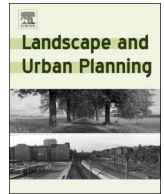




ELSEVIER

Contents lists available at ScienceDirect

Landscape and Urban Planning

journal homepage: www.elsevier.com/locate/landurbplan

Research Paper

The varying driving forces of urban expansion in China: Insights from a spatial-temporal analysis

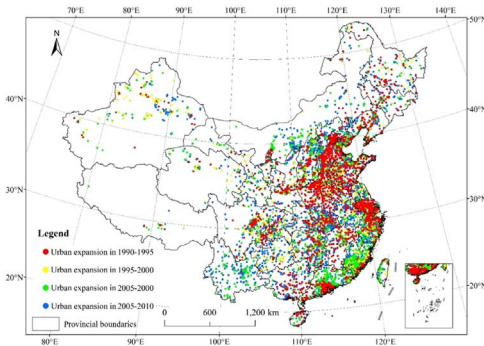
Guangdong Li, Siao Sun*, Chuanglin Fang*

Key Laboratory of Regional Sustainable Development Modeling, Institute of Geographic Sciences and Natural Resources Research (IGSNRR), Chinese Academy of Sciences (CAS), 11A Datun Road, Chaoyang District, Beijing 100101, China



GRAPHICAL ABSTRACT

Urban expansion points between 1990 and 2010 in China.



ARTICLE INFO

Keywords:

Urban expansion
Driving forces
National-level sampling
Spatial-temporal modelling
Spatial Probit model
China

ABSTRACT

Identifying the driving mechanisms and forces of urban expansion is an important step toward better understanding of the spatial pattern, process, and consequences of urban expansion, which is essential for making effective urban growth planning and policies. Despite many previous studies devoted to investigating urban expansion patterns and mechanisms, the spatial-temporal dynamics of driving forces and their regional differences have not been well-documented. This study examines drivers of urban expansion and their effects across different regions in China in different periods. A spatial Probit model is employed, with data selected based on a national-level sampling strategy, to model urban expansion probability from a spatially explicit perspective. Results indicate that multiple factors including socioeconomic, physical, proximity, accessibility, and neighborhood factors have driven urban expansion in China. Driving factors for urban expansion vary between national and regional levels, suggesting that analyses on different spatial scales are necessary. The dynamics and driving forces of urban expansion in China have been spatial heterogeneous. Furthermore, driving forces have trended toward more diversity over time, and the constraining effects of natural conditions on urban expansion have gradually decayed. These findings aid in gaining a better understanding of the urban expansion process in China, which will in turn benefit urban planning and management across different regions. Lastly, important policy implications are inferred.

* Corresponding authors.

E-mail addresses: suns@igsnr.ac.cn (S. Sun), fangcl@igsnr.ac.cn (C. Fang).<https://doi.org/10.1016/j.landurbplan.2018.03.004>

Received 1 November 2016; Received in revised form 18 February 2018; Accepted 2 March 2018

0169-2046/ © 2018 The Author(s). Published by Elsevier B.V. This is an open access article under the CC BY license (<http://creativecommons.org/licenses/by/4.0/>).

1. Introduction

Urbanization has been one of the most irreversible anthropic activities driving global environmental changes over the past few decades (Grimm et al., 2008; Wu, Jenerette, Buyantuyev, & Redman, 2011). The Earth's eco and socioeconomic systems have been profoundly changed by urbanization (Seto, Sánchez-Rodríguez, & Fragkias, 2010). Urbanization brings both socioeconomic development opportunities and environmental challenges. While urbanization boosts urban economic growth, industrial upgrading, population aggregation, and social development (Seto et al., 2010), it is also associated with a number of adverse environmental impacts (Grimm et al., 2008), including air pollution (Civerolo et al., 2007; Stone, 2008; Van Metre, Mahler, & Furlong, 2000), water pollution (Foley et al., 2005), anthropogenic greenhouse gas emissions (Liu & Deng, 2011), urban heat island effect (Miao et al., 2009; Weng, Lu, & Schubring, 2004), and biodiversity reduction (Pauchard, Aguayo, Peña, & Urrutia, 2006). However, it is widely acknowledged that the causes, processes, patterns, and consequences of urbanization remain largely unknown (Kaza, 2013). Identifying the driving forces of urban expansion is still a fundamental challenge, but is essential for understanding the attributions and trends in urbanization, and for supporting related decision-making (Qu, Zhao, & Sun, 2014).

Many literature studies have been devoted to exploring the driving forces and mechanisms of urbanization. As a product of human activity worldwide, urban expansion is strongly influenced by geophysical, socio-economic, and institutional conditions. Previous studies have shown that urban expansion is driven by socioeconomic factors (Liu, Zhan, & Deng, 2005; Xiao et al., 2006a; Dewan & Yamaguchi, 2009; Estoque & Murayama, 2013; Jiang, Deng, & Seto, 2012; Zhang, Su, Xiao, Jiang, & Wu, 2013). Under the classic econometric frame, many urban expansion studies have used standard economic factors to investigate the causes of urban expansion or urban sprawl. For example, Brueckner and Fansler (1983) have found that fundamental economic factors, including population, income, and agricultural land rent, are of primary importance in determining urban spatial sizes. They further stated that “urban sprawl is the result of an orderly market process rather than a symptom of an economic system out of control.” More recently, McGrath (2005) has confirmed this result, and has further stated that unexplained effects beyond conventional economic factors also contribute to urban expansion. The key determinants of urban expansion in China are population, income, and agricultural land rent, and urban core growth is affected by industrialization (Deng, Huang, Rozelle, & Uchida, 2008). Furthermore, physical factors such as slope and elevation (Li, Zhou, & Ouyang, 2013; Wu & Yeh, 1997), proximity factors (Luo & Wei, 2009), neighborhood factors (Cheng & Masser, 2003), and land use policy and urban planning (Wu & Yeh, 1997) have influenced urban expansion (see Table 1 for a detailed literature compilation) (Kaza, 2013; Su, Xiao, Jiang, & Zhang, 2012; Zhang et al., 2013). In addition, infrastructure, employment opportunity, foreign investment (Wu & Yeh, 1997), soil suitability (Batisani & Yarnal, 2009), and land category (Gustafson, Hammer, Radeloff, & Potts, 2005) are also arguably linked to urban expansion.

While driving forces of urban expansion identified in different studies seem to be different, it is natural to raise the question: do driving forces of urban expansion vary spatially and temporally? A few literature studies have showed that the contributions of different factors to urban expansion present temporal changes based on analyses of data in different time periods (Aguir, Câmara, & Escada, 2007; Aspinall, 2004; Huang, Zhang, & Wu, 2009; Li et al., 2013; Vermeiren, Van Rompaey, Loopmans, Serwajja, & Mukwaya, 2012; Wu & Yeh, 1997), whereas variation of driving forces of urban expansion at different spatial scales was rarely studied. This study will endeavor to answer this question by quantifying driving forces of urban expansion in China at different time periods and spatial scales. This study will provide evidence showing how driving forces of urban expansion change spatially and temporally.

China has been subject to dramatic urbanization since the economic reform in 1978. Many studies have examined the relationship between urban expansion and influencing factors, the results of which have advanced our knowledge on driving mechanisms of urban expansion in China. However, previous studies have shown several limitations. First, analysis of driving forces of urban expansion has mostly been conducted at the single city level, e.g., Beijing (Li et al., 2013), Guangzhou (Wu & Yeh, 1997), Nanjing (Luo & Wei, 2009), and Wuhan (Cheng & Masser, 2003). A few studies have examined the driving forces of urban expansion in a number of cities or counties (Deng, Huang, Rozelle, & Uchida, 2010; Liu et al., 2005). Investigation of driving forces of urban expansion via a sampling approach on the national scale, which is necessary for national policy-making (Brueckner & Fansler, 1983; Deng et al., 2008; Jiang, Deng, & Seto, 2013; McGrath, 2005), is still lacking. Second, most studies have focused on analyzing driving forces over one specified period. Not enough attention has been paid to long-term temporal changes in urban expansion and its driving forces (Li et al., 2013). Third, regional differences in urban expansion have been rarely discussed. Driving mechanisms and factors may vary regionally due to distinct geophysical conditions, natural environments, and socio-economic development levels. Fourth, spatial autocorrelation has not been explicitly addressed in most previous urban expansion studies (Fan & Myint, 2014; Zhang et al., 2013). Ignoring spatial effects in some cases, i.e., spatial autocorrelation in the dependent variable or spatial autocorrelation of model residuals due to omitted independent variables, in limited dependent variable models may lead to biased results (Anselin, Bera, Florax, & Yoon, 1996; Luo, Yu, & Xin, 2008; Yu & Wei, 2008). A few researchers have made progress in incorporating spatial effects in urban expansion studies by applying geographically weighted logistic regression and GIS-based logistic regression models (Luo & Wei, 2009; Luo et al., 2008; Monteiro, Fava, Hiltbrunner, Della Marianna, & Bocchi, 2011).

Many mathematical models have been developed to examine the relationship between urban expansion and related factors, mostly via a regression approach. Depending on whether the dependent variable is quantitative or qualitative, the regression can either be a general regression (Deng et al., 2008) or a discrete choice model (Dubovyk, Sliuzas, & Flacke, 2011; Hu & Lo, 2007a; Li et al., 2013). A general regression often addresses the relationship between the size of urbanized areas and other quantities, whereas a discrete choice model, most frequently a binary choice model, handles land use change data in pixels in an urban expansion study, i.e., change or no change expressed by binary data. Both approaches are able to identify significant explanatory variables. An advantage of the binary choice model is that its results directly predict locations that are likely to be urbanized (Dubovyk et al., 2011; Hu & Lo, 2007a).

The objective of this study is to identify the driving forces of urban expansion in China and their spatiotemporal patterns. Based on 1×1 km resolution land use data, a random sampling method is used to select pixels to detect explanatory factors for urban expansion. A spatial econometric model based on a binary choice regression, i.e., the spatial Probit model, is employed. The spatiotemporal dynamics of urban expansion in China, and the urban expansion driving forces on the national and regional scales are investigated. These results should provide useful insights into urban land use management and planning.

2. Materials and methods

2.1. Study area

China, the world's largest developing country, has shown unprecedented economic growth in recent decades and undergone rapid urbanization since the economic reform in 1978 (Chen, 2007; Fang, Li, & Wang, 2016). In 1978, urban dwellers only represented 17.9% of the whole population. By 2016, this proportion had increased to 57.4% (National Bureau of Statistics PRC, 2017). Concurrently, the urban

Download English Version:

<https://daneshyari.com/en/article/7459804>

Download Persian Version:

<https://daneshyari.com/article/7459804>

[Daneshyari.com](https://daneshyari.com)