



# Urban land expansion and the transitional mechanisms in Nanjing, China



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## ABSTRACT

Using integrated official land use statistics and remote sensing data, this study investigated the processes and mechanisms of urban land expansion in the Nanjing metropolitan area, which is a major city in the Yangtze River Delta (YRD). Using sector, concentric and gradient analyses, we determined that urban land has expanded dramatically during the past three decades with an average annual growth of 3.14%. In addition, a transition from a monocentric to polycentric city after 2001 was detected. The rise of development zones and new towns has been the primary cause of urban land expansion in Nanjing. Regarding the transitional mechanisms, the panel data regression results show that urban land expansion is highly related to increases in the non-agricultural population, foreign direct investment (FDI) and tertiary sector at the county-level. In the context of decentralization, the metropolitan government can exert tight control over land use using the tools of urban planning and the allocation of land-use quotas. Our study confirms that the transitional framework, which includes urbanization, globalization, marketization and decentralization, can enable better understanding of rapid urban growth in China.

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## 1. Introduction

The conversion of the earth's land surface to urban uses is one of the most irreversible human impacts on the global biosphere (Turner, Meyer, & Skole, 1994). It drives the loss of farmland, affects the local climate, fragments habitats and threatens biodiversity (Foley et al., 2005; Kalnay & Cai, 2003). Together with India and Africa, China has experienced the highest rates of urban land expansion in the past 30 years (Bai, Shi, & Liu, 2014; Seto, Fragkias, Güneralp, & Reilly, 2011). Joseph Eugene Stiglitz, the Nobel-winning economist and former vice president of the World Bank, named urbanization in China and high-tech development in the United States as the two primary factors that are shaping the world of the 21st century (Yang, Wang, & Wang, 2012). Since 2012, more than half of the total population in China lives in urbanized areas, which signifies the beginning of a new age of urbanization. Alongside the drastic increase in the urban population, the country

has lost vast amounts of valuable cropland to factories, warehouses, roads, parking lots and homes (Brown, 1995). At this tipping point in China's urban development, scholars in urban geography, land use planning and other resource management disciplines are being urged to come to terms with the issues mentioned above, in order to create a vision for China's urban future. Indeed, scholars have paid increasing attention to both urban land expansion and its consequences at various spatial scales, including the whole country (Lin & Ho, 2003; Li, Wei, Liao, & Huang, 2015; Tian et al., 2005), coastal provinces (Gao et al., 2014; Ho & Lin, 2004), forthcoming global regions (Chen, Yan, Gao, & Liu, 2015; Gao, Wei, Chen, & Yenneti, 2015; Wu, Li, & Yan, 2015a; Wu, Zhao, Zhu, 2015b) and cities (He, Okada, Zhang, Shi, & Zhang, 2006; Yu & Ng, 2007; Ma & Xu, 2010; Liao & Wei, 2014) and other important second tier cities (Cheng & Masser, 2003; Liu, Yue, & Fan, 2011; Schneider, Seto, & Webster, 2005; Tan et al., 2014; Yue, Liu, & Fan, 2010).

As a major city in the Yangtze River Delta (YRD), Nanjing is representative of rapidly growing second tier cities that are at the forefront of globalization, national reforms and economic development (Wei, 2015), although the institutional opportunities and development trajectories of Nanjing are greatly different from those of globalizing metropolises such as Beijing, Shanghai and Guangzhou. By closely discussing the patterns and mechanisms of

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urban land expansion during the transition period (1985–2013), we generalize and provide an empirical study different from the aforementioned cases, in order to condense the theory of urban land expansion, which is applicable to the universal characteristics of China’s urbanization.

In recent years, scholars have studied the expansion of urban land in Nanjing from different perspectives. For instance, Xu et al. (2007) conducted a series of spatial analyses using remotely sensed data from 1979 to 2003 to analyze the spatio-temporal dynamics of the urban landscape in the metropolitan region. Luo and Wei (2009) employed both global and local logistic regressions to model the probability of urban land expansion in the city proper against a set of spatial variables. Using an institutional framework, Qian (2013) examined China’s master plan mechanism and investigated the discrepancy between the master plans and the reality of urban land development in the city. Zhang, Pu, and Zhu (2013) also analyzed the patterns and characteristics of land use change along three major transportation arteries using land use data from 2000 to 2008 and found that construction land generally tends to be located close to major transportation arteries and that railways have the most obvious influence on land use change in the urban–rural fringe. Wei (2015) recently investigated the changing contents and effects of government policies, especially project-oriented, development-zone policies, and their effects on urban growth and land expansion in Nanjing.

With heightened globalization, land use change has become more complicated and is no longer a local physical process that is supposed to be mainly influenced by accessibility and the physical environment. Land use change is influenced by global processes and institutional changes as well (Wei & Ye, 2014). Foreign capital often finances “land grabs”. In addition, scholars have proposed the urban land teleconnections (ULT) framework to advance the conventional conceptualization of urbanization and land (Güneralp, Seto, & Ramachandran, 2013). They have also promoted the use of economic geography to reinvigorate land-use science (Munroe, McSweeney, Olson, & Mansfield, 2014). This paper is one among such recent efforts to integrate globalization, institutional change and economic transition to better understand the expansion of construction land in urban China.

Studies of the underlying driving forces of urban land expansion tend to be theoretically weak and have had difficulty analyzing the impacts of macro and institutional forces, particularly within such a transition context, although scholars have classified the key factors of land use change into natural and socio-economic driving forces (Gao, Wei, Chen, & Chen, 2014). This paper attempts to build a conceptual framework for the analysis of construction land expansion during the transition era within the context of the triple processes of China’s economic transition, namely globalization, marketization and decentralization, in addition to the new type of urbanization. After this introduction, the rest of the paper is organized as follows. First, the paper provides a brief review of the study area, followed by a discussion of the data and methodology. We then begin to examine the patterns of the expansion of construction land in the metropolitan areas. Thereafter we discuss the mechanisms of construction land expansion at the county level under the given analytic framework. Finally, we conclude with the major findings and policy implications.

## 2. Conceptual framework and literature review

From the perspective of resource economics, the fundamental driving factors for the consumption of natural resources, including urban land in particular, are increases in population and economics (Deng, Huang, Rozelle, & Uchida, 2010; Skonhoft & Solem, 2001). Economic and urban population growth in China are significantly

affected by the aforementioned triple transition processes, which in turn accelerate the expansion and spatial restructuring of urban land (Gao et al., 2014, 2015; Wei & Li, 2002). Globalization, in particular foreign investment (FDI) and trade, integrates the Chinese economy into the world economy and opens China to global competition, which has dramatically increased the demand for land (Huang, Wei, He, & Li, 2015). Because it is an important carrier of FDI, the development zone is also an important cause of urban expansion (Ding & Zhao, 2011). The particular political system of China also makes decentralization (e.g., vertical and horizontal governmental competition) an important factor that affects local urban expansion (Wu, Li, et al., 2015; Zhu & Sim, 2005). Within the marketization background, the development of the service industry can change the regional image and attract high-quality investments and high-end talent, but it can also bring about plentiful tax resources, given that a large number of land resources are not consumed. It is important that local governments adjust their industrial structures. The spatial transformation of metropolises in the last few decades has also been driven by the economic development of the service industry (Lin, 2004). Thus, for this research we have developed an integrated conceptual framework based on the features of transitioning population urbanization, economic globalization, development of service industries and decentralization (Fig. 1).

### 2.1. Urbanization and urban land expansion

Population has played a dominant role in urban expansion (Seto et al., 2011). There are three basic conditions for the survival and development of human beings, namely food and clothing, housing and employment. Along with economic development, human beings have begun to aspire to improve their quality of life after basic survival demands are satisfied. Better food, clothing and housing help improve our quality of life. This naturally means that increased land supply or more intensive land use is needed to satisfy our requirements for a higher quality life, so that new pressure is put on urban lands. Along with the acceleration of urbanization, our living space has become relatively crowded, and the living environment has deteriorated (Wei, 2015). Requirements intended to improve housing conditions and the surrounding environments have induced a gradual enlargement of completed areas, encroachment on plentiful croplands surrounding cities and increased conflict between “food” and “construction”. According to an aerial survey of 44 counties in the western US from 1950 to 1960, the addition of a single person required an additional 80–1740 square meters of urban land (Meadows, Goldsmith, & Meadow, 1972). Gao et al. (2015) also detected the increased impact of population growth on urban land expansion in the YRD.

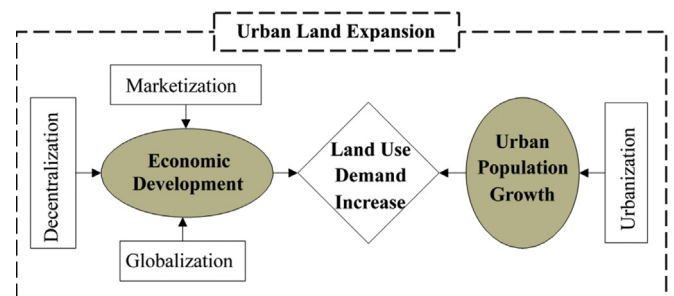


Fig. 1. The conceptual framework of urban land expansion in transitional China.

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