RESEARCH ARTICLE

Spatial pattern and changing trend of population inflow in China’s five major urban agglomerations

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Abstract: Urban agglomeration plays an important role in China’s urbanization pattern, and it is also the main population inflow place in the period of rapid urbanization. This paper focuses on the five urban agglomerations of Beijing-Tianjin-Hebei, the Yangtze River Delta, the Pearl River Delta, the middle reaches of the Yangtze River and Chengdu-Chongqing. Using the census and dynamic monitoring survey data of floating population, this paper analyzes the spatial pattern of population inflow in urban agglomerations from the multi-dimensional aspects of inflow population distribution pattern, flow range and source, and discusses the development trend of spatial pattern and its impact on inflow and outflow from the perspective of spatial differences in residence and settlement willingness. The study found that the inflow population of urban agglomerations continued to concentrate in the key cities, and the level and spatial distribution pattern were generally stable; the scope of flow has been expanded, and the growth rate of flow within the province is generally higher than that between provinces; the population attraction range of coastal urban agglomeration is large, but it still obeys the law of distance attenuation. There are differences in the preference of urban agglomeration from different origins. In the inflow area, the key cities of coastal urban agglomerations face the continuous challenge of floating population management services, and the attraction of key cities and general cities of inland urban agglomerations coexist; in the outflow areas, the equal and open supply of high-quality public services is an important way to attract population return, and the population loss in a few areas may become a long-term phenomenon.

Keywords: Population inflow; Spatial mode; Migration distance; Residence and settlement; Urban agglomeration

1. Introduction

Since the 1980s, the rapid industrialization process in coastal areas, the gradual expansion of urban-rural income gap and the elimination of population mobility barriers have led to the sustained and rapid growth of floating population, which has become the main body of China’s new urban population (Chan and Zhang, 1999; Zhang and Song, 2003; Hu, Xu, and Chen, 2011; Liu, Qi, and Cao, 2015). In recent years, China’s population mobility has shown new characteristics. From the perspective of population size, 236 million floating population¹ in 2019 were in a significant fluctuation in recent years (Qi and Liu, 2015; National Bureau of Statistics, 2020), which has been considered to be related to the decrease of rural labor force to be transferred which is caused by the slowdown of national popular-

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¹ This study is about the inflow population of city groups. But in other literatures, the “floating population” which respects the
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The transfer of industries to the traditional population outflow areas and the loose registered residence system in inflow areas. From the perspective of spatial model, the current population flow is characterized by intra-provincial flow as main trend and inter-provincial flow as supplement. The nearby flow within the province may become one of the main modes of population urbanization in China (Liu, Qi, and Cao, 2015; Wang and Pan, 2013; Wang and Gao, 2019). The transformation of the characteristics of population mobility will have many effects on China’s urbanization pattern: For major population inflow places such as urban agglomerations, the driving force of urbanization will shift from the expansion of the scale of floating population to the stable residence and settlement of existing floating population in the inflow cities; For the main population outflow areas, the flow mode dominated by intra-provincial flow means that the capital cities and regional key cities in the Central and Western regions are gradually more attractive to the floating population, and the back-flow of population also brings new impetus to the urbanization of the population outflow areas. The spatial reconstruction of the stock floating population will become an important part of China’s future urbanization pattern.

The settlement of floating population in urban agglomeration and other major inflow places still faces multiple obstacles. Generally speaking, the realization of full citizenization of floating population in the inflow area will go through two-stage decision-making of “staying locally” and “settling locally” (Liu, Chen and Cao, 2019), and the influencing factors of short-term and long-term residence are different (Zhu, 2004; Lin, Zhu, Ke, et al., 2019). With the increase of the floating population’s residence time and the trend of family migration (Duan, Lv, and Zou, 2013), people have higher demand for public services and social welfare in the inflow city, and registered residence threshold has become an obstacle to their long-term residence (Zhu and Chen, 2010). Residence and settlement intention is the rational expectation of the floating population for the future spatial choice. It is a comprehensive judgment based on the ability of subjective will and objective constraints. It can reflect the long-term attraction of cities and regions to the floating population, and then reflect the evolution trend of the distribution of floating population and urbanization pattern in the future. In recent years, the spatial pattern and influencing factors of the floating population’s residence and settlement intention have become academic hotspots (Cao, Li, Ma, et al., 2015; Lin and Zhu, 2016; Tang and Hao, 2018; Gu, Xiao and Shen, 2018). Studies have found that the decision-making of the floating population’s residence and settlement is affected by individual and family factors. At the same time, the economic and social development, public facilities and services in the immigration and emigration areas are also very important (Liu and Wang, 2020). The comparative study of the two shows that the residence intention of the floating population is more closely related to the expectation of economic income, and the settlement intention is related to the expectation of public services and welfare (Liu, Chen, and Cao, 2019; Qi, Xi, and Xu, 2017; Zhang, 2011). The analysis of residence and settlement intention is helpful to predict the spatial distribution of floating population and the change trend of urbanization pattern. It can also reflect the source of attraction of different cities and regions to floating population, and then provide decision-making reference for relevant policies of “attracting” and “retaining” in regional competition.

In the context of new urbanization, urban agglomeration will become the main form of China’s urbanization and the main carrier of floating population (Lu and Chen, 2015; Chen, Guo, and Lu, 2018). The research on the spatial pattern of population inflow and its urbanization effect in urban agglomeration areas will help to study and judge the trend of population flow and the future urbanization pattern in China, and provide decision-making reference for exploring the new urbanization path. Combining the literature, it is found that the existing research on the spatial pattern of population inflow mainly focuses on the spatial distribution pattern of inflow places. In fact, population flow promotes the interactive development of inflow places and outflow places. In recent years, some population outflow places have the fastest urbanization speed, and this trend is likely to continue. Therefore, it is necessary to comprehensively analyze the spatial pattern of population inflow from the perspective of flow range and source place. At the same time, the research on the population inflow of urban agglomerations mainly focuses on coastal urban agglomerations. Under the background of the spatial balance of population flow and the spatial inland urbanization, the necessity of comparative research on major urban agglomerations in coastal and inland areas is prominent, which is helpful to comprehensively understand the spatial model of population flow and the future urbanization pattern in China. In addition, although the academic circles are generally aware of the importance of population mobility to the urbanization pattern, the systematic evaluation and trend judgment are relatively insufficient, while the willingness to stay and settle down can establish an effective relationship between micro decision-making and macro pattern, providing a feasible observation perspective for the development trend of population mobility and urbanization pattern.

Based on the data of the fifth and sixth national censuses and the data of 2017 national dynamic monitoring survey of floating population, this paper takes Beijing-Tianjin-Hebei, Yangtze River Delta, Pearl River Delta, the middle reaches of the Yangtze River and Chengdu-Chongqing as the research object, and analyzes the spatial pattern of population inflow in China’s urban agglomerations from multiple dimensions such as the spatial pattern of distribution and growth, the scope...
of flow and the place of origin. Taken into concern the residence and settlement intention of the inflow population, this paper studies and judges the spatial model and development trend, and discusses its impact on the inflow and outflow places.

2. Research Methods and Data Sources

2.1 Study Area

This paper focuses on the urban agglomeration of Beijing-Tianjin-Hebei, Yangtze River Delta and Pearl River Delta located in the Eastern coastal area and the urban agglomeration of the middle reaches of the Yangtze River and Chengdu-Chongqing located in the inland of the Central and Western regions. The five major urban agglomerations cover 83 prefecture level cities in four municipalities directly under the central government and nine provinces in China. In 2014, the GDP was 34.84 trillion yuan and the resident population was 530 million in the five major urban agglomerations. With a land area of 10% of the country, they carried 38% of the resident population and 54% of the GDP, and played an important role in economic development and population agglomeration. The spatial scope of urban agglomeration in this paper is based on the corresponding urban agglomeration development plan issued by the state.

2.2 Data Sources

The research data are the data of 2017 national floating population dynamic monitoring survey (CMDS) organized by counties of the fifth and sixth national census and the National Health Commission. The respondents of CMDS survey include the floating population who have lived in the local area for 1 month or more, who are not registered in the district (county, city) and aged 15 years or above. They are representative of provincial administrative units and major urban agglomerations through stratified, multi-stage and scale proportional PPS sampling method. In order to keep consistent with the statistical caliber of the census data, taking the floating population sample of “living locally for 6 months or more” as the research object, 154,586 samples were screened, accounting for 90.94% of the total sample. Census data is the most accurate floating population data at the county level at present. The advantage of CMDS data is to fully show the structural characteristics of floating population and have strong timeliness. In addition, the registered residence population data of various provinces and cities are derived from the China Population and Employment Statistics Yearbook 2018 and the statistical yearbook of 2018 of related provinces. All “national” data in this paper do not include Hong Kong, Macao, Taiwan and active servicemen.

The floating population (inflow population) is defined as the population living in the local, and the registered residence area is outside the county (city, district) and the population have leaved the registered residence for more than half a year, including inter provincial and inter county mobility within the province (only 3.2.1 section considers the flow in the county). Since the separation of people and households between districts within a city divided into districts does not belong to inter county mobility, the municipal districts are merged into one geographical unit. In order to facilitate spatial analysis, the data of the two censuses are integrated according to the boundaries of administrative divisions in 2010. Referring to the urban agglomeration development planning and existing research, the basic geographical units of each urban agglomeration are divided into three categories: central city, general city and peripheral counties and cities.

The basic situation of the inflow population of each urban agglomeration is shown in Table 1. In 2017, the national floating population dynamic monitoring survey obtained 65,966 valid samples in five urban agglomerations, accounting for 42.67% of the country. The average age of the floating population in China is about 36 years old, and the new generation of floating population born after the 1980s accounts for nearly 60%. The inflow population of Beijing-Tianjin-Hebei and Chengdu-Chongqing urban agglomeration has the characteristics of high quality, relatively high proportion of elderly population and “city to city” floating population. In contrast, the Pearl River Delta urban agglomeration has an absolute majority of the young and middle-aged population under the age of 40 and the “country to city” floating population. In recent years, the residence of the floating population in the inflow area has gradually stabilized and the trend of familialization has increased. The average residence time has reached 6.83 years, and the average family size in the inflow area is 2.79 people. However, compared with the national average, the residence time of the inflow population in each urban agglomeration is generally low, and the family size in the inflow area is close to or slightly lower than the average. From these two indicators, the residence stability and family migration trend of the inflow population of urban agglomeration are lower than that of the whole country. Beijing-Tianjin-Hebei urban agglomeration is characterized by the smallest family size but the longest residence time.

2.3 Method

This paper takes statistical analysis as the main research method. In addition, it also uses the methods of variation coefficient,
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rank correlation coefficient, chi-square test and spatial visualization based on ArcGIS. The coefficient of variation is the ratio of the standard deviation of the inflow population of each city and county in the urban agglomeration to its mean value, which is used to describe the spatial concentration of the inflow population of urban agglomeration at a specific time point. The greater the coefficient of variation, the more concentrated it is. The rank correlation coefficient is the correlation coefficient of the order of inflow population scale in 2000 and 2010, which is used to describe the overall stability of the spatial distribution pattern of inflow population in urban agglomeration. The closer the rank correlation coefficient is to 1, the more stable it is. Chi-square test is to judge whether the two classification variables are independent of each other at a certain significance level by calculating the chi-square value. This paper applies it to test “whether it is the inflow population from the outside of the urban agglomeration” and whether the willingness to stay and settle down are independent of each other.

Table 1. Basic situation of inflow population of five major urban agglomerations in 2017

| Whole country | Beijing-Tianjin-Hebei urban agglomeration | Yangtze River Delta urban agglomeration | Pearl River Delta urban agglomeration | Urban agglomeration in the middle reaches of the Yangtze River | Chengdu-Chongqing urban agglomeration |
|--------------|------------------------------------------|-----------------------------------------|--------------------------------------|-------------------------------------------------|--------------------------------------|
| Sex ratio (100 for women) | 106.09 | 102.67 | 106.07 | 100.52 | 104.87 | 98.42 |
| Average age (years) | 36.37 | 36.72 | 35.41 | 33.32 | 36.13 | 37.96 |
| Proportion of people aged 60 and over (%) | 3.71 | 4.75 | 2.47 | 1.10 | 1.93 | 7.26 |
| Proportion of the “new generation” (%) | 59.21 | 60.07 | 62.49 | 69.77 | 58.30 | 53.99 |
| Proportion of college degree or above (%) | 17.64 | 25.37 | 20.52 | 16.58 | 16.54 | 21.96 |
| Proportion of registered residence in agriculture (%) | 82.18 | 75.52 | 83.22 | 87.79 | 81.83 | 77.63 |
| Average residence time (years) | 6.83 | 7.59 | 6.81 | 6.19 | 6.06 | 5.45 |
| Average local family size (person) | 2.79 | 2.63 | 2.73 | 2.69 | 2.82 | 2.74 |
| Sample size (pcs.) | 154,586 | 15,545 | 23,719 | 8,057 | 10,131 | 8,514 |

Note: “new generation” refers to the floating population born in 1980 and later.

In order to describe the population flow between regions, the relative intensity index of population inflow is constructed. Comprehensively considering the factors of inflow and outflow, this paper investigates the population flow between regions from the perspective of the distribution of inflow population sources in specific regions. Since the scale of inter regional population flow is affected by the total population size of the outflow area and the population attraction of the inflow area, the relative intensity index NOD of population inflow from inflow area O to inflow area D is constructed based on the idea of location quotient. The calculation formula is shown in (1).

\[
N_{OD} = \frac{M_{OD}}{p_O} \frac{M_D}{P_{NonD}}
\]

(1)

where: MOD is the population size flowing from place O to place D; PO is the population size of O registered residence. The ratio of the two reflects the intensity of population flow from O to D. MD is the total size of inflow population in D; PNonD is the total size of registered residence in all parts of the country except D. The ratio of the two reflects the average intensity of the population moving to D across the country. NOD greater than (or equal to or less than) 1 indicates that the intensity of population inflow into place D in place O is higher than (or equal to or lower than) the average intensity of population inflow into place D in China. The index comprehensively reflects the population outflow intensity of outflow place O and its preference for inflow place D. By calculating and comparing the NOD between outflow place O and multiple main inflow places D, we can clarify the total intensity of population outflow of place O and the distribution of preference for each main inflow place.

3. Spatial Pattern of Population Inflow in Urban Agglomeration

The Southeast coastal area is the forefront of China’s reform and opening up. Therefore, the Pearl River Delta and Yangtze River Delta urban agglomerations are the earliest inflow population agglomerations in China, and continue to attract the largest inflow population. As shown in Figure 1, in 2000, the inflow population of urban agglomeration in the Pearl River Delta was nearly 20 million, and that in the Yangtze River Delta was nearly 14 million, which was much higher than that of other urban agglomerations. In the 21st century, an all-round opening-up pattern has gradually taken shape. Beijing-Tianjin-Hebei, the middle reaches of the Yangtze River and Chengdu-Chongqing urban agglomeration have become
emerging major population inflow places. From 2000 to 2010, the advantages of the Yangtze River Delta and the Pearl River Delta as the first inflow places of China’s population continued. In 2010, the inflow population reached 37.88 million and 28.71 million respectively. The inflow of population from Beijing-Tianjin-Hebei increased rapidly, with an increase of more than 100% from 2000 to 2010. The inflow population of each urban agglomeration shows the overall characteristics of rapid growth in scale and high spatial agglomeration, while the spatial patterns of population inflow of urban agglomerations in different locations and different development stages are different. This section examines the typical characteristics of the spatial pattern of population inflow of urban agglomerations from three dimensions: the spatial pattern of distribution and growth, the intra provincial and inter provincial characteristics of the flow range, and the differences between urban agglomerations of origin.

Figure 1. Population inflow scale and its changes in five urban agglomerations from 2000 to 2010.

3.1 Place of Population Inflow

3.1.1 The inflow population continues to concentrate in key cities, and the diffusion effect of the Yangtze River Delta and the Pearl River Delta appears

The key city is a stable center of population concentration in urban agglomeration. In the first inflow places such as the Yangtze River Delta and the Pearl River Delta urban agglomeration, the inflow population concentration has been relatively stable, and the inflow population concentration in the later inflow places such as Beijing-Tianjin-Hebei, the middle reaches of the Yangtze River and Chengdu-Chongqing urban agglomeration has increased rapidly. The hierarchical structure of inflow population distribution in key cities, general cities and peripheral counties and cities of various urban agglomerations in 2000 and 2010 is shown in Figure 2. The proportion of the inflow population in the key cities of each urban agglomeration accounts for more than 40% of the urban agglomeration, indicating that the inflow population in the urban agglomeration is stably concentrated in a few 2-3 key cities. The inflow population of Beijing-Tianjin-Hebei urban agglomeration is highly concentrated in Beijing and Tianjin, and the concentration continued to rise from 2000 to 2010. The variation coefficient of inflow population distribution in this urban agglomeration reached 7.01 in 2010, which is much higher than that of other urban agglomerations. From the perspective of the change of spatial distribution, the inflow population of the Yangtze River Delta and Pearl River Delta urban agglomeration is relatively stable in cities at all levels. The inflow population of Beijing-Tianjin-Hebei, the middle reaches of the Yangtze River and Chengdu-Chongqing urban agglomeration shows a trend of concentration to the key city. The proportion of the inflow population of general cities and peripheral counties and cities in Beijing-Tianjin-Hebei urban agglomeration has decreased significantly, and the proportion of the inflow population of peripheral counties and cities in the middle reaches of the Yangtze River and Chengdu-
Chongqing urban agglomeration has decreased.

Figure 2. Spatial distribution of internal migration by city’s level, 2000-2010.

The inflow population of the urban agglomerations in the Yangtze River Delta and the Pearl River Delta are moderately dispersed, and Beijing-Tianjin-Hebei and inland urban agglomerations are still gathering. We analyzed the hierarchical structure of inflow population growth, and took the ratio of urban growth rate at all levels to urban agglomeration growth rate as the relative growth rate, and calculate the proportion of inflow population increment in urban agglomeration at all levels (Table 2). In the first inflow places such as the Yangtze River Delta and the Pearl River Delta, the diffusion effect has appeared, but it has not changed the growth pole position of the key city. There is a small gap in the growth rate of units at all levels of urban agglomeration in the Yangtze River Delta and the Pearl River Delta, and there is no obvious gap in the degree of attraction to the inflow population. The growth rate of peripheral counties and cities is the highest in all levels of units, and the diffusion effect has appeared. Among them, the Yangtze River Delta urban agglomeration is the only urban agglomeration with the lowest relative growth rate and increasing growth rate from the center to the periphery, and the diffusion effect is obvious. In terms of increment, due to the large inflow population base of key cities, under the condition of maintaining a certain growth rate, key cities are still the growth pole of the inflow population of urban agglomerations. The concentration of inflow population in emerging inflow places such as Beijing-Tianjin-Hebei continues to increase rapidly, and the key city is still the most important place to carry the inflow population of urban agglomeration in the coming period. The key cities of Beijing-Tianjin-Hebei, the middle reaches of the Yangtze River and Chengdu-Chongqing urban agglomeration are the only local areas in the urban agglomeration where the inflow population growth is faster than the whole, and the attraction of the inflow population is much stronger than that of the periphery. The inflow population of Beijing-Tianjin-Hebei urban agglomeration is particularly prominent in accelerating the agglomeration to the key city. Beijing-Tianjin is the city with the fastest growth rate of inflow population among the 15 urban levels of the five urban agglomerations; 81.72% of the new inflow population of Beijing-Tianjin-Hebei urban agglomeration is concentrated in the two key cities.

Table 2. Urban level differences of inflow population growth in five urban agglomerations from 2000 to 2010

| Index | Name of urban agglomeration | Key city | General city | Peripheral counties and cities |
|-------|-----------------------------|----------|--------------|--------------------------------|
| Relative growth rate of inflow population (%) | Beijing-Tianjin-Hebei urban agglomeration | 1.37 | 0.60 | 0.31 |
| | Yangtze River Delta urban agglomeration | 0.94 | 1.02 | 1.07 |
| | Pearl River Delta urban agglomeration | 1.04 | 0.93 | 1.38 |
| | Urban agglomeration in the middle reaches of the Yangtze River | 1.47 | 0.70 | 0.71 |
Table 2. (Continued)

| Index | Name of urban agglomeration          | Key city | General city | Peripheral counties and cities |
|-------|--------------------------------------|----------|--------------|--------------------------------|
|       | Chengdu-Chongqing urban agglomeration | 1.17     | 0.99         | 0.69                           |
|       | Beijing-Tianjin-Hebei urban agglomeration | 81.72    | 11.72        | 6.56                           |
|       | Yangtze River Delta urban agglomeration | 40.01    | 31.21        | 28.78                          |
|       | Pearl River Delta urban agglomeration | 47.89    | 46.38        | 5.72                           |
|       | Urban agglomeration in the middle reaches of the Yangtze River | 56.43    | 25.05        | 18.52                          |
|       | Chengdu-Chongqing urban agglomeration | 64.27    | 15.98        | 19.75                          |

3.1.2 The level and spatial distribution pattern are generally stable, and Beijing-Tianjin-Hebei and inland urban agglomerations are still changing

The distribution pattern of inflow population within urban agglomerations is basically stable, and compared with coastal urban agglomerations, inland urban agglomerations change slightly. The distribution pattern of large cities is basically fixed, and the distribution pattern of small and medium-sized cities has changed significantly. Sort the inflow population scale of cities and counties in the urban agglomeration, and calculate the percentile order and rank correlation coefficient of the inflow population scale of cities and counties in 2000 and 2010, as shown in Figure 3. The rank correlation coefficients of the order of the inflow population size of each urban agglomeration are more than 0.8, and the spatial pattern is relatively stable. Among them, the middle reaches of the Yangtze River and Chengdu-Chongqing urban agglomeration are 0.82 and 0.83, the Beijing-Tianjin-Hebei urban agglomeration is 0.88, and the Yangtze River Delta and Pearl River Delta urban agglomeration are 0.95 and 0.98 respectively. The distribution pattern of inflow population in the first inflow area has been basically fixed, indicating that the more mature the development of urban agglomeration, the more stable the functional connection and division of labor among internal cities, the more balanced the development level of each city, and the distribution pattern of inflow population gradually tends to be stable. On the whole, the order of cities and counties with the largest inflow population in the top 25% of the urban agglomerations remains basically unchanged, while the order of small and medium-sized cities with small inflow population changes relatively significantly, which indicates that a relatively fixed inflow population concentration center has been formed in the urban agglomerations. However, the relative attraction of cities and counties in the middle reaches of the Yangtze River and Chengdu-Chongqing urban agglomeration to the inflow population has still changed greatly in the past 10 years, and the phenomenon of rank adjustment is relatively common, reflecting that the spatial pattern of economic development and population attraction of urban agglomeration is still in the process of formation and adjustment. The spatial pattern of Beijing-Tianjin-Hebei urban agglomeration is between the mature and stable Yangtze River Delta and Pearl River Delta urban agglomeration and the inland urban agglomeration in the process of formation and adjustment.

3.2 Scope of Population Mobility

3.2.1 The scope of mobility has been expanded, and the proportion of inter county mobility in the province and inter province mobility has generally increased

The inflow population of urban agglomeration is divided into three categories: intra county, inter county and inter province according to the flow range, and the flow range of inflow population of urban agglomeration is discussed. From 2000 to 2010, the floating range of urban agglomeration inflow population expanded; the proportion of floating population in counties decreased; and the proportion between counties and provinces increased. The average flow range of inflow population in coastal urban agglomeration is larger than that in inland. In 2000, 48.66% of the inflow population of the three coastal urban agglomerations came from outside the province, and this proportion increased to 55.49% in 2010. In the same period, the proportion of inland urban agglomeration was only 9.80% and 11.53% respectively.
Figure 3. Changes in the order and scale structure of inflow population in cities and counties of five major urban agglomerations from 2000 to 2010. Note: rank correlation coefficient is in brackets.

Figure 4. Scope structure and changes of inflow population flow in five urban agglomerations from 2000 to 2010.

The flow distance of the inflow population of major urban agglomerations has increased, and the scope of population attraction has generally expanded. As shown in Figure 4, the inter provincial floating population (65%) of the Pearl River
Delta urban agglomeration has always been an absolute advantage, and has always been the urban agglomeration with the highest proportion of long-distance mobility; since the 21st century, the trend of population agglomeration in Guangdong Province to the Pearl River Delta has increased, and the proportion of inter county floating population in Guangdong Province has increased slightly. The attraction of Yangtze River Delta and Beijing-Tianjin-Hebei urban agglomeration to inter provincial floating population is also increasing rapidly. In 2010, about half of the inflow population came from outside the province. At the same time, Beijing-Tianjin-Hebei have become the coastal urban agglomeration with the most significant increase in the proportion of inter county floating population in the province, and also the urban agglomeration with the largest decrease in the proportion of inter county floating population, reflecting the rapid improvement of the relative status of key cities in Hebei Province and the insufficient ability of general counties and cities to retain local population. Although the middle reaches of the Yangtze River and Chengdu-Chongqing urban agglomeration are still dominated by intra county flows, and the proportion of inter provincial flows is still stable at a low level, the proportion of inter county flows in the province has increased significantly. The rise of key cities in the province has also driven the increase of population flow distance and the expansion of population attraction scope of urban agglomeration.

3.2.2 The inter county flow in the province is growing rapidly, and the inter provincial inflow is concentrated in coastal urban agglomeration

The population growth of urban agglomeration inflow is analyzed from the perspective of intra provincial and inter provincial mobility by using census data. Seen from the comparison of growth rate, except for the urban agglomeration in the Yangtze River Delta, the growth rate of inflow population in each urban agglomeration is faster than that among provinces. Under this trend, the inflow population of Beijing-Tianjin-Hebei and Pearl River Delta urban agglomeration will gradually show the characteristics of paying equal attention to both intra province and inter province. The dominant position of intra provincial inflow of inland urban agglomeration will be further strengthened, and intra provincial mobility may become one of the main forms of population mobility in the future. From the perspective of incremental structure, the new inflow population of the three coastal urban agglomerations is mainly inter provincial growth, accounting for more than 65%, while the inland urban agglomerations are mainly intra provincial growth, accounting for 80%, indicating that the population attraction scope of the coastal urban agglomerations is larger than that of the inland urban agglomerations. Further analyze the growth of intra provincial and inter provincial floating population in cities at all levels within the urban agglomeration (Figure 5). The inflow population growth patterns of key cities, general cities and peripheral counties and cities of Beijing-Tianjin-Hebei urban agglomeration are significantly different. The new inflow population of the two key cities of Beijing and Tianjin is mainly inter provincial flow, but the growth rate of inter provincial flow is lower than that of intra provincial flow, which indicates that a large number of people in the outer suburbs of Beijing and Tianjin flow into the central urban area, and the outer suburbs of big cities are less attractive to foreign population. The growth characteristics of the inflow population of general cities represented by Shijiazhuang, Tangshan and Baoding are consistent with those of inland urban agglomerations. The newly added inflow population is dominated by intra provincial mobility, and the growth rate of intra provincial mobility is faster than that of inter provincial mobility, indicating that the general cities of Beijing-Tianjin-Hebei urban agglomerations are less attractive to the inter provincial floating population than the cities of the same level of other coastal urban agglomerations, and the attraction range is similar to the cities of the same level of inland urban agglomerations. The characteristics of intra provincial/inter provincial growth of inflow population of cities at all levels within other urban agglomerations are basically consistent with those of their urban agglomerations. Although the inter provincial inflow accounts for the absolute majority of the new inflow population, compared with the Yangtze River Delta urban agglomeration, the growth rate of inter provincial inflow population in cities at all levels of the Pearl River Delta urban agglomeration is lower than that in the province; in the inland urban agglomeration dominated by inflow in the province, it is noteworthy that the growth rate of inter provincial inflow population in the peripheral counties and cities of the urban agglomeration in the middle reaches of the Yangtze River is higher than that in the province, which is the only urban grade type with this feature in the inland urban agglomeration.

3.3 Population Source

3.3.1 The population hinterland of coastal urban agglomeration is vast, but the circle characteristics of decreasing distance are obvious

Taking the prefecture level administrative area as the basic unit, the city population inflow sample is divided into two categories: the external inflow and the internal flow of the city group according to the present residence and registered residence. The inflow population of coastal urban agglomerations is mainly from the outside of urban agglomerations. In 2017, nearly 95% of the inflow population of urban agglomerations in the Pearl River Delta came from areas outside the
Urban agglomerations, and the proportion of Yangtze River Delta and Beijing-Tianjin-Hebei urban agglomerations was more than 60%. Inland urban agglomerations are dominated by the internal flow of urban agglomerations. More than 80% and 75% of the inflow population of the middle reaches of the Yangtze River and Chengdu-Chongqing urban agglomerations belong to the internal flow of urban agglomerations respectively, indicating that the scope of population attraction is significantly smaller than that of coastal urban agglomerations.

**Figure 5.** Inter provincial and intra provincial sources of new inflow population in five urban agglomerations from 2000 to 2010.

**Figure 6.** Main sources of population inflow from China’s coastal and inland urban agglomerations in 2017. The population attraction range of coastal urban agglomeration is larger than that of inland urban agglomeration, but it shows the
characteristics of decreasing distance. Beijing-Tianjin-Hebei urban agglomeration is closely connected with North China and Northeast China. The inflow population of the Pearl River Delta urban agglomeration is mainly from South China, mainly from non Pearl River regions in the province and Hunan, Guangxi and other places. The Yangtze River Delta urban agglomeration is in the leading position in the Yangtze River Economic Zone and the main destination of the outflow population in the Central region. The main sources of inflow population of inland urban agglomeration are surrounding provinces. Spatial proximity is still an important factor in the choice of destination for floating population.

3.3.2 The population in the central part mainly flows to the Yangtze River Delta and the Pearl River Delta, and the outflow population from the Northeast highly prefers Beijing, Tianjin and Hebei

Since the reform and opening up in 1978, a large number of labor forces have been separated out in rural areas, especially in the main traditional grain producing areas. The Central region, which is close to the Eastern coast and has sufficient labor force, has long been the main outflow area of population in China (Chen, 1996; Wang, Yao, and Zhou, 2013). In recent years, the population loss caused by various pressures such as industrial transformation and resource depletion in Northeast China has also attracted attention (Qi, Liu, and Jin, 2017). The three major coastal urban agglomerations of Beijing-Tianjin-Hebei, Yangtze River Delta and Pearl River Delta are important carriers of the outflow population in the Central and Northeast regions. Taking the three urban agglomerations as inflow areas and the Central and Northeast regions as outflow areas, the relative intensity index NOD of inter regional population inflow is calculated respectively, as shown in Table 3, which can comprehensively reflect the population loss in the Central and Northeast regions.

Table 3. Relative strength index of O-D migration in 2017

| Place of discharge | Flowing land | Yangtze River Delta urban agglomeration | Pearl River Delta urban agglomeration |
|-------------------|--------------|----------------------------------------|--------------------------------------|
| Central region    | 0.81         | 1.55                                   | 1.12                                 |
| Northeast China   | 1.56         | 0.22                                   | 0.11                                 |

The relative intensity index of inflows from the Central region to Beijing-Tianjin-Hebei urban agglomeration is 0.81, and the relative intensity index of inflows to the Yangtze River Delta and Pearl River Delta urban agglomeration is as high as 1.55 and 1.12. The relative intensity of outflows from the Central region into the Yangtze River Delta and Pearl River Delta Urban agglomeration is much higher than that of the whole country, and the relative intensity of inflows into Beijing-Tianjin-Hebei urban agglomeration is similar to that of the whole country. Referring to Figure 6, it can be found that many provinces in the main population sources of the three coastal urban agglomerations are located in the Central region. It shows that the Central region is the main outflow area of population in China. In contrast, the relative intensity index of inflow from Northeast China to urban agglomeration in Yangtze River Delta and Pearl River Delta is only 0.22 and 0.11. The intensity of population outflow is not only far lower than that in Central China, but also lower than the national average. It is noteworthy that the relative intensity index of inflow from Northeast China to Beijing-Tianjin-Hebei urban agglomeration is as high as 1.56, indicating that compared with the urban agglomerations in the Yangtze River Delta and the Pearl River Delta, the outflow population in Northeast China highly prefers to flow into Beijing-Tianjin-Hebei urban agglomeration.

4. Trend Characteristics of Population Inflow in Urban Agglomeration

Population migration is a key factor in shaping China’s current and future urbanization pattern and model, and the residence instability of the inflow population also brings uncertainty to the future development of the inflow cities. With the emergence of the trend of population and capital back-flow in recent years, the places of population outflow usher in an important opportunity to improve the level of urbanization. It is urgent to explore a new urbanization model different from the places of population inflow. The willingness to stay and settle down reflects the spatial choice preference of the inflow population. This section reflects the population flow trend by the willingness to stay and settle down of the inflow population. Combined with the differences of influencing factors of the willingness to stay and settle down, this section analyzes the impact of this trend on the future urbanization development from the perspective of inflow and outflow places, and puts forward countermeasures. Main discussion: (a) For typical population inflow places such as urban agglomeration, will the inflow population still be stably concentrated in a few key cities? Can general cities and peripheral counties and cities share the pressure of migrant population in key cities? (b) For the outflow areas represented by the Central and Western regions and the Northeast, is it possible to reverse the trend of continuous population loss?
4.1 Residence and Settlement Intention of Inflow Population in Urban Agglomeration

In urban agglomerations, especially in the key cities with high concentration of population, the household registration is still the important prerequisite for the supply of basic services such as education, pension and affordable housing. Therefore, the demand for settlement closely related to the appeal of public services will be accompanied by the increase in the residence time and the trend of family migration. The local household registration will provide more convenience for the long-term residence of the inflow population. According to the data (Table 4), more than 80% of the floating population in the country and all urban agglomerations said that they “intend to stay here for some time in the future”. However, for the inflow population who intend to continue to stay in the inflow area, when further inquired about their estimated residence time in the local area, it is found that most of the inflow population are not ready to live in the inflow area for a long time out of subjective will, and the proportion of people willing to stay for a long time (more than 5 years) and settle in the inflow area is obviously low. On the whole, the settlement intention of the inflow population is similar to that of long-term residence. The data partially confirms the close relationship between the above mentioned settlement and long-term residence decision-making.

Table 4. Residence and settlement intention of the inflow population of the five major urban agglomerations in 2017 (%)

| Name of urban agglomeration                 | Residence | Long-term residence (more than 5 years) | Settle  | Hukou register |
|--------------------------------------------|-----------|----------------------------------------|---------|----------------|
| Beijing-Tianjin-Hebei urban agglomeration   | 84.56     | 49.02                                  | 34.67   | 60.39          |
| Yangtze River Delta urban agglomeration     | 86.68     | 43.88                                  | 30.25   | 45.65          |
| Pearl River Delta urban agglomeration       | 82.59     | 35.57                                  | 18.25   | 42.48          |
| Urban agglomeration in the middle reaches of the Yangtze River | 82.30     | 43.63                                  | 31.01   | 30.15          |
| Chengdu-Chongqing urban agglomeration       | 86.06     | 51.10                                  | 38.13   | 33.40          |
| Five urban agglomerations                   | 84.93     | 44.73                                  | 30.96   | 44.77          |
| Whole country                               | 83.39     | 45.47                                  | 31.86   | 39.88          |

The overall comparison of the residence and settlement willingness of the five urban agglomerations and the national floating population shows that the long-term residence and settlement willingness of the inflow population of the urban agglomerations are slightly lower than the national average level, indicating that the residence stability of the inflow population of the urban agglomerations is slightly lower than that of the whole country. Although there is no significant difference between the inflow population of urban agglomerations and the whole country in terms of their willingness to stay (indefinite term, more than 5 years and settlement), their willingness to settle down is significantly higher than that of the whole country, indicating that the registered residence of urban agglomerations, especially of coastal cities, has a stronger attraction to the inflow population, and the high-quality public services attached to the local registered residence are an important reason to attract the inflow population. A specific comparison of the residents' willingness to settle in the urban agglomerations shows that the long-term residence and settlement willingness of the inflow population in the Pearl River Delta is relatively low among the urban agglomerations. This may be related to the absolute majority of the inflow population from the outside of the urban agglomerations, which will be further analyzed below. The willingness to settle in coastal urban agglomeration is generally higher than that of inland urban agglomeration, among which the Beijing-Tianjin-Hebei urban agglomeration (60.39%) is the highest, the Yangtze River Delta and Pearl River Delta urban agglomeration are more than 40%, both higher than the whole country, and the middle reaches of the Yangtze River and Chengdu-Chongqing urban agglomeration are only about 30%, 6-10 percentage points lower than the whole country. Considering the close relationship between long-term residence and settlement, next, take “whether willing to stay in the inflow place for more than 5 years” as “residence intention”, and “whether willing to move the registered permanent residence to the inflow place” as “settlement intention”, analyze the future trend of population inflow in urban agglomeration.

4.2 Population Agglomeration Trend of Urban Agglomeration from the Perspective of Inflow Place

From the perspective of inflow places, there are obvious differences in the residence and settlement willingness of the inflow population in key cities, general cities and peripheral counties and cities of various urban agglomerations (Figure 7).

4.2.1 The key cities of coastal urban agglomerations have strong attraction for residence and settlement, and the challenge of inflow population management services will continue to exist

The willingness to stay and settle in the key cities of coastal urban agglomeration is significantly higher than that in other regions, and the inflow population will continue to gather stably in the key cities. Chi-square test shows that there are significant differences in residence intention and settlement intention of geographical units at all levels within the three
coastal urban agglomerations, indicating that compared with general cities and peripheral counties and cities, the residence stability of the inflow population in the key cities is significantly stronger than that in general cities and peripheral counties and cities. The key city is not only the concentration center of the inflow population of the coastal urban agglomerations, but also will maintain a high concentration of the inflow population in the future. The residence and settlement intention of the inflow population in general cities and peripheral counties and cities are less than 50%, which once again shows the instability of the spatial distribution pattern of the inflow population in small and medium-sized cities of the urban agglomeration. Most of the inflow population do not plan to stay and settle in the current inflow place for a long time, which means that they may choose to return or re-flow, which will have an adverse impact on the development of local urbanization.

The willingness to settle in the key cities of coastal urban agglomeration is about 13 percentage points higher than the willingness of residence. Previous studies have pointed out that there are differences in the influencing factors of residence and settlement intention. Therefore, compared with the level of employment opportunities and income, the advantages of public services and social welfare in key cities are the more important factors to attract the inflow of population. Compared with the willingness to stay, there is a greater gap of the willingness to settle in the key cities and other regions. Key cities generally have relatively rich financial and administrative resources, and correspondingly have high-quality infrastructure and public services (Chan, 2009). Because of the strict administrative boundary of registered residence, the advantage of key cities is only within its administrative limits. Therefore, the gap between settlement intention in key cities and other regions is significantly greater than residence intention.

4.2.2 The attraction of key cities and general cities in inland urban agglomeration will coexist for a long time

The willingness to settle in the key cities of the inland urban agglomeration is significantly higher than that of ordinary cities and peripheral counties and cities, indicating that the advantages of public services such as education, pension and medical care brought by financial and administrative resources are also an important source of the attraction for the inflow of population from the inland key cities. The highly concentrated urbanization mode with the key cities as the core in the inland region will continue in the long run. The residence intention of the inflow population in the key city of the inland urban agglomeration is close to or slightly lower than that in the general city of the urban agglomeration. Considering that the inflow population of inland urban agglomerations is mainly the internal flow of urban agglomerations and the flow within the province, and further comparing the residence willingness of the floating population within the province and urban agglomerations in cities at all levels, it is found that the residence willingness of the inflow population in general cities are higher than those in the other two types of areas, which confirms the spatial preference of the close floating population of inland urban agglomerations for general cities in urban agglomerations. There are two possible reasons for
this preference: First, the development level gap between the key city of the inland urban agglomeration and the general city is relatively small, and the key city has limited advantages in employment opportunities and income level. Second, the population flow of inland urban agglomeration is dominated by the internal flow of close urban agglomeration and the flow within the province. Compared with the key cities with high cost of living and strong flow resistance, the close floating population may prefer general cities.

4.3 Inflow and Back-Flow Trend of Urban Agglomeration from the Perspective of Source Area

The registered residence in key cities is difficult, and the household register threshold is relatively high, which causes the inflow population to be unable to obtain the urban public service that is equal to the local registered residence residents, forming the “local–foreign” dualistic phenomenon within the city. Various reasons have led to the phenomenon of inflow and return of population, which has had an impact on the urbanization model of corresponding regions (Cao and Liu, 2011; Wang, Feng, and Xu, 2014; Yin, 2015; Luo, Cao, and Gu, 2020). The willingness to stay and settle down is a direct reflection of the future decision-making of the inflow population, which helps to predict the return trend of the inflow population of the urban agglomeration and provide countermeasures for the outflow areas.

4.3.1 Equal and open supply of high-quality public services is an important way to attract population back-flow in non-urban agglomeration areas

Over the years, the main direction of population flow has been from non-urban agglomeration areas to urban agglomeration areas. However, in recent years, with the slowdown of the growth rate of inflow population and the gradual emergence of the trend of population return, urban agglomeration areas are facing the pressure of urbanization power transformation, while non-urban agglomeration areas are expected to attract population back-flow and improve the problem of population loss. The residence and settlement willingness of the external inflow and internal floating population in each urban agglomeration are shown in Table 5.

On the whole, compared with the floating population within the urban agglomeration, the inflow population from outside the urban agglomeration has a lower willingness to stay and a higher willingness to settle down. On the one hand, it shows that the long-distance mobility leads to the increase of the cost of population mobility, and the spatial and psychological distance between the inflow place and the hometown widened, resulting in the inflow population unwilling to stay in the inflow place for a long time, and the trend of population back-flow may continue. On the other hand, it shows that the advantages of public services such as education, medical treatment and pension in urban agglomerations have a strong attraction to the external inflow population.

In inflow urban agglomeration, especially in the key cities, high quality public service has strong attraction for inflow population. However, the linkage between registered residence and public service leads to the difficulty of achieving equalization of public services in the inflow area, and it becomes an important obstacle to the long-term residence of the inflow population. This obstacle is also one of the reasons for the phenomenon of population back-flow. For non-urban agglomeration areas and other places with population outflow, efforts should be made to improve the supply quality and openness of urban core public services such as employment services, children’s education and pension security, so as to attract population back-flow with equal and open public service supply.

Table 5. Difference of residence and settlement intention of external inflow and internal inflow population in 2017

| Willingness to stay/settle down | Name of Urban Agglomeration | External inflow ( anos) | Internal inflow ( anos) | External internal difference (%) | Chi square test (significance level) |
|--------------------------------|----------------------------|------------------------|------------------------|----------------------------------|-------------------------------------|
| Residence intention           | Beijing-Tianjin-Hebei urban agglomeration | 48.45                  | 50.07                  | -1.63 (-)                        | 0.053                               |
|                               | Yangtze River Delta urban agglomeration | 38.65                  | 55.46                  | -16.81 (-)                       | 0.000                               |
|                               | Pearl River Delta urban agglomeration | 32.92                  | 44.16                  | -11.25 (-)                       | 0.000                               |
|                               | Urban agglomeration in the middle reaches of the Yangtze River | 38.30                  | 45.36                  | -7.06 (-)                        | 0.000                               |
|                               | Chengdu-Chongqing urban agglomeration | 54.68                  | 50.41                  | 4.26 (+)                         | 0.004                               |
| Settlement intention         | Beijing-Tianjin-Hebei urban agglomeration | 63.99                  | 53.77                  | 10.22 (+)                        | 0.000                               |
|                               | Yangtze River Delta urban agglomeration | 46.55                  | 43.64                  | 2.91 (+)                         | 0.000                               |
|                               | Pearl River Delta urban agglomeration | 42.88                  | 36.09                  | 6.79 (+)                         | 0.004                               |
|                               | Urban agglomeration in the middle reaches of the Yangtze River | 50.14                  | 30.15                  | 20.00 (+)                        | 0.999                               |
|                               | Chengdu-Chongqing urban agglomeration | 38.72                  | 32.38                  | 6.35 (+)                         | 0.000                               |
4.3.2 The probability of population back-flow in Northeast China is low, and the trend of population loss may be difficult to reverse in the near future

Studies have shown that the Central region and Northeast China are the main outflow areas of population in China. Registered residence in the city is divided into Eastern, Central, Western and Northeast areas. The comparison of the residence and settlement of different registered residence in different urban communities is shown in Table 6.

Table 6. Residence and settlement intention of inflow population from different sources in 2017 (%)

| Name of urban agglomeration | East | Central section | West | Northeast |
|-----------------------------|------|-----------------|------|-----------|
| Beijing-Tianjin-Hebei urban agglomeration | 50.76 | 42.07 | 45.17 | 59.03 |
| Yangtze River Delta urban agglomeration | 52.59 | 42.95 | 28.60 | 68.83 |
| Pearl River Delta urban agglomeration | 42.16 | 30.81 | 24.77 | 47.14 |
| Urban agglomeration in the middle reaches of the Yangtze River | 31.91 | 44.57 | 40.79 | 40.38 |
| Chengdu-Chongqing urban agglomeration | 50.18 | 49.44 | 51.18 | 61.54 |

The inflow population from Northeast China has a significantly higher willingness to stay and settle down than the inflow population from other regions (Table 6). Although the intensity of population loss in Northeast China is not high, the high willingness to stay and settle means that most of the outflow population in Northeast China want to live and settle in the inflow place for a long time, and the return probability is low, so they are “firm outflows”. The data of residence and settlement intention show that the employment opportunities, income level and public service supply in Northeast China are not satisfying, resulting in low population attraction and difficulties to reverse the trend of population loss.

5. Conclusion

Using the statistical analysis method and constructing the relative intensity index of population inflow, this paper comprehensively analyzes the spatial model of population inflow in China’s five major urban agglomerations from the perspectives of the spatial pattern of distribution and growth, the intra provincial and inter provincial characteristics of flow range and the differences between urban agglomerations of origin, then this paper discusses the trend characteristics of population inflow in urban agglomerations in combination with residence and settlement intention. As for the spatial pattern of population inflow in urban agglomeration, this paper draws the following main conclusions.

(i) The trend of inflow population gathering in key cities continues, and the diffusion effect of urban agglomeration in the Yangtze River Delta and the Pearl River Delta appears. The grade and spatial distribution pattern of the inflow population of various urban agglomerations are generally stable, and Beijing-Tianjin-Hebei and inland urban agglomerations are still changing. As the most leading gathering place for China’s incoming population, the spatial distribution pattern of the incoming population in the urban agglomeration of the Pearl River Delta and the Yangtze River Delta has become stable, and the key cities still have the advantage of population agglomeration, but the growth rate of the incoming population in cities at all levels is roughly the same, basically forming a balanced spatial model with the coexistence of agglomeration and dispersion. Beijing-Tianjin-Hebei, the middle reaches of the Yangtze River and Chengdu-Chongqing urban agglomerations are the emerging clusters of inflow population in recent years. The growth rate of inflow population in key cities is much higher than that in general cities and peripheral counties and cities. The trend of continuous population agglomeration will continue in the short term. The relative attraction of cities and counties, especially general cities and peripheral counties and cities, to inflow population changes greatly, indicating that the spatial pattern of economic development and population attraction of urban agglomerations is still in the process of formation and evolution.

(ii) The proportion of inter county and inter provincial flows in the province has generally increased, the inter county flows in the province have increased rapidly, and the inter provincial inflows are mainly coastal urban agglomerations. The proportion of mobility in all urban agglomerations and counties has decreased, and the scope of mobility has expanded. Inter provincial mobility is the most important mode of population mobility in coastal urban agglomerations. Inter provincial mobility accounts for the majority of the newly added inflow population. The proportion of inter county mobility in Beijing-Tianjin-Hebei and inland urban agglomerations has increased rapidly. The rise of key cities in the province has also driven the increase of population mobility distance and the expansion of population attraction scope of urban agglomerations. Except for the Yangtze River Delta urban agglomeration, the growth rate of inter county flow in each urban agglomeration is higher than that of inter provincial flow. The medium distance inter county mobility in the province
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may become one of the main modes of population mobility in the future. The characteristics of the flow range of inflow population in cities at all levels within the urban agglomeration are basically the same, but there are great differences in Beijing-Tianjin-Hebei urban agglomeration.

(iii) The attraction range of population inflow in coastal urban agglomeration is much larger than that in inland urban agglomeration, and spatial proximity is still an important factor affecting the destination choice of floating population. More than 60% of the inflow population of coastal urban agglomeration comes from outside the urban agglomeration. The population hinterland is vast, but there is obvious distance attenuation. More than 75% of the inflow population of inland urban agglomeration belongs to the internal flow of urban agglomeration. Beijing-Tianjin-Hebei urban agglomeration is closely connected with North China and Northeast China. The Yangtze River Delta urban agglomeration mainly attracts the population inflow of the Yangtze River Economic Zone and the Central region. The Pearl River Delta urban agglomeration is the population concentration center of South China. From the main source places, the population in the Central region tends to flow into the Yangtze River Delta and the Pearl River Delta, and the outflow population from the Northeast highly prefers Beijing-Tianjin-Hebei.

Based on the above conclusions, and referring to the residence and settlement willingness of floating population, this paper discusses the population inflow trend of urban agglomeration, and finds that:

(i) From the perspective of population agglomeration in inflow areas, key cities are still the focus of the contradiction between supply and demand of urban public services. The willingness to stay and settle in the key cities of coastal urban agglomerations is much higher than that in other regions. The inflow population will stay here for a long time and strive to settle down. Mega cities such as Beijing, Shanghai, Guangzhou and Shenzhen will still face the challenge of management service demand brought by large-scale inflow of population. The attraction of key cities and general cities to the inflow population will coexist for a long time. Key city’s attraction is more reflected in the advantages of household registration, namely, urban public service. In the inland city group with the nearest flow as the main mode of flow, the inflow population is preferred to settle in general cities.

(ii) From the perspective of attracting population return in outflow areas, the equal and open supply of public services is an important way to attract population return. The trend of population loss in Northeast China is difficult to reverse in the short term. Registered residence threshold is a major obstacle for the long-term stability of the urban population in the city. The floating population within the city groups is more likely to live in the inflow area. Whether from the perspective of the scope of attraction or the residence and settlement intention of the inflow population, nearby urbanization is an urbanization model with high possibility. Therefore, non-urban agglomeration areas should take the initiative to attract the return of local lost population. The Central region is still the main outflow area of population. The intensity of population loss in Northeast China is small and the direction is concentrated, but the possibility of return is low. The relative intensity index of population inflow from the Central region to coastal urban agglomerations is much greater than that in the Northeast region. The lost population in the Northeast region shows the characteristics of high preference for flowing into Beijing-Tianjin-Hebei urban agglomerations, stable residence in various urban agglomerations and strong willingness to settle down, and the possibility of return is low. The trend of population loss in Northeast China is difficult to reverse in the short term.

This paper also finds some problems that need to be deeply considered and further studied. First, urban agglomerations with different location characteristics and different development stages have different spatial patterns of population inflow, and the induction and summary of the differences of spatial patterns and their influencing factors need to be further studied. Second, the urbanization process of floating population is affected by many aspects. The analysis at the individual level is helpful to explain this macro phenomenon more deeply from the micro level.

Conflict of Interest
The authors declared no conflict of interest.

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