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Estimating urban green space production in the macroeconomy: From public goods to a profitable method of investment

Liang Zhao, Weizhen Chen*

College of Architecture and Urban Planning, University of Tongji, Shanghai, CHN 200092, China

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ABSTRACT

Accompanied by long-term urbanization, the Chinese production of urban green space (UGS) is gradually transforming into a land operation strategy for local governments to maximize land lease revenue. This paper presents empirical research on different types of investment, urban space, and gross domestic product (GDP) with a simultaneous equations model (SEM) of econometrics to test the capital circulation and accumulation of UGS production in China. The regression results strongly support our hypothesis that UGS production contributes to GDP growth and that there is an economic feedback loop between them. One billion RMB of the government's fixed-asset investments produces 0.899 km^2 UGS in the long term, and this UGS yields 1.749 billion RMB tertiary industry GDP in return. Thus, the total return rate in the representative economic chain of "fixed-asset investment-UGS-tertiary industry GDP" is greater than 174.9%. However, this percentage also reveals the weakness of providing rewards in maximizing land lease relative to urban industrial, traffic and residential spaces. We also estimate the lagged correlation coefficient with a rational distributed lag model, showing that the production of UGS has a longer-term and more profitable influence on tertiary industry GDP than on secondary industry GDP. The long-run effect of investment on UGS lasts for approximately five years in producing secondary industry GDP and more than ten years in producing tertiary industry GDP. A continuous increase in fixed-asset investments in UGS would achieve a balanced return rate (100%) and start to produce profits after the 4th year, according to the economic chain of ΔFAI-ΔUGS-ΔTGDP.

1. Introduction

The Chinese economic reform and "Open Door" policy were initiated in 1978. Subsequently, the urbanization level of China increased from 22% in 1983–59% in 2017, according to official statistics, and it is estimated that it will reach 75% by the middle of the 21st century. In China, the urbanization process is a form of "hybrid urbanization" that involves a combination of socialist and market economies (McGee, 2009). Accompanied by the long-term urbanization in China, the social production of urban green space (UGS), as well as other kinds of urban space, is gradually transforming into a land operation strategy for local governments to maximize land lease revenue in the circulation and accumulation of macroeconomic capital.

It is argued that Lefebvre's theory of the "production of urban space" (Lefebvre, 1991) offers a useful approach in explaining this phenomenon, and the political economy concept it adopts helps identify the major driving forces in the urbanization process (McGee, 2009). By using this concept, many researchers have offered new views of urban space production worldwide (Harvey, 1990a,b; Klink, 2013; McGee, 2009; Purcell, 1997; Raco and Gilliam, 2012). "UGS production", a concept and a framework elaborated in Chapter 2, is used to discuss the logics, mechanisms and practices of the social production process of UGS. The mechanism of UGS production mainly follows political and socio-economic logics which can be estimated by empirical research. Generally, three aspects of studies are crucial in explaining the socio-economic mechanism of UGS production: the driving force behind UGS, the benefits of UGS, and the mechanism between them.

Regarding the first aspect, five major driving forces of UGS's changes have been identified: socio-economic, political, technological, natural, and cultural (Brandt et al., 1999), and the social, economic, and political driving forces frequently interact with each other (Chen and Wang, 2013b; James et al., 2009). Socio-economic and political factors (e.g., developmental history, urban morphology and land area, population densities, GDP, income, education, social preference, management, and policies) affect the planning, construction, and maintenance of UGSs in direct or indirect ways (Chen and Wang, 2013a; Hill et al., 2010; Kendal et al., 2012; Li et al., 2005; Tan et al., 2013;

* Corresponding author.
E-mail addresses: 1410147@tongji.edu.cn (L. Zhao), 03022@tongji.edu.cn (W. Chen).

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Visscher et al., 2016; Young, 2011; Zhao et al., 2013; Zhou and Wang, 2011; Zhu and Zhang, 2008). Characterized by a luxury effect (Hope et al., 2003; Mennis, 2006), the distribution of vegetation has been determined by income based on social stratification (Jenerette et al., 2013; Landry and Chakraborty, 2009; Wolch et al., 2014; Zhu and Zhang, 2008), with the wealthy moving to landscapes with higher plant diversity (Hope et al., 2003) or altering their local environment by planting more trees (Mennis, 2006). As a result, income may be the most important variable contributing to the distribution of urban tree canopy coverage (Schwarz et al., 2015), which is in contrast with previous research suggesting that education level is a better predictor of urban tree cover than income (Heynen and Lindsey, 2003; Kendal et al., 2012; Luck et al., 2009; Troy et al., 2007). In China, the demographic transfer and gross domestic product (GDP) growth are key factors in explaining the changes of UGS coverage (Chen and Wang, 2013a). Additionally, recent research has documented that a combination of economic growth, climate change, and urban greening policies is the most likely cause of urban green coverage changes in Chinese cities (Yang et al., 2014) while land-based finance has been revealed to be the primary determinant of the UGS provision in China (Chen and Wang, 2013a; Chen and Hu, 2015; Zhao et al., 2013).

Regarding the second aspect, UGSs provide a wide array of economic, social, physical, psychological, and environmental benefits (e.g., Baycan-Levent and Nijkamp, 2009; Chen and Jim, 2008; Landry and Chakraborty, 2009; Nowak and Dwyer 2007; Payton et al., 2008; Peckham et al., 2013; Schetke et al., 2016; Shackleton et al., 2015; Swanwick et al., 2003). Much of the economic valuation literature regarding UGS pays close attention to how urban trees or green spaces contribute to property values (e.g., Donovan and Butry, 2010; Orford, 1999; Wu et al., 2015a,b), whereas some other studies focus on the converted monetary valuation of environmental services (Tyrväinen, 2001; Garmendia et al., 2016). Nine types of economic benefits (property values, construction savings, operation and maintenance savings, replacement avoidance, visitor spending, tax revenue, economic development, job creation, and increase enrollment) are valued for each landscape case in the “Landscape performance series” of America. During the past few years, a new type of potential economic benefit yielded by top-down land finance has led to the argument that governments should produce more favorable urban built environments to attract more investment, both in developed and developing countries (Baycan-Levent and Nijkamp, 2009; Ding, 2003; Peterson, 2008).

A few socio-economic mechanisms have already been revealed. It has long been extensively argued that few private entities proactively provide public UGS because of its public goods characteristics and the spatial spillover effect of its benefits (Choumert and Salanié, 2008; Choumert and Cormier, 2011; Salanié, 2000), although UGS provides environmental benefits as natural infrastructure (Beatley, 2000; James et al., 2009; Waldheim, 2006) and significantly increases house prices (e.g., Brasington and Diane, 2005; Orford, 1999; Xiao et al., 2016). However, the production of UGS is central to the economic development of a country. On one hand, the coverage of UGS has a close relationship with GDP. This relationship is characterized by an environmental Kuznets curve (EKC) (Chen and Wang, 2013a; Dinda, 2004; Kijima et al., 2010), which previous studies have suggested to be a U-shaped curve (Kijima et al., 2010) and an N-shaped curve in the case of China (Chen and Wang, 2013a). On the other hand, if local governments seek to maximize land lease revenue, public parks in many cities might be transformed into high-value-added land, such as commercial zones or residential buildings, as predicted by the “Pareto-optimal” theory (Chen and Hu, 2015; Cheng and Masser, 2003; Choumert and Cormier, 2011; Jim and Liu, 2000).

Theoretically, the production of urban space is essential and plays an important role in capitalism, which has been generalized by the classic three-stage capital circulation model (Harvey, 1990a,b). In this model, urban spaces are treated as capital and taken into a secondary circuit centered on man-made environments or even a tertiary circuit represented by technology research and public utility investment. Accordingly, UGS has been addressed as an undifferentiated commodity or economic good following the logic of markets (Chen and Hu, 2015; Chen and Wang, 2013a; Panduro and Veie, 2013; Zhu and Zhang, 2008), and it has been inevitably evaluated based on its monetary value since the eighteenth century (Ginn and Demeritt 2009; Harvey, 1996). In theories of neoclassical economics, the efficient management of UGS calls for criteria and indicators expressed in monetary terms for evaluating public policies and for reaching the economic Pareto optimality (Choumert and Salanié, 2008).

In addition, some researchers focus on system dynamic analyses of urban growth boundaries and urban ecological land change possibilities. The forests, bodies of water, wetland and grassland outside urban growth boundaries have a higher possibility of being transformed into urban construction lands if the lands are flat and near roads and city centers (Peng et al., 2017). They also have a higher possibility of being transformed into the same type of their ambient land already constructed, which is conceptualized as “spatial autocorrelation” (Anselin, 2003; Zank et al., 2016). However, these studies are more objective on the land transformation phenomenon and seldom focus on revealing the political and socio-economic mechanisms.

In explaining the socio-economic mechanism of UGS production, different types of research approaches have been applied, including willingness to pay (WTP) to test the fictitious investment costs of UGS (e.g., Majumdar et al., 2011; Mell et al., 2016; Yang et al., 2017), the hedonic price model (HPM) to test the UGS’s spillover monetary values (e.g., Brasington and Diane, 2005; Jiao and Liu, 2010; Jim and Chen, 2006; Luttik, 2000; Lutzenhiser and Netusil, 2001; Orford, 1999; Panduro and Veie, 2013; Saphores and Li, 2012; Xiao et al., 2016; Wu and Dong, 2014; Wu et al., 2015a,b), and other multiple linear regression models comprising price-relevant variables to test the relationship between UGS coverage and GDP, for example (Chen and Wang, 2013a; Chen and Hu, 2015).

To the best of our knowledge, only a few studies emphasize the socio-economic mechanism of UGS production in macroeconomics and the roles that UGS production has played in macroeconomic capital circulation and accumulation. Whether UGS production follows the concept of “space capitalization” and the three-stage model of capital circulation described by Harvey (1985) is still unknown. Although land-based finance has been revealed by some researchers to be the driving force behind UGS provision (Chen and Wang, 2013a; Chen and Hu, 2015), there is a lack of empirical evidence regarding how direct investment produces UGS and how much financial reward, such as increased GDP, is yielded by the production of UGS.

In this context, we test a hypothesis describing the capital circulation and accumulation of urban space production (see Fig. 1) that argues that urban spaces are mainly produced economically by the fixed-asset investments (FAI) from the government and real estate investments (REI) from private entities, and these newly added urban spaces could lead to GDP growth. Thereafter, new investments increase as a result of the increase in GDP. These three processes result in macroeconomic capital circulation and accumulation of urban space production. We estimate UGS production in the entire urban system. The specification of the econometric model, study area, data source and selected variables are reported in Chapter 3. The regression results are presented and discussed in Chapter 4, and the conclusions are provided in Chapter 5.

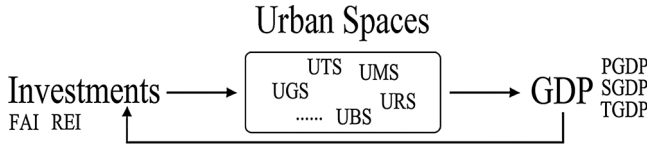

Fig. 1. Hypothesis on capitalist circulation and accumulation of urban space production.