper. Because people who had their current residence and registered residence in different districts of a city were not counted as inter-county migrants, all districts were combined as a geographic unit. Therefore, we obtained 2284 basic geographical units, including 287 districts in cities at the prefecture level or above, 370 county-level cities, and 1627 counties. In this study, if no specific explanation

was provided, cities at or above the prefecture level generally signified the districts in the cities. The county-level data in the national censuses used in this study also involved total population, registered household (*hukou*) population, employed population by industry, and urban and rural population. Moreover, the econometric model and assisted analysis employed data extracted from *Tabulation on the 2010 Population Census of the People's Republic of China*, *China City Statistical Yearbook 2011*, *China Statistical Yearbook for Regional Economy 2011*, and *China County Statistical Yearbook 2011*. However, because data regarding the income and fixed asset investment of the Tibet Autonomous Region were unavailable, this region was excluded from the econometric model.

2.2 Methods

The global spatial autocorrelation statistics measure Moran's I was used to verify the spatial dependence of the distribution of the national floating population (Eq. 1) (Gatrell, 1979).

$$I = \frac{n \sum_{i=1}^n \sum_{j=1}^n w_{ij} (x_i - \bar{x})(x_j - \bar{x})}{\sum_{i=1}^n \sum_{j=1}^n w_{ij} \sum_{i=1}^n (x_i - \bar{x})^2} \quad (1)$$

where x_i and x_j denote the scale of county (or city) i and j ; w_{ij} is an element of a matrix of spatial weights; and n signifies the number of counties and cities in the region. The values of I range from -1 to 1 , of which the sign represents the type of spatial autocorrelation and the absolute value indicates the strength of the autocorrelation. The Moran's I value of 0 means no spatial autocorrelation exists. The statistical significance of Moran's I is represented by Z-scores: $Z(I) = [I - E(I)] / \sqrt{\text{Var}(I)}$.

The local spatial autocorrelation statistics measure local Moran's I (LMI) was also used in this study (Anselin, 1995). The LMI for a county (or city) i was calculated using Eq. 2, where county (or city) i was influenced by county (or city) j .

$$I_i = \frac{(x_i - \bar{x})}{\sum_i (x_i - \bar{x})^2} \sum_j w_{ij} (x_j - \bar{x}) \quad (2)$$

To analyze the influence of the state and market on migration, this study adopted a multiple regression method to estimate the econometric model. Other analysis methods were also employed, involving coefficient of variation, correlation analysis, rank correlation coefficient, chi-square test, ArcGIS spatial visualization, and spatial gravity model.

3 Changing spatial patterns of China's floating population

In the past decade, the floating population in China increased from 79.0 million in 2000 to 170.6 million in 2010, or by 115.9% with an average annual growth rate of 8.0% (Table 1). During the same period, the ratio of the floating population to the *hukou* population showed a twofold increase, from 6.4% to 12.7%. The number of intra-provincial migrants increased from 36.4 million to 84.7 million (by 132.8%), and that of interprovincial migrants increased from 42.6 million to 85.8 million (by 101.4%). In the following section, the migrant concentration and dispersion trends, the changing spatial patterns, and the evolving migration models are analyzed.

Table 1 Concentration of China's floating population (million person, %)

		Floating population	%	<i>Hukou</i> population	Floating/ <i>hukou</i> ratio
2000	Top 10	27.0	34.1	50.1	53.8
	Top 23 (1%)	35.9	45.5	93.9	38.3
	Top 100	53.5	67.7	204.5	26.1
	Nation	79.0	100.0	1234.3	6.4
2010	Top 10	54.9	32.2	77.4	70.9
	Top 23 (1%)	77.9	45.6	118.4	65.7
	Top 100	120.3	70.6	235.6	51.1
	Nation	170.6	100.0	1345.5	12.7

Sources: National Census 2000 and 2010

3.1 Overall trend of concentration and dispersion

3.1.1 Stable concentration in extra-large cities and the slight dispersion

The overall trend that migrants are concentrated in a few large cities has not changed significantly over the past decade. Data from the 2000 national census showed that the top 1% of cities that had the largest floating population received 45.5% of all migrants in China, and this percentage remained stable in the following 10 years (Table 1). However, the *hukou* population in these large cities in 2000 and 2010 only accounted for 7.6% and 8.8% of the national total, respectively. In 2000, more than two thirds of the floating population (67.7%) was concentrated in 100 cities and counties, and the proportion increased to 70.6% in 2010. When analyzing the population size of new migrants in counties and cities from 2000 to 2010, we observed that the cities that involved a high number of migrants in 2000 continued to receive a large floating population in the following 10 years (Figure 1). The correlation

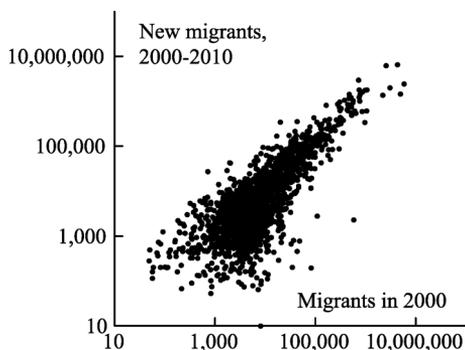


Figure 1 The stock and increment of floating population in China's counties

coefficient between the stock and the increment of floating population in Chinese counties was 0.764. Furthermore, the total population size of migrants in county-level divisions, the population of inter-provincial migrants, and that of intra-provincial migrants were ranked, and the rank vectors of the data from 2000 and 2010 were compared. The result showed that the Spearman's rank correlation coefficients for the three ranking positions between 2000 and 2010 were all larger than 0.85. Thus, the overall stability of migrant distribution across cities was further verified.

The overall migrant distribution pattern continued to be a high level of concentration, whereas a slight tendency of dispersion was also observed. The coefficient of variation (i.e., the ratio of the standard deviation to the mean value) for the floating population size at county level declined from 6.39 in 2000 to 5.91 in 2010, indicating a dispersed tendency. Moreover, in 2000, the migrants in the top 10 cities that had the largest floating populations accounted for 34.1% of the total migrants in China, but the percentage decreased to 32.2% in 2010. Although the range of decrease was small, the data reflected that the ability of mega-

cities to absorb migrants is not limitless. In addition, although the ratio of the floating population to the *hukou* population exhibited a twofold increase from 2000 to 2010 at the national level, the ratio for high-level cities did not increase at a similar rate. In high-level cities, the ratio only shows a small increase (from 53.8% to 70.9%) over the 10-year period. Consequently, the overall pattern of the highly centralized distribution of the floating population in China did not change substantially, but a tendency of dispersion and equilibrium distribution has recently emerged.

3.1.2 Various concentration models in coastal megacity regions

In 2010, 12 cities in China had more than two million migrants, and nine of these cities were located in the three major coastal megacity regions, namely, the Yangtze River Delta, Pearl River Delta, and Beijing-Tianjin-Hebei Region (Figure 2). Shanghai particularly involved the highest number of migrants (10.85 million). Another two central cities of the Yangtze River Delta, Hangzhou and Nanjing, had 2.48 million and 2.19 million migrants, respectively, which ranked the 11th and 12th largest floating population size. In the Beijing-Tianjin-Hebei Region, the number of migrants in Beijing and Tianjin was 8.79 million and 3.72 million, respectively, ranked the 2nd and the 6th. In the Pearl River Delta, the floating population sizes of Shenzhen, Dongguan, Guangzhou, and Foshan were ranked the 3rd, 4th, 5th, and 7th, respectively, and the total floating population in the four cities was 23.32 million. In the inland region, the population of migrants in Chengdu, Wuhan, and Chongqing ranged between 2.50 million and 3 million and were ranked from the 8th to the 10th. Furthermore, when we combined the 25 cities that had one million to two million migrants, the different patterns of migrant distribution in the three major coastal megacity regions can be clearly identified. Specifically, in the Beijing-Tianjin-Hebei Region, only Beijing and Tianjin possessed a floating population larger than one million, whereas Shijiazhuang was one of the only two coastal provincial capitals that had less than one million migrants (the other one was Haikou). This phenomenon indicated a polarization pattern of floating population distribution, that is, one central city accompanied with one sub-center without any other cities with a relatively large number of migrants. In the Yangtze River Delta, the sizes of the floating population in Ningbo, Suzhou, Wuxi, Changzhou, and Wenzhou were all between one million and two million. Thus, there were totally nine cities in the Yangtze River Delta that had a floating population exceeding one million, demonstrating a distribution pattern in which population concentration and dispersion were combined (i.e., a major city and two secondary cities with multiple poles). In the Pearl River Delta, Zhongshan and Huizhou were cities that involved more than one million migrants; together with the four cities in which the floating population exceeded two million (i.e., Shenzhen, Dongguan, Guangzhou, and Foshan), these megacities were geographically closely connected and formed a megacity region, exhibiting a population distribution pattern described as the co-existence of multiple poles. By comparison, the floating population in the surrounding cities was relatively small. Moreover, Xiamen, Qingdao, and Dalian, which were specifically designated cities in the state plan, as well as 14 provincial capitals, accommodated more than one million migrants. Jinjiang City, Fujian Province was the only county-level city that attracted more than one million floating populations, although the total floating population was only 1.01 million.

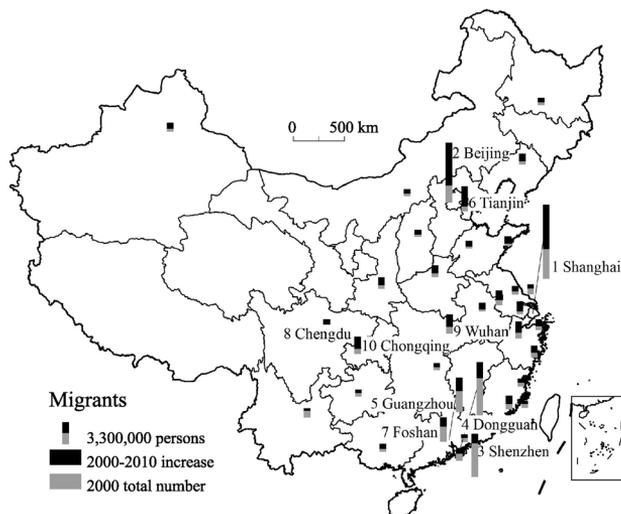


Figure 2 Cities with more than 1 million floating population in China
 Sources: National Census 2000 and 2010
 (Note: The number before a city is the rank of the city in floating population)

3.2 Changing spatial distribution

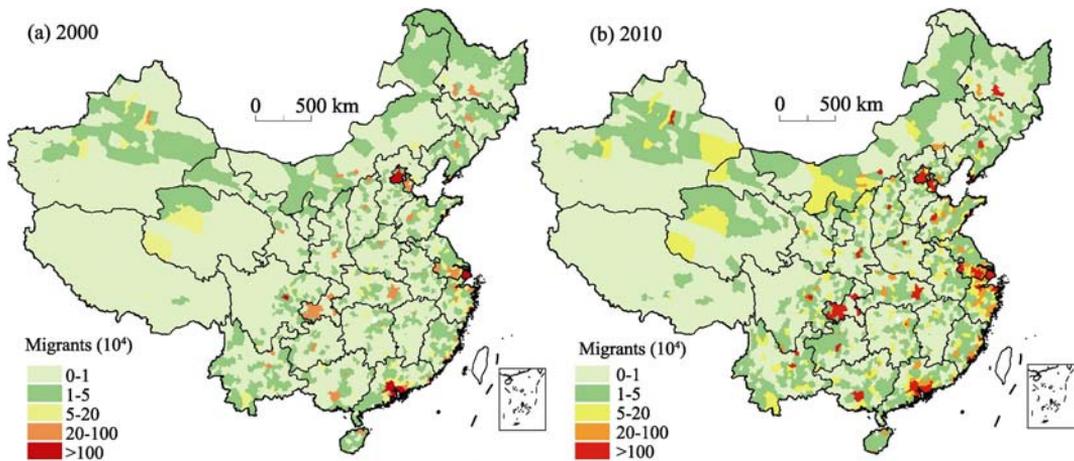
3.2.1 Expanding coastal clusters and rising inland regions

This study further examined the detailed characteristics of dispersion and concentration of China's floating population by conducting spatial visualization. Through a comparison of the spatial patterns in 2000 and 2010, several characteristics could be identified in the changing spatial distribution of the floating population (Table 2 and Figure 3). First, the migrants in the eastern, central, and western regions remained to account for a similar proportion of the total floating population from 2000 to 2010. The migrant growth rates of the three areas were all in a range of 115% to 120%, indicating that no significant difference existed among the three areas. Migrants in the eastern region accounted for approximately two thirds of the total migrants in China, and the proportion remained steady over the 10 years. Migrants in the western region accounted for a higher proportion of the total floating population than those in the central region did, and the proportion increased comparatively quickly. The ratio of the floating population to the *hukou* population in the western region was also higher than that in the central region. This difference in the floating population between the two regions becomes more remarkable when we consider the higher developmental level and the larger amount of employment opportunities in the central region than those in the western region. The reason for this difference is multifold. Specifically, the central region is geographically close to the highly developed eastern area, enabling the rural surplus labor force in the central region to easily move to eastern coastal cities to search for jobs. By contrast, the western region is distant from the developed areas where employment opportunities were ample. Additionally, because the transportation development in the western region remains inadequate, and the culture and customs in the west and those in the east differ considerably, people in the western provinces are more willing to stay in their home province than those in the central provinces.

Table 2 Floating population by region in China

		Eastern	Central	Western	Nation
Floating population (million)	2000	51.10	12.38	15.53	79.01
	2010	109.87	26.62	34.07	170.56
	Growth rate (%)	115.0	115.1	119.4	115.9
Share in the national total (%)	2000	64.7	15.7	19.7	100.0
	2010	64.4	15.6	20.0	100.0
	Change (%)	-0.3	-0.1	0.3	0.0
Floating/ <i>hukou</i> ratio (%)	2000	11.1	3.0	4.4	6.4
	2010	22.1	5.8	8.8	12.7
	Change (%)	11.0	2.8	4.4	6.3

Sources: National Census 2000 and 2010

**Figure 3** Spatial distribution of floating population in China

Sources: National Census 2000 and 2010

Second, the coastal migrant concentration area expanded continuously and showed a tendency to spatially connect with each other. The tendency was most prominent in the Yangtze River Delta, where the migrant concentration area expanded not only to interior regions of Zhejiang and Jiangsu but also to nearby Anhui province located in the central region. Therefore, the growth of the floating population in Anhui was the highest in all central provinces. Conversely, the spatial expansion of the migrant concentration areas in the Pearl River Delta and the Beijing-Tianjin-Hebei Region was limited. The development of the Pearl River Delta was driven majorly by the path-dependent effect of the export-oriented economy. The interaction between industry clustering and transportation networks has reinforced each other and generated the highly developed Guangzhou-Foshan-Dongguan-Shenzhen cluster with limited spatial spillover. The expansion tendency was also minimal in the Beijing-Tianjin-Hebei Region mainly because of the excessively strong attractiveness of Beijing and Tianjin and the administrative separation (Ma *et al.*, 2007; Sun *et al.*, 2013). Furthermore, the floating population grew rapidly in the Shandong Peninsula, the coastal

area of Fujian, and the central and southern areas of Liaoning. Together with the three discussed above, these six largest coastal megacity regions are highly attractive for migrants. Consequently, the entire coastal region showed a trend of migrant expansion and became the primary region for economic activities and population concentration.

Third, the capability of the inland region for attracting migrants was continuously enhanced. A study reported that the contribution of the inland region to China's urbanization continues to increase (Cao and Liu, 2011), which is consistent with the migrant movement toward the inland region. The enhancement of the inland region's capacity for absorbing migrants can be reflected by three aspects: (a) Most of the provincial capitals involved more than 1 million migrants, and a large number of migrants were clustered in the surrounding area of numerous provincial capitals, leading to the regionalization of migrant concentration areas. (b) Almost all prefecture-level districts had more than 50,000 migrants, indicating the rapid rise of regional central cities. (c) The boost of county-level economies did not only occur in the coastal region, numerous inland cities and counties attracted a large floating population as well. In fact, in the inland region, a number of specialized cities have emerged in places that featured superior traffic location and abundant resources. Although investments and floating populations were commonly concentrated in prefecture-level cities, numerous county-level cities acquired superior advantage in market competition, and their attractiveness for migrants has even exceeded that of many prefecture-level cities that consist of several districts. Thus, the overall migrant distribution pattern in the inland region can be summarized as that migrants were highly concentrated in provincial capital cities and were relatively evenly distributed in other places.

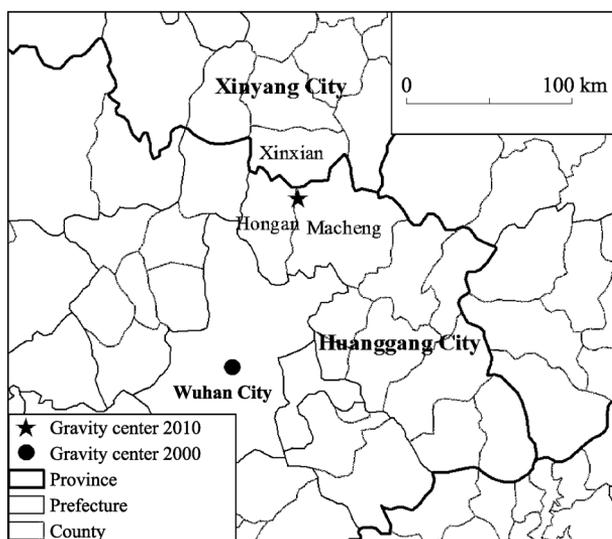


Figure 4 Spatial gravity of floating population, 2000–2010

Lastly, although the southeastern coast has been the primary migrant concentration area, the migrant distribution showed a trend of northward movement (Figure 4). This study employed the spatial statistics tool of Mean Center in ArcGIS and used the floating population size as a weight field for gravity analysis. The results showed that the gravity center of floating population was located in the center of the administrative area of Wuhan in 2000 and then moved 110 km toward the northeastern direction to Macheng City, near the boundaries of Hong'an County and Xinxian County, Henan in 2010.

3.2.2 Overall significance of spatial autocorrelation and outstanding performance of the Yangtze River Delta

To understand the spatial interdependence of the floating population distribution, this study employed ArcGIS spatial statistics tools to conduct a spatial autocorrelation analysis on the

county-level migrant distribution in China in 2000 and 2010. In the county-level analysis, because the absolute volume of floating population in districts of prefectures and that of the surrounding counties and cities are not comparable with each other, this study adopted its ratio of the floating population to the *hukou* population for analysis. The results showed that the ratios in 2000 and 2010 exhibited a positive spatial autocorrelation, which was significant at a confidence level of 0.0001. This verified the characteristics of migrant spatial distribution obtained in the above section (Figure 5), such as the remarkable expansion of the migrant concentration area in the Yangtze River Delta, the stability of migrant distribution in the Beijing-Tianjin-Hebei Region, migrant concentration in the surrounding area of inland provincial capitals, the rise of many cities that were not provincial capitals in the inland region, and the northward movement of the gravity center of migrants. Furthermore, a typical core-periphery structure was salient in Guangdong Province, demonstrating that the spatial expansion of migrants in the Pearl River Delta was insignificant. In 2010, the only area of low migrant concentration was observed in the border area of Jiangsu, Shandong, Henan, and Anhui which is a major migrant sending area. Because its attractiveness to local people and migrants was minimal, this area is the typical backward provincial border area (Qiu *et al.*, 2009).

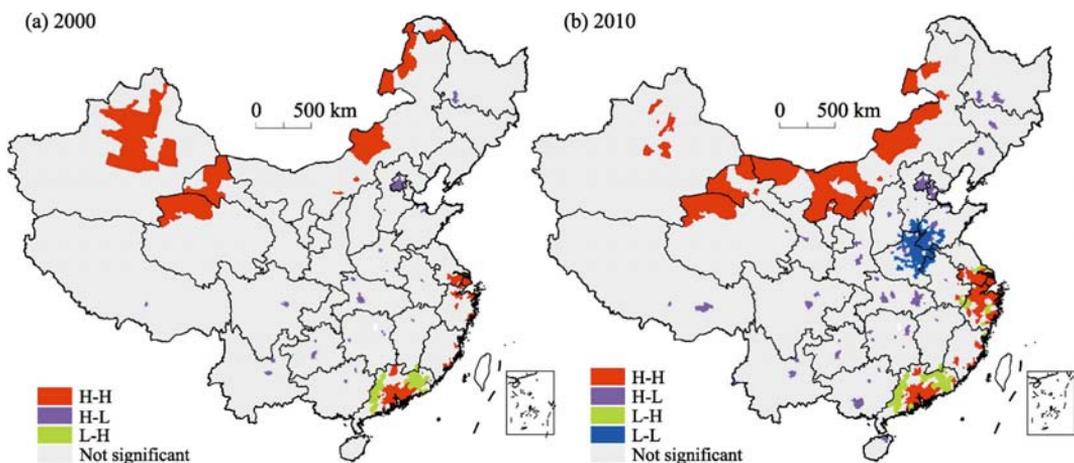


Figure 5 Spatial autocorrelation of floating population in China

Sources: National Census 2000 and 2010

3.3 Evolving spatial model of migration

3.3.1 Burgeoning intra-provincial migration

Migrants in counties and cities can be categorized as intra-provincial and interprovincial. The national censuses also included data regarding migrants moving across townships within a county. Through comparing the changes in the populations of migrants from various original places, the spatial model of China's population movement can be portrayed. In 2000, the amounts of migrants moving within a county, across counties but within a province, and across provinces were 65.60 million, 36.39 million, and 42.46 million, respectively, and the ratio of the three population sizes was 45.4:25.2:29.5 (Table 3). Over the following 10 years, the intra-county floating population increased by 38.6%, and the intra-provincial (inter-county) and interprovincial floating population increased by 132.8% and 101.4%, re-

spectively. As a response, the intra-county migrants accounted for 45.4% of the total floating population in 2000, but the percentage decreased to 34.8% in 2010. Although interprovincial migration remained to be the primary migration pattern, the scale of intra-provincial migration had increased to an extent that was comparable to the scale of interprovincial migration. More importantly, because interprovincial migrants encountered great obstacles in the process of complete urbanization, the intra-provincial migration may become the dominant track of population urbanization in China.

Table 3 Evolving spatial model of China's floating population, 2000–2010 (million persons, %)

		Intra-county	Inter-county/ Intra-provincial	Interprovincial	Total
2000	Floating population	65.6	36.4	42.6	144.6
	%	45.4	25.2	29.5	100.0
2010	Floating population	90.9	84.7	85.8	261.5
	%	34.8	32.4	32.8	100.0
2000–2010	Growth	25.3	48.3	43.2	116.9
	Growth rate	38.6	132.8	101.4	80.8
	% change	-10.6	7.2	3.4	0.0

According to data from the 2010 national census, the proportion of migrants who have lived in their current location for more than 6 years was 25.4% for the intra-provincial migrants and 20.7% for the interprovincial migrants, while the proportion of floating population who have lived in the current location no longer than one year was 19.4% for intra-provincial migrants and 23.6% for interprovincial migrants, implying that population mobility within provinces was relatively stable. From 2008 to 2009, the researcher conducted a questionnaire survey of 2,398 migrant households in 12 cities of 6 provinces and the results can support the described phenomenon (Table 4). Compared with interprovincial migrants, a significantly higher proportion of intra-provincial migrants intended to settle down and purchase real estate in urban areas, but a substantially lower percentage of them planned to obtain real estate in rural areas. This proves that intra-provincial migrants showed a higher possibility of complete urbanization than interprovincial migrants did.

Table 4 Settlement intention of floating population

	Intra-provincial	Interprovincial	Chi-square (p value)
Intend to settle in cities (%)	61.65	48.83	26.58(0.000)
Plan to buy houses in cities (%)	29.23	21.54	13.21(0.000)
Plan to construct houses in villages (%)	23.50	27.78	3.95(0.047)

Sources: Questionnaire survey on floating population in 12 cities

3.3.2 Positive effects on complete urbanization

The ratio of interprovincial floating population to the total population of inter-county and interprovincial migrants was used in spatial visualization, which revealed the subtle regional difference in the spatial patterns of migration (Figure 6). In the eastern coastal region, the

domination of interprovincial migration was manifested majorly in several megacity regions. Migrants in northwestern border provinces such as Xinjiang, Inner Mongolia, and Tibet mostly came from other inland provinces. The internal mobility in these provinces was not vibrant. Conversely, the concentration areas of interprovincial migrants were almost unnoticeable in the provinces of the central region. Although Shanxi Province was previously an exception because of its coal industry, in recent years its attractiveness to migrants from other provinces has also considerably declined. The comparison analysis showed that except for the Yangtze River Delta and Fujian, the interprovincial floating population in other coastal regions and the inland border area decreased substantially from 2000 to 2010. Correspondingly, the intra-provincial floating population increased, which facilitated migrants' permanent settlement in cities and complete population urbanization. Unexpectedly, the border areas between provinces functioned mostly as the concentration places for interprovincial migrants. This characteristic was extremely prominent in 2010, reflecting that migration was largely and increasingly influenced by the market force. The population attracted by cities in border areas was typically from the surrounding provinces rather than from places in the same province that are distant from the border areas.

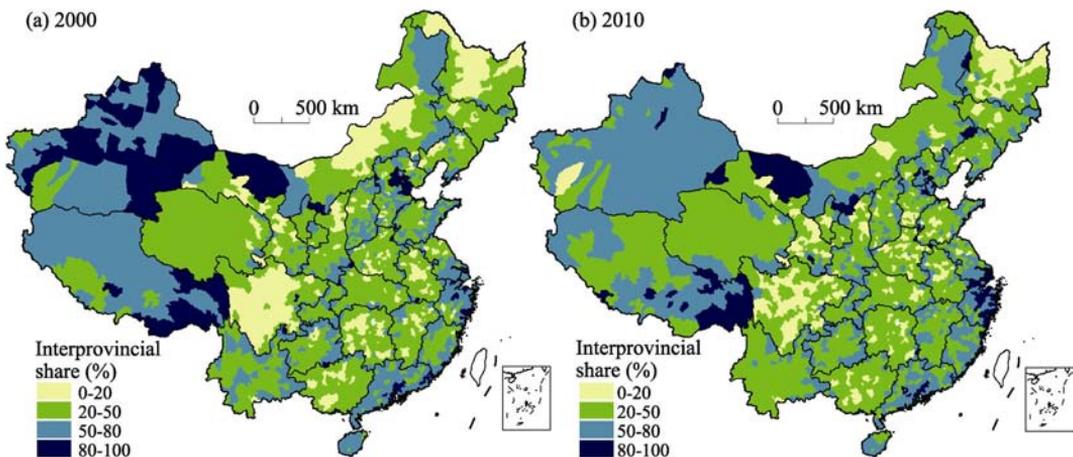


Figure 6 Proportion of interprovincial floating population in China

Sources: National Census 2000 and 2010

4 Forming mechanisms and the effects on urbanization

The changing spatial patterns of floating population are actually the demographic representation of the evolutionary dynamics of China's market-oriented reforms. Therefore, a conceptual framework can be developed by highlighting the interactive roles played by state and market forces to understand the forming mechanisms of the striking patterns identified above. An econometric model is then constructed to examine the various effects of these forces. Moreover, the substantial effects of internal migration on the Chinese urbanization and urban system also need to be systematically evaluated.

4.1 Determinants of China's migration landscape

4.1.1 Empirical model: state vs. market

The formation and evolution of the spatial patterns of the floating population are results

caused by migrants' decisions regarding their destinations. Therefore, analyzing the factors that influenced migrants' destination decisions can effectively elucidate the forming mechanisms for the distribution patterns of migrants. Although rural-urban migration is simultaneously affected by the push factors in rural areas and the pull factors in urban areas (Li, 2003; Xiao, 2010; Yazgi *et al.*, 2013), only the pull factors in cities were analyzed because this study focused on migrants' choices of destinations rather than their decisions on whether to migrate. In China, after several decades of market reform, the governmental control on household registration remains a major obstacle hindering migrants from settling down in cities (Chan and Zhang, 1999). However, the movement of the people is not restricted, and the destinations that people choose is therefore generally considered a market behavior. From the perspective of labor markets, the pull factors in cities for the rural population include various respects such as employment, income, lifestyle, and politics. For migrants, seeking nonagricultural employment opportunities that offer high wages is the primary reason for leaving their hometowns (Zhu *et al.*, 2001; Lu *et al.*, 2005; Cao *et al.*, 2012; Shen, 2012). According to data from the 2010 national census, 74.7% of the interprovincial floating population moved to other provinces for a better job. Fixed asset investment was closely related to the creation of employment. Thus, in this study, the employment opportunities and income levels in migrant-receiving places were denoted by the employment scale in nonagricultural industries, fixed asset investment per capita, and the average wage of employees in cities and townships.

In addition to the market forces, the economic development and urbanization in China have been continuously and substantially influenced by the governments at various administrative levels (Liu and Cao, 2011). The state's vital role in the allocation of economic resources such as urban land and government investments exerts indirect but fundamental impacts on the attractiveness of cities to migrants. Cities at a higher administrative level may have a superior advantage in the acquisition of land quotas and the process of project approval. Therefore, job opportunities in these cities are expected to be more available than those in cities at a lower administrative level. Additionally, public service resources may be concentrated in such cities, which greatly attracts migrants as well (Li *et al.*, 2007). Compared with counties, county-level cities possess more fiscal and administrative independence and thus have less possibilities of being deprived of financial and investment projects. These cities often have better urban infrastructures and investment environment and are therefore more attractive for migrants than counties (Ma, 2005; Guo and Jia, 2010). Furthermore, fiscal expenditure is an effective variable that reflects the government's role in economic development. In this study, the effects of local governments on attracting migrants were represented by local fiscal expenditure per capita and three dummy variables of administrative levels of cities and counties. Accordingly, we developed an econometric model:

$$\ln fltpop_i = \beta_0 + \beta_1 \ln wage_i + \beta_2 \ln empna_i + \beta_3 FAI_i + \beta_4 \ln pcfindex_i + \beta_5 capital_i + \beta_6 prefecture_i + \beta_7 city_i + \varepsilon_i \quad (3)$$

The definitions and basic statistical information about the variables are listed in Table 5. All the correlation coefficients for the correlations among the independent variables were smaller than 0.5, and all the variance inflation factors had values smaller than 3, indicating that there was no significant problem of collinearity. In addition, the results of the Breusch-Pagan test and the White test revealed the existence of heteroscedasticity. Thus, this

study conducted robust regression to eliminate the effect of heteroscedasticity. This approach has been proven to be capable of yielding asymptotically valid results (White, 1980). Specifically, two sets of variables that represented the state and market forces were fitted respectively. Subsequently, full model estimation was conducted on all samples and the samples were then categorized by region and administrative level. The results are displayed in Table 6.

Table 5 Definitions and key information of variables

Variable	Definition	No.	Mean	Std. Dev.	Min	Max
<i>Infltpop</i>	Floating population (logarithm)	2211	9.46	1.47	5.14	16.20
<i>Inwage</i>	Urban average wage (logarithm)	2211	10.23	0.24	8.98	11.18
<i>Inempna</i>	Nonagricultural employment (logarithm)	2211	11.21	1.14	7.50	16.29
<i>FAI</i>	Fixed assets investment (per capita)	2211	1.83	1.66	0.04	21.20
<i>Inpcfinex</i>	Per capita fiscal expenditure (logarithm)	2211	8.23	0.53	5.35	10.56
<i>capital</i>	Province-level city or provincial capital (dummy)	2211	0.01	0.12	0	1
<i>prefecture</i>	Prefecture-level cities (dummy)	2211	0.12	0.32	0	1
<i>city</i>	County-level cities (dummy)	2211	0.16	0.37	0	1

4.1.2 Results and discussion

According to the regression results, the state and market forces both exerted crucial influence on migrants' destination decisions, and almost all variables had salient effects in all models. Moreover, the contribution of market forces was larger than that of state forces; the goodness-of-fit values for the models of the two sets of variables were 0.688 and 0.539, respectively, indicating that the market force exerted a dominant effect on the migration process. The integrated model achieved a goodness-of-fit value that was larger than the aforementioned two values, implicating that the effects of the market and government forces were simultaneously interactive and independent.

When making choices among the various counties and cities in the eastern region of China for migration, the floating populations were concerned majorly about the employment scale in nonagricultural industries and the level of government fiscal expenditure, which separately signified the employment opportunities and the urban public service level. For long-distance migrants, their primary purposes were obtaining jobs and enjoying a city lifestyle. This largely explained why the central megacities in the coastal megacity regions such as the Yangtze River Delta, Pearl River Delta, and Beijing-Tianjin-Hebei Region have continued to attract numerous migrants. Compared with the Pearl River Delta, the strong local governments in the Yangtze River Delta possessed the prominent advantage of maintaining the fiscal capability and therefore were able to provide better public services to the floating population; thus, the Yangtze River Delta was the area where the floating population increased most rapidly over the past decade. The results of the national model also explained the significantly increasing attractiveness of inland megacities for the floating population.

Regarding the central and western regions, migrants considered more about the wages and the administrative level of their target cities. The wage level was emphasized because counties and cities in the central region typically have a low wage level. A higher wage level in

Table 6 Regression results of econometric models

	Full sample			By region			By level	
	Market	State	Full	Eastern	Central	Western	Prefecture [^]	County ^Δ
<i>lnwage</i>	1.784*** (20.14)		1.152*** (13.25)	0.564*** (3.27)	1.179*** (8.77)	0.492*** (3.38)	0.687*** (5.10)	1.152*** (12.03)
<i>lnempna</i>	0.884*** (53.15)		0.766*** (32.48)	0.970*** (22.91)	0.570*** (8.43)	0.710*** (18.50)	1.031*** (26.96)	0.769*** (28.07)
<i>FAI</i>	0.133*** (9.65)		0.038*** (3.36)	-0.038 (-1.54)	0.064** (2.15)	0.095*** (5.63)	0.041** (2.18)	0.036*** (2.86)
<i>lnpcfinex</i>		0.146*** (3.19)	0.491*** (9.94)	0.890*** (10.34)	0.516*** (3.73)	0.131** (2.02)	0.111 (1.31)	0.553*** (10.10)
<i>capital</i>		5.280*** (38.61)	1.768*** (15.35)	0.932*** (4.33)	2.421*** (7.91)	2.171*** (13.08)	0.440*** (4.81)	
<i>prefecture</i>		2.717*** (38.08)	1.042*** (16.60)	0.617*** (5.53)	1.365*** (8.64)	1.023*** (11.62)		
<i>city</i>		1.249*** (19.37)	0.421*** (8.41)	0.391*** (4.99)	0.312*** (4.03)	0.739*** (7.54)		0.421*** (8.20)
<i>_cons</i>	-18.952*** (-20.79)	7.667*** (20.55)	-15.237*** (-17.93)	-14.567*** (-10.81)	-13.762*** (-7.26)	-4.815*** (-2.86)	-9.490*** (-7.59)	-15.779*** (-16.08)
<i>N</i>	2211	2211	2211	628	703	880	286	1925
<i>adj. R²</i>	0.688	0.539	0.760	0.842	0.729	0.715	0.865	0.550
<i>F</i>	1514.00	769.66	1729.06	700.72	430.93	946.36	592.47	414.67

Note: [^] Districts of cities at the prefectural level or above; ^Δ county and county-level cities; t statistics in parentheses; * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

inland regions often stands for more job opportunities and higher incomes. By comparison, because economic development in the eastern region was generally high, the migrants in the eastern region did not consider much about the difference of cities in the wage. This was also the reason why the concentration phenomenon of the floating population was more salient in the inland region than in the coastal region. This difference was also observed in the influence of fixed asset investments. The importance of administrative level reflected the essential effect of the state force on the dotted development in the inland region. Specifically, in the inland region, the top-down policy-oriented investments accounted for a large proportion of the total investment, and the economic resource allocation that was led by adminis-

trative authorities still had a decisive influence on the economic development and the spatial distribution of migrants (Liu and Cao, 2012). The effects of most variables in the central region were between those in the eastern and western regions, which to a certain extent reflected the gradient pattern of the migration decision-making mechanisms. However, the influence of the nonagricultural employment opportunities in the central region on migrants' decisions was substantially weaker than those in the eastern and western regions. One explanation is that migrants from the central region, whose primary migration purpose was employment, tended to move to the eastern coastal region that is not far from their hometowns. Intra-provincial migrants may have other reasons hindering them from moving eastward. Thus, migrants absorbed by cities and counties in the central region mostly came from other regions of the same province, while few cities were attractive for interprovincial migrants in the central region.

Migrants' choice among the numerous counties and cities was more substantially influenced by the fiscal capability of the county or city governments than that of the district governments. The administrative authorities at the county level often have weak fiscal capability and lack sufficient funds for improving infrastructures and public service facilities and promoting economic development. Since the tax reform in 1994, the fiscal capability of local governments has been weakened (Liu and Lin, 2014), and the funds for transfer payments are allocated top-down based on the administrative divisions. Therefore, prefecture-level cities generally have stronger fiscal capabilities than counties and county-level cities. However, because prefecture-level cities are basically similar to each other in this term, their fiscal capability does not substantially influence their attractiveness to the floating population. Furthermore, compared with other cities and counties, provincial capitals possess great fiscal advantages and are able to promote industrial development and construct public service systems. This is the reason why provincial capitals become the primary migrant concentration areas in the inland region. Similarly, county-level divisions that can acquire high amounts of fiscal resources are able to effectively promote economic development and establish public service systems and therefore are attractive to the floating population. In addition, county-level cities have stronger fiscal autonomy and attractiveness to migrants than counties do (Ma, 2005), facilitating the expansion of migrant concentration areas in the coastal region and the rise of county-level central cities in the inland region.

4.2 Multi-dimensional effects on Chinese urbanization

4.2.1 Improving the urbanization level

Migration is a major factor contributing to the rapid urbanization in China (Chan and Zhang, 1999; Zhang and Song, 2003). The effects of migration on China's urbanization are twofold. On the one hand, the rural-to-urban migration of floating population as the major body of China's new urban residents substantially promotes the urbanization process. On the other hand, the destination choice of migrants among cities of different sizes and at various administrative levels considerably reshapes the urban system in China. Population urbanization can be realized in situ or through migration. The former is achieved through the increase of the urban population and the decrease of the rural population at the same time and in the same amount. Regarding the urbanization driven by rural-to-urban migration from one place to another, the urban population increases whereas the rural population remains the same in

net immigration places, and the rural population decreases whereas the urban population remains the same in net emigration places. Thus the urbanization level of both migrants-sending and -receiving regions will improve as a result. Assuming that all migrants have moved from rural to urban areas, their contribution to the urbanization of the sending and receiving areas can be estimated.

According to the 2000 and 2010 national censuses, the urbanization level of 1,069 net emigration counties and cities increased by 12.70% over the 2000s, 2.54% of which was contributed by migration. The urbanization level of 675 net immigration counties and cities increased by 9.78% over the 10 years, 4.84% of which was contributed by migration. The contribution rate of migration for the urbanization of net immigration and emigration places was 49.5% and 20.0%, respectively. Although the data may be overestimated because not all migrants moved from rural to urban areas, the contribution of migration to China's rapid urbanization is beyond all doubt very significant. In addition, an important change in the spatial patterns of migration was the overall increase of intra-provincial migration, which is also a positive signal for the complete urbanization of floating population in the long term.

4.2.2 Varying the coast-inland difference in urbanization

Inland regions will contribute more to China's urbanization as a response to the different spatial models of migration in coastal and inland regions. The spatial patterns of migration

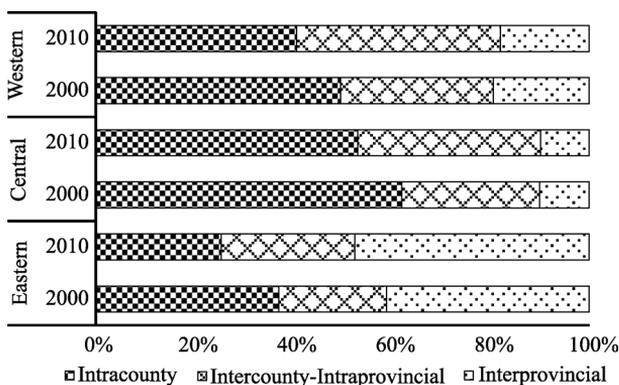


Figure 7 Structure of floating population by region in China
Sources: National Census 2000 and 2010

varied according to various areas (Figure 7). Although the absolute amount of intra-county and inter-county (intra-provincial) floating population in the eastern region was larger than that in the central and western regions, interprovincial migration still obtained a lion's share in the total floating population in the eastern region. This structural pattern of floating population has been continuously reinforced in the past decade.

Compared with intra-provincial migrants, the interprovincial migrants had lower intention and ability to settle down in their destinations. They are more likely to eventually return to their hometowns to retire. By comparison, intra-county migration was the leading migration pattern in the central and western regions, especially in the central region where the number of interprovincial migrants was the lowest. In fact, intra-provincial migrants served as primary contributors to the urbanization of the inland region because they tended to and were capable of settling down in their destination counties or cities to work and live permanently (Table 3). Consequently, we can conclude that the migrant population in the eastern region typically underwent incomplete urbanization, whereas the migrants in the central and western regions tended to become new residents who undergo complete population urbanization. In this sense, the speed of urbanization in inland regions will not always slower so much than that in the coastal east and the rising role played by inland regions in promoting China's urbanization

will be strengthened in the long term.

4.2.3 Reconstructing the city size distribution

Migrants' preferences for cities of various scales have largely led to the alteration of the urban hierarchy in China. Migrants generally tended to concentrate in large cities because of the various job opportunities, high income standards, and satisfactory living services, which was proved by the significant positive correlation between the population sizes of a city and the ratio of the floating population to the *hukou* population in the city (Figure 8). Cities in which migrants accounted for a high proportion of the total population are typically large-scaled cities. Thus, migrants' preference for megacities has substantially reinforced the prominent status of megacities in the urban system in the country. Regarding cities that possessed a population of approximately one million, many of these cities only served as regional employment and service centers and cannot attract a large floating population. As a response, the medium- and large-scale cities were differentiated because of the varying proportion of the floating population. However, some cities that only had less than half a million people also involved a large proportion of migrants, which not only indicated the market rationality in the decision-making of the destination cities, but also reflected that the ability of small cities, county, and townships to attract population agglomeration has been rapidly enhanced.

4.2.4 Transforming the spatial organization of cities

The spatial distribution of the floating population also exerted considerable influence on the spatial patterns of the urban system in China. Figure 2 shows the overall dispersion pattern of migrants in the megacity regions in the Yangtze River Delta, Shandong Peninsula, and the coastal area of Fujian. The multiple counties and cities that migrants can select among the megacity regions facilitated the optimization of the functions and spatial structures of these regions. In the inland region, migrants continued to favor the provincial capital cities, and counties and cities in the surrounding area of the capitals also became the new concentration places for migrants. This can facilitate the formation and development of inland megacity regions based on the provincial capital cities, including Chengdu, Changsha-Zhuzhou-Xiangtan City Cluster, and Zhengzhou. By comparison, the attractiveness of some provincial capital cities such as Wuhan, Xi'an, and Urumqi to the floating population clearly did not extend to the surrounding counties and cities, which became an obstacle for the formation and development of megacity regions. In addition, the floating population in the inland region exhibited a clear trend of dispersion. Numerous county-level cities and counties absorbed more of the floating population than prefecture-level cities did. The market rationality for migrants' decision-making regarding their destination cities significantly led to the spatial equilibrium distribution of cities in the inland region.

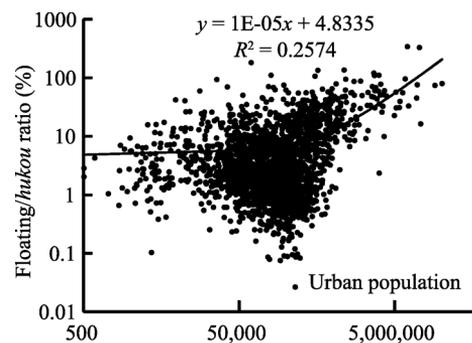


Figure 8 City size and ratio of floating population to *hukou* population

Sources: National Census 2000 and 2010

5 Conclusions

Based on the latest national censuses conducted in 2000 and 2010, this study examined the changing spatial pattern of China's floating population, explored its forming mechanism, and evaluated its effects on China's urbanization and urban system. Several important conclusions can be drawn from our analysis.

(1) The floating population has continued to concentrate in some large cities, but simultaneously slightly dispersed. The top 1% of cities that had the largest floating population received 45.5% of all migrants in China, and this percentage has remained stable in the following 10 years. The coastal migrant concentration area has expanded continuously and showed a tendency to spatially connect with each other. The concentration and dispersion of the floating population significantly differed in various coastal megacity regions. The migrant concentration area in the Yangtze River Delta is the largest and its expansion is also the most salient. Accompanying with the rising capability of the inland region for attracting migrants, the coastal migrant concentration areas has shown a trend of moving inland.

(2) The forming mechanisms for the spatial patterns of the floating population in China were explained from the perspective of migrants' decision-making regarding their destinations. In this study, we observed that the state and market forces both played a substantial role in promoting migration and shaping the spatial patterns of migrant distribution, and that the influence of market force has exceeded that of state force. Difference among eastern counties and cities in the attractiveness to the floating population came mainly from the variations in the nonagricultural employment opportunities and public services that they can provide to migrants, reflecting that long-distance and long-term migrants moved not only to gain employment but also to enjoy city life. In the central and western regions, places that had advanced economic development and were at high administrative levels were highly attractive to floating populations, demonstrating that the state remained to play an important role in allocating economic resources and promoting regional development in inland China. This coast-inland difference in the mechanisms of attracting floating population may provide constructive enlightenments to policy makers who are willing to improve the urbanization and regional development through attracting migrants from outside their jurisdictions.

(3) As the main body of new urban residents, the floating population has contributed substantially to the elevation of the urbanization levels of migrant-sending and -receiving places, by 20.0% and 49.5% respectively. Moreover, because intra-provincial migrants possess stronger intention and capability to permanently stay in their destination cities than inter-provincial migrants do, complete urbanization is expected to be more possibly realized in the central and western regions, where intra-provincial migration was the dominant migration pattern, than in the eastern coastal region. Furthermore, taking into consideration of its increasing contribution to China's internal population movement, intra-provincial migration is estimated to be the leading pattern of population urbanization in China. In addition, inland regions will contribute more to China's urbanization as a response to the different spatial models of migration in coastal and inland regions.

(4) China's urban system has been considerably reconstructed by the large-scale internal migration as well. Migrants' preference for cities in different regions and at various scale levels has reinforced the scale advantage of the megacities, prompted the size divergence of

medium- and large-scale cities, facilitated the population agglomeration function of many counties and cities, and further critically influenced the reconstruction of the hierarchical structure and spatial organization of China's urban system. Additionally, migrants' destination preference has also facilitated the optimization of the spatial structure of megacity regions in the coastal region, the rise of megacity regions in the inland region, and the spatial equilibrium distribution of Chinese cities as a unified system. We can therefore come to the conclusion that migration has to a great extent altered the spatial distribution pattern of China's urban system.

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