Urban Land Expansion

Subjects: Sociology

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At the county level, this entry investigated the relationship between urban land and regional economic development in Beijing-Tianjin-Hebei Region in China. The interaction effects were quantitatively investigated. The spatial effects decomposition was used to analyze the influence of socioeconomic factors on the scales of urban land through direct effect, spillover effect and total effect. It is an important finding that average wages are the most prominent among the spatial spillovers.

urban land | urban expansion | cross-sectional | spatial spillover effect | spatial econometric

1. Introduction

The city is a large-scale residential area formed by the agglomeration of socioeconomic activities, dominated by non-agricultural industries and the agglomeration of non-agricultural population.

Many literature studies are devoted to exploring the influencing factors of urban land expansion, including natural, socioeconomic, infrastructure, and policy factors. Natural factors are mainly topographic conditions, such as elevation and slope [1][2][3][4][5][6], that restrict urban land development. Socioeconomic factors include population [1][5][6][7][8][9], GDP [5][7][8][9][10], urbanization rate [11][12], fixed-asset investment [5][9][13], foreign direct investment [7][14], and urban wages or disposable income [4][5][7][10][13]. Infrastructure factors are mainly traffic conditions [9][13]. Policy factors are national, provincial, or municipal land-use policies or regulations [3][5][9]. The research methods of the driving force of urban land expansion mainly include multiple linear regression [15][16][17], logistic regression [18][19][20], analytic hierarchy process (AHP) [21], principal component analysis (PCA) [22], ridge regression [9], artificial neural network [23], and cellular automata [2]. The dependent variable of logistic regression is two classified variables, and the independent variable can be a continuous variable or a classified variable, which can reflect the spatial characteristics of the variable. This means where the urban expansion will take place. So it can be used for the driving force analysis and prediction of land-use change. However, the logistic regression model ignores the interaction and random disturbance in the neighborhood. Multiple linear regression uses time series data to explore the relative importance of different factors. Only continuous variables can be used, and it is not applicable when the dependent variable is a classified variable. The analytic hierarchy process (AHP) determines the relative importance of factors at all levels through pairwise comparison, which is a subjective method. The accuracy of the result is largely dependent on expert knowledge, and it is difficult to analyze the spatial information of urban land expansion. The artificial neural network (Ann) has strong nonlinear processing ability. It uses the trained image template to identify the image, and the image extraction results depend on the expert knowledge and experience

stored in the image template. Cellular automata (CA) model simulates the process or future scenario of urban expansion by using cells and transformation rules that are discrete in space and time [24].

Many studies have investigated the influencing factors of urban land or construction land scale. However, there are some deficiencies in previous studies. Firstly, the spatial autocorrelation of spatial units is seldom considered in the study of driving factors of urban expansion. Spatial effects are very important in geographical processes, and ignoring them may lead to biased results [1]. The expansion of urban land in a certain administrative region is not carried out alone. The expansion of urban land is affected by neighboring administrative regions. For example, Zhang et al. [25] compared the spatial and temporal pattern of urban growth in Beijing, Tianjin, and Tangshan from the 1970s to 2013, and emphasized the influence of neighboring cities on the direction of urban expansion. In view of this, scholars suggested that the teleconnections framework of urban land promote urbanization [26]. That is to say, in the process of studying urban land expansion, the spatial autocorrelation of adjacent administrative areas and the layout of regional urban land should be fully considered. Secondly, previous quantitative studies on the driving force of urban land expansion have mostly focused on individual cities or prefecture-level cities as a unit by which to study the national level, provincial level, or the Yangtze River Delta and other economic zones. The explanatory ability of the driving factors determined by a single urban scale to the dependent variables is often difficult to extend to the regional research composed of the county level. The scale of the analysis unit influences the correlation between the land-use system and its potential explanatory variables [27]. The driving effect of explanatory variables on urban land may vary with a change in space and time scale [28]. For example, Li, Li, and Wu [29], based on data from four periods from 1990 to 2008, found that the relative importance of key drivers of urban growth in the central part of the Yangtze River Delta is different at the regional-, prefecture-, and county levels. Thirdly, previous studies mostly analyzed multi-year data and seldom used cross-sectional data, which can capture information of specific time nodes. Gao et al. [30] used panel data from 2000 to 2010 to find that six factors, such as foreign direct investment and population, drove the urban land expansion in the Yangtze River Delta region. Using panel data from 1995 to 2010, Jiang and Zhang [31] found that urban wages were the basic factor to promote the conversion of agricultural land into urban land. Using 2008 cross-sectional data, Ye, Zhang, and Pu [11] concluded that the GDP growth of a region would not only drive the expansion of its own construction land, but also the growth of construction land in neighboring regions.

Cross-sectional data have some limitations compared to panel data. For example, the problem of missing variables cannot be solved and the dynamic behavior information of individuals cannot be provided. In addition, because the cross-sectional data have only one dimension, the accuracy of the estimation is not as good as the panel data. However, cross-sectional data can capture specific time node information. In the field of land use, the cross-sectional econometrics model can be used to accurately explore the factors affecting the urban land scale in a certain year. Fourthly, most of the previous studies only analyzed the influence of socioeconomic factors on urban land use or construction land, rarely involving spatial effect decomposition. As for the spatial spillover effect of the influencing factors of urban land or construction land, Wang and Gao have made in-depth research and put forward valuable opinions. Wang [12] analyzed the impact of GDP, population, and urbanization rates on construction land using data from 30 provincial-level sources in mainland China. Based on the 285 Chinese prefecture-level and above cities, Feng et al. [32] investigated the driving forces of urban expansion of different

sizes at the national and regional levels. However, in the literature on the topic of influencing factors of urban land or construction land, existing studies have analyzed indirect effect (spatial spillover effect) based on the spatial lag coefficient of explanatory variables.

2. Urban Expansion in China

In November 2014, the Chinese State Council defined a new standard for classifying cities. Cities are divided into super-mega, mega, large, medium, and small cities according to the size of urban permanent residents with a population greater than 10×10^6, between 5×10^6 and 10×10^6, between 1×10^6 and 5×10^6, between 0.5×10^6 and 1×10^6, and below 0.5×10^6, respectively. Urbanization is an important symbol of the level of economic development and reflects the process of social structure reform in a country or region. China is not only the engine of global economic growth but also the engine of global urban population growth. Since the reform and opening up, China's economy has maintained rapid growth for nearly 40 years [33][34], and China's urbanization process has been advancing at an unprecedented speed. The urbanization rate has increased from 17.92% in 1978 to 56.10% in 2015 [35], which means that 771 million people live in urban areas. At the same time, rapid urbanization has accelerated the urbanization of land [36]. Cities attract a large number of immigrants from rural areas due to the higher income and increased job opportunities [37][38]. These migrations, and the growth of the urban population itself, led to a dramatic increase in the urban population. The increase in the urban population and its desire for better housing will inevitably lead to the expansion of urban land. That is, the spread of urban built-up areas in space [39][40][41].

In addition, the rapidly growing urban population increases the urban population density [42]. In the construction of residential areas, it is necessary to pay attention to the surrounding supporting facilities, such as the construction of parks. The land occupied by these supporting facilities is also an important reason for the expansion of urban land. Urban expansion provides land for urban development and effectively supports socioeconomic development [43]. However, the essence of urban land expansion is the conversion of rural and natural land to urban land. This conversion is the transformation of natural land into semi-natural, semi-artificial or artificial land [44][45][46]. Significant changes in the constituent elements of the ecosystem and their quantity-to-ratio relationship cause the original natural surface to lose its original ecological functions, and the resulting ecological environment problems will become one of the biggest problems of the 21st century [29][47][48]; for example, the loss of natural vegetation and farmland [49][50], air pollution [51], water pollution [1], water cycle changes [52], local climate change [53], biodiversity reduction [2], wetland destruction [25], impacts on public health [54], greenhouse gas emissions, and heat island effect, etc. [55][3]. How do we supply the land needed for urban development and minimize the adverse effects of land-use change? Harmonizing the contradiction between the supply and demand of land is the current problem to be considered. Therefore, it is of extraordinary significance to obtain the boundary of urban built-up areas and analyze the influencing factors of the urban land scale to protect limited cultivated land resources and promote the sustainable development of the urban ecological environment [56].

Population growth and economic development are the main factors affecting urban land growth [57][58]. The rapid expansion of urban land in China has been driven not only by economic development and market forces, but also

by government plans for urbanization [59]. Urbanization means that the proportion of urban population in the total population increases, which inevitably leads to the increase of land occupied by the urban population. China's rapid urbanization and urban development constantly consume a large number of land resources. The essence of urban land scale growth is to rely on local investment or foreign capital to convert non-agricultural land into construction land. Roads are the lifeblood that connects passenger and freight traffic to different cities. In China, if cities want to develop, transportation must go first. Terrain is the background of urban development, which restricts the growth of urban land.

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