

Centrographic Analysis of Urban Growth in Xinjiang

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Abstract: Xinjiang has experienced considerable urban growth in the past fifty years, especially since the implementation of socio-economic reforms in 1978. When Xinjiang was founded as a Uygur Autonomous Region in 1955, there were only three cities with an urban population of 870 thousand, while in 2008 it had 21 cities with a total urban population with 8.45 million. Such an urban growth is attributed to the boost in the number of cities and the urban population. Urban expansion enhanced geographic inequality between the two major regions in Xinjiang. Compared to the Northern part, Southern Xinjiang only has 33.3% of the total cities and 35% of the urban population. Using centrographic analyses, this study aims at explaining the movement of urban center in Xinjiang during the past three decades. The conclusions are the following: 1. The center of city gravity moved to southwest, while the center of town gravity moved to southwest first then returned back to northeast; 2. The main factors which effected the movement of urban center in Xinjiang are government new rural economy system (1980), the new urban definition (1984) and superior geographical location as well as better socio-economic conditions are main factors .

Key words: Xinjiang; urban growth; spatial pattern; Centrographic Analysis

1 Introduction

Xinjiang has experienced considerable urban growth in the past sixty years, especially since the implementation of socio-economic reforms in 1978. When Xinjiang was founded as a Uygur Autonomous Region in 1955, there were only three cities with an urban population of 870 thousand, while in 2008 it had 21 cities with a total urban population with 8.45 million. Such an urban growth is attributed to the boost in the number of cities and the urban population. Urban expansion enhanced geographic inequality between the two major regions in Xinjiang. Compared to the Northern part, Southern Xinjiang only has 33.3% of the total cities and 35% of the urban population.

The urbanization in developing countries has attracted attentions of many scholars since the end of World War II (Cohen, 2004; Pugh 1995; Henderson 2002; Jo, 2002). They studied urban growth in developing countries from different point of view. The urban study in China

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has only begun since the last decade of 20th century, but has already well documented in the literature (Chan, 1992; Fan, 1999; George, 1999, 2002; Han et al., 1994; Hsu, 1994; Tian et al., 2002; Wang, 1999; Xu et al., 2002; Yang, 1998; Yao et al., 1999; Goldstein, 1990; Gu, 1999; Li et al., 1998; Chan et al., 2003; Victor et al., 1997; Ingram, 1998). The selected cases of Chinese urbanization mostly are concentrated in the east coast metropolitan centres such as Beijing (Gu, 2003), Jiangsu (Ma, 1994; Wang, 1999), Shanghai (Han, 2000), Fujian (Zhu, 2000), Guangzhou (Piper, 1999), Zhejiang (Xu, 2002) and Pearl River Delta (George, 1999). There were very a few case studies on the western provinces (Yue et al., 2004), especially of Xinjiang. Among some studies on Xinjiang, scholars analyzed the spatial feature of towns, the economic difference of urban system, spatial imbalance of urbanization and the status quo and significance of urbanization in Xinjiang (Gong, et al. 2008; Chen, 2008; Shi, 2008). Very few researches focus on the centrophagic analysis of urbanization in Xinjiang.

The regions emphasized in former studies have highly distinguishing social and economic environment from Xinjiang. Socially, Xinjiang is a minority concentrated multi-national area, 60% of population is minorities; economically, it is an under developed region. More than 60% of its total employment is engaged in agriculture. Per capita GDP is 4 times lower than the Shanghai City (Xinjiang Statistical Yearbook 2009). Therefore the systematic research of urban development in Xinjiang not only can be helpful for the local planning and regional development, but also has the inspiration meaning to urban development in other minority regions.

2 Methodology and Data

Urbanization level in this study is measured by using the proportion of urban populations. This study adopts the official definitions of urban population which refer to the permanent residents of urban area such as districts, streets and resident comities in cities and towns. There are 21 cities and 229 towns in Xinjiang in 2008. The spatial pattern is analyzed on the basic of 87 county level administrative regions and three large geographic units, namely Northern Xinjiang, Eastern Xinjiang and Southern Xinjiang.

Data used in this study come from Xinjiang Census 1982, 1990 and 2000, Xinjiang Statistical Yearbook 2001, 2004 and 2009.

The analytical part of this research we used centrophagic analysis. Centrophagic analysis is an advanced spatial analysis method, which has experienced a rapid renewal over the last few years, in large part due to its integration with GIS. This technique provides the equivalent of statistical measures of central and dispersion tendencies adapted for two-dimensional geographical space (Caprio, 1970). Jones (1980) presents centrophagic measures as describing the three most important characteristics of a spatial phenomenon: its location, dispersion and form.

3 Urbanization Process in Xinjiang

3.1 Brief History of Urbanization in Xinjiang

When Xinjiang was founded as a Uygur Autonomous Region in 1955, there were only three cities: Urumqi and Gulja city in the north and Kashkar city in the south with an urban population of 870 thousand (Geographic Society of Xinjiang, 1993). Urbanization rate was only 12.21%. From 1953, Central government began to pay more sustained attention to

Xinjiang and then urbanization began to change its pace and spatial structure. Urban development in Xinjiang had gone through the following distinct stages.

Initial period of urbanization (1949-1959): The main features of Xinjiang's urbanization in this period are as follows:

Firstly, urbanization pace was faster than the national average. In 1949, there was only one city, Urumqi, in Xinjiang. From 1949 to 1959, the urbanization rate of Xinjiang increased by 11.23 %, 7.77% higher than the national average. The urban population reached 1.56 million, with the urbanization rate of 23.44%. Secondly, the main explanation for the rapid increase in urban population during the period is industrialization and the expansion of non-agricultural economic activities accelerated by the First Five-Year Plan, mainly the development of mining and processing industry. At that time, the key point of urban construction in Xinjiang was Urumqi city as well as Karamay. As a result there were designated three new cities. The number of cities reached to four. Third, inter-provincial in-migration was the main source of urban population. There were two forms of in-migration, organized and spontaneous. At that time the organized in-migration had been increasing rapidly. During the mid 1950s annual net in-migration of 250,000 was dominated by production and construction corps in-migrants. 1949-1953 Xinjiang get net in-migration from other provinces such as Beijing, Jingsu, Zhejiang, Hubei, Hunan, and Shandong 330 thousand people.

De-urbanization stage (1960 -1965): This was the economic recovery and adjustment period. Urbanization in Xinjiang had the following characteristics: firstly, government increased the urban criteria. Like other provinces in China, Xinjiang has to decrease urban population by deporting or "sending down" to the countryside. As a result, 61 thousand urban populations were reduced and faced de-urbanization phenomenon. Secondly, urbanization rate was dropped and the disparity with the national average was enlarged. In 1965, the percentage of urban population in Xinjiang dropped from 23.44% to 18.93%, while the national average rate reduced from 10.5% to 9.2%.

Stagnation and Slow development stage (1966-1977): In this stage, urbanization was stagnated or slow developed due to the Cultural Revolution and associated misguided ideology. The campaign of "up to mountain and down to the villages" force urban educated youth to move out of the cities to resettle in rural villages or remote areas. Only three new cities were designated in the 11 years. The number of cities and towns reached to 7 and 53 respectively with the urban population of 2.76 million. 610 thousand urban populations increased in this period but its proportion stayed at 22.86%, 0.58% lower the end of the first stage.

High Speed Urbanization stage (1978 to 1990): The economic reforms since 1978 have brought deep changes to China's urban-rural relations. Market economy and rural system reform have created a great impetus for the remarkable growth of small towns, which functioned as the rural economic center. Especially since the relaxed urban and town criteria in 1984 re-energized small cities and towns have flourished all over the China. At that time, however, the pattern of structural change of cities in Xinjiang has been the result of political consideration. Each prefecture designated at least one city as a political center. Then the number of cities rose significantly from 7 in 1978 to 16 in 1990, an increase of 9 new cities in 12 years, more than two times than the four new cities established over the previous two

decades. The number of towns also increased from 53 in 1978 to 131 in 1990. At the same time urban population increased from 3.21 million to 6.86 million with the proportion of 44.86%.

Stable Development period (1990 to 2000): From 1990 to 2000, economic factors played more roles in growth of cities. The Development of cities was effectively guided by economic needs. In this period, the number of cities rose from 16 to 19, increased 3 new cities. At the same time, the number of towns increased from 131 to 197. Despite of the growth of the cities and towns, urban population and its proportion dropped to 6.2 million and 33.75% respectively mainly due to the new urbanization criteria in 2000 census.

Accelerate urban growth period (2000 to 2008): In 2000, Chinese central government announced a major, new initiative -“Great Western Development Strategy” to develop China's poor, backward western regions. This strategy brings Xinjiang a historic opportunity for urban development. Along with the implementation of this new favorable regional development strategy, population and industrialization grew rapidly in these areas, especially in Xinjiang. Xinjiang entered accelerate urban growth stage again. Three new cities and 32 new towns were designated in these eight years with the nearly 4% of annual growth rate. Urbanization rate reached 39.64% with 8.45 million of the urban population. In this period, Southern Xinjiang has gone through more urbanization than the North and East. Two of the three new cities and 22 of the 32 new towns are located in Southern Xinjiang, while one city and seven towns are in North and only three towns are in East.

3.2 Centrographic Analysis of urbanization in Xinjiang during last three decades

The centrographic analysis shows a significant reorganization of the spatial distribution of cities and towns in Xinjiang over the three decades (Figure 1). Figure 1 consists of 5 thematic maps, 3 of them corresponding respectively to cities and towns in three different time period (1982, 1990, and 2008). Each of the maps contains one hierarchical ellipse representing the migratory phenomenon of urbanization. Another two maps consist of three ellipses of the special distribution of cities and towns, each of ellipses representing each year.

The center of gravity (CG) of an ellipse in centrographic analysis is the relative center of the region being studied, according to the weight of each of its geographical unit. When studying the spatial distribution of a phenomenon, if the phenomenon is distributed unevenly, it can be interesting take into consideration the weight of each geographical unit and therefore to assign this weight to each point. The calculation of the coordinates of the center of gravity will take into account the disparities in the weights of geographical units in the region. The center of gravity is a useful reference point for the comparison of several geographical units at points in the same geographical region or for the comparison of the position of one geographical unit over time (Cao, 2003). We calculated weighted centers of gravity for the spatial distribution of urban population for the three time periods 1982, 1990 and 2008, and presented them in Figure 1. The evolution of the forms of the ellipses and the changes in their major and minor axes in Centrographic analysis indicate the dispersion of the research phenomenon under study in relation to the two spatial dimensions. In order to report better the spatial distribution of the research objects, the ellipse can be oriented according to the track with most variation (Cao, 2003). In this study we also examined the evolution of the forms of the ellipses and changes in their major and minor axes to better understand the process of urban concentration in Xinjiang.

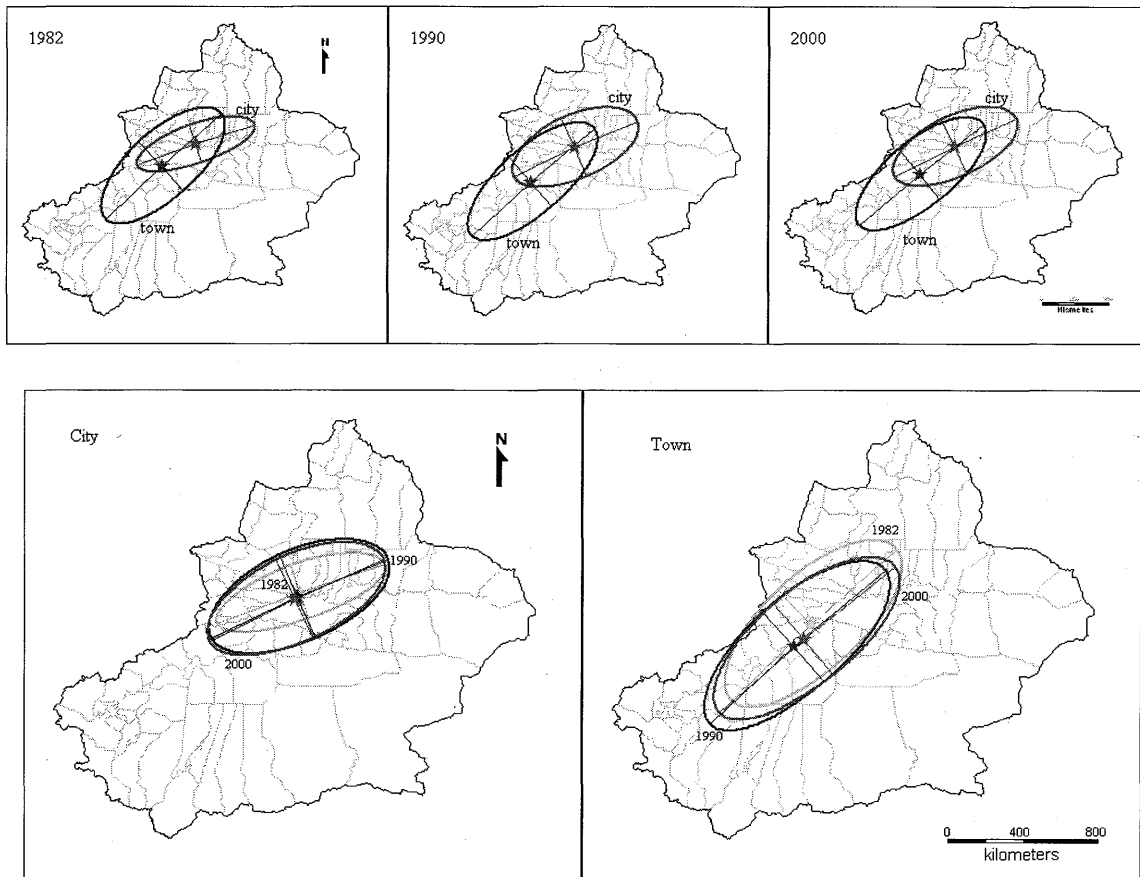


Figure 1 Centrophoric analysis of the distribution of cities and towns in Xinjiang, 1982-2000

3.2.1 City vs. town

In 1982, the center of gravity for cities was located in Sawan County ($N43.49^{\circ}$, $E85.15^{\circ}$), while the center of towns was located in eastern corner of Bay County ($N42.37^{\circ}$, $E82.86^{\circ}$), which is 225 km southwest of city center. In 1990, the center of city gravity moved 19 km to southwest and placed in Hejing County ($N43.33^{\circ}$, $E85.07^{\circ}$). At the same period, the town center also has the same moving trend with a bigger scale than cities. It was located in Toksu County ($N41.58^{\circ}$, $E82.08^{\circ}$), moved 110km to southwest. The distance between city center and town center enlarged to 315 km. In 2008, however, the center of city gravity was also located in Hejing County but still continued its direction towards southwest ($N43.27^{\circ}$, $S84.94^{\circ}$) and made a movement of 14 km to southwest, while the center of town gravity changed its direction and moved 50km back to northeast. This time it was located in Bay County ($N41.85^{\circ}$, $E82.55^{\circ}$) again. The distance between the two centers decreased to 250 km.

Statistics confirm that, in 1982 the area of ellipse for cities was only 116300 km^2 , while it was 256600 for towns. In 1990, both of these ellipses expanded to north and south directions, covers the area of 206400 km^2 and 269000 km^2 respectively. However, the ellipse for cities expended 77.5%, much bigger than 4.8% of that for towns. Contrarily, in 2008, both of the ellipses have a trend of reduction. Now the covered scopes of them are reduced to 195200 km^2 and 260400 km^2 , the ellipse for cities shrink 5.4%, 2.2% larger than that of 3.2% for towns.

What is more, the major and minor axis of ellipses for cities has experienced more

changes then that for towns. For example, the major axis of ellipse for cities, which is the horizontal length of the ellipses, measured 682.8 km in 1982, while it measured 876.5 km for towns. In 1990, they extended to 747.1 km and 925.5 km respectively. Yet, the axis for cities changed 9.5%, while the axis for towns altered 5.6%. In 2008, they measured 744.1 and 901.6, shortened 0.4% and 2.6%. The minor axis of ellipse, which is the vertical length of the interior ellipse, was 216.9 km for cities and 372.9 for towns in 1982. In 1990, it was 351.9 for cities and 370.9 for towns. In the eight years the minor axis of ellipse increased 62%, while that of towns decreased 0.7%. In 2008, both of them have same trend of reduction. It reduced 5.1% for cities and 0.6% for towns. This shows that decentralization in the first stage and concentration in the second period was more obvious for cities than towns.

3.2.2 Temporal change

In 1982, the center of gravity for cities was located in Sawan County (N43.49°, E85.15°), while the center of towns was distributed in eastern corner of Bay County (N42.37°, E82.86°). In 1990, both of them moved to southwest, and the area, major and minor axis of both ellipses expanded with the exception of minor axis for towns. In 2008, the center of city gravity still continued its direction towards southwest, while the center of town gravity returned back to northeast. Nevertheless, covered area, major and minor axis of both ellipses decreased. This indicates that the distribution of cities and towns was tending to be balanced from 1978 to 1990, while it is concentrated in the northern area in 2008. This kind of tendency displays more obviously in the city than towns (Table 1).

Table 1 Centrographic Analysis Parameters

	1982	1990	2008	Difference 1982-1990	Difference 1990-2008	Difference 1982-2008
City						
Area of ellipse(km ²)	116300	206400	195200	+77.5%	-5.4%	+67.8%
Major Axis(km)	682.8	747.1	744.1	+9.5%	-0.4%	+9.1%
Minor Axis(km)	216.9	351.9	334.1	+62.2%	-5.1%	+54%
Ellipse orientation (degrees)						
Town						
Area of ellipse(km ²)	256600	269000	260400	+4.8%	-3.2%	+1.5%
Major Axis(km)	876.5	925.5	901.6	+5.6%	-2.6%	+2.9%
Minor Axis(km)	372.9	370.2	368.0	-0.7%	-0.6%	-1.3%
Ellipse orientation (degrees)						
City + Town						
Area of ellipse(km ²)	180200	246000	228400	+36.5%	-7.2%	+26.8
Major Axis(km)	761.8	844.9	821.6	+10.9	-2.8%	+7.9%
Minor Axis(km)	301.3	370.9	354.1	+23.1	-4.5	+17.5
Ellipse orientation (degrees)						

This kind of movement of city and town centers has some relations of government urban policy as well as economic development in Xinjiang. From 1982 to 1990 the main propelling force of urbanization in Xinjiang was the administrative strength. In 1982, there were only eight cities and 64 towns in Xinjiang. From the 1982 to 1990, the number of cities and towns rose to sixteen and 131 respectively with the rapid annual growth rate of 9.05% and 9.37%. This is because Chinese government launched new rural economy system in 1980 and

changed the urban definition in 1984. According to new urban definition in China, those areas where local governments of county level or higher are designated as urban areas irrespective of the size of their permanent resident population (*Asian Development Bank, 2002*). Therefore, 8 counties are turned into cities as capital cities of prefectures, 67 new towns were designated. As a result, the city and town distributions tend to the homogenization. This is partial explanation for why the CG shifted to south as well as spatial disparity urbanization was lower in this period. After 1990, urbanization speed slowed down and began to concentration on the economic belt of northern slope of Tianshan Mountain. At that time economic development played the major role in the urbanization. After 1990, six new cities are established serving as economic center and four of them are located on the economic belt of northern slope of Tianshan Mountain because of the superior geographical location and better economic development of these areas.

4 Conclusion and discussion

1. The center of city gravity moved to southwest, while the center of town gravity moved to southwest first then returned back to northeast.
2. The main factors which effected the movement of urban center in Xinjiang are government new rural economy system (1980), the new urban definition(1984) and superior geographical location as well as better socio-economic conditions are main factors.

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