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Effects of accessibility and environmental health risk on housing prices: a case of Salt Lake County, Utah

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ABSTRACT

While transportation infrastructure can increase housing price by improving accessibility to opportunities, it generates environmental health risks, such as noise and air pollution, which may have negative effects on housing price. However, the combined effects of accessibility and environmental health risk on housing price have not been well examined in the literature, especially in the auto-oriented urban context of the United States. In this study, we use assessed housing value data and the hedonic model to examine the single-family housing market's reaction to accessibility and environment health risks in Salt Lake County, a growing metropolitan area in Utah experiencing significant air pollution. Three regression models are employed with the consideration of spatial effects: ordinary least squares (OLS), spatial lag regression (SLR), and hierarchical linear modeling (HLM, or multilevel modeling/MLM). By controlling for the influences of structural attributes and socioeconomic conditions, we find that the negative impacts (traffic noise and air pollution) of transportation systems on single-family housing prices are greater than the positive impact (accessibility). Single-family residents in Salt Lake County are willing to pay more to reduce environmental health risks than to get better accessibility. These findings are different from what have been found in some dense and compact urban areas in the literature. These findings suggest that people's willingness to pay for minimizing environmental health risks varies across different urban contexts.

1. Introduction

Housing values are a significant indicator of a region's economy, infrastructure, and environment. Understanding the patterns and dynamics of housing value changes and their relationship with infrastructure and the environment provides insights into future development and sustainability. Transportation infrastructure, shaping both urban form and urban system, has substantial impacts on housing prices and quality of life (Seo, Golub, & Kuby, 2014).

Air quality has long been linked to house prices (Nourse, 1967; Ridker & Henning, 1967). Studies have estimated the marginal willingness to pay for good air quality in various local contexts (Smith & Huang, 1993; 1995), and noise has been a factor in measuring the economic costs of housing (Nelson, 1982). However, only a few studies have tested the effects of both accessibility (the access of a location to resources and opportunities) and environmental health risks (air pollution and traffic noise) on housing prices. Results of these studies are inconsistent in different urban contexts such as Edinburgh, Madrid, and Hong Kong (Chasco and Gallo, 2013, 2015; Hui, Chau, Pun, & Law, 2007; Wardman & Bristow, 2004). No detailed study has been done in the urban context of the United States, where urbanization and suburbanization are mainly auto-oriented. This literature gap leaves us with questions about how the housing market in the United States reacts to accessibility and environmental health risks.

This study examines the effects of accessibility, air pollution and traffic noise on single-family housing values in a metropolitan area in the United States. We hypothesize that people are willing to pay more for houses with good accessibility to opportunities and low environmental health risks such as traffic noise and air pollution. To test this hypothesis, we chose Salt Lake County, Utah, a growing metropolitan area, as our study area.

The State of Utah is growing and highly urbanized. Its total population increased by 12.4% in the last 15 years (U.S. Census, 2016) and is forecasted to nearly double in the next 35 years (GOMB, 2016), while many metropolitan areas in the United States are shrinking (Pallagst, 2015). Salt Lake County, as the largest metropolitan county in the state, had 1.03 million residents in 2012 and 2090 km^2 total area, which is a typical middle-sized metropolitan area in the United States. A basin-like topography makes air quality a serious issue in the county, which is ranked seventh in the nation for short-term spikes in particle

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pollution (ALA, 2015); 48% of the cause of these particles is vehicles emissions (Utah Department of Health, 2015).

This study will advance our knowledge of housing prices in three aspects. First, we quantify both accessibility and environmental health risk to examine how they affect housing prices. Second, we control for the spatial effects (spatial autocorrelation and heterogeneity) on housing price by using spatial regressions. Last, we conduct a case study in Salt Lake County, which is a good example of the auto-oriented urban context, and is experiencing fast population growth and significant air pollution.

2. Literature review

Housing price has been well studied in the literature by using hedonic models, where the housing price is the value of a house for its utility-bearing attributes or characteristics in the market. Housing price has been studied by researchers in many different fields such as economics, geography, urban planning, and transportation, etc., by including various attributes in hedonic models, such as household income, metropolitan size, transportation cost, local climate, open space, schools, and other urban amenities (Chen, 2017; Li, Wei, Yu, & Tian, 2016; Nilsson, 2014; Seo et al., 2014; Shimizu, 2014; Yu, Wei, & Wu, 2007). Among all housing price determinants, structural characteristics are always the primary factors, including land area, floor area, age of the house, number of bathrooms and bedrooms, and other physical characteristics (Can, 1990, 1992; Adair et al., 1996).

Location is a primary factor and determines the access of a household to jobs, resources, and other social and urban amenities. Being close to transportation infrastructures such as highway exits and transit stations can bring good accessibility to resources for a household. However, too close to transportation infrastructures can also bring disamenities such as noise and air pollution generated by transportation vehicles. It is challenging to quantify both the positive and negative effects of proximity to transportation infrastructures at the same time. Theoretically, the net effect of proximity to transportation infrastructures may follow an inverted-U pattern, which is a positive longer-range distance-decay accessibility effect minus a smaller and shorter-range distance-decay disamenity effect (Seo et al., 2014). Although this inverted-U pattern has not been directly observed in the literature (Seo, Golub, & Kuby, 2017), the positive effect of accessibility and negative effect of traffic noise and air pollution on housing price have been separately reported in many studies.

Accessibility or transportation access indicates the access of a location to resources and opportunities. Accessibility has been operationalized in four commonly used approaches (Cervero, Rood, & Appleyard, 1999; Handy & Niemeier, 1997; Koenig, 1980; Levine, Grengs, Shen, & Shen, 2012; Nuzzolo & Coppola, 2007; Pooler, 1987; Wachs & Kumagai, 1973). The first and simplest approach is the proximity to transportation facilities, where accessibility is measured as the distance to the nearest highway exit, bus stop, or rail station or the number of highway exits, bus stops, or rail stations within a certain distance. The second approach is a cumulative opportunities measure, where accessibility is the count of opportunities that fall within a threshold distance or travel time. Third, is a gravity-based measure, in which opportunities are weighted by an impedance, which is generally a decreasing function of travel cost or time for reaching these opportunities. This final approach is based on random utility theory, in which the probability of an individual making a particular choice depends on the utility of that choice relative to the utility of all choices. Accessibility is the utility of all choices. In addition, different situations demand different approaches, depending on data availability, cost of calculation, and difficulty of interpretation (Handy & Niemeier, 1997). By using any of these accessibility measures, a positive relationship between accessibility and housing price has been consistently reported (Armstrong & Rodriguez, 2006; Dorantes, Paez, & Vassallo, 2011; Efthymiou & Antoniou, 2013; Giuliano, Gordon, Pan, & Park, 2010; Habib & Miller, 2008; Palm, Gregor, Wang, & McMullen, 2014).

However, vehicles always generate traffic noise. A significant negative effect of traffic noise on housing price has been found in many places, such as Stockholm in Sweden (Wilhelmsson, 2000), a Western area of Netherlands (Theebe, 2004), Glasgow in the UK (Day, 2003), Seoul in South Korea (Kim, Park, & Kweon, 2007), and St. Paul in the U.S. (Swoboda, Nega, & Timm, 2015). In these cases, the negative effect of a 1% increase in traffic noise on housing prices ranged from 0.3% to 1.3%. Additionally, there are studies specifically looking at effects of airport noise on housing price. By conducting a meta-analysis on 20 studies, Nelson (2004) finds that a 1-dB increase in airport noise reduces property values by 0.5%–0.6%. A more recent study (Cohen & Coughlin, 2008) looks at housing near the Atlanta airport and finds that housing prices in areas with a sound level of 70–75 dB are 20.8% less than those in areas with a sound level below 65 dB. However, this is not always the case. Jim and Chen (2006) find that exposure to traffic noise does not significantly influence housing price in Guangzhou, China.

Studies have also found a negative effect of air pollution on housing price in the United States, and the elasticity of housing values with respect to different pollutants ranges from -0.07 to -0.63 (Bajari, Fruehwirth, Kim, & Timmins, 2012; Bayer, Keohane, & Timmins, 2009; Chay & Greenstone, 2005). Focusing on toxic air emissions generated by industrial plants, Currie, Davis, Greenstone, and Walker (2015) find that the prices of houses within a half mile of industrial plants decline by 11%. Similar relationships are also found in cities in developing countries. Zheng, Cao, Kahn, and Sun (2014) find that a 10% increase in pollution is associated with a 0.76% decrease in housing price in Chinese cities. Yusuf and Resosudarmo (2009) find that property values are significantly higher in less polluted areas in Jakarta. However, Chasco and Gallo (2013) find a more complicated relationship between air quality and housing price in downtown Madrid. A negative effect of air pollution on housing price is found from subjective measures of pollutants, while a positive effect of air pollution on housing price is found from objective measures of pollutants.

Another important environmental factor that may affect the net effect of traffic noise and air pollution on housing price is green space. Green space provides ecological benefits to homes and neighborhoods by attenuating noise and removing pollution and therefore increases housing price (Nilsson, 2014). Luttik (2000) finds that in Netherlands open green space can increase residential property values by 6–12%, and in Finland as the distance from urban forests decreases by 1 km, the residential housing price rises by 5.9% (Tyrväinen and Miettinen, 2000).

As we can see from the literature, transportation could have a positive effect on housing price by improving the accessibility of houses to opportunities and amenities, but it could have a negative effect by generating health risks through traffic noise and air pollution. There are only a few studies that have examined the effects of accessibility, air pollution, and traffic noise on housing price in integrated models (Chasco and Gallo, 2013, 2015; Hui et al., 2007; Wardman & Bristow, 2004). By using stated preference data, Wardman and Bristow (2004) find that the effects of air quality and traffic noise on people's willingness to pay in Edinburgh are relatively minor after controlling for socioeconomic variables. By using objective measurements, Chasco and Gallo (2013) and Hui et al. (2007) find that the effect of accessibility on housing price is consistently positive, but the effects of air pollution and traffic noise are inconsistent. Chasco and Gallo (2013) find a positive effect of air pollution on housing price in Madrid and conclude that residents in wealthier neighborhoods do not perceive their environment as being highly polluted because of their higher “sense of place.” Hui et al. (2007) find a positive relationship between noise and housing price in Hong Kong, due to the uniquely dense living environment in Hong Kong where people are willing to sacrifice serenity for convenience.

In sum, effects of both accessibility and environmental health risk