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Walking accessibility and property prices

Linchuan Yang^a, Bo Wang^{b,*}, Jiangping Zhou^c, Xu Wang^d^a Department of Real Estate and Construction, Faculty of Architecture, The University of Hong Kong, Hong Kong^b Department of Geography, Faculty of Social Science, The University of Hong Kong, Hong Kong^c Department of Urban Planning and Design, Faculty of Architecture, The University of Hong Kong, Hong Kong^d Department of Housing and Urban-Rural Development of Sichuan Province, China

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ABSTRACT

Walking is an imperative travel mode, especially for short trips. Walking accessibility, which is defined as the ease of reaching essential destinations in the walk-in catchment area, may affect property prices because residents are more likely to be willing to pay for this attribute. In addition, different categories of public services may have varied influencing directions and magnitude. These two hypotheses are tested in this study. Taking Xiamen, China as a case study, we estimate the cumulative opportunities of public services on foot and develop a set of hedonic pricing models (more specifically, two pre-specified ordinary least squares models, four Box-Cox transformed models, and two spatial econometric models) to estimate, whether and to what extent, walking accessibility contributes to price premiums (or discounts). Using a database of 22,586 second-hand residential properties in 358 multi- or high-storey residential complexes, we find that (1) walking accessibility to public services contributes to the variations in housing prices and plays a role in determining housing prices; (2) different categories of services have vastly divergent, even opposite, influencing impacts; and (3) walking accessibility to primary schools, commercial centers, and sports and cultural centers have positive effects on house prices whereas walking accessibility to comprehensive hospitals adversely affects housing prices. Methodologically, we confirm that spatial econometric methods improve estimation accuracy and have more explanatory power relative to the standard non-spatial models. Robustness check analysis further guarantees the plausibility of this study.

1. Introduction

Walking is a low-carbon and sustainable non-motorized travel mode, which is beneficial to both individuals and the community (Plaut, 2005; Agrawal and Schimek, 2007). Developers and residents alike highly desire some degree of walking accessibility for their properties, which can be defined as the ease of reaching essential destinations in the walk-in catchment area of a property.

Enhancing walking accessibility to amenities is generally desirable, and residents may be willing to pay for this property attribute (Litman, 2003; Yang, 2018). A widely-used, well-accepted and publicly-available walking accessibility measure is Walk Score, which was developed in July 2007. Its algorithm combines approximately 10 variables of accessibility to amenities within the walk-in catchment area into a scale ranging from 0 (car dependent) to 100 (walker's paradise) (Carr et al., 2010). Several studies have focused on ascertaining the association of Walk Score with property prices, and nearly all of these works suggest that properties with higher Walk Scores command significant price premiums (Cortright, 2009; Pivo and Fisher, 2011; Rauterkus and Miller, 2011; Li et al., 2015).

* Corresponding author at: Room 927, 9/F Jockey Club Tower, Department of Geography, The University of Hong Kong, Pokfulam, Hong Kong, China.

E-mail addresses: yanglc0125@gmail.com (L. Yang), wangbo.nju@gmail.com (B. Wang), zhoujp@hku.hk (J. Zhou), wangxu_hk@connect.hku.hk (X. Wang).

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Walking accessibility to various amenity categories, however, may affect housing prices differently, in both influencing directions and magnitudes. Despite being easy to interpret, as a composite (or integrated) indicator, Walk Score has an inherent shortcoming, namely, the failure to fully capture users' preference for a broad spectrum of amenities. As Gilderbloom et al. (2015, p. 22) present, "neighborhood walkability is heavily tied to the number and variation of amenities or destinations available within a short walking distance". That is, properties with the same Walk Scores can have vastly different amenities within the walk-in catchment areas. For example, adding one school or entertainment facility to the walk-in catchment area of a location contributes the same magnitude of increase in the score because the two amenities carry the same weight in the calculation. However, the said amenities may have remarkably divergent impacts on property prices. Indeed, some amenities (e.g., school and park) generate positive externalities for nearby properties and increase their prices. Residents may have high willingness to pay for proximity to these amenities. Nevertheless, some destination categories considered for the Walk Score calculation may not be deemed as amenities (Li et al., 2015), and may have negligible or very marginal effects on property prices, possibly arising from their relatively insignificant roles in residents' lives.

In existing hedonic scholarly literature, the cumulative opportunity (or isochronic) accessibility measure is used rarely to measure walking accessibility compared to the three other accessibility measures (i.e., travel impedance, dummy variables, and gravity-based metrics). This approach counts the number of potential opportunities that can be reached within the constraints of the predetermined travel time or distance (Vickerman, 1974) with an obvious inherent drawback of searching distance/time threshold setting. Yet, this approach remains an appropriate and suitable measure for representing walking accessibility to opportunities that can reflect the ease to reach opportunities in the walk-in catchment area of a property because the value of walking distance/time threshold is undoubtedly acknowledged (e.g., half a mile).

Public services always act as amenities, exerting positive effects on nearby property prices. Nevertheless, some categories of public services (e.g., hospital, airport, and cell phone station) may have a negative influence on nearby property values, given nuisances such as pollution, noise, vibration, and radiation. Proximity to such services would result in a price penalty. Indeed, empirical evidence concerning the capitalization effects of walking accessibility to public services based on the cumulative opportunity measure is lacking. Moreover, few studies have incorporated spatial econometric techniques. In light of the above, we look at urban China where few empirical studies have been conducted on quantifying price premiums/discounts attributable to walking accessibility to date and where many cities are rapidly growing and expanding at an unprecedented rate. In the context, severe concerns over walkability are extant as private automobiles encroach sidewalks and open spaces rapidly and excessively with exploding automobile ownership (Cao, 2017; Wang and Zhou, 2017). Furthermore, a number of Chinese-specific attitudes (e.g., preferences for proximity to essential service, and short commuting) (Cao, 2014) make walkability more significant.

The dual focuses of this study include *evaluating walking accessibility* and *pricing (or estimating the value of) walking accessibility*. We first generate the walk-in catchment areas of properties in ArcGIS and use the cumulative opportunity approach to measuring the walking accessibility to four categories of public services. Our cumulative-opportunity-based measure seems to better reflect the diversity and number of available amenities. We then calibrate a set of functional forms, more specifically, two pre-specified hedonic pricing models, four Box-Cox transformed models, a spatial lag model (SLM) and a spatial error model (SEM) (both of which incorporate spatial effects) to evaluate the capitalization values of walking accessibility to public services comparatively and to ascertain which model provides the most reliable estimated values. Finally, a two-stage regression analysis further guarantees the robustness of our key findings.

The main contributions of this paper include: (1) applying the cumulative opportunity approach to measuring walking accessibility to desired destinations, which was inspired by Carr et al. (2011) who scrutinized the relationship between Walk Score and cumulative opportunity-based accessibility to amenities; (2) quantifying the walking accessibility impacts on housing values in a context where few studies have focused on the same topic and gaining a more thorough understanding of capitalization effects; (3) comparing how different models perform when used to quantify those impacts and providing insights regarding the usefulness of spatial econometric models in evaluating the impacts of walking accessibility on housing prices; and (4) offering evidence for the implementation of value capture schemes for financing public service investments.

The remainder of this paper proceeds as follows. Section 2 briefly reviews the relevant literature. Section 3 introduces the hedonic pricing model, Box-Cox transformation, and spatial econometric models, and describes the necessity of employing spatial econometric methods. Section 4 presents the study area and data and describes the independent variables for hedonic pricing modeling. Section 5 discusses the modeling results whereas Section 6 draws conclusions and indicates avenues for future research.

2. Related studies

We first review diverse accessibility definitions and metrics briefly, as well as accessibility applications in property valuation studies. Then, we synthesize the pertinent studies in relation to the connection between property prices and Walk Score.

2.1. Accessibility metrics and applications in property valuation studies

Accessibility is an extensively studied concept in many fields including transportation, urban planning, and geography, but it lacks a unified and unambiguous definition, which hinges on the problem and context (Kwan, 1998). Selected definitions are summarized in Table 1. Notably, accessibility is thought to be influenced "by the qualities of the transport system (reflecting the travel time or the costs of reaching a destination) on the one hand and by the qualities of the land-use system (reflecting the qualities of potential destinations), on the other hand" (Straatemeier, 2008, p. 128).

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