

Urban Shrinkage in Liaoning Province

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Abstract: In the context of rapid economic development and rapid urbanization, due to the uneven development of industries and regions, the problem of urban shrinkage has attracted people's attention. Establish the identification index of shrinking cities, and analyze the types, influencing factors and development evolution trends of shrinking cities through the increase and decrease of total population and GDP of 30 cities in Liaoning Province.

Keywords: Shrinking cities; Population; GDP value; Economic and social development; Regression model

Urban shrinkage is an economic and social phenomenon that is widely present at home and abroad, and at the same time has obvious regional characteristics. At the end of the last century, it was noted that under the influence of globalization, deindustrialization and resource depletion, many cities were used. The city experienced population loss and economic recession. In Europe and the United States, the "Rust Belt" cities in the United States and the Ruhr in Germany, represented by traditional industrial cities such as Liverpool in the United Kingdom, in the transition countries of Eastern Europe, as well as Central and South American and Asian countries, this phenomenon is also not uncommon.

In China, under the background of rapid economic development and rapid urbanization, due to the development of industries and regions, in recent years, the problem of urban shrinkage has also attracted people's attention. Studies show that Northeast veterans, industrial areas, traditional heavy industrial cities in the central region, developed urban circles in the east, and remote areas in the west have all shown a situation, there are different degrees of urban contraction, and the urban shrinkage in the three eastern provinces is the most significant. In the process of transformation and development in the new normal, some resource-based cities in the northeast have begun to experience urban shrinkage problems such as population decline, economic recession, and inefficient land use, and urban development has been seriously hindered.

As a national traditional heavy industry base, Liaoning is also the first province to begin industrialization and urbanization, it also faces the problem of urban shrinkage.

According to some data of population and economic and social development indicators of 30 cities in Liaoning Province, the identification index of shrinking cities is first established, and shrinking cities are those that occur in population decline for three consecutive years. Through MATLAB, the population of these cities from 2009 to 2020 is charted, and whether they are shrinking cities are determined by the charts. Further establish a classification model, combine population and GDP changes, and classify shrinking cities.

The data comes from the Liaoning Statistical Yearbook, China Urban Statistical Yearbook, China County Statistical Yearbook and the Statistical Bulletin of National Economic and Social Development of various cities. Among them, population and GDP change data of 30 cities in Liaoning Province from 2009 to 2020.

Step 1: First filter, integrate, and then import the useful data into a new excel sheet.

Step 2: Import MATLAB into the population of each city in different years of the integrated Liaoning Province, and calculate the annual growth rate with an excel table, including the population growth rate and GDP growth rate.

Step 3: Use the Plot function to plot the population number curve in each year, and calculate the growth rate with Excel table.

The given data is filtered and integrated through data preprocessing. The population of each city in Liaoning Province from 2009 to 2020 was sorted out, 30 cities were grouped, every six cities were grouped, Dalian and Shenyang were divided into a group, the year was used as the dependent variable, and the population number was used as the independent variable, a mathematical model

was established, the GDP and population growth rates were calculated, and the contraction cities were identified and classified by comparing the total growth rate.

The expansion and contraction of cities depend on the flow of population, and the structural changes caused by the growth and decline of population are important factors in judging shrinking cities, so the establishment of three consecutive years of population decline is the identification index of shrinking cities. According to the slope of each population curve in Figures 1 to 6, the cities with three consecutive years of population decline from 2009 to 2020 were screened, and it can be judged that the prefecture-level cities in Liaoning Province are Anshan, Fushun, Benxi, Dandong, Jinzhou, Fuxin, Liaoyang, Panjin, Tieling and Huludao; Among the county-level cities, the shrinking cities are: Xinmin, Wafangdian, Zhuanghe, Haicheng, Donggang, Fengcheng, Linghai, Beizhen, Gaizhou, Dashiqiao, Lighthouse, Jiabingshan, Kaiyuan, Beiqiao, Lingyuan, and Xingcheng. Most of the annual growth rates in shrinking cities are negative, among which almost all of the shrinking cities in county-level cities have experienced continuous population decline since 2009, and prefecture-level cities are relatively backward. From the perspective of the number of shrinking cities, whether in stages or overall, nearly half of the cities in Liaoning Province are in a state of contraction, indicating that urban contraction has become more obvious, It has become an inevitable stage and major problem facing urban development

Shrinking cities can be roughly divided into four categories, and according to the population growth rate and GDP growth rate in Tables 1 to 6, both of which grow as absolute growth; Population growth, urban GDP reduced to population agglomeration; Population decline, urban GDP growth to shrewd contraction; If both atrophy, it is an absolute contraction type. The growth rate is positive or increase and negative is decrease, so it can be judged that among the 30 cities:

Table 4.4 Classification of cities

type	city
Absolute growth	Shenyang, Dalian, Jinzhou, Yingkou, Liaoyang, Panjin, Tieling, Chaoyang
Smart contraction	Fushun, Benxi, Dandong, Fuxin, Huludao, Wafangdian, Zhuanghe, Haicheng, Donggang, Fengcheng, Linghai, Beizhen, Gaizhou, Dashiqiao, Lighthouse, Jiabingshan, Kaiyuan, Beiqiao, Lingyuan, Xingcheng
Absolute shrinkage type	Anshan, Xinmin

Among them, the proportion of smart shrinking cities is large, and most of the county-level cities are smart shrinking types.

The causes of urban shrinkage are complex. Economic and social factors have different degrees of influence on population changes in shrinking cities, and these effects are quantitatively analyzed and discussed in response to the conclusions obtained.

Various economic and social factors (GDP, total retail sales of consumer goods, fixed asset investment (excluding rural households), general public budget expenditure, gross industrial output value above designated size, household registration population, number of employed persons in urban units_ secondary and tertiary industries, domestic water supply, real estate development investment) all have different degrees of impact on the population, and multiple linear regression analysis of various factors of the economy and society is required. In the first question, one typical city is extracted from each of the different types of shrinking cities, and the corresponding correlation coefficient matrix is obtained, and the discussion is carried out according to the analysis results, and the first question obtains that there are no population agglomeration shrinkage cities among the 30 cities in Liaoning Province, so the fitting analysis is carried out for the other three types of shrinking cities.

Take the establishment and solution of smart contraction model as an example - ---- Dandong City

Set the number of urban population to y and GDP x_1 , the total retail sales of social consumer goods x_2 , fixed asset investment (excluding rural households), x_3 general public budget expenditure, the x_4 total output value of industries above designated size, x_5 the number of urban unit employment _ secondary and tertiary industries are, x_6 domestic water supply is x_7 , and real estate development investment is x_8 Multiple linear regression x_8 analysis was carried out to establish a regression model between various factors of economic society and population size.

For multiple regression, due to the large number of independent variables, this title is octary regression, theoretically choosing the regression equation is more difficult, we first calculate the correlation coefficient matrix between the variables, draw the correlation coefficient matrix diagram, so to analyze the linear correlation between the variables, call the self-programmed matrix plot function to draw the correlation coefficient matrix diagram.



Fig.1 Correlation coefficient matrix of Dandong City

The flatter the ellipse, the closer the absolute value of the correlation coefficient between variables is to 1, and the rounder the ellipse, the closer the absolute value of the correlation coefficient between variables is to 0. If the direction of the ellipse's major axis is from bottom left to upper right, there is a positive correlation between the variables, and vice versa.

Here we do octadic linear regression, building a regression model of y about $x_1, x_2, x_3, x_4, x_5, x_6, x_7, x_8, i=1,2,\dots,n$

$$\begin{cases} y_i = b_0 + b_1x_{i1} + b_2x_{i2} + b_3x_{i3} + b_4x_{i4} + b_5x_{i5} + b_6x_{i6} + b_7x_{i7} + b_8x_{i8} + b_9x_{i9} + \varepsilon_i \\ \varepsilon_i : N(0, \sigma^2) \end{cases} \quad (1)$$

We call the fit method of the LinearModel class for multiple linear regression, and return the parameter estimation results and significance test results.

Based on the data, we plot the residual histogram and the residual normal probability plot, and look for outliers based on the studentized residuals.

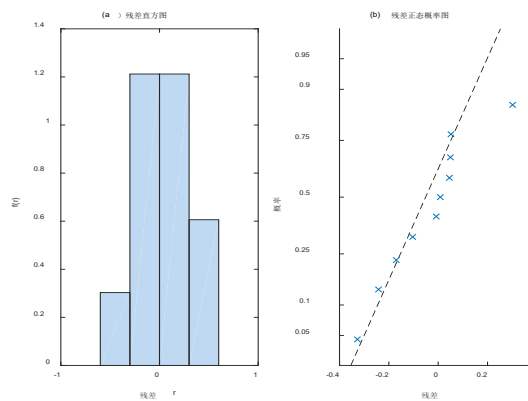


Fig. 2 Multiple linear regression residual histogram and residual normal probability plot in Dandong City

The stepwise method of the LinearModel class object is used for stepwise regression. Here, on the basis of the quadratic polynomial regression model, the stepwise regression method is used to establish a quadratic polynomial regression model between population size and various factors of economy and society.

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