

# Spatial Characteristics and Migration Mechanism of Population Suburbanization in Chinese Big City

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## To cite this article:

Qin Xianhong. Spatial Characteristics and Migration Mechanism of Population Suburbanization in Chinese Big City. *Urban and Regional Planning*. Vol. 3, No. 2, 2018, pp. 73-79. doi: 10.11648/j.urp.20180302.15

**Received:** August 15, 2018; **Accepted:** September 12, 2018; **Published:** September 18, 2018

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**Abstract:** Urban spatial expansion and population suburbanization are very common after urban growth to a certain stage, and also an important research topic of human geographer. Chinese cities have experienced unprecedented growth since the launch of reforms in the late 1990s. Studies have found that the leading cities in China such as Beijing and Shanghai are undergoing the process of suburbanization, while the country as a whole is still at the stage of urbanization. However, it is difficult to judge whether suburbanization has happened by the traditional method. In this paper, the graphic analysis method is introduced to analyze the spatial distribution of population in big cities, and the migration analysis method is introduced to analyze the source of new population. The results show that: with the rapid urbanization and population growth, the urban population distribution area in Chinese big cities is expanding very much; Inner suburbs are the fastest population growth areas, expanding continuously as circles, and the newly increased people mainly are migrants from the central city and intraprovincial urban people; Outer suburbs reflect unbalanced population growth as a leap-frogging, with faster rates at locations of county/district governments and prioritized development districts, and the newly increased people mainly are interprovincial rural people. It is the general spatial model of population growth in the suburbs of big cities in China, which is obviously different from those in western countries.

**Keywords:** Population Suburbanization, Spatial Characteristics, Migration Mechanism, Big City, China

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## 1. Introduction

Efforts to understand the complexity of urbanization and urban change have been heightened recently due to the consequences of intensified human activity on resource allocation, urban spaces, and the natural environment [1]. The importance of monitoring and modeling urban change is even drawing the attention of premiere scientific journals such as *Nature* and *Science* [2].

Since the launch of economic reforms in the late 1970s, deepening with market reforms and open door policies in the mid-1990s, China's urban population and urbanized territory have expanded dramatically. While urbanization has long been the subject of academic inquiry, urbanization on such a massive scale as that of China has rarely been witnessed in human history. While reform and growth have pulled millions of people out of poverty and made China a growth engine of the world, China's rapid urbanization is accompanied by

disappearing agricultural land, spatial fragmentation, and sustainability challenges [3-5]. Rapid urban growth has become a major source of protests, corruption, inequality, and environmental problems. Urbanization and the pressure for livable cities and sustainable development will continue to increase. In the United States, suburbanization as a process of spatial shift of population and economy between the central city and the suburb areas is associated with progressive social problems and spatial conflicts, such as Inner city decline, and traffic congestion, and urban sprawl [6-8]. It is critical to accurately estimate the extent of urban development and population change to understand the processes underlying urbanization. There is an urgent need for a careful evaluation of urban growth and spatial change in China and for better management of urban spaces and development.

Second, how does the patterns of population distribution across the city change over time? Existing studies have noticed the process of suburbanization in China, especially in the leading cities such as Beijing, Shanghai, and Guangzhou

[9-16]. However, unlike the United States where suburbanization has been accompanied by central city decline, the process of suburban development does not really lead to urban decline, and in this sense, suburban development in China may exhibit different patterns and mechanisms comparing to suburbanization in the West.

Last, what is the contribution of migration and jobs to suburban development? Suburban areas of Chinese cities are not a unified space deprived of spatial differences. Scholars have noticed the development of inner suburban areas, while outer suburban areas have been less developed, and some are even primary rural areas. Sources of population growth within the suburban areas are also different. Such differences within the suburban areas of Chinese cities have hardly been studied.

## 2. Research Setting and Methodology

### 2.1. Nanjing: The Research Setting

Nanjing is a core sub-center of the Shanghai-centered Yangtze River Delta (YRD) which consists of the sixteen municipalities from three provincial units--Shanghai, Jiangsu, and Zhejiang (Figure 1). This is the largest globalizing city region and growth engine of China and has experienced unprecedented growth during the last thirty years, threatening food security, bio diversity and social stability. While most studies on urban China have been focused on Beijing, Shanghai and cities in the Pearl River Delta [17], less attention has been paid to the secondary cities in the YRD. Nanjing exemplifies the rapidly growing coastal cities of China.

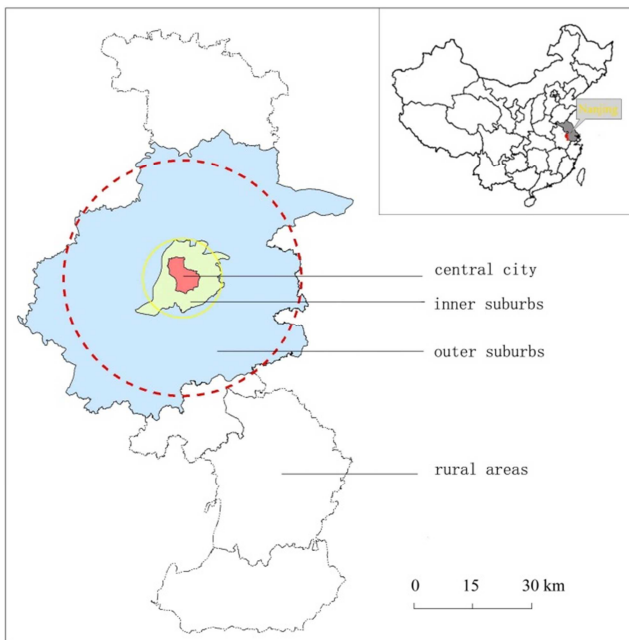


Figure 1. Different zones of Nanjing.

As the capital of Jiangsu province, Nanjing consists of six urban districts (Xuanwu, Baixia, Jianye, Gulou, Qinhuai, Xiaguan), five suburb districts (Yuhuatai, Qixia, Jiangning, Pukou, Liuhe) and two counties (Gaochun, Lishui), with a

total land area of 6000 km<sup>2</sup>. We categorize the territorial space of Nanjing into three zones as the central city, inner suburbs, and outer suburbs. In China it is conventional to define the built-up district before 1949 as the central city. In Nanjing, the area within the old city wall is defined as the central city. This central city consists of 26 Jiedao blocks in Xuanwu, Baixia, Qinhuai and Gulou with a land area of 43.6 km<sup>2</sup>. The inner suburb generally matches the 10 km buffer zone from the downtown with 27 Jiedao blocks and a land area of 972 km<sup>2</sup>. The outer suburb is about 30 km from the downtown and includes Pukou and part of Jiangning, Qixia, Liuhe, Yuhuatai and Jianyu with 49 Jiedao blocks and 3000 km<sup>2</sup>.

### 2.2. Data

This research uses 4<sup>th</sup>, 5<sup>th</sup> and 6<sup>th</sup> Chinese population census data and 1% population sample surveys in 2005. The definition of the total population in Nanjing is based on the 6<sup>th</sup> population census, which stands for the people who live longer than half a year in Nanjing, including resident population (people holding local registration or Hukou) and flowing population (people who do not have local Hukou).

### 2.3. Methodology: Shift-Share Analysis

This paper uses the shift-share analysis method to detect population agglomeration over the whole city and compare the differences among the three regions. The population growth can be itemized as “share” and “shift”. “Share” represents the local increase attributed to regional increase, and “shift” represents the differences between local increase and regional increase. Positive “shift” means local increase is relatively faster than regional average rate, and population agglomerate in this local area; negative “shift” means local increase is relatively slower than regional increase, and population move outward.

$$SHIFT_i = ABSGR_i - SHARE_i = POP_{it_1} - \left( \sum_{j=1}^n POP_{it_1} / \sum_{j=1}^n POP_{it_0} \right) POP_{it_0} \quad (1)$$

$$VOLSHIFT_{intra} = \sum_{j=1}^m VOLSHIFT_{intra_j} \quad (2)$$

$$VOLSHIFT_{intra_j} = \frac{\sum_{i=1}^r |SHIFT_{ij}| - \left| \sum_{i=1}^r SHIFT_{ij} \right|}{2} \quad (3)$$

$$VOLSHIFT_{inter} = \sum_{j=1}^m \left( \sum_{i=1}^r |SHIFT_{ij}| / 2 \right) \quad (4)$$

$$VOLSHIFT_{total} = \left( \sum_{i=1}^n |SHIFT_{ij}| \right) / 2 = VOLSHIFT_{intra} + VOLSHIFT_{inter} \quad (5)$$

Where  $ABSGR_i$ 、 $SHARE_i$  和  $SHIFT_i$  are absolute increase, share increase and shift increase during time span ( $t_0$ ,  $t_1$ ) at location  $i$ ;  $VOLSHIFT_{intra}$  is the intraregional total shift increase;  $VOLSHIFT_{inter}$  is the interregional shift increase;  $VOLSHIFT_{total}$  is the regional total shift increase;  $r$  is the number of districts in one sub-region;  $n$  is the number of

regions; m is the number of sub-regions.

### 3. Spatial Analysis and Findings

#### 3.1. Overall Population Growth and Change

Nanjing has experienced rapid urbanization in the past three decades, resident population increases about 1.15 million from 1990 to 2010. Along with rapid population growth,

urban population distribution shows a history of concentration first and then dispersion. During 1982 to 1990, population ratio to total population in suburbs decreased from 78.6% to 77.9%, keeping a centralization state. During 1990 to 2010, population in suburbs increased from 4 million to 5.5 million and represents 78.6% finally, which shows a new dispersion trend.

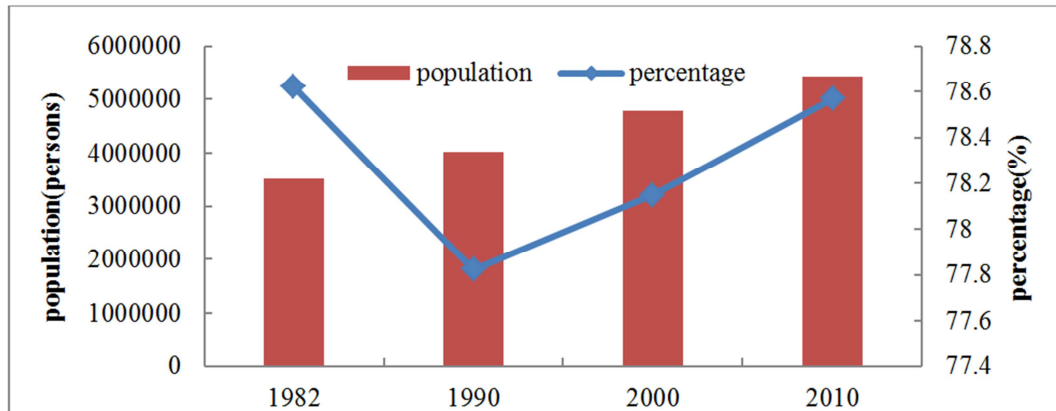


Figure 2. Population growth in suburbs between 1982 and 2010.

#### 3.2. Spatial Change of Population Distribution

The rate of population increase at suburban areas varies across districts (table 1). The inner suburb is the fastest regions of population growth. From 1990 to 2010, the population at inner suburbs increases nearly 850 thousands, with the portion of total population 15.95% to 25.57%. The population at outer suburbs and rural areas increases at slower rate than inner suburbs, and their portions of total population

continuously decrease after 1990. The outer suburb is still the largest population habitat. Population density generally increases across the city, highest at inner suburbs with 8613 persons/km<sup>2</sup> at 2010. Outer suburbs and rural areas have much smaller density. These changes show that Nanjing is still in the era of rapid urbanization as large volume population moving to inner suburbs.

Table 1. Population changes of different regions in 1990, 2000 and 2010.

	Years	Central	Inner suburb	Outer suburb	Rural	Whole city
Population (persons)	1990	1148159	825981	1925564	1277501	5177205
	2000	1338101	1376772	2185327	1237800	6138000
	2010	1478472	1778925	2436636	1263323	6957356
Percent (%)	1990	22.18	15.95	37.19	24.68	100
	2000	21.80	22.43	35.60	20.17	100
	2010	21.25	25.57	35.02	18.16	100
Population density (persons/km <sup>2</sup> )	1990	26334	3999	599	408	1294
	2000	30690	6666	679	395	1535
	2010	33910	8613	758	404	1739

Population growth areas expand continuously as circles at inner suburbs. From the figure of population density distribution divided by rings, we can see that population density declines from the city center to the suburban area. In 1990, the highest population density rings (>10000 persons/km<sup>2</sup>) were within 4km from CBD. The second highest population density rings (5000~10000 persons/km<sup>2</sup>) were between 4km and 6km. The medium population density rings (2000~5000 persons/km<sup>2</sup>) were between 6km and 10km. Finally, the lowest population density rings (<2000

persons/km<sup>2</sup>) were more than 10km. As urban population increased, population density rings expanded too. Until 2010 the highest population density rings (>10000 persons/km<sup>2</sup>) expanded to 6km from CBD. The second highest population density rings (5000~10000 persons/km<sup>2</sup>) were between 6km and 10km. The medium population density rings (2000~5000 persons/km<sup>2</sup>) were between 10km and 16km. Finally, the lowest population density rings (<2000 persons/km<sup>2</sup>) were more than 16km from CBD.

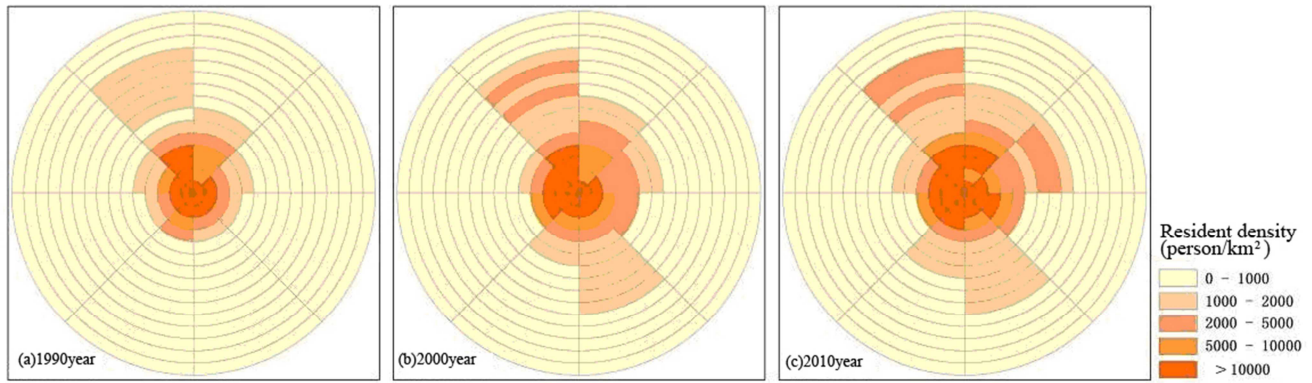


Figure 3. Population density distribution of Nanjing (divided by rings, distance is 2km).

### 3.3. Shift-Share Analysis of Different Region

We use share-shift analysis to disclose the population growth difference among central city, inner suburbs and outer suburbs. From table 2 we can find: 1) the intraregional shift increment is positive at inner suburbs and negative in others; 2) the interregional average shift increment is relatively smaller at inner suburbs and larger at outer suburbs. Inner suburbs

experiences “balanced” development as nearly all the blocks has rapid population increment, but only a few blocks at outer suburbs observe rapid development. In other words, the population growth is convergent at inner suburbs and diversified at outer suburbs, presenting a leap-frogging process.

Table 2. Population growth and shift on Jiedao scale of Nanjing, 1990~2010.

	1990~2000	2000~2010
Total shift population increments	1029413	748259
(Increment rate)	23.46%	13.97%
Intra-district shift:	368209	248800
Central city	-63858	-60839
(Increment rate)	-5.56%	-4.55%
Inner suburb	368209	248800
(Increment rate)	44.58%	18.07%
Outer suburb	-304351	-187960
(Increment rate)	-12.61%	-6.14%
Inter-district shift:	661200	499454
Central city	114753	133361
(Increment rate)	9.99%	9.97%
Inner suburb	50719	39173
(Increment rate)	6.14%	1.28%
Outer suburb	495727	326920
(Increment rate)	20.54%	12.37%

Two categories of population growth agglomeration at suburbs can be identified across political administration boundaries: blocks where district/county governments locate, such as Dongshan in Jiangning district, Zhujiang in Pukou district and Xiongzhou in Liuhe district; prioritized development areas where government stimulates population movement with policies (table 3, table 4). For example, Hexi new town is the new central business district (CBD) planned

by government in 1990s. Since then it becomes a hot-spot for immigration, especially with the construction of Olympic center. Xianlin new district attributes its rapid population increment to construction of Xianlin University in 2002. Pukou new district clusters a large amount of population after the development of state industrial park and Pukou University in late 1990s.

Table 3. Distribution of the population hotspots in the outer Nanjing.

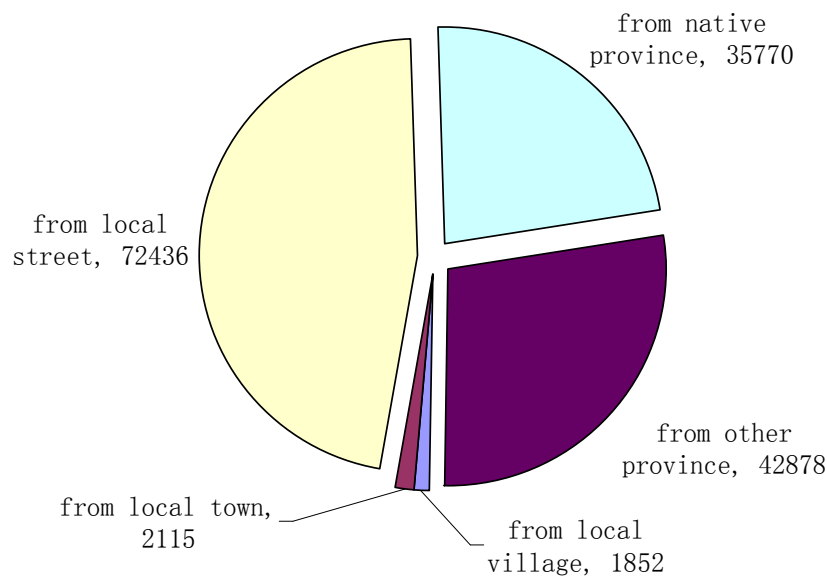
Class	ID	Blocks	County	Class	ID	Blocks	County
County government location	A	dongshan town	Jiangning	Prioritized development districts	1	Jiangdong, Mochou	Jianye
	B	zhujiang town	Pukou		2	Xianlin, Yaohua	Qixia
	C	xiongzhou town	Liuhe		3	Taishan, Yanjiang	Pukou
					4	Dachang	Liuhe
					5	Banqiao	Yuhuatai

*Table 4. Shift increment of the population hotspots, 1990~2010.*

Class	ID	population increment(person)		shift increment(person)	
		1990~2000	2000~2010	1990~2000	2000~2010
County government locations	A	86390	30369	72733	8792
	B	28425	16313	17875	4050
	C	13318	18426	7805	3670
Prioritized development districts	1	222689	156891	128134	50423
	2	22357	74537	18922	69038
	3	46736	22864	33653	7487
	4	30840	25712	5438	1661
	5	41259	13641	38083	6189

## 4. Migration Analysis and Interpretation

### 4.1. Inner Suburbs



*Figure 4. Composition of flowing population in Jianye, 2010.*

Jianye in Hexi new district is representative to explain the population movement at inner suburbs. In 2010 there were 155,051 flowing population (people who do not have Hukou at local census but reside longer than half year), 72436 of whom were from blocks in old town, who flow here for better living conditions but hold their Hukou in central city in order to maintain better access of education, health care, retirement and other well beings.

*Table 5. Immigrants in different regions, 2005 ~2010.*

	Jianye	Gulou	Nanjing
Total immigrants	13648	25985	136747
Interprovincial	10955	20987	105845
From Xiang	1078	2068	14136
From Zhen's Cunweihui	1148	2101	17889
From Zhen's Juweihui	684	2021	12054
From Jiedao	8045	14797	61766

Note: Data from fifth census in Nanjing, Sampling proportion is 10%.

Immigrants with urban Hukou will have significant impacts on the urban development because their long terms of

residence. In table 5, there were totally 13,648 immigrants in Jianye between 2005 and 2010, and 80.2% of them were from the native province (Jiangsu). 8729 of these interprovincial immigrants already had urban Hukou, and 8045 of them are from urban “blocks”. Thus population increase in Jianye majorly resulted from intraprovincial immigration, which shows a high-level of urbanization.

### 4.2. Outer Suburbs

Zhujiang, Xianlin and Dongshan are hot-spots of population growth in outer suburbs. Due to lacking data of these towns, we analyze the counties where they were located to explore population dynamics. In table 6, the floating population ratio in Pukou, Jiangjing and Qixia are 30.43%, 13.69% and 26.82% in 2000, while the whole city's average ratio is 22.82%. However, the ratios of population without local Hukou at these areas were smaller than the whole city's average. As a result, suburbanization is not the major reason of population growth in outer suburbs. The flowing population was mainly exogenous immigrants of the city.



**Table 6.** Floating population of different districts in 2010.

Location	Floating population				Registered population.	Percentage
	Total population	Other districts	Interprovincial immigration	Interprovincial immigration		
Pukou	68187	20421	21720	26046	150604	29.95
Jiangning	106993	35775	40840	30378	662708	33.44
Qixia	106033	40103	34869	31061	287532	37.82
Nanling	1398218	602471	405933	389814	4676264	43.09

Note: Percentage is calculated as the percentage of people separated with registration.

Compared to large proportion of intraprovincial urban immigration at inner suburbs, increasing ratios of interprovincial immigration and rural flowing population were found at outer suburbs (table 7). We found farmers immigrated

to outer suburbs as primary urban populations, because outer suburbs were more accessible than inner suburbs and central city to the first generation of immigrants.

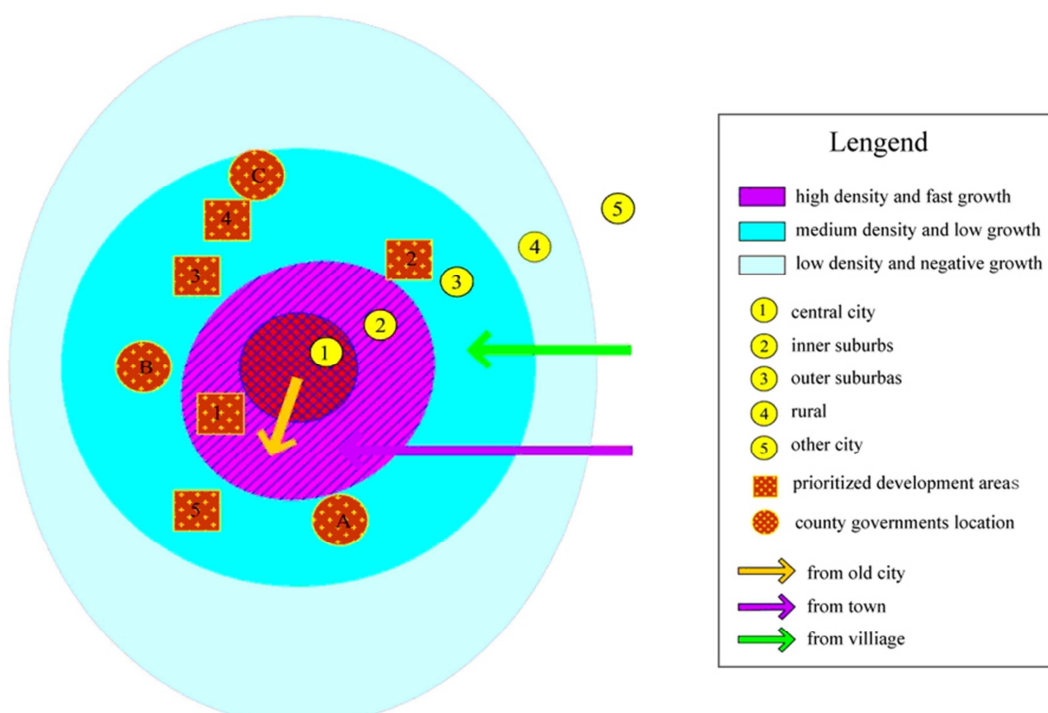
**Table 7.** Immigrants of different districts, 2005 ~ 2010.

	Pukou	Jiangning	Qixia	Nanjing
Total immigrants	6547	9270	10252	136747
Inter-provincial	3862	6592	7735	105845
From Xiang	954	1109	1806	14136
From Zhen's Cunweihui	1230	2944	2003	17889
From Zhen's Juweihui	534	1588	1228	12054
From Jiedao	1144	951	2698	61766

## 5. Conclusion and Discussion

This research explores the spatial characteristics and migration mechanisms of population at suburbs in Nanjing. The major findings are as follows: 1) with the rapid urbanization and population growth, the urban population distribution area in Chinese big cities is expanding very much. The inner suburbs are the fastest population growth areas; outer suburbs reflect unbalanced population growth with faster rates at locations of county/district governments and prioritized development districts. These areas are the hot-spots

of population growth in big cities. They are results of Chinese government's regulation, and which is different from the Western county's Edge City, Suburban Magnetic Center, and Rural Secondary Employment Center. 2) Flowing population at suburban areas has been increasing to a significant portion. Migration from the central city is the major source of population growth at inner suburbs, followed by intraprovincial immigration; interprovincial population from the rural areas is the main source of population growth at outer suburbs, where migration from central city is few.

**Figure 5.** Spatial model of population growth in China's big city.

This study used national census and survey sample to analyze migration patterns. With the expansion of urban commuting districts, temporal population and employment data are helpful to explain spatiotemporal urban population dynamics. More researches expect to discover changes in the new era of urbanization and suburbanization in China.

## Acknowledgements

The authors acknowledge the Humanities and Social Sciences Foundation of the Ministry of Education (Grant: 17YJC630115), the Natural Science Foundation of Jiangsu Province (Grant: BK20170876) and the Fundamental Research Funds for the Central Universities (Grant: 2016B12214).

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