

Dialectical Understanding on Urban Shrinkage and Growth in China: Taking the Old Industrial Base Cities in Northeastern China as an Example

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Abstract: According to statistical data, nearly 60 percent of China's population had lived in cities, by 2018. Recently, research reports show that China's population growth will enter a period of stagnation, followed by a likely rapid decline. This paper selects the old industrial base cities, in Northeastern China, as the research object. Based on the data of population, urban construction, fiscal revenue and LGDP, etc., utilizing data spatial visualization analysis software such as ArcGIS, this research reveals the space-time dynamic association between urban growth and shrink, happening in cities and in regions. Furthermore, the research analyzes the dynamic process of growth and reduction of population and land-use scale in individual city case, focusing on industrial land-use and the situation of related employment. At the same time, it reflects the socio-economic characteristics of urban outflow population, such as age, occupation, income, and the structural characteristics of the urban secondary industry as well as the transition trends. That means, the areas and cities to which the population flows, and the jobs performed, also have important explanatory implications on the things happening in case cities. Based on the analysis above, the paper proposes an understanding and definition of the shrinking cities in the context of contemporary China. And then it argues that, comparing with the economic growth and population accumulation previously, the status of population outflow, industrial decline and spatial shrink happening currently, still can be regarded as an urban development mode which isn't represented by the growth of space and economic, but by the reconstruction of space, population and industry. Furthermore, the reconstruction of space has the rich connotation of smart growth. It is the right way for cities to seek new development engine and the mechanisms by which the engine works.

Keywords: Shrinking cities; urban development; space-time analysis; Northeastern China

Introduction

Worldwide spread of shrinking cities

The unemployment and marketization of labor force caused by German reunification along with the process of deindustrialization is the reason of population loss and economic recession, and at this time, the German scholar, Schrumpfende Städte present the word 'Shrinking Cities'. In the following research about rustbelt region, 'urban decline' had been used to describe the recession and the loss of population. Not until 1996, 'Shrinking Cities' was adopted by the academe field(高舒琦, 2015).

There is no unified answer to the definition of shrinking cities so far. The current definition of urban shrinkage is more of a description of the characteristics, rather than a typical conceptual definition (Rink and Kabisch, 2009). For now, shrinking cities are defined from two perspectives. One of the perspectives is demographic changes, including changes in demographic structure, population loss, and changes in labor force, such as ‘population loss accounts for at least 10% of the population’, ‘cities with an annual population loss rate greater than 1% per year’ (Oswalt P, 2006) or ‘a population loss of more than 25% over the past 40 years, accompanied by land vacant and the increasing of abandoned residential, commercial and industrial buildings’ (Schilling and Logan, 2008); based on this, another perspective considers the policies of economic and industrial as well such as ‘urban shrinkage is accompanied by significant population decline, economic recession, or decline in international standing affecting the development of regions or metropolitan areas’ (Pallagst, 2005).

With the process of globalization, urban shrinking is widespread around the world. The study of shrinking cities is no longer confined to individual cities. Scholars have gone further to study the mechanism with a global perspective. Globalization has intensified competition between cities and regions. The global flow of capital caused by the economy liberalism has concentrated most of resources on several global cities. The international division of labor system has further exerted competitive pressure on areas with insufficient development momentum. With the continuous loss of resources and the lack of pulling power, some cities inevitably face the situation such as population loss and industrial recession. Some cities might spend a quite long period in this situation. Therefore, the conception of “urban shrinkage” has been continuously expanded and attracted attention widely in recent years. Many scholars from multi-field have focused on the study of shrinking cities, and some planning strategies for the shrinkage of case cities have been put into discussion.

Shrinking Northeastern China

Since the founding of the People's Republic of China, the Northeast has been a national heavy industry basement mainly made up by resource-based cities and heavy industrial cities which are the net outflow areas of the country in the country's large development pattern and urbanization pattern, and in the long run, the outflow trend of various factors is difficult to reverse and the shrinking pressure it faces is hard to resist. In the study of urban shrinkage identification and overall spatial distribution characteristics in Northeast China, the shrinking cities in Northeast China is characterized by globality, non-equilibrium, development paradox and pseudo-shrinkage. The population of Shenyang Dalian and Chaoyang growth slightly with lower latitudes and the remaining 33 prefecture-level cities have been suffering with shrinkage for a long time. Despite the serious population loss, the urban shrinkage in the entire region has always maintained a landuse growth.

1. Study Review

1.1 Quantitative Research in Study of Urban Shrinkage

The research methodology of shrinking cities is mainly based on the quantitative research, combined with spatial analysis methods and qualitative research methods in most circumstances. Starting from the definition of shrinking city, it has become a basic consensus to measure urban shrinkage with urban resident population. By reviewing relevant papers, the quantitative research methodology can

be made up by socioeconomic methods, geospatial statistical methods and geographic landscape methods(刘合林, 2016).

Moran's I is widely used when it comes to spatial correlation analysis composed by global Moran's I and Local Moran's I. Global Moran's I is suitable for analyzing spatial correlation analysis from the whole, reflecting the global spatial distribution and verifying the spatial pattern of a certain element in the region when the local Moran's I is suitable for analyzing the local spatial autocorrelation(吴拥政, 2010).

1.2 Reiprocity of Phenomenon and Mechanism in Shrinking Cities

The growth and shrinkage of cities had appeared in various famous cities that have existed in the history of the world. The reasons were mostly wars, plagues, natural disasters, etc. The shrinking cities in the 20th century developed in a more peaceful and stable era, without drastic changes in external conditions, population loss and economic recession are changing slowly correspondingly, and the causes of urban shrinkage have their particularities (杨振山 和 孙艺芸, 2015). The analysis of the causes of urban shrinkage often starts from the four main aspects of the stage characteristics of urban development, migration and demography structural degradation, the transformation of post-socialist countries and the impact of urban policy.

Research based on the stage characteristics of urban development, focuses on economic globalization, industrial transformation and urban suburbanization. Capital globalization caused by the economic liberalism has concentrated a large amount of capital in several global cities, resulting in global inequality in space, and the gradual improvement of the international labor system forced the transformation of industrial and space in some cities, resulting in economic fluctuation and the flow of population. Population mobility is regarded as a core indicator in the identification and measurement of urban shrinkage in most times. However, demographic change not only serves as a sign of urban shrinkage, but sometimes as a motivation. For example, Japan is facing a shortage of domestic labor resources caused by population aging. The natural population growth rate is low, and the young labors tend to accumulate in large cities such as Tokyo, leading to the continuous shrinking of small towns (Martinez-Fernandez *et al.*, 2016). After the disintegration of the post-socialist states, along with the disappearance of the political boundary, the planned economy being affected by the global economic tide at the same time. The state-owned enterprises with insufficient competitiveness were forced to privatize. Take Leipzig as an example, the dominant manufacturing industry not only faces the challenges of the original capitalist region, but also faces competition from the same type of countries in Eastern Europe, resulting in a population loss of nearly 50%(邓嘉怡 和 李郇, 2018). In addition to the above reasons, urban policies have a direct or indirect impact on the urban economy for the purpose of local ecosystem protection or regional resource allocation, resulting in the wilting of some of the leading industries. For example, Yichun in Heilongjiang is promulgating the Forest Law. The Law and its series of amendments have led to a sharp decline in the output of wood processing and furniture manufacturing, local pillar industries. The large loss of population caused by the job lossing has intensified the shrinking of urban industries(高舒琦 和 龙瀛, 2017).

1.3 Summary

Above all, the causes of a shrinking city always come from various aspects, and the resulting economic sluggishness and population loss often act on urban shrinkage again. The underlying causes are difficult to distinguish and different regions have unique internal mechanisms, making it difficult to form a planning paradigm. At present, a large number of studies have been devoted to the shrinkage and growth between cities or regions, however, research on districts in specific city is still scarce. In addition, at the time of transformation from urban growth to urban renewal, how to deal with the role of urban planning in shrinking cities, should be a question worth considering.

2. Growth and Shrinkage among Districts in Case City

2.1 Shenyang: The Study of a Central City of Northeastern China

As the capital of Liaoning Province and one of the regional central cities in Northeast China, Shenyang is representative in terms of history and economy. Since 2000, with the gradual decline of the secondary industry, the Northeastern economy, which is dominated by heavy industry state-owned enterprises as the wilting of the economy, has been severely impacted and intensified, which has also had a tremendous impact on Shenyang's economic construction and urban development, and problems such as the population aging and the failure of industrial transformation are widespread in the region. Shenyang had not faced the problem of population loss, according to the two population censuses in 2000 and 2010, the permanent residents in Shenyang has increased from 7,037,517 in the

fifth census to 8,106,171 in the sixth census. In the past ten years, the population growth rate is 12.53%. Although the population of Shenyang was growing slightly in quantity, non-Shenyang City area is almost completely degraded. Most of the street population loss rate is within 30%, and even some populations lose 60%, such as Xinchengzi residential district in Xinmin (68.9%) and the suburban town of Liaozhong (73.4%). Shenyang hadn't faced the problem of demographic shrinking according to the number of populations, however, when referring to spatial distribution, the rural hollowing couldn't be ignored. From the perspective of the change in the number of juveniles under the age of 14 In the past ten years, it has decreased by 302,982. In 2010, the population age of the population is 798,013, the population aged 14-65 is 6,529,159, and the elderly population over 65 is 844,597. The number of young people was decreased from 15.21% of the total population to 9.7%. It is clear that under this trend, Shenyang would soon face the problem of population shrinking for the foreseeable future.

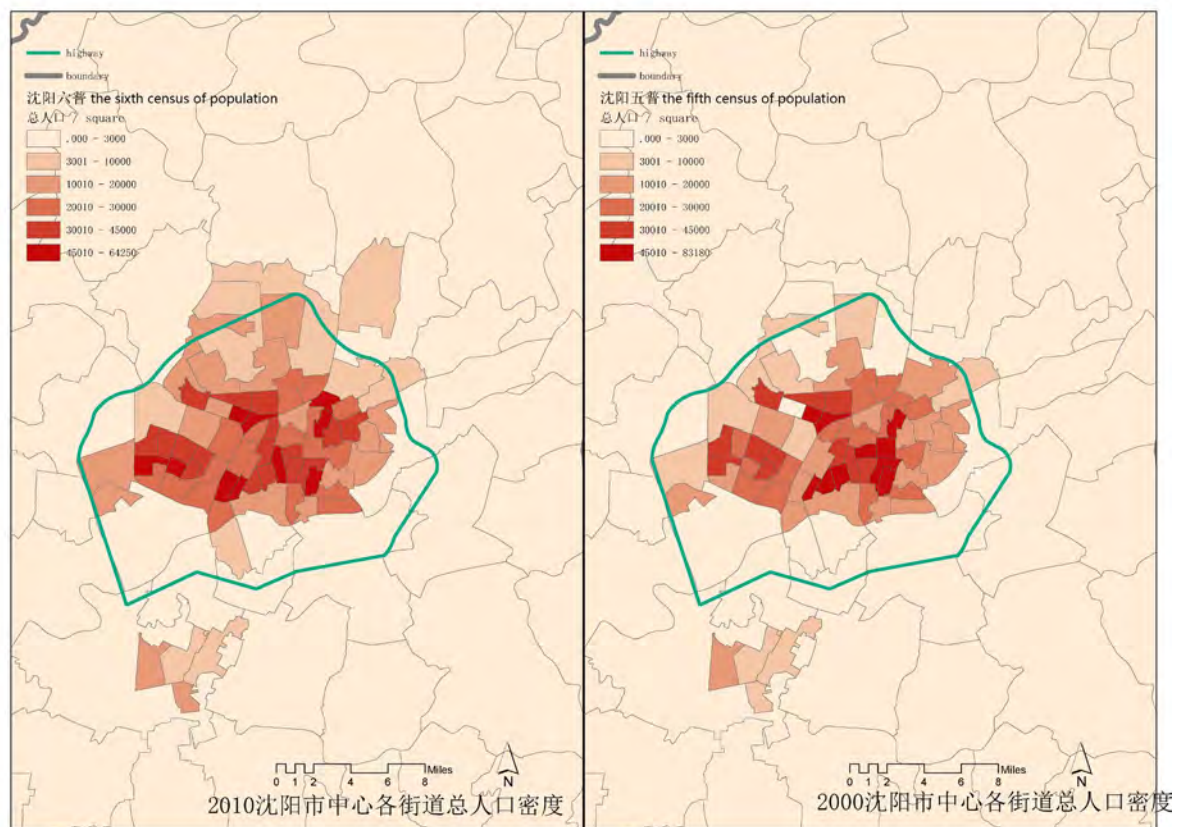
During the interval of the fifth and sixth censuses, the changes in the internal population of Shenyang City also showed certain changes. During the period of rapid urbanization in China, the rural population gathered in large numbers in cities, and the problem of rural hollowing out is also common in China. Although the population of the city has increased as a whole, the agglomeration effect or mutual exclusion effect of the growth and shrinkage of the population within the internal unit reflects the development status of the city. This research perspective has a unique meaning of understanding the urban population shrinkage as well as reflecting the phenomenon.

2.2 Characteristics of Population among Residential Districts in Shenyang

During the two censuses, the administrative divisions of township district in Shenyang had changes a lot. After reviewing the township district directory, the author sorts out the 2000 demographic residential district units that have been split or merged in 2010. The corresponding population is merged into the new unit, with the street unit of the sixth census in 2010 as the basic unit of analysis. In the research area division of Shenyang, the whole area of Shenyang is divided into three layers: the innermost circle is the concentrated construction area enclosed by Shenyang G1501, which is the downtown area of Shenyang; the middle is the boundary of Shenyang. Within the area outside the construction area; the remaining part is the third part, which is the area outside the municipal area within the scope of Shenyang.

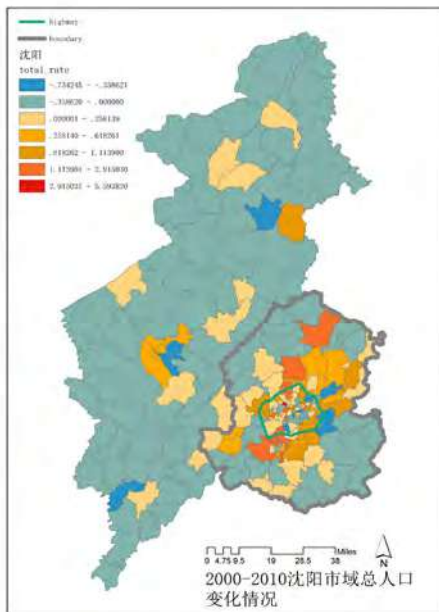
2.2.1 Districts of High Population Density Presenting a Single Center Agglomeration

According to the results of the total population of the fifth national census, the population density of the street units of all towns is less than 3000pop/km² outside the boundary, G1501, the highway around the urban area, in a more evenly distributed state, the second layer of the city beyond the city's high-speed zone also has the same characteristics, while the high-density total population area is concentrated in the innermost layer. From the perspective of global distribution, the high-density area presents the city center. The single-center distribution of the area, the street unit with a population density higher than 20,000 people/km² accounts for 17.13% of the total area. The county-level administrative area under the jurisdiction of Shenyang City has not formed a high-density population distribution pattern, and is at a relatively preliminary stage in the construction of the urban system. However, the distribution pattern of the total population density of township streets in the sixth census after ten years has not changed significantly. The district with a high population density in the urban



Pic.1 Spatial distribution of total population density in municipal

area enclosed by G1501 has increased significantly, and the total population density has reached 20,000 people/km². The number of township units accounted for 21.3% of the total area. From the distribution point of view, it began to appear on the periphery of the original core area, and the area expanded. Comparing the population density distribution of the two census results, the distribution area of the high-density unit of the population began to increase to the north, while the population of the southern part of the urban area did not change significantly, indicating that the area where the population was concentrated in the decade was mainly to the North of Hun River. Regional population change south of the Hun River is still small (*pic.1*).

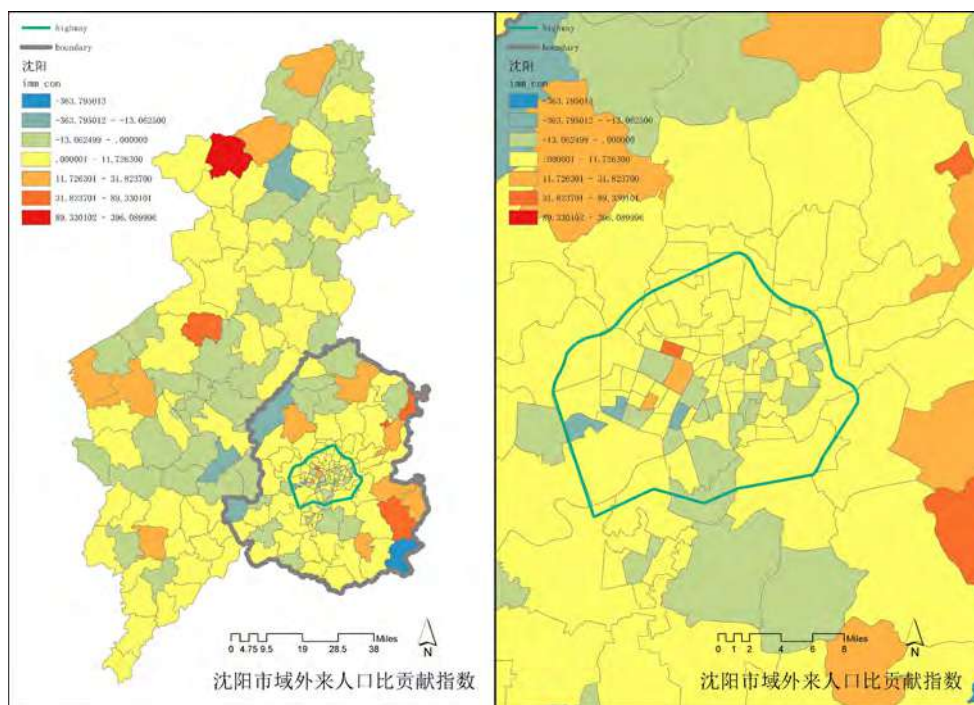


Pic.2 Spatial distribution of changes in total population density

In terms of the change in population density over the past decade (*pic.2*), except for the unit area where the population density has increased significantly within the second circle, the population reduction is the main situation. For the urban area, the population of the old urban area in Shenyang has contracted while the residential district near the G1501 line showed an increase in population density.

2.2.2 Districts of High Ratio of Migrants Presenting a ring agglomeration

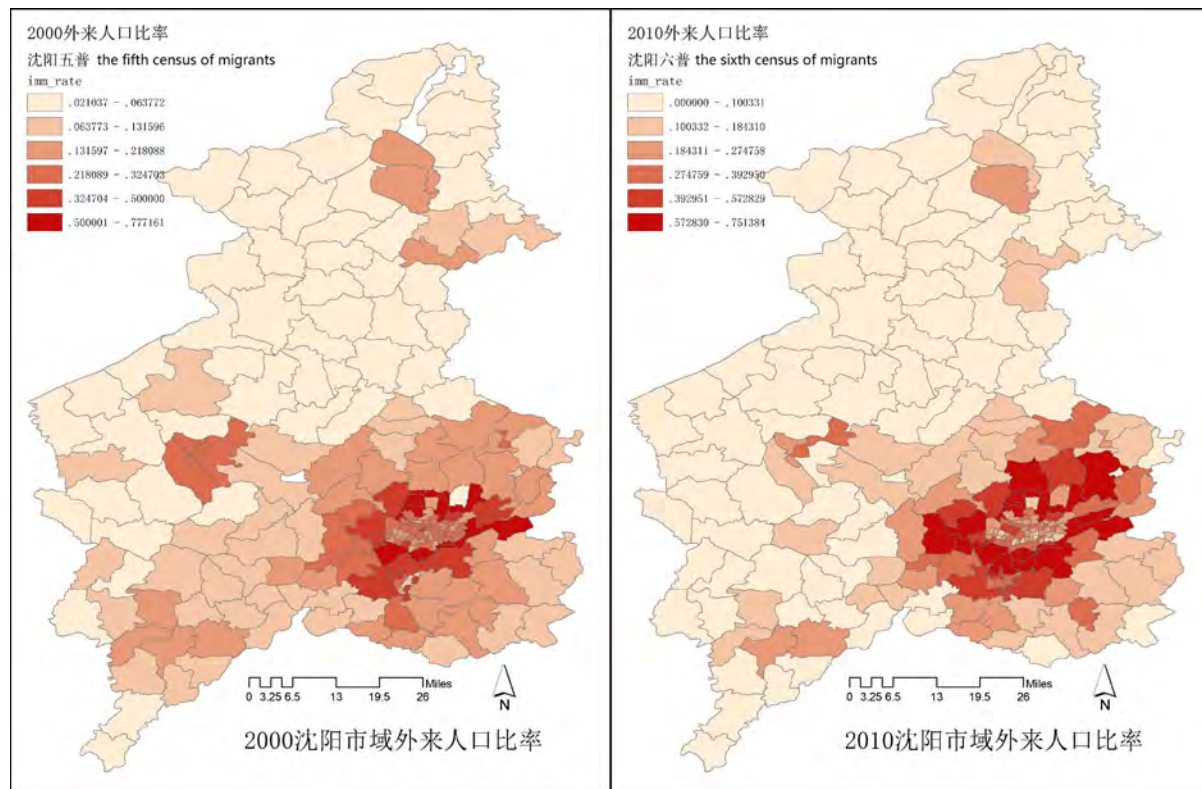
As migrant is the main force of urban development, the contribution index is defined by the change of ratio of migrant rate in the study of Shenyang. Districts with high contribution index will shows more impetus in urban development (*pic.3*). According to the pic. most of districts in Shenyang shows an index lower than 11.7 as well as the index in downtown, but it shows a higher result in the east of



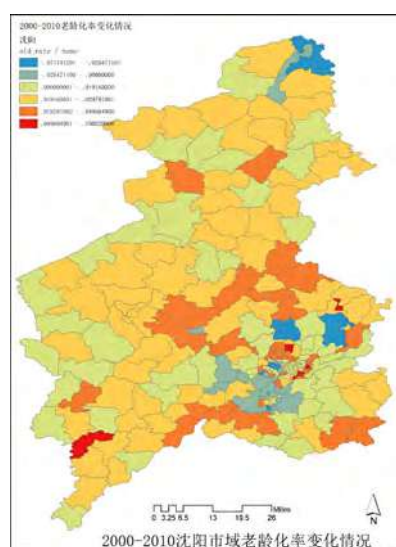
Pic.3 Spatial distribution of contribution index of migrants

Shenyang near to the boundary between Shenyang and Fushun, which means a fierce change in migrant.

According to the spatial distribution of migrant rate, it shows a more obviously concentrate when moving eyes to the edge of the city in the fifth census, and the phenomenon appears again in the result of the sixth census with a more centralized ring around the city (*pic.4*). In the fifth census, the spatial distribution of the migrant rate is more balance over the residential district between G1501 and the boundary of municipal district than it in the sixth census. Overall migrant density become more concentrate over the decade.



Pic.4 Spatial distribution of migrants in Shenyang (two census)



Pic.5 Change of aging rate

2.2.3 Significant Growth of the Ratio of Aging

The outflow of youth labor resources has led to the general problem of aging in the Northeast of China. This section based on comparison of the population ratio of the elderly aged over 65 between two censuses. And take 7% and 13% as the classification criteria which represent the aging degree, below 7% means that there is no aging problem in the city, 7%-13% means that the district has an aging population, and more than 13% means that the district is in an aging society.

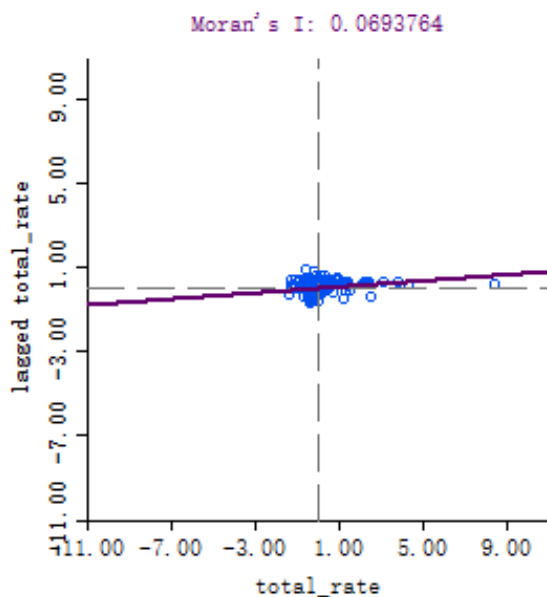
In the fifth census, the number of residential district with an aging population below 7% accounted for 22.2% of the total, and the remaining 77.8% of the district ageing population ratio was almost

13%, comparing with the sixth census in 2010, district with an aging ratio below 7% reduced to about 6.9%, one-third of the former quantity; aging ratio in 82.4% of residential district is between 7% and 13%, facing the problem of aging; 9.3% of the districts had an aging ratio of more than 13% which means entering an aging society. In the past decade, the problem of aging in Shenyang has been highlighted (*pic.5*). The overall aging ratio of cities had also increased from 8.6% to 10.3%. According to the data of the sixth census, almost all street units with an age ratio of more than 13% are distributed in the G1501 city expressway, which means the aging ratio is relatively higher in the urban area of Shenyang, and combined with the juvenile population under 14 years old, the population structure of the city is seriously out of balance, the population's development momentum is seriously insufficient, and aging has also increase the city's financial burden, which could do harm to social development.

2.3 Spatial Autocorrelation of Demographic Changing in Shenyang

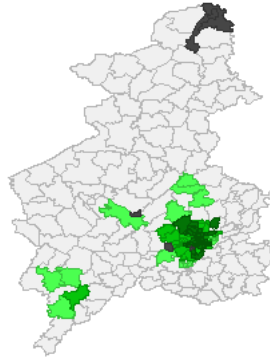
After observing the changes in various population indicators in Shenyang, it's not hard to found that the changes in various indicators have a certain spatial correlation, and continue to calculate the global Moran's I and the local Moran's I and illustrate the point with the graphical representation of spatial autocorrelation. In this case, the method of face and angle adjoining is used as the principle of allocation of spatial weights of each street unit (Queen's Case). The spatial autocorrelation setting $P < 0.05$ was significant, and the credibility reached 95%; $P < 0.01$ means that the credibility reached 99%; $P < 0.001$ means the credibility reached 99.9%. The LISA Significant Map will represent significant residential districts, while the LISA Cluster Map will classify significant districts into high-high, low-low, high-low, and low-high class, the districts are divided into high-high clustering as population agglomeration area; low-low clustering is defined as population contraction area; high-low clustering indicates that the street is in an increasing state to attract populations in other areas; low-high cluster indicates that the street is in a state where the population is being attracted to other regions.

2.3.1 Rate of Change in Total Population



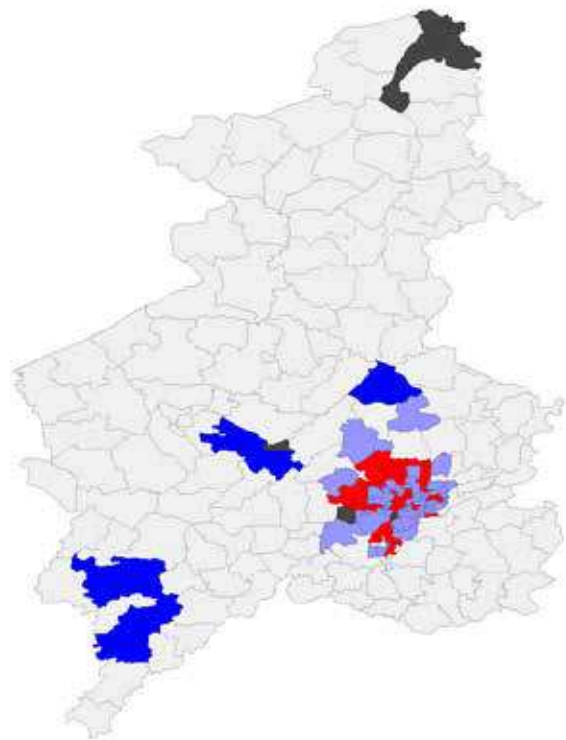
The global Moran index is calculated for the total population change rate of the residential districts in Shenyang, and $\text{Moran's } I = 0.0693764$. The global Moran index is positive, indicating that the observed data is significantly aggregated, and the total population change rate has a spatial strong correlation in space. The LISA significance map (*pic.6*) shows that $P < 0.001$ in most areas of Shenyang urban area in terms of total population change rate, which proves that the probability of population change rate in urban areas is 99.9% which is not randomly distributed. In addition, the analysis results of four street units in the western part of Xinmin and

LISA显著性地图
 □ 不显著 (124)
 ■ p = 0.05 (18)
 ■ p = 0.01 (33)
 ■ p = 0.001 (36)
 ■ 未定义/空值 (5)



Pic.6 LISA Significant Map of Total Population

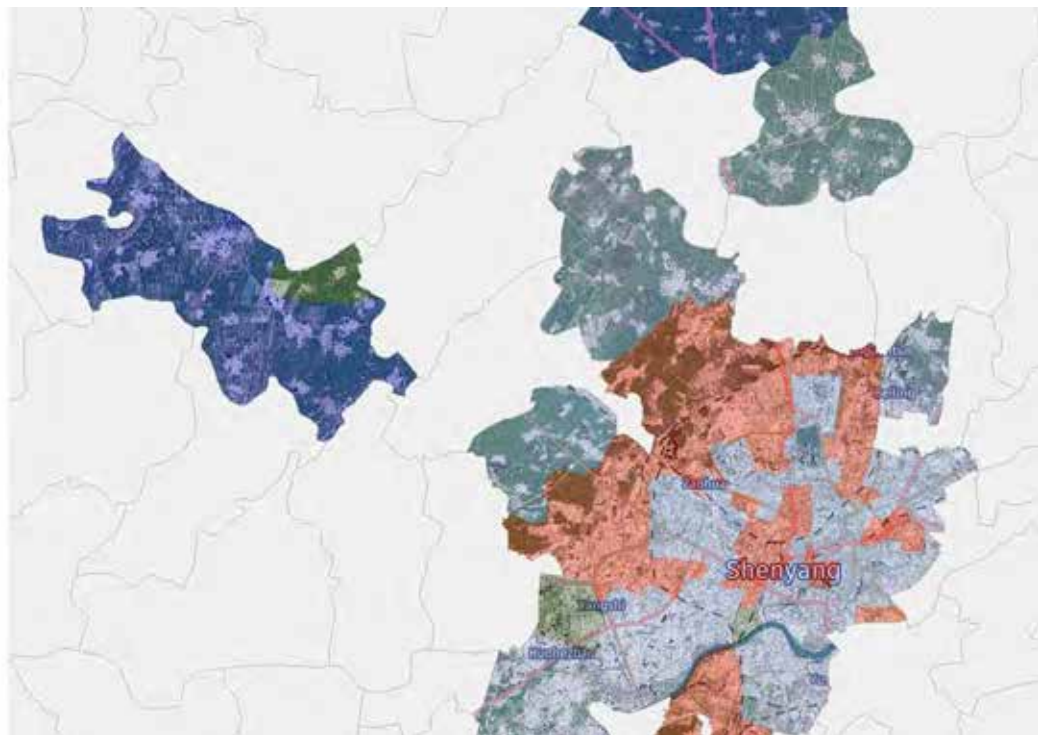
LISA聚类地图
 □ 不显著 (124)
 ■ 高-高 (28)
 ■ 低-低 (17)
 ■ 高-低 (11)
 ■ 低-高 (10)
 ■ 未定义/空值 (5)



Pic.7 LISA Cluster Map of Total Population

Liaozhong are also significant, with 95% probability being not randomly distributed. Overall, the areas with significant results are concentrated in the urban area of Shenyang.

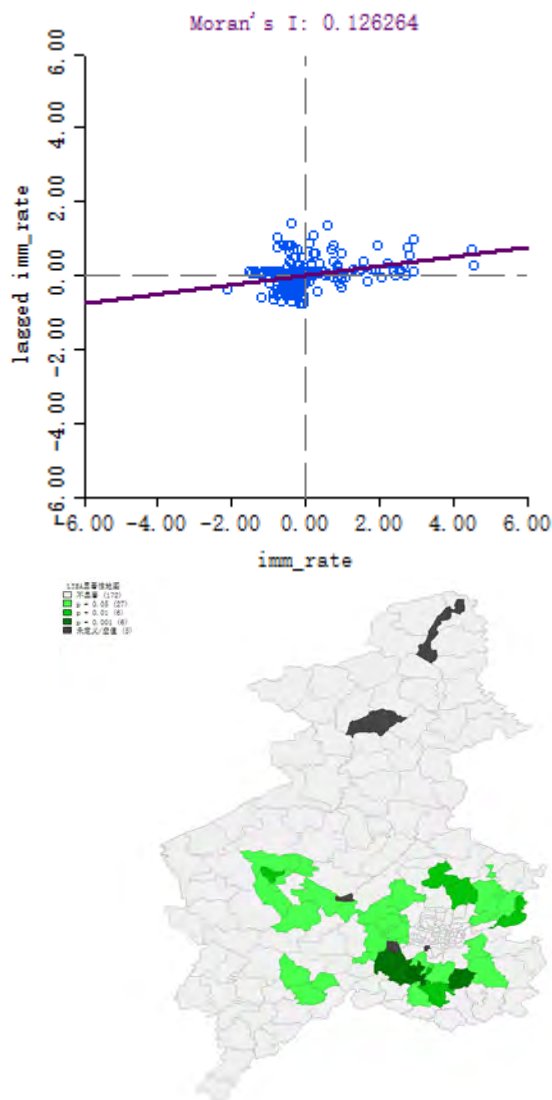
LISA聚类地图
 □ 不显著 (124)
 ■ 高-高 (29)
 ■ 低-低 (7)
 ■ 高-低 (23)
 ■ 低-高 (0)
 ■ 未定义/空值 (5)



Pic.8 LISA Cluster Map of Total Population of the Urban Area

The LISA clustering map (*pic.7, pic.8*) shows that the significant areas of Xinmin and Liaozhong are both low-low clusters, which are the shrinking districts of the population, while the urban areas of Shenyang are dominated by low-high clusters and high-high clusters. The high-high cluster area around the northwest of the area forms a semi-ring, surrounded by the built-up area of the city, and several districts in the downtown area also form a high-high cluster area, among other scattered four streets. Four high-high islands are formed in the annulus formed by the low-high cluster, and the other significant regions are low-high clusters. The northwest semi-circular ring has become a significant population agglomeration area, forming a population growth zone, while the urban area has also formed a growth pole. There is a low-high population shrinking zone between the two, and preliminary judgment can be made that people of the shrinking zone was flowing to the both sides. Comparing the quantity distribution maps, it is easy to found that the high-high areas are areas with large population growth, while some districts in the low-high cluster area still have a small increase in population, showing that the population growth is positive, but take a look at the big picture, its population is still in a state of being attracted to other regions.

2.3.2 Rate of Change in Ratio of Migrants

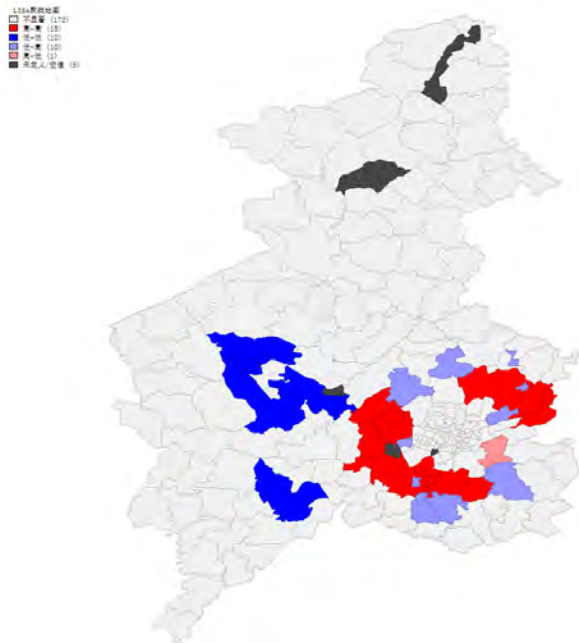


In the spatial cluster analysis of the change of the ratio of migrants in the two censuses, Moran's $I = 0.126264$. The positive value indicates that the changes of the migrants have significant spatial agglomeration distribution characteristics, and the change of the ratio of foreign population has a strong space. Correlation.

The LISA significant map (*pic.8*) shows that the spatial clustering significant area is concentrated in the periphery of Shenyang downtown, showing a roughly complete circular distribution. In addition, the significant area of Xinmin is also connected with the ring, indicating that the districts of Xinmin had an spatial correlation with the urban area. According to the map, P value of most significant areas is between 0.05 and 0.01, the ratio change of the foreign population has a 95% probability of non-random distribution in the spatial distribution, and the area of $P < 0.001$ is concentrated in the outer ring of the urban area. The southwestern region of the belt has a spatial distribution with a 99.9% probability of non-random distribution. The central city area did not show significance under this indicator, and there is no analytical value.

In the LISA clustering map (*pic.9, pic.10*), the

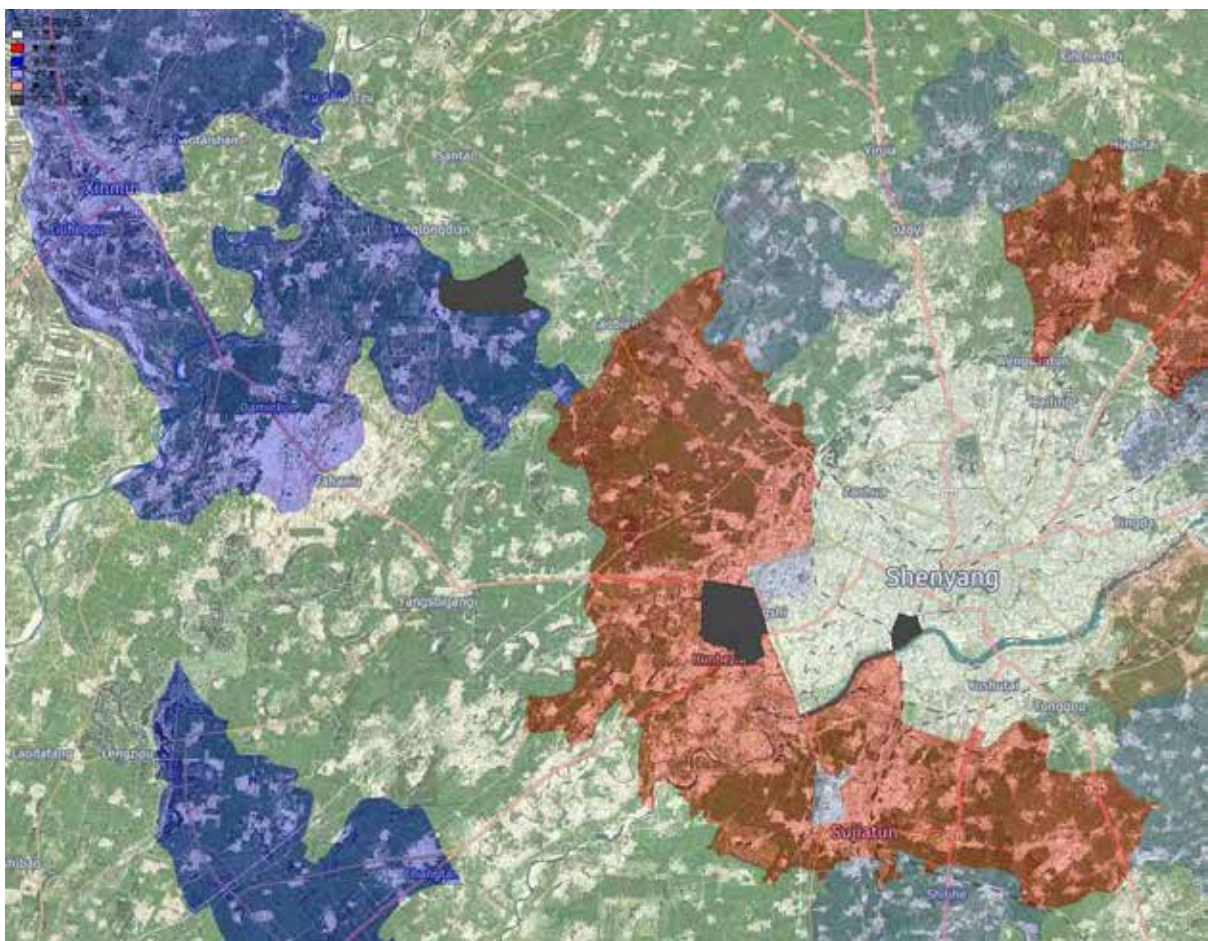
Pic.8 LISA Significant Map of change of migrants ratio



Pic.9 LISA Cluster Map of change of migrants ratio

significant areas of Xinmin and Liaozhong are completely in the population-loss zone with low-low population clusters, and the population-growth growth zones of high-high clusters in the ring zone are distributed in the southwest half of the outer ring. In the northeast part of Xinchengzi Town (Shenbei New District), the north and south of the ring are two low-high cluster areas, and the high-cluster area is more likely to show the attracted area of the population. In addition, Donghu residential district in Dongling District is the only central gathering area (high-low area), showing the attraction area of the migrant population. Comparing the above observations with the growth rate ratio of the foreign population, there is a similar situation with the change rate of the total population. The region with a higher growth rate of the migrants also

forms a circle around the urban area, the low-high cluster areas which is composed by attracted districts shows a great increase, so despite the number is growing, they were classified into



Pic.10 LISA Cluster Map of change of migrants ratio of Urban Area

population-attracted areas in spatial cluster analysis.

2.4 Summary

By comparing the LISA cluster map and spatial distribution of the quantities, it seems that there appears to be a paradox in the index of total population changing ratio and the change of migrants, that is, districts determined shrinking in the LISA cluster map still shows an growth in quantity, which can be defined as a relatively shrinking. This kind of circumstance happens all the time in the process of the analysis, so it is not reliable that identify the growth and shrinkage in cities with the change in value and the synthetic judgement with other index is necessary.

3. Discussion

3.1 Factors of Growth and Shrinkage in the City

In the study of the shrinkage and growth of the inter-city population, a lot of analysis has been done on the causes of the phenomenon of the shrinking, partly because of the stage characteristics of urban development such as globalization, suburbanization and de-industrialization. There are also factors such as the transformation of the state regime, the imbalance of demographic structure, and the side effects of government intervention. However, the reasons for the population shrinking and growing in various districts within the city are obviously different from the research level between cities or regions, and specific analysis is necessary. According to two national censuses in Shenyang, Shenyang City faced the combined effect of the population in the process of urbanization to the large concentration of urban population and the shrinking of the inner-city population at the same time. The period of research in Shenyang is in the decade of China's high-speed urbanization, and the urbanization rate in China has increased from 35.39% to 49.68%, an increase of 14.29%. The rural population migrated to the cities, resulting in the hollowing rural areas. Problems such as aging and population aging, and the expansion of the city's scope has led to a focus on building on the edge of the city, which in turn has caused the population of the inner city to shrink. In the course of the research, although Shenyang City has been found to be facing a severe problem of aging, there has not been a natural decline in population due to imbalances in population structure in countries such as Japan, but associated with the prevalence of minority births and low fertility in the three eastern provinces Shenyang is more likely to face problems such as insufficient population development and lack of labor resources in the foreseeable future.

3.2 Research Prospect

In 2020, the Chinese government is about to announce the seventh national census. Combining with the latest data, the research can study on the changes in the population of Shenyang in the first 20 years of the 21st century more evidentially. In the past ten years, domestic news media have been more pessimistic about the Northeast China region. Shenyang and even the entire three eastern provinces are often come out with keywords such as falling house prices, population loss, aging, and economic downturn. The data of the seventh national census can provide researchers with more accurate information. The source of the data is conducive to in-depth exploration of the demographic changes in the Northeast China, and better feasible strategy can be made. Since 2000, urban renewal is taking the place of urban growth in China gradually, and the shrinkage and growth in city

population must be influenced in a way, this paper just describe the phenomenon of shrinking, and needs a furthermore study of the factor that behind the phenomenon.

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