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Rail transit investment and property values: An old tale retold

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ABSTRACT

Although a number of researchers have used the hedonic pricing model to value transit improvements by comparing prices of real estate properties within a certain distance from a transit station with those beyond that distance, the accuracy of these assessments is subject to questioning due to methodological limitations. By analyzing single-family and multi-family property sale transactions in Los Angeles (CA) during 2003 and 2004, this spatial hedonic study examines how the property value effects of rail transit can become volatile depending on housing markets, rail transit technologies, near-station land uses and transit development phases. By contrasting results from the spatial Durbin models and the Geographically Weighted Regression models with those from the conventional Ordinary Least Squares approach, the study shows the estimation accuracy can be improved considerably by controlling for the spatial dependence effect. Proximity to mature rail transit stations generally benefits multi-family property values, but the effect is negative for single-family properties. Residents (especially those from single-family households) seem to favor proximity to heavy rail transit more than light rail services. The premiums for rail transit accessibility also largely depend on different development phases and can be heavily discounted by the existence of Park-and-Ride facilities. This study provides policy makers with new empirical evidence and analytical tools to revisit value capture as a financing alternative and to reform investment strategies for rail transit services.

1. Introduction

Transit systems bring societal benefits such as congestion relief, social equity improvement, emissions reduction and economic development (Boarnet et al., 2013; Mohammad et al., 2013). Thus, improving and expanding rail transit systems has been on the agenda in many cities (Peter et al., 2013). In order to justify their investment, policy makers often argue that rail transit systems can potentially benefit property values, and as a result, may choose value capture as one of the financing means. However, the literature is still unsettled regarding the effect of rail transit systems on property values. Numerous previous studies have found that transit accessibility benefited property values (Al-Mosaind et al., 1993; John, 1996; Landis et al., 1995), but others have reported negative effects (Chen et al., 1998; Weinstein and Clower, 1999). The mixed findings might be partly due to different socio-demographic and land use contexts, as well as model estimation biases (Debrezion et al., 2007; Kuminoff et al., 2010; Mohammad et al., 2013). Because previous hedonic studies on transit accessibility mainly relied on Ordinary Least Squares (OLS) regression, the estimates were likely biased due to the lack of control for the spatial dependence effect, which reveals a complex and intertwined relationship among housing transactions. For example, Kuethe (2012) found that land use diversity had a positive impact on housing prices using an OLS model, while such an impact became statistically non-significant after controlling the spatial dependence effect.

This study, by controlling for such an effect, examines how rail transit accessibility impacts both multi-family and single-family property values in Los Angeles during 2003–2004. Our study sheds light on this long lasting but unsettled policy debate by making the following contributions. First, based on our unique study site and period, we reveal that premiums for rail transit accessibility can be volatile depending development stages, housing markets, and near-station land uses (particularly the availability of Park-and-Ride facilities). While some previous studies discussed the volatility in a piecemeal fashion and in different cities, we examine it comprehensively in the same city. Second, we introduce a novel spatial modeling system and compare it with the conventional OLS approach; we improve estimation accuracy by controlling for the spatial dependence effect. The remainder of this paper is organized as follows. In the next section, we present a literature review relevant to the hedonic analysis of rail transit. Then we introduce study design, model specifications, and results. Finally, we provide concluding remarks and discuss policy implications.

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2. Literature review

In Table 1, we summarize the analytical methods and results of recent hedonic studies on the property value impact of rail transit access. Consistent with meta-analyses by Debrezion et al. (2007) and Mohammad et al. (2013), we found that rail transit systems influence property values in both positive and negative directions and at various magnitudes. These findings may be attributed to different methods, various contexts, different rail systems and property types.

Most previous studies found positive property value impacts of rail transit systems and many of them relied on the OLS method (Billings, 2011; Bowes and Ihlanfeldt, 2001; Cervero and Duncan, 2002b; Duncan, 2008; Hess and Almeida, 2007; Pan, 2013; Pan et al., 2014; Yan et al., 2012). A handful of studies conducted in Asian cities, such as Bangkok, Thailand (Chalermpong, 2007), Seoul, Korea (Cervero and Kang, 2011), Beijing, China(Zhang et al., 2014) and Shanghai, China (Pan et al., 2014), found positive impacts on property values. Researchers have also reported positive impacts in European cities/countries, such as Netherlands (Debrezion et al., 2006), Helsinki, Finland (Laakso, 1992), and London, UK (Gibbons and Machin, 2003). Compared to American cities, the impacts were generally higher in European and Asian cities, where access to private transportation is more limited and transit-oriented cultures are stronger (Debrezion et al., 2007; Mohammad et al., 2013; Mulley, 2014).

However, rail system effects on property values may vary, depending on types of technology, development stages, housing markets and land-use characteristics around the station areas. For example, rail transit systems can be either light rail transit (LRT) or heavy rail transit (HRT); these two types of systems differ in terms of construction cost and carrying capacity, but their land use implication has not been well discussed (Zhang et al., 2014). Even though Cervero and Landis (1997) found no large scale land value changes associated with the transit system in San Francisco after 20 years of operation, most previous studies confirmed that transit might have some positive property value impact. Agostini and Palmucci (2008) identified anticipated capitalization of the transit system in Santiago, Chile; Yan et al. (2012) found that the property value impact of rail transit systems was negative before the opening of the system, but shifted to positive in the operational phase. In contrast, Ko and Cao (2013) indicated that houses in the vicinity of transit stations may already have higher prices before the introduction of a transit system and argued that the premium for the proximity to rail stations may be attributed to other location factors. Mathur and Ferrell (2013) found no anticipated capitalization before the rail system's opening, and they further found that positive property value impacts existed only during Transit Oriented Development (TOD) construction and after the construction.

Single-family housing prices, especially in middle-income neighborhoods, often react negatively or neutrally to rail transit accessibility (Cervero and Duncan, 2002a). However, access to rail systems can be capitalized at a higher extent for multi-family properties than for single-family properties (Cervero and Duncan, 2002a; Duncan, 2008). Multi-family residences generally better align with TOD criteria than do single-family houses.

Moreover, the effects may depend on context-specific land use characteristics. Capitalization effects are usually associated with walkable residential neighborhoods (Duncan, 2010a), healthy economies (Cervero, 2006), proactive and encouraging land use planning (Cao and Porter-Nelson, 2016; Mejia-Dorantes and Lucas, 2014), and land use intensification and development along the transit systems (Cervero and Kang, 2011), particularly for residential uses. Du and Mulley (2007) found large variations (ranging from −42% to 50%) depending on location in England. Carlton et al. (2012) and Bowes and Ihlanfeldt (2001) also found large variations in their San Diego and Atlanta case studies, respectively. Concerning developing countries, researchers have found higher magnitudes and greater catchment areas of public transit systems (Jun, 2012; Xu and Zhang, 2016).

However, there is no widely accepted agreement about how the above factors influenced residents' preferences toward the rail systems. Moreover, most previous studies employed the Ordinary Least Squares regression technique and their estimates may be potentially biased and inconsistent due to the lack of control for the spatial dependence effect (Ibeas et al., 2012). According to Anselin (1988), such an effect describes the relationship between the price of a house and the price and various characteristics of nearby properties. Previous researchers, such as Li and Saphores (2012b) and Redfearn (2009), have shed light on this issue in their empirical analyses. In a complex urban housing market, such a spatial relationship violates a basic assumption of linear regression–that observations are independent from one another (LeSage and Pace, 2009). Numerous spatial regression techniques (LeSage and Pace, 2009) have been developed to address this issue (LeSage, 1999).

3. Methodology

3.1. Research questions

This study contributes to literature and the policy debate about whether proximity to rail transit benefits property values, by exploring the following questions. First, is there a need to control for the spatial dependence effect to obtain unbiased estimates? Second, does the property value impact of rail transit differ by housing market type, development stage, rail technology and near-station land use characteristics? To answer the first question, we estimate spatial regression models and compare the results with those from OLS models. To answer the second question, we estimate the models for multi-family and single-family markets separately and add several relevant interaction terms into the models.

3.2. Study area and period

We analyze single-family and multi-family property sale transactions in Los Angeles during 2003–2004 (see Fig. 1). Los Angeles is regarded by many researchers as an example of urban sprawl and auto-dependent development (Ewing, 1997; Wachs, 1996). During the 1980s, the Los Angeles County Metropolitan Transportation Authority began to build consensus among multiple stakeholders about adding a rail transit system (named LA County Metro Rail, or LACMR in this paper) and raised funds from various sources (Wachs, 1996). The first rail transit line opened in 1990; since then, vast investments have expanded and enhanced the system.

In 2003–2004, the LACMR consisted of 5 lines (Red, Purple, Blue, Green, and Gold) with 70 stations; such a study period affords a valuable opportunity to investigate different development phases in one city's transit system during the same time period. The Red Line, opened in different stages between 1993 and 2000, stretched from downtown Los Angeles to Hollywood; the Purple Line (Union Station to Wilshire/Western Station) opened in 1996. Together, the Red and Purple Lines were two heavy rail lines (mainly underground), and were also the busiest LACMR lines. The Blue Line (opened in 1990, from downtown Los Angeles to downtown Long Beach), Gold Line (opened in 2003, from downtown Los Angeles to Pasadena) and Green Line (opened in 1995, from Redondo Beach to Norwalk) were three light rail lines. By