


## Analyzing In-Migrants and Out-Migrants in Urban China

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**Abstract** Massive urbanization is producing large-scale urban migration in China. Based on the database of the Population Information System of the Health and Family Planning Commission, the spatial characteristics and demographic structural characteristics of migrants have been analyzed at the inter-provincial, intra-provincial and city scales, using Wuhan, China as a case study. A panoramic image of the overall migration in this area has been produced, illustrating that in-migration continues to have a “squeezing” effect on low-skilled jobs with low barriers to entry. There are clear differences between in-migrants and out-migrants; the great majority of in-migrants are fertile women and floating children, and out-migrants have left their children. Moreover, basic public services are insufficient for in-migrants. This paper concludes by presenting a selection of policies to help manage migrants.

**Keywords** Migration · Spatial Characteristics · Demographic structure · Wuhan · China

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## Introduction

Internal migration in China has been increasing steadily since the beginning of the country's economic reform; it has also been fueled by the elimination of legal barriers (Chan 2008). China's internal migration has been particularly affected by the hukou system<sup>1</sup>, which has no equivalent in other countries. There are two types of internal migration: hukou migration (i.e., migration based on "local" residency rights) and rural–urban migration or informal migration (i.e., migration without hukou residency rights; Chan et al. 1999). Hukou migration is only available to a small minority of people (Chan and Buckingham 2008), and thus the type of migration documented in the literature is mainly non-hukou migration. This paper examines non-hukou migration under which migrants have no hukou at their place of residence.

China's migrant population exceeded 2.53 hundred million at the end of 2014 and will reach 2.91 hundred million based on an average increase of 6 million additional migrants per year<sup>2</sup>. Moreover, migration patterns are changing and exhibiting some new features, including slow growth in the migrant population, a decline in working-age migrants, and increasingly stable in stay and live at their place of residence. Compared to other countries with the same levels of social and economic development, China has a much more evenly distributed population in its cities (Fujita et al. 2004), indicating that the agglomeration of economies and population growth can promote economic development (Bosker et al. 2012). In fact, the increase in internal migration has significantly contributed to both economic development and social progress (Yang 1996). With China's rapid urbanization, more and more people are moving to metropolitan areas. It is therefore valuable to examine the characteristics of these migrants, including population size, age structure, places of origin, and education levels.

The spatial and demographic characteristics of China's migrants have been studied mostly at the province or county scale (Fan 2005a, b; Liu et al. 2015), whereas they have rarely been studied at the inter-province, intra-province, and intra-city scales. Some of these spatial and demographic characteristics have been described by Ravenstein (1885) in his seven laws of migration. The primary spatial characteristic at the macro-level is the flow of migrants from underdeveloped to developed areas (Harris and Todaro 1970; Bosker et al. 2012; Shen 2013, 2015). In this paper, we explore migrants' spatial characteristics at the macro-, meso-, and micro-levels. Based on research at the meso- and micro-levels, pathways of migration can be found across a range of metropolitan areas (Newbold 1999; Li and Zhu 2014). By investigating characteristics of migrants' age structure, Rogers (1984) developed an age-migration rate model, which showed that the working population has a high migration probability while children and the aging have a low rate of migration. However, due to its unique

<sup>1</sup> The Hukou system is used to record household registration and is required by law. It was first established in 1951 for urban areas only and then extended to include rural areas in 1955. Under this system, Chinese residents are divided into two groups – rural and urban – based on where they live. Those wanting to change their hukou permanently or formally must obtain approval from local authorities. Reformation of the hukou system has been controversial in China. On December 4, 2014, the Legal Affairs Office of the State Council released a draft residence permit regulation proposing the cessation of the hukou system in small cities and towns, gradual easing of the system in medium-sized cities, and retention of the system in large metropolitan cities. However, it will still be quite some time before rural citizens or migrant workers enjoy the same benefits as urban citizens.

<sup>2</sup> Data are from the "2015 Report on China's Migration Population Development."

cultural background, China exhibits a different age-related migration pattern. For example, China's aging population has a higher migration rate than the aging populations of other countries because Chinese elders move from rural areas to care for their grandchildren in urban areas. Moreover, by comparing the size of in-migrant and out-migrant populations, the common characteristics of the populations that are left behind and move away can be determined, thereby facilitating the identification of problems and the implementation of a targeted population management strategy. The comparison of gender differences among migrants shows that Chinese women prefer short-distance migrations because they are responsible for child-rearing and supporting the elders of the family. In addition, the influence of in-migrants on the employment of local workers has also been studied (Yang 2001; Yang et al. 2004; Giuntella 2012). This paper offers some conclusions relevant to labor patterns based on an investigation of the educational levels of in-migrants. From the perspective of effective management of metropolitan populations, this paper presents an analysis of the spatial and demographic characteristics of metropolitan in-migrants and out-migrants, thus providing important theoretical and practical knowledge to fill research gaps in the study of metropolitan migration.

Because little is known about internal migration in metropolitan cities using three scales (i.e., the inter-province, province and inter-city scales) from two perspectives (i.e., in-migrants and out-migrants), we suggest that a study of internal migration at the inter-province, province, and inter-city scales from both the in-migrant and out-migrant perspectives is warranted. To gain a better understanding of migration directions and the magnitude of internal migration in Wuhan, we examine the spatial characteristics of internal migration. Our goals in this study are threefold: (a) to identify which populations are left behind, (b) to identify which populations flow out, and (c) to draw conclusions that can help promote immigration policy and the welfare of immigrant populations.

In the sections below, we introduce our research methodology, including our data collection approach. We then analyze the characteristics of migrants' spatial distribution and the demographic attributes of internal migration at three scales (i.e., inter-province, intra-province, and intra-city). In the final sections of the article, we discuss the significance of our findings regarding the spatial characteristics of internal migration, and offer recommendations for policy makers and future researchers.

## Data and Methods

### Data

Data used in the study were drawn from the Hubei Population Information System in the Information Center of the Health and Family Planning Commission of Hubei Province on December 6, 2012. There are two databases in the Hubei Population Information system: the *Population Information* database (PI) and the *Mobile Population Information* database (MPI). The PI consists of eighteen social-demographic variables, such as the individual's

unique code, name, identity card number, gender, date of birth, nationality, household registration address, code of household registration address, current residential address, and code of current residential address. The MPI has six variables, which are the individual's unique code, flow direction, flow date, flow reasons, outflow address, and code of outflow address. Meanwhile, to determine the size of different types of populations, we also included the Sixth National Population Census of China data as a benchmark.

Table 1 lists basic information on the internal migrants in Wuhan based on data in the Hubei Population Information system and the Sixth National Population Census of China Data. Comparing the two types of data, we see that the data in the Hubei Population Information system do not include all relevant information on internal migrants in Wuhan, but the existing population size is large enough to allow us to analyze the general characteristics of internal migrants.

**Table 1** General status of internal migrants in Wuhan city

	The Sixth Census data	Data of Hubei population information system	Percentage (%)
① Resident Population	9,785,388	8,853,642	90.48
② Sex Ratio of Resident Population <sup>a</sup>	105.91	104.91	-
③ Household Registered Population	8,383,650	8,059,607	96.13
④ Out-migrants	2,226,878	1,436,366	64.50
⑤ In-migrants	3,835,009	2,230,382	58.16
#⑥ in the Province	3,308,975	1,948,959	58.90
#⑦ in the City	1,186,636	1,262,538	106.40 <sup>b</sup>
#⑧ out of the City	2,122,339	686,421	32.34
#⑨ out of the Province	526,034	281,423	53.50
⑩ Inter-city In-migrants	2,648,373	967,844	36.54
⑪ Inter-city Out-migrants	1,040,242	173,828	16.71
⑫ Net Inflow of Population	1,608,131	794,035	-

(1) the out-migrants and in-migrants in Table 1 denote the population that has left the town or street where the household was registered and moved to a new location. (2) All information on the population is acquired from the Hubei population information system based on the town or street level – not the neighborhood level – in order to compare it with the data from the sixth census. (3) The data are calculated based on the sixth census data according to these equations:  $⑩ = ⑧ + ⑨$ ,  $⑫ = ④ - ⑦$ ,  $⑫ = ① - ③ = ⑩ - ⑪$ . (4) There are two reasons for the inconsistency between the net inflow of population (calculated based on the sixth census data) and that based on the Hubei population information system. On the one hand, the resident population in the sixth census data does not include those who have left their registered residence for less than 6 months. On the other hand, the out-migrants calculated based on the sixth census do not include the population whose registered residences are uncertain, nor does it include the population who works or studies abroad. If these two reasons are considered, the two results are indeed consistent. (5) For the data in the Hubei population information system, null values have not been considered in the query results, thus resulting in a slight deviation

<sup>a</sup> The ratio of males to females in a population, 105.91 means 105.91 males to 100 females

<sup>b</sup> Because the data from the Hubei population information system was extracted in 2012, the percentage rate is more than 100 %. Although the data are not necessarily representative of the actual situation in 2012, it is possible that the sample size is larger than that of the sixth census data. At the same time, it shows that the updates to the Hubei population information system are very timely

## Statistical Methods

The database management software used for the Hubei population information system is SqlServer2008. The data are first extracted using SQL, followed by a statistical analysis using SPSS software. The graph of spatial characteristics is generated, based on the results, using ArcGIS software. The age pyramid of internal migrants is produced using Excel software.

## Analysis

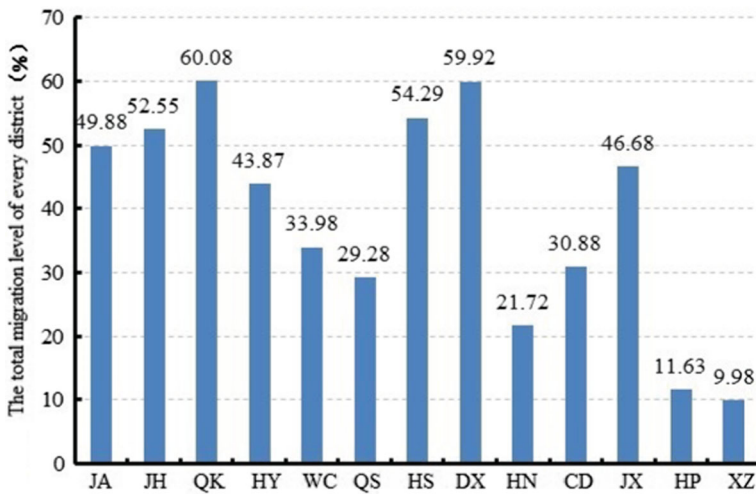
### Overview of Internal Migrants in Wuhan City

According to the sixth census data in 2010, there are approximately 9.78 million residents and 8.38 million households registered in Wuhan, and the sex ratio of the resident population is 105.91. The following is an overview of internal migrants in Wuhan based on data from the sixth census.

We take the resident population as the total population in this study. There are 3.8 million migrants who moved from one town/street to another town/street (i.e., migration at the town/street scale) in Wuhan city, which accounts for 40 % of the resident population. Among the migrants, 12.13 % moved into Wuhan city (i.e., migration at the city scale), 21.69 % moved into Hubei province (i.e., migration at the province scale), and 5.38 % moved out of Hubei province (i.e., migration at the inter-provincial scale). Meanwhile, when we consider the population of registered households as the total population, we find 2.23 million migrants at the town/street scale in Wuhan. Of the total number of migrants, there are 1.19 million (53.29 %) migrants at the city scale and 1.04 million (46.71 %) migrants who moved from one city to another city (i.e., inter-city scale). The number of internal migrants at the city scale in Wuhan city is almost equal to the number of migrants at the inter-city scale. There are 2.65 million in-migrants moving from other cities to Wuhan, 2.12 million in-migrants from other cities in Hubei province, and 0.526 million in-migrants who came from other provinces.

Based on the resident population of Wuhan city, the overall situation of migrants in different districts is shown in Fig. 1. The percentage of migrants varies greatly in different districts. Huangpi (HP) and Xinzhou (XZ) districts, which are suburbs of Wuhan city, have the lowest percentage (approximately 10 %). The district of Hannan (HN) has the second lowest percentage, at approximately 21.72 %. The districts of Wuchang (WC), Qiangshan (QS) and Caidian (CD) have approximately 30 % migrants; the districts of Jiangan (JA), Hanyang (HY) and Jiangxia (JX) have approximately 40–50 %; and the districts of Jianghan (JH), Hongshan (HS), Dongxi Lake (DX) and Qiaokou (QK) have 50 % or above. The percentage of migrants in the districts of Qiaokou and Dongxi Lake is approximately 60 %.

Geng (2005) noted that city planners should pay particular attention when the ratio of internal migrants to the resident population is 30–40 % and is still continuously growing. Wang et al. (2008) discussed how the proportion of internal migrants, especially those at the inter-county/district scale, reached 20 %, which requires special



**Fig. 1** Overall situation of internal migrants

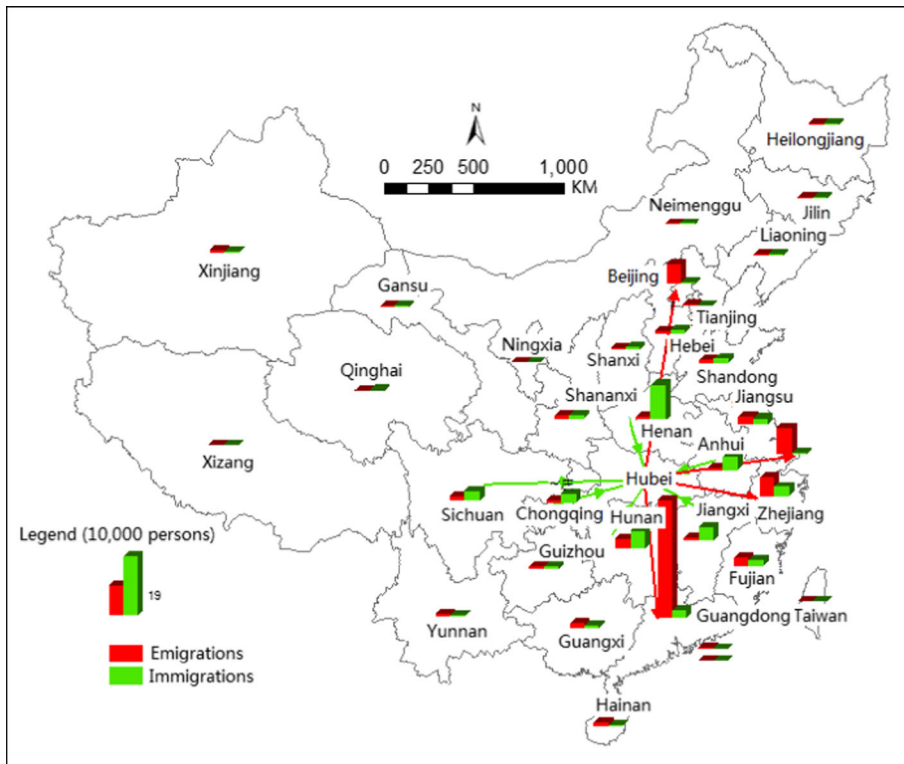
attention. The results show that the proportion of migrants in Wuhan is very high, and the data do not include migrants at the inter-neighborhood or inter-village scale; thus it is essential to extensively study the internal migrants of Wuhan city.

## Inter-Provincial Migration

### *Spatial Characteristics*

Using the method mentioned in this paper, in-migrants and out-migrants at the inter-provincial scale have been classified based on their individual information. The flow direction and total size of migrants are obtained according to the ratio of the database data to the sixth census data as listed in Table 1. Figure 2 shows the spatial characteristics of internal migrants at the inter-provincial scale.

According to Fig. 2 and the results presented herein, inter-provincial immigration has obvious regional features (see Table 2). In-migrants mainly come from Hunan and Henan provinces, at 22.32 and 10.74 %, respectively; meanwhile, the total percentage of migrants from these two provinces is more than 30 %. There are percentages of in-migrants above 5 % in these regions: 8.56 % in Anhui province, 8.31 % in Jiangxi province, 6.50 % in Sichuan province, 6.13 % in Chongqing city, and 6.10 % in Zhejiang province. Percentages between 2 and 5 % are found in the following regions: 4.45 % in Guangdong, 3.81 % in Fujian, 3.64 % in Jiangsu, 2.61 % in Shandong, and 2.29 % in Hebei. In contrast to these thirteen provinces or cities, 20 other provinces or cities have immigration percentages below 2 %, and the percentage of total immigration is less than 15 %. The in-migrants mainly come from two regions: neighboring provinces and cities in Hubei province, which are major labor-exporting regions with stronger economies and more active economic development.



**Fig. 2** Spatial characteristics of internal migrants at the inter-provincial scale

As shown in Fig. 2, emigrations at the inter-provincial scale have obvious regional features similar to those of immigrations. Out-migrants mainly move to four regions: Guangdong, Shanghai, Beijing and Zhejiang. Guangdong has the highest percentage at

**Table 2** The portion of in-migrants coming from different provinces or cities

Provinces or city	Percent (%)	Total (%)
Hunan	22.32	>30
Henan	10.74	
Anhui	8.56	>35
Jiangxi	8.31	
Sichuan	6.50	
Chongqing	6.13	
Zhejiang	6.10	
Guangdong	4.45	>15
Fujian	3.81	
Jiangsu	3.64	
Shandong	2.61	
Hebei	2.29	
Other 20 provinces or cities	<2	<15

45.41 %, whereas the percentages of the other three regions are lower: 10.3 % in Shanghai, 7.5 % in Beijing, and 7.32 % in Zhejiang, respectively. The total sum of the percentages in these four regions is more than 70 %. Moreover, these four regions have the highest levels of economic development in China.

The other provinces with a relatively high percentage of emigration are Hunan province (3.7 %), Fujian province (3.21 %), and Jiangsu province (2.94 %), respectively. The combined total is approximately 10 %. Hunan province, as a neighbor of Hubei province, is experiencing relatively rapid economic development, causing many out-migrants to move to Hunan province. Fujian and Jiangsu provinces have many manufacturing factories, which attracts many out-migrants. In addition to these seven provinces or cities, some out-migrants move to the other 26 provinces or autonomous regions with percentages lower than 2 %, and the total of the migrant populations of these regions is less than 20 %. Emigrations at the inter-provincial scale are distributed as the spatial characteristics of “one province, two cities and three regions”. According to these percentage data, Guangdong province is the first choice of out-migrants, the cities of Shanghai and Beijing are second choices, and Su, Zhe and Min are third choices<sup>3</sup>. All of these regions have highly developed economies.

Based on the overall situation of immigration and emigration, combined with the level of economic development of the various regions, the spatial characteristics of the inter-provincial migration scale can be obtained. (1) The majority of in-migrants at the inter-provincial scale come from central parts of China, including the labor-exporting provinces around Wuhan city such as Hunan, Henan, Anhui, Jiangxi, Sichuan and Chongqing. Except for Hunan, the other five provinces are the main regions from which the in-migrants move to Wuhan city. There are in-migrants and out-migrants moving between Wuhan city and Hunan province show that, based on absolute numbers, Wuhan city has more in-migrants than Hunan province. (2) There are in-migrants and out-migrants moving between Wuhan city and the four provinces (Zhejiang, Guangdong, Fujian, and Jiangsu). Linking the absolute number with the percentage, Wuhan city has a net outflow in contrast to the four other provinces; the largest number of these emigrants go to Guangdong, where there are 0.36 million migrants from Wuhan city. Shandong and Hebei provinces have a similar migration flow to the other provinces cited above, whereas Wuhan city has a net inflow relative to these two provinces. (3) The net outflow at the inter-provincial scale occurs in Wuhan city. The out-migrants usually flow to the more developed areas, such as Beijing, Shanghai and Guangzhou. In addition, some of the in-migrants comes from central China to alleviate the net outflow state of Wuhan city.

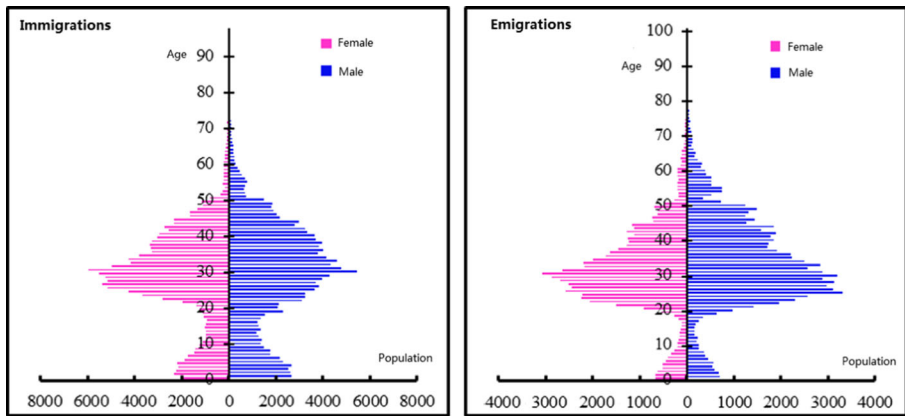
### *Characteristics of Demographic Structure*

#### (1) Age structure

The age pyramid of inter-provincial migrants, as shown in Fig. 3, is obtained based on data on the ages and genders of migrants. Most migrants are between 20 and 44 years old. The percentage of inter-provincial out-migrants in the 20–44 year-old age group is more than 73.76 %, which is 10 % higher than that of

<sup>3</sup> Su is the abbreviation of Suzhou City, Zhe is the abbreviation of Zhejiang City and Min is the abbreviation of Fujian City.





**Fig. 3** Age pyramid of inter-provincial migrants

in-migrants. This age group mainly consists of the 25–29-year-old and 30–34-year-old age groups, which account for 20.07 % and 18.37 %, respectively, of inter-provincial out-migrants, indicating that the young labor population accounts for the majority of inter-provincial out-migrants.

For the groups below age 15, there is a large difference in the adolescent population between in-migrants and out-migrants. The portion of in-migrants younger than 20 years old out of total migrants is more than 20 %, while out-migrants account for approximately 10.2 %, which is 10 % lower than in-migrants. The percentage of the adolescent population reflects the number of left-behind children who do not migrate out with their parents. Based on the initial gestational age of Chinese women and the total fertility rate, we hypothesize that female out-migrants aged 25–29 years would have one child aged 0–4 years. We find that the ratio of out-migrants aged 0–4 years to female out-migrants aged 25–29 years is just 47.33 %. If our hypothesis were true, it would imply that the percentage of left-behind children is approximately 50 %. Most (90 %) of children immigrating to Wuhan are floating children (i.e., children who accompany their parents to Wuhan). Thus, improving children’s health and education has become more difficult in Wuhan due to the large number of left-behind and floating children.

(2) The gender structure

Regarding the gender structure of migrant populations, the proportion of males to females does not differ much between inter-provincial in-migrants and inter-provincial out-migrants. The percentage of male in-migrants is 52.36 % while the percentage of female in-migrants is 47.64 %; the percentage of male out-migrants is 57 %, and the percentage of female out-migrants is 43 %. Male migrants outnumber female migrants.

If the relation between the sex ratio and age groups is analyzed, a very interesting phenomenon is found. The sex ratio corresponding to different age groups is shown in Fig. 4, in which there is a large “depression” in the number of inter-provincial in-migrants aged 20–34 years, while there is a large “dump” in the number of inter-provincial in-migrants and out-migrants aged 45–59 years. The “depression” of the sex ratio can be attributed to the fact that the number of

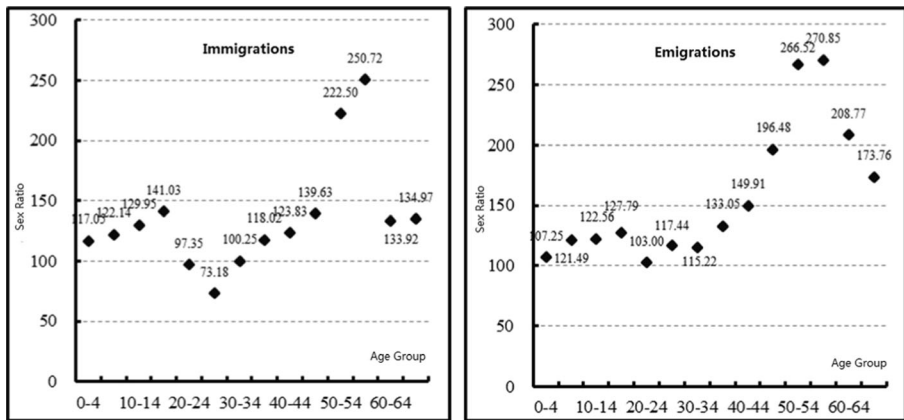


Fig. 4 Variation in the sex ratio of inter-provincial migrants by age group

inter-provincial female in-migrants aged 25–29 years far exceeds the number of male in-migrants; the sex ratio of the in-migrants is 73.18, and the sex ratios of the in-migrants aged 20–24 years and 30–34 years are relatively low. The sex ratio of the inter-provincial internal migrants aged 20–60 years increases linearly with age; it then quickly decreases for migrants aged 60 years and older, which is the retirement age. The sex ratio of inter-provincial in-migrants begins to increase at the 25–29 year-old group and begins to fall at the 55–59 year-old group. Inter-provincial out-migrants have the lowest sex ratio (103), which is slightly lower than that of the total resident population (105.91). For out-migrants, the sex ratio increases with age and reaches its highest point at the 55–59 year-old group, followed by a decrease for older people, leading to the obvious “bump” with inter-provincial migrants.

The obvious difference in sex ratio for different age groups is mainly ascribed to migration selectivity by gender. Females show “inertness” of migration as manifested by two factors compared males. The first factor is that females tend not to migrate when they get older, resulting in the “dump” in Fig. 4. The second factor is that females tend to choose migrations with short distances rather than long distances. Zhang and Zhang (1996) noted that female migrants tended to choose short-distance migrations compared to their male counterparts. As revealed by spatial characteristics, the distance between Wuhan city and regions where out-migrants move is longer than that between Wuhan city and regions where in-migrants come from, resulting in no “depression” among the young group of inter-provincial emigrants. The regions in which in-migrants come from are the neighboring provinces of Wuhan city, and there is gender selection for employment because of the industrial structure of Wuhan city, leading to the “depression” among the young groups of inter-provincial in-migrants.

(3) Education level

Inter-provincial in-migrants and out-migrants have very similar education levels. Figure 5<sup>4</sup> shows the percentage of inter-provincial migrants with different

<sup>4</sup> Internal migrants below the age of 16 constitute a very small group, and education level is thus analyzed by considering all migrants without eliminating migrants under the age of 16.

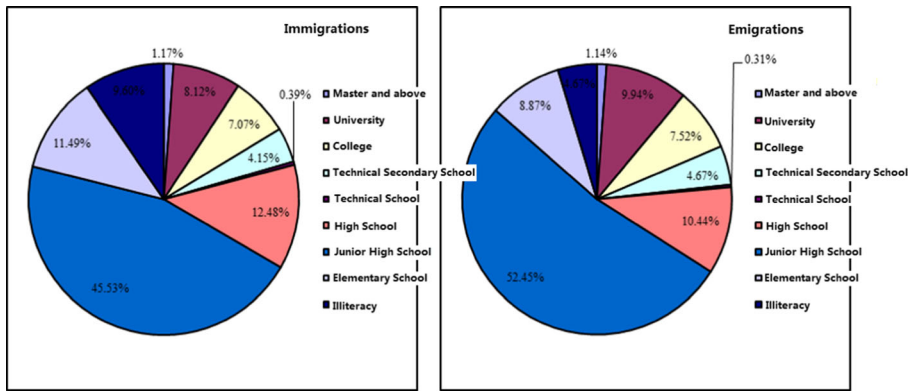


Fig. 5 Percentage of the inter-provincial migrants with different education levels

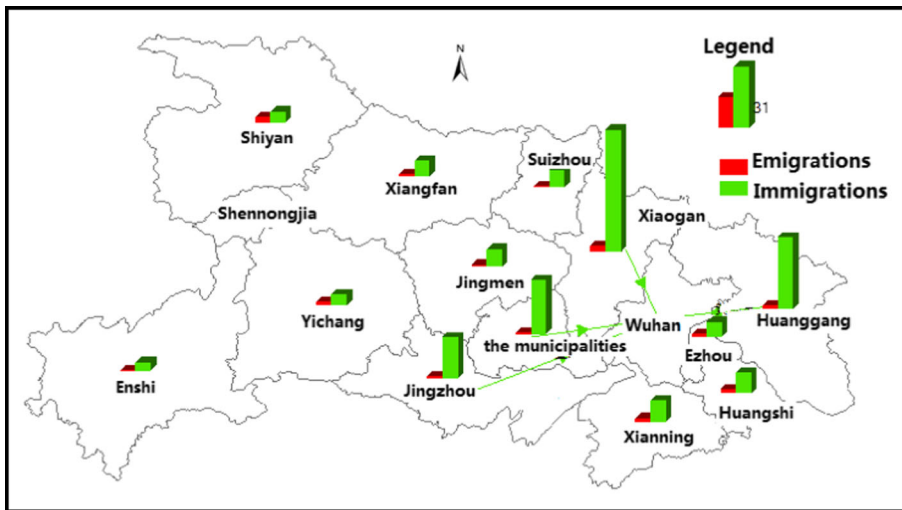
educational levels. In-migrants coming from other provinces mainly graduated from junior middle school, and out-migrants vary in terms of their education levels: 45.53 % finished junior middle school, 11.49 % finished elementary school, and 9.6 % are illiterate. The total percentage is 66.62 %. The percentage of migrants with a college degree or higher is 20.9 %, and the percentage of migrants with high school, technical school and/or secondary school education levels is 12.48 %.

Similarly, the out-migrants flowing from Hubei province mainly graduated from junior middle school, and the education levels of such out-migrants vary: 52.45 % completed junior middle school, 8.8 % completed elementary school, and 4.67 % are illiterate. The total of these out-migrants – with these three different education levels – is 65.92 %. The percentage of out-migrants with a college degree or higher is close to 20 %. The inter-provincial migrants are mainly peasant workers who move from rural areas to urban areas. These results can be confirmed by querying the type of household registration of the migrants, and the query results show that the percentage of inter-provincial in-migrants with rural household registration is 72.46 %, and for out-migrants it is 60.53 %.

### Migration at the Provincial Scale

#### *Spatial Characteristics*

Figure 6 shows the spatial characteristics of migrants at the provincial scale. As shown in Fig. 6, in-migrants at the provincial scale mainly come from Xiaogan, Huanggang, the municipalities directly under the province (including Xiantao, Tianmen, Qianjiang and Shennongjia forest area), and Jingzhou, and the corresponding percentages are 28.76, 16.92, 10.88, and 9.62 %, respectively. The total is close to 70 %. All these cities are close to Wuhan city, and there are convenient routes between these cities and Wuhan. The percentages of the other nine cities are below 5 %, and the total is less than 30 %. The portions of in-migrants from the cities of Huangshi, Ezhou, and Xianning to Wuhan city is not high, possibly due to the short-term travel of the population with



**Fig. 6** Spatial characteristics of internal migrants at the provincial scale

socio-economic ties between these cities and Wuhan city as a result of convenient routes.

The out-migrants at the provincial level mainly flow out from Wuhan city to the cities of Xiaogan, Shiyian and Huanggang; the percentages of these out-migrants are, respectively, 16.52, 13.47 and 10.88 %, and the total is more than 30 %. The percentages are relatively high in the cities of Xianning, Huangshi, Yichang, Xiangfan and Jingzhou, all of which are between 5 and 10 %, and the total reaches 58 %. The percentage of out-migrants is the lowest in the cities of Jingmen, the municipalities, Suizhou and Enshi, all of which are less than 5 %, and the sum is approximately 12 %.

By linking the characteristics of migration with the developmental state of the cities, some spatial characteristics of the provincial scale can be obtained. (1) In-migrants mainly come from cities that belong to the Wuhan metropolitan coordinating region, including Xiaogan, Huanggang and the municipalities. Some in-migrants also come from Ezhou, Huangshi and Xianning, but the total number is relatively small. However, this does not mean that there are not frequent inflows and outflows of population between the three cities and Wuhan city; some people may move only for the short-term based on the convenience of travel routes. For areas farther away from the Wuhan metropolitan coordinating region, in-migrants come mainly from Jingzhou city, where there is a large population and convenient travel routes to Wuhan city. (2) The number of out-migrants leaving Wuhan city for the other cities of Hubei province is very small. In addition to the cities of the Wuhan metropolitan coordinating region, the cities of Shiyian, Yichang, Xiangfan and Jingzhou are the other major cities to which out-migrants flow from Wuhan city. Given education levels and types of household registration, it is inferred that these out-migrants are “squeezed” out of the low-end labor market. (3) Wuhan city is a net inflow city in Hubei province because the number of in-migrants from the other cities of Hubei province is larger than that of out-migrants flowing from Wuhan city to other provinces.

### Characteristics of Demographic Structure

#### (1) Age structure

The age pyramid of migrants at the provincial scale is shown in Fig. 7. Most in-migrants are between 20 and 44 years old; they are mainly laborers, with more than 65 % of the percentage. The proportion of in-migrants of 5 years of age as a group to all in-migrants is more than 10 %, and the percentages of in-migrants aged 25–29 years and 30–34 years are the highest, at 16.92 and 15.31 %, respectively. The percentage of in-migrants below 20 years of age is slightly higher than 20 %, and the percentage of in-migrants above 50 years old is approximately 7.4 %.

Most of the out-migrants at the provincial scale between 20 and 49 years of age are laborers population, and they account for approximately 70 % of the out-migrants. The proportion of out-migrants in the 5-year age group to all the out-migrants is more than 10 %, and the out-migrants aged 25–29 year and 30–34 year show the highest proportion values of 14.04 and 13.38 %, respectively. The percentages of out-migrants younger than 20 years and older than 50 years are approximately 16 and 14 %, respectively.

According to the above-mentioned assumption about the initial gestational age of Chinese women and the total fertility rate, the percentage of in-migrants aged 0–4 years to female in-migrants aged 25–29 years is 64.23 %, indicating that the percentage of left-behind children is approximately 35 %; the percentage of out-migrants aged 0–4 years to female out-migrants aged 25–29 years is 90 %. Both cases contrast with the inter-provincial scale. Associating sex ratios with individual information, it can be inferred that the out-migrants at the provincial scale flow out with their families to the other cities of Hubei province.

#### (2) Gender structure

Considering the gender structure, the percentages of male and female in-migrants are 47 and 53 %, respectively, at the provincial scale. The female in-migrants outnumber their male counterparts. Figure 8 shows the relation between the sex ratio and the different age groups at the provincial scale, which exhibits a larger “depression” compared to that of the inter-provincial scale. Female in-migrants far exceed their male counterparts. The lowest sex ratio, of 55.94, is

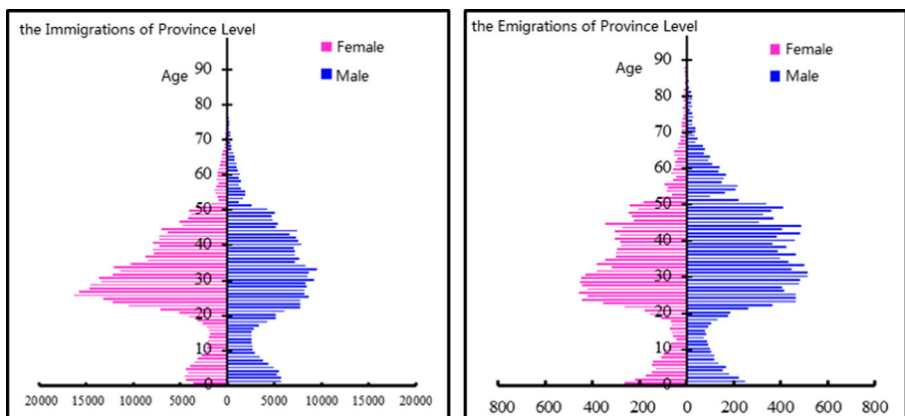
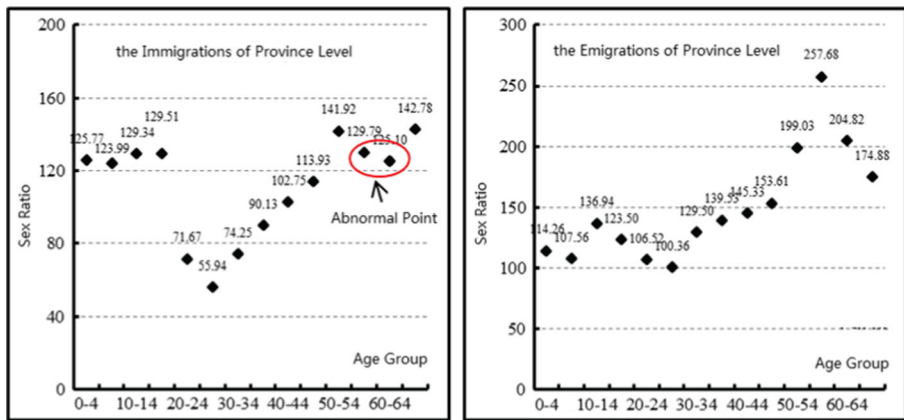


Fig. 7 Age pyramid of the migrants at the provincial scale



**Fig. 8** Relation between the sex ratio and the age of migrants at the provincial scale

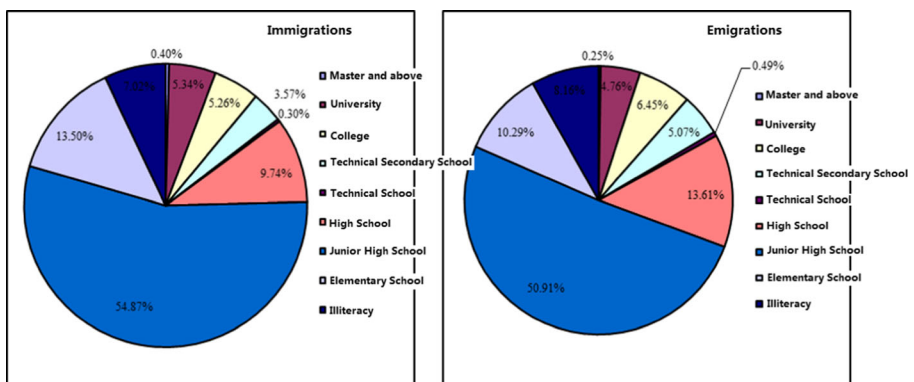
found in the 25–29 year old age group, and there are about half as many male migrants as female migrants. The sex ratio is very low between the 20–24-year-old and 30–34-year-old age groups and is similar to that at the inter-provincial scale, although more prominent.

For out-migrants at the provincial scale, the percentage of male out-migrants is 57 %, and the percentage of females is 43 %. Male emigrations far exceed female emigrations. The male out-migrants of all age groups exceed female out-migrants, and the sex ratio increases with age. Among all the age groups, the highest sex ratio (257.68) is found in the 55–59 age group; the lowest sex ratio (100.36) is in the 25–29 age group, and it is lower than the total sex ratio of the resident population in Wuhan city.

It is inferred that the variation in the sex ratio with age is similar to that of the inter-provincial scale. Figure 8 shows that there is an “abnormal” point in the group within the 55–64-year-old group, which is not caused by the labor market but rather because this population migrates to care for grandchildren.

(3) Education level

Figure 9 shows the percentage of provincial scale migrants with different educational levels. Of the total number of in-migrants who come from other cities



**Fig. 9** Percentage of provincial-scale migrants with different education levels

in Hubei province, 50.91 % of in-migrants graduated from middle school, 10.29 % graduated from elementary school, and 8.61 % were illiterate. The total percentage of these in-migrants (i.e., population from other cities in Hubei province) is more than 69.81 %, which is slightly lower compared to the population at the inter-provincial scale. On the other hand, 17.02 % of in-migrants from cities in Hubei province had received higher education.

The out-migrants moving from Wuhan city to the other cities in Hubei province had also mainly graduated from middle school, with a total of 54.87 %, followed by 13.50 % from elementary school; 7.02 % were illiterate. The total percentage of these three types of out-migrants exceeds 75 %, which is the highest percentage among inter-city migrants. Approximately 10 % of out-migrants had at least a college degree.

Thus, the out-migrants with lower education levels move to cities with lower levels of economic development. Based on current data, these migrant laborers have a “squeezing” effect on the local labor markets in terms of low-skilled jobs with low barriers to entry (Yang 2001; Yang et al. 2004; Giuntella 2012). However, this effect needs to be studied quantitatively.

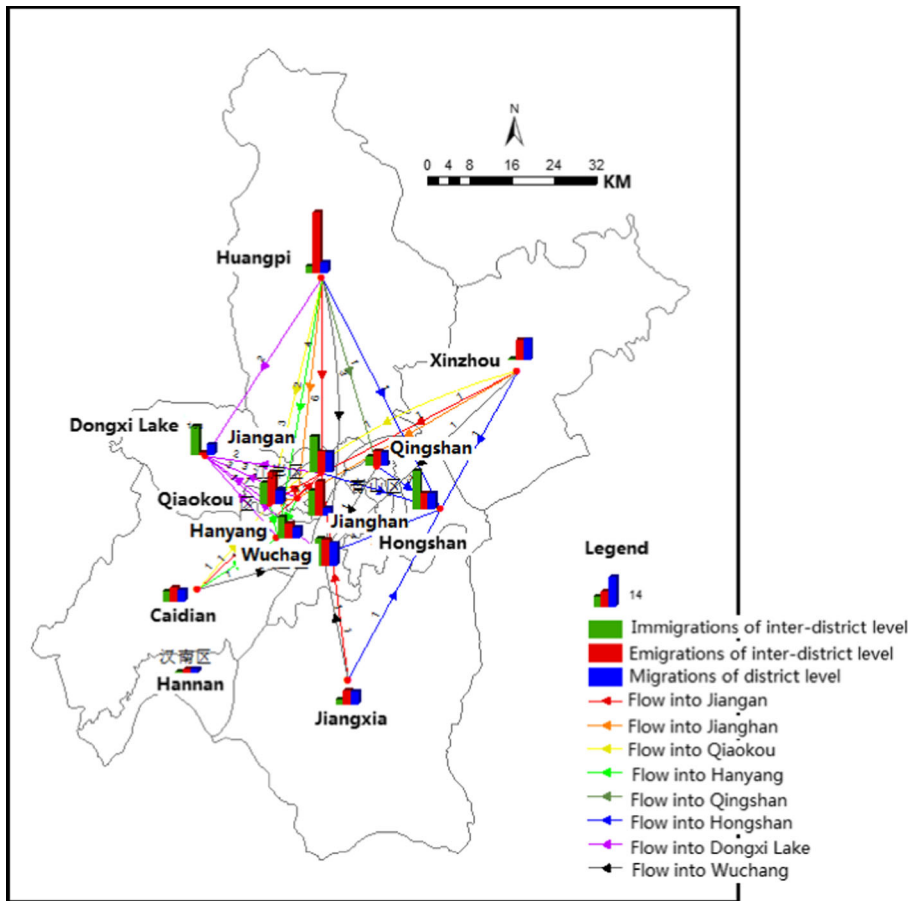
## Migration at the City Scale

### *Spatial Characteristics*

The spatial characteristics of city-scale migrants are illustrated in Fig. 10, which shows eight districts with net outflows (Huangpi, Xinzhou, Caidian, Qiaokou, Jianghan, Jiangxia, Qiangshan and Hannan) and seven districts with net inflows (Wuchang, East Lake new technology development zone, Hanyang, Wuhan economic and technological development zone, Jiangan, Hongshan and Dongxi Lake). Among the net-outflow districts, Huangpi has the largest net migration rate of 21.6 %, followed by Caidian (10.8 %). The other six districts have net outflow migration rates between 0 and 10 %. Among the net inflow regions, Dongxi Lake is the district with the largest net migration rate of 47.8 %, followed by the Wuhan economic and technological development zone (28.3 %). Jiangan and Hongshan have net inflow migration rates in the range of 10–20 %, and the net inflow migration rates below 10 % correspond to Wuchang, the East Lake new technology development zone, and Hanyang.

Regarding migration at the district scale in Wuhan city (moving within one district), Dongxi Lake has the largest net migration rate of 21.03 %, followed by Hannan. Seven districts (Wuhan economic and technological development zone, Jiangxia, Hanyang, Qiaokou, Wuchang, Qiangshan and Jiangan) have district-scale migration rates between 10 and 15 %. The migration rates in the range of 5–10 % correspond to five districts, including Jianghan, Hongshan, Caidian, East Lake new technology development zone, and Xinzhou. Huangpi has the smallest migration rate, at only 4.06 %.

Accounting for the inter-district-scale (moving from one district to another district) and district-scale migration features, and the economic development levels of districts, we identify spatial characteristics at the city scale. First, district-scale migrants have a slightly smaller population compared to inter-district-scale out-migrants, accounting for 75 % of inter-district-scale out-migrants. Most of the districts show an equal number of



**Fig. 10** Spatial characteristics of internal city-scale migrants. *Notes:* the arrowed lines denote the net migration direction between two districts, and the number on the arrowed lines represents the number of migrants. (Unit: 10 thousand persons)

out-migrants at inter-district-scale and migrants at district-scale, except for three districts (Jiangnan, Qiaokou, and Huangpi), which have a high percentage of out-migrants. Second, the net outflow regions are mainly located in the suburbs of Wuhan city (Huangpi, Xinzhou, and Jiangxia) while the central districts of Wuhan city (Dongxi Lake, Jiangnan, and Hoangshan) are the net inflow regions. The migrants move very frequently between the central districts of Wuhan. Overall, this shows that the migrants spread from the old city districts to the new city districts. The old city districts – Qiangshan, Jiangnan and Qiaokou – show a net-outflow tendency. Third, three districts (Jiangnan, Qiaokou, and Huangpi) have a much larger number of inter-district-scale out-migrants than of district-scale migrants. The number of out-migrants is very large in Jiangnan and Qiaokou because many residents need to find new homes due to reconstruction in these two districts. In Huangpi, many people flow out to find jobs or are self-employed by running their own businesses, which leads to a large number of out-migrants. Dongxihu is the only district in which the number of inter-district-scale out-migrants (14.5 thousand) is smaller than that of district-scale migrants (52.4



thousand). Furthermore, Dongxihu has frequent population shifts and has the highest number of inter-district-scale in-migrants among all the districts in Wuhan, which is consistent with its active level of economic development.

### *The Characteristics of the Demographic Structure*

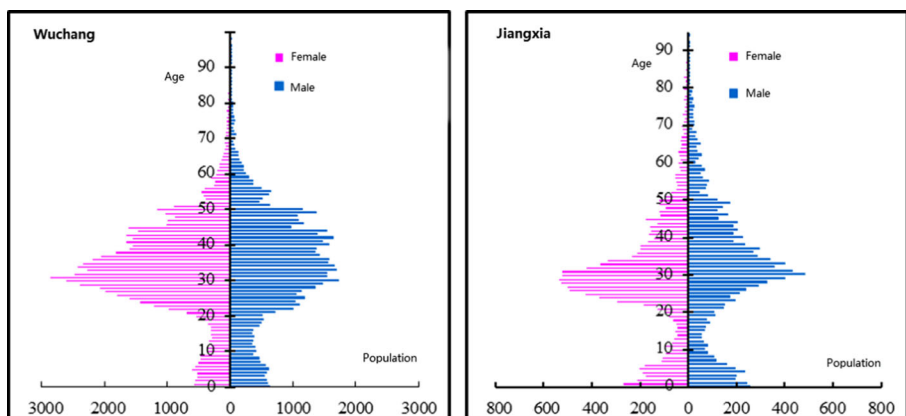
Because city-scale migrants and district-scale migrants have similar demographic structures, we choose Wuchang and Jiangxia as samples to investigate the demographic structures of inter-district-scale migrants.

#### (1) Age structure

The age pyramid of inter-district-scale migrants is shown in Fig. 11. In Jiangxia, approximately 61.87 % of in-migrants are between 20 and 44 years old, and they belong to the laboring population. The highest proportions of in-migrants are in the 25–29-year-old and 30–34-year-old age groups, accounting for 16.57 and 18.85 % of in-migrants, respectively. The percentage of in-migrants younger than 20 years old is slightly above 20 %, and in-migrants older than 50 years account for approximately 12 % of total in-migrants. The age distribution of in-migrants is similar to that of provincial-scale in-migrants.

In Wuchang, approximately 70 % of in-migrants are between 20 and 49 years old, and they mainly constitute a laboring population. Migrants aged 30–34 years account for the highest proportion at 16.84 %. The percentage of in-migrants younger than 20 years is approximately 14 %, while the percentage of in-migrants older than 50 years is approximately 13 %, thus these percentages are similar. The age distribution of in-migrants is similar to that of provincial-scale out-migrants.

In summary, the age structure of the in-migrants in suburban districts is similar to that of the in-migrants from other cities in Hubei province; the age structure of in-migrants in the central district is similar to that of out-migrants flowing from Wuhan to other cities in Hubei province. Further studies should be conducted to explain more subtle differences.



**Fig. 11** Age pyramid of the inter-district-scale in-migrants

(2) Gender structure

Regarding gender structure, 45.83 % of in-migrants in Wuchang are male and 54.17 % are female. Figure 12 shows the relation between the sex ratio and age of the inter-district-scale migrants. If we analyze based on age group, we see similarities to the inter-provincial scale and provincial scale. Owing to shorter migration distances, the smaller sex ratio with more female in-migrants continues to be in the 40–44 year group, and the “depression” appears in the 20–44-year-old group. The 25–29-year-old group has the lowest sex ratio (58.37), and the number of male in-migrants is only half of the number of female in-migrants. The sex ratio is very low for two age groups: 20–24 years and 30–39 years.

In Jiangxia, the numbers of male and female in-migrants are almost equal, and their percentages are approximately 50 %. The exception is that the percentage of female migrants aged 20–29 years is very high. However, due to the small size of the total sample, these results should be interpreted cautiously.

(3) Education level

Figure 13 shows the percentages of inter-district-scale in-migrants with different education levels in Wuchang and Jiangxia. Figure 13 shows that 38.11 % of in-migrants in Wuchang have a middle school diploma, 8.57 % of in-migrants graduated from elementary school, and 5.73 % of in-migrants are illiterate. The total percentage of these three types of in-migrants exceeds 52.41 %; 26.49 % of in-migrants have a college degree or higher. The education level of inter-district-scale in-migrants is superior to that of province-scale in-migrants.

In Jiangxia, 44.54 % of in-migrants graduated from junior middle school, leaving 12.77 % of in-migrants who graduated from elementary school and 8.45 % who are illiterate. The total percentage of these three types of in-migrants exceeds 65.76 %. In addition, 19.01 % of in-migrants have a college degree or higher. The education levels of in-migrants in this district are similar to those of inter-provincial in-migrants.

In summary, it has been found that migrant laborers have a “squeezing” effect on local laborers in terms of seeking low-skilled jobs with low barriers to entry among provincial-scale and inter-district-scale migrants. Individuals with low education levels are usually forced to move away from Wuhan as a result of the

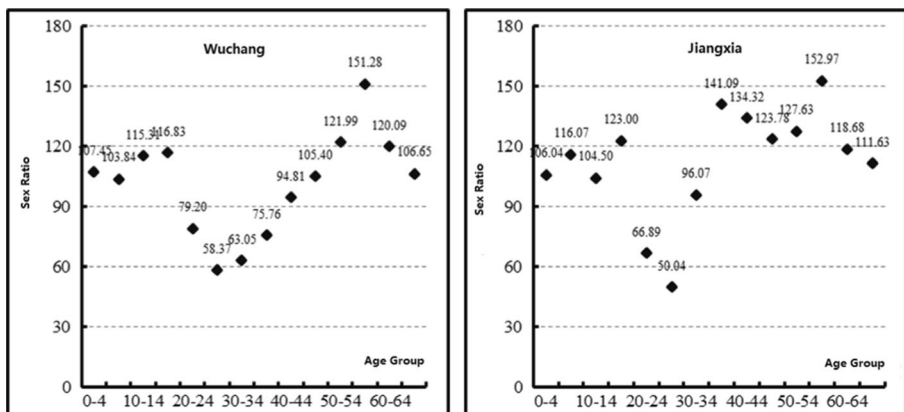


Fig. 12 Relation between the sex ratio and the age of inter-district-scale migrants

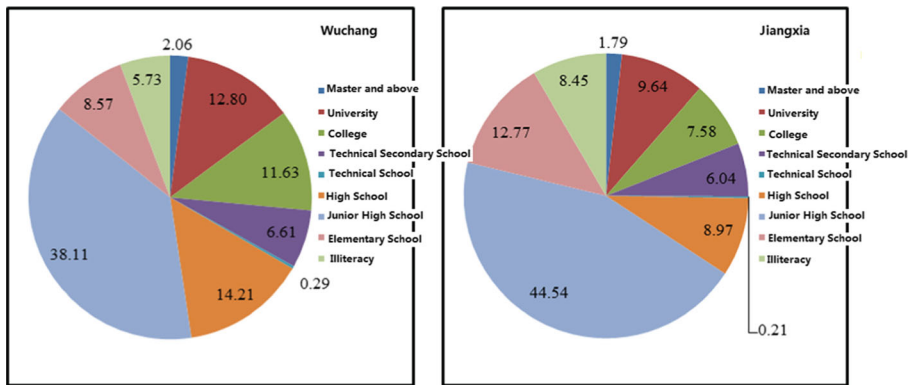


Fig. 13 Percentage of inter-district-scale migrants with different education levels

squeezing effect of foreign labor. Even for populations with relatively low education levels in the central part of Wuhan, they are forced to look for jobs in the suburbs of Wuhan.

## Conclusions

This study explores the migration directions and population sizes of internal migrants in Wuhan, as well as the spatial characteristics and the demographic structural characteristics of internal migrants on three scales (i.e., inter-provincial, provincial, and city scales). Our primary findings can be summarized as follows: (1) the percentage of internal migrants is high in Wuhan. The net outflow dominates at the inter-provincial scale, although in-migrants from neighboring provinces partly offset the out-migrants who flow out to “one province, two cities and three regions”. At the provincial scale, it is the population of in-migrants coming from the neighboring cities of Wuhan that makes the resident population larger than the registered population of households. At the city scale, the migrants flow from the suburbs of Wuhan city to the central urban zones, and spread from old urban zones to new urban zones. (2) The migration inertness of female migrants leads to obvious differences in gender structure between different age groups at the provincial scale. Specifically, the great majority of female migrants only move short distances. (3) Improvements to the health and education of children require more attention because of the large number of left-behind children and floating children. (4) The “squeezing” effect caused by migrant laborers acts as the main force driving internal migration at the inter-provincial, city, and provincial scales (Yang 2001; Yang et al. 2004; Giuntella 2012). (5) Analyses of three spatial scales found that the population size at the inter-provincial scale is smaller than that at the provincial and city scales. In terms of the economy, the findings imply that Wuhan is still a local central city and lacks economic radiation capacity at the national scale.

This investigation adds to the extremely limited body of research on internal migration at the inter-provincial, provincial and inter-city scales for in-migrants and out-migrants. In addition, we tentatively highlight further implications for policy makers and researchers. First, in the two regions where internal migrants flow in and flow out, cooperate with each other should be strengthened to manage migrants. For

inter-provincial-scale out-migrants, government departments in Wuhan should focus on cooperate with the Guangdong province to enhance the management of the floating population. Because 50 % of the out-migrants flow from Wuhan to Guangdong province, both regions should take the initiative to expand their collaboration to manage internal migrants and promote the healthy development of migrants. Furthermore, successful strategies of managing the floating population in pilot areas can be replicated in other areas. At the provincial scale, the relevant government departments of Wuhan should strengthen their cooperative work with the relevant government departments of the cities coordinating Wuhan to manage the population. At the city scale, the relevant government departments of Wuhan should pay attention to the regions with high migration rates, such as Huangpi, Dongxihu and the central areas of Wuhan, and strengthen the management of internal migrants in smaller areas such as streets and neighborhoods. Second, the relevant government departments of Wuhan should promote reproductive health services for female migrants. The analyses show a large percentage of female in-migrants of childbearing age in Wuhan. However, the provision of reproductive health and education services is limited for female in-migrants. Therefore, the government should allocate more funds to promote educational resources and services for reproductive health. For example, free healthcare newsletters or magazines could be distributed to female in-migrants on a regular basis.

Third, the government should focus on the physical and mental health of children from migrant families. Our results indicate that there are a large number of left-behind children and floating children in Wuhan compared to other regions. Therefore, it is very important to develop prevention and promotion programs to address health issues for left-behind children and floating children. Regarding left-behind children, further research, such as survey studies, should be conducted to gain insights into their characteristics and the status quo in health care. Meanwhile, by enhancing interdepartmental collaboration (e.g., health departments and public schools), more policies can be implemented to improve the physical and mental health of floating children.

Fourth, more education and employment training for immigrant workers should be provided. The findings show that the majority of internal migrants are middle school graduates or less, and their low educational attainment makes them uncompetitive in labor markets. Their employment outcomes can be improved by job training. The Chinese economy has experienced major structural changes, making it very important to have job training, which will not only lead to economic growth and sustainability but also enhance each migration family's overall welfare.

Finally, the relevant government departments of Wuhan should implement appropriate policies to provide qualified migrants with formal household registration. Furthermore, it is necessary to reduce the population growth of internal migrants and improve population management capabilities. Different measures should be applied to different groups. For internal migrants from other cities, policies should be implemented to establish standardized conditions for obtaining formal household registration in Wuhan and to ease the application process for applying for formal household registration in Wuhan. The principle

of the standardized conditions is to enable applicants to live in Wuhan long-term. Easing the application process for formal household registration will serve internal migrants with high abilities, who can then be encouraged to settle in Wuhan, which will enhance the capabilities of population management and promote Wuhan's economic development.

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