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Spatial effects of accessibility to parks on housing prices in Shenzhen, China

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ABSTRACT

Accessibility to parks could be an important determinant of housing prices. This article applies the gravity model to calculate accessibility based on park classification in Shenzhen, China. Unlike most traditional studies that use the ratio method and nearest distance (including straight-line distance and network distance) to measure accessibility to given facilities, in this study, we use gravity-based accessibility by park type. Then, we explore the relationships between accessibility to parks and housing prices using a hedonic price model. In addition, we apply a geographical detector method to assess the association between housing price and related factors. The results indicate the following conclusions: (1) compared to traditional methods, the gravity model provides a more effective and objective measure of accessibility to parks because it considers distance decay effects, supply, and demand; (2) it is necessary and important to investigate the effects of the accessibility to different park types on housing prices; and (3) geographical detector models can efficiently detect correlations and interactions among housing prices and related factors.

1. Introduction

The implementation of housing commercialization and housing subsidy monetization policies has resulted in an active and energetic housing market in China (Wei, Lam, Chiang, & Leung, 2014). Buyers tend to pursue high-quality living environments as their living standards improve. A park is an important type of green space with ecological, entertainment, recreational, social, and cultural functionality. Vegetation in parks can absorb atmospheric carbon, maintain a particular degree of humidity in the atmosphere, and moderate temperature. Furthermore, green space can reduce noise by functioning as acoustic screens between roads and residential areas (Morancho, 2003). Therefore, important contributions can be made to control housing prices, analyse spatial equity and guide urban planning by scientifically examining the effects of parks on housing prices.

In recent years, numerous scholars in China and abroad have conducted empirical research regarding the effects of parks on real estate values in different cities. A pioneering study of the impact of parks on real estate was performed by Hammer, Coughlin, and Horn (1974), who found a statistically significant increase in land value with increasing proximity to parks. Many subsequent studies have focused on the valuation of various green spaces. Anderson and Cordell (1988) noted that landscaping with trees can increase sale prices. Furthermore, More, Stevens, and Allen (1988) used three methods to evaluate the value of urban parks and concluded that urban parks had an active influence on housing values. Tyrväinen (1997) indicated that large urban forests had a positive influence on apartment prices, whereas the effect of small forest parks was unclear. Tyrväinen and Miettinen (2000) and Thorsnes (2002) revealed that the price of a house increases with increasing proximity to nearby parks. Morancho (2003) revealed an inverse relationship between housing price and the distance from a green urban area. Jiao and Liu (2010) showed that city-level parks

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have significant amenity values, whereas district-level parks do not. Panduro and Veie (2013) classified green spaces into different types and investigated the valuation of different types on housing values. Wu, Wang, Li, Peng, and Huang (2015) noted that proximity to a park increases housing prices. Prior studies, however, have primarily relied only on distance as a measure of accessibility and treated all types of parks equal. Thus, these studies did not fully capture the attractions of different parks from the perspective of supply and demand. Simultaneously, related studies that used the hedonic price model (HPM), spatial regression model (SRM), geographical regression model (GWR) and eigenvector spatial filtering (ESF) revealed the effects and relative degrees of importance of influential factors. However, no study to date has focused on the relationships and interactions among factors from a real estate perspective. The geographic detector (GD) is a spatial statistical approach that can be used to explore the relationships and interactions among independent variables but has never been employed in a housing price study (Wang et al., 2010).

According to previous research, the proximity to parks also generates differential effects on nearby real estates. We examine the combined effects of accessibility to parks based on a classification using the gravity model and explore the relationships and interactions between variables using the GD. The remainder of this article is organized as follows. Section 2 provides an overview of the findings from previous studies. Section 3 describes the study area and data sources. Section 4 illustrates the methodology, including the gravity model and geographic detector method used to examine the effects of parks on housing prices. Section 5 presents the research results. Finally, conclusions are presented in Section 6. The data and analysis tools used in this study include ArcGIS 10.2, SPSS 19, and GeoDetector.

2. Literature review

Accessibility to parks can affect the surrounding environment because parks provide entertainment venues to which buyers are attracted. Therefore, the effects of parks on housing prices have been thoroughly studied by scholars. However, previous studies of the effects of parks on housing prices mainly focused on quantitative measures and regression models.

First, accessibility is an important topic in various fields, and it refers to the quantitative ease associated with overcoming an obstacle to reach a destination, such as the distance, travel time, or travel cost to a location or service facility (Comber, Brunsdon, & Green, 2008). Land use and location theory suggests that accessibility is an important determinant of residential land values and changes in those values. In previous studies, the most commonly used method to measure accessibility to parks was based on the shortest distance, including straight-line distance (Ardeshiri, Ardeshiri, Radfar, & Shormasty, 2016; Poudyal, Hodges, & Merrett, 2009), network distance (Lu, Charlton, Harris, & Fotheringham, 2014), and cost-weighted distance (Kong, Yin, & Nakagoshi, 2007). Most studies focused on the distance to urban parks or the proportion of open space within a real estate buffer to measure their effects on housing prices. However, measuring accessibility not only involves determining the shortest OD (origin to destination) distance but also the attractiveness of the destination and the demand of an origin. Therefore, scholars have not been limited to simple measures of accessibility but rather tend to use more suitable calculation methods, such as the cumulative opportunities measure (Cordera, Coppola, dell'Olio, & Ibeas, 2016; Handy & Niemeier, 1997), locational profile approach (Sohn, Choi, Lewis, & Knaap, 2012), kernel density method (Guagliardo, 2004) and gravity model (Hansen, 1959). Gravity models, or potential models, are widely used to study socioeconomic spatial interactions and are based on Newton's law of universal gravitation. Hansen (1959) was the first to use a gravity model to measure accessibility. Guagliardo (2004) argued that gravity models provide the most reliable measure of spatial access, whether potential or actual. Geurs and Van Wee (2004) identified four types of accessibility: land use, transportation, temporal and individual. They concluded that the gravity model can be easily computed using existing land-use and transport data and/or models that are traditionally employed as input for estimating infrastructure-based measurements. Gravity-based accessibility has important advantages in capturing supply and demand features while considering distance decay effects, which have previously been studied most often in the medical field (Schuurman, Bérubé, & Crooks, 2010) and have rarely been used to measure accessibility to forests or urban and community parks in real estate studies.

Second, planners and park managers often use HPM to examine whether and how (positively or negatively) park proximity is incorporated into housing values while holding other housing factors and neighbourhood attributes constant (Payton & Ottensmann, 2015). HPM is a popular and effective quantitative method used to precisely estimate the marginal prices (as defined by Cropper, Deck, & McConnell, 1988) of various factors. The HPM was first used in the field of real estate and urban economics by Rosen (1974). Thereafter, an increasing number of researchers began to use HPM to measure and evaluate the impact of various factors on housing prices in China (Jim & Chen, 2007, 2009a, 2009b; Wen & Jia, 2004; Wen, Jia, & Guo, 2005; Wu, Deng, & Liu, 2014) and in other countries (Ali, Bashir, & Ali, 2015; Benson, Hansen, Schwartz, & Smersh, 1998; Gibbons, Mourato, & Resende, 2014; Kassie, Abdulai, & Wollny, 2011; Selim, 2011; Seo, Golub, & Kuby, 2014; Wheeler, Páez, Spinney, & Waller, 2014). Previous studies using HPM to examine housing prices typically classify the influential variables into different categories—such as structural variables, neighbourhood characteristics, and market and environmental variables—and use them as independent variables (Ali et al., 2015; Poudyal et al., 2009; Wen & Jia, 2004; Wu et al., 2015). In this model, the market values of various factors are inferred by estimating the sales price of a property as a function of various attributes (such as accessibility to green space and the central business district (CBD)) in association with other characteristics (Jim & Chen, 2006). Overall, different studies have roughly similar categories for their particular area of emphasis, providing a reference for our work to classify the variables according to our focus. Although HPM is widely used in housing price studies, it can only be applied to explore the quantitative relationships between factors and housing prices. Clarifying the relative degrees of importance of various factors and the interactions between these factors and housing prices is also very important. The GD is a spatial statistical method that can be used to analyse the effects of geographical spatial factors on human health (Wang et al., 2010), land use (Liang & Yang, 2016), and socioeconomics (Yansui & Ren, 2012). The GD has been widely used in many fields because it is based on simple assumptions and can identify the relative importance of various factors and the interactions among these factors.

Based on the above discussion, few studies have focused on the access to different types of parks by applying an HPM and GD simultaneously from the perspective of supply and demand. Therefore, this study assesses the relationships between residential property sale prices and parks by type using a gravity-based model. In addition to common traditional regression models, we use the GD to extract the interrelationships among accessibility to parks by type and the relative importance of factors to housing prices. By exploring the premiums associated with different types of parks based on spatial equity and identifying the interactions between