Cities 62 (2017) 10–22

Contents lists available at ScienceDirect

Cities

journal homepage: www.elsevier.com/locate/cities

Measuring the effect of greenbelt proximity on apartment rents in Seoul

Myung-Jin Jun [a,*], Hee-Jae Kim [b]

[a] Department of Urban Planning and Real Estate, Chung-Ang University, South Korea
[b] Kangnam University, South Korea

ARTICLE INFO

Article history:
Received 29 July 2016
Received in revised form 3 November 2016
Accepted 18 November 2016
Available online xxxx

Keywords:
Greenbelt
Apartment rent
Spatial hedonic price model
Seoul

ABSTRACT

This paper uses spatial hedonic price models to examine how the implicit value of the natural amenity provided by Seoul's greenbelt (GB) is reflected in apartment rents in the Seoul metropolitan area, Korea. We test spatial autocorrelation with six different spatial weight matrices (SWM) in three different spatial models: the spatial lag model, spatial error model, and general spatial model. The spatial error model with 1 km distance cutoff SWM performs the best.

Findings indicate that apartment rents decrease by 3.83–3.95% with a one-unit decrease in the distance to the nearest GB. The marginal implicit value of decreasing the distance to the nearest GB by 1 km, evaluated at the average apartment rent, yields about a $34 drop in monthly rent, ceteris paribus. This finding appears to be related to the centripetal residential location pattern in Seoul, in which people prefer to live in the central city rather than in the suburbs, contrary to the pattern common in North American cities.

1. Introduction

A greenbelt (GB) usually refers to a band of green space drawn tightly around an existing urban area intended to contain urban expansion or preserve environmental and recreational resources (Pendall & Martin, 2002; Kuhn, 2003; McConnell & Walls, 2005; Amati & Yokohari, 2006; and Bengston & Youn, 2006). Among many GB-related issues, their effect on housing prices has long been controversial because a GB designation, as one of the most stringent land use control measures, inevitably affects housing prices.

Two main contradictory theoretical arguments explain why GBs (or containment policies in general) increase housing prices, both based on microeconomic theory. The first argument is that GBs reduce the amount of developable land and thus the quantity of new housing units, thereby shifting the housing supply curve inward and raising the housing prices. The second explanation says that, on the other hand, GBs cause the demand curve to move outward because of the increased natural amenities attributable to close proximity to open space and natural resources (Dawkins & Nelson, 2002).

In reality, however, empirical analyses of the effect of GBs on housing prices is not as simple as theory suggests because of the dynamics and complexity of housing markets and methodological limitations. For example, the relationship between a GB policy and housing prices in contained communities could be affected by socio-economic conditions (i.e., population growth and household income level), housing market segmentation, zoning regulations, and the temporal gap between housing demand and supply.

Dawkins and Nelson (2002) identify several methodological issues in empirically analyzing the relationship between containment policies and housing prices. First, as shown in the aforementioned theoretical arguments, housing quantity is an important variable in urban containment studies. However, few studies have used housing quantity variables in their analyses because of the difficulty in disentangling whether housing investment decisions result from the imposition of a GB policy or from regional or national economic changes. The lag between housing demand and supply makes this task even more difficult. Another methodological barrier includes the poor availability of adequate data representing housing stocks and services.

Like the theoretical arguments, existing empirical studies on the effects of GBs on housing prices can be classified into two groups: 1) studies that emphasize the supply side effects of GBs, which regard GBs as land use control measures (Black & Hoben, 1985; Knaap, 1985; Nelson, 1985, 1986; Segal & Srinivasan, 1985; Kim, 1993; Hannah, Kim, & Mills, 1993; Glaeser & Gyourko, 2003; Choi, 1994; Jun, 2012); and 2) studies focusing on the demand side effects of GBs, which view GBs as amenity generators (Correll, Lillydahl, & Singell, 1978; Nicholls & Crompton, 2005; Asabere & Huffman, 2009; Gibbons, Mourato, & Resende, 2011; Herath, Choumert, & Maier, 2015; and Deaton & Vyn, 2015).

* Corresponding author.
E-mail addresses: mjjun1@cau.ac.kr (M.-J. Jun), irex1@naver.com (H.-J. Kim).

http://dx.doi.org/10.1016/j.cities.2016.11.002
0264-2751/

Besides controversies on the effects of GB policy from an economic perspective, there has been a longstanding controversy on the GB policy in terms of social and political perspectives. For example, Seoul's greenbelt policy[i] has been acclaimed by the general public, environmentalists, and urban planners as a successful urban containment policy to protect natural environment and agricultural land and to control urban sprawl. However, land owners in the greenbelt and a conservative liberal group strongly oppose the greenbelt policy because of restriction of private property right and socio-economic costs of the policy such as housing cost rise due to the restriction of land supply and increase in transport cost caused by leap-frog development.

This study aims to estimate marginal implicit prices for GB proximity embedded in apartment rents for the Seoul metropolitan area (SMA) and to examine how these implicit prices differ by apartment rental market segment. In doing so, we employ spatial hedonic price model because the model can extract the value of non-market goods (GB proximity in this study) implicitly traded through a housing market (Pearce, Atkinson, & Mourato, 2006). We use the spatial hedonic model rather than the traditional hedonic model because the spatial model has some advantages to account for spatial autocorrelation and to address omitted variable bias (Brasington & Hite, 2005), resulting in consistent and unbiased estimates.

The remainder of the paper is structured as follows. The next section presents a literature review. Section 3 describes the data and analysis methods, and we discuss the analysis results in Section 4. In the first part of Section 4, we discuss the GB's price effects in terms of the aggregated housing market for the Seoul metropolitan area (SMA), and in the second part, we describe the price effects of the GB by housing submarket. Section 5 presents conclusions and policy implications.

2. Literature review

During the past several decades, a considerable body of empirical studies has investigated the effect of proximity to urban green (or open[ii]) spaces on housing prices. Because our primary concern in this study is the effect of proximity to Seoul's GB on housing prices, we focus here on the major findings of more than a dozen studies published since 2000 that have similar research objectives in terms of model specification and analysis method, natural amenity type, and case area under study, as presented in Tables 1 and 2.

First, a variety of statistical model specifications have been developed to analyze the price effects of green spaces. As the dependent variable, sales prices of single-family housing were most widely used, but some studies used the asking prices of apartments (Herath et al., 2015) or vacant farmland price per acre (Deaton & Vyn, 2015). Most studies transformed the dependent variable into a natural log form for statistical advantages such as control of the nonlinearity of housing prices and the legible interpretation of coefficients as the percentage change in price associated with a unit change in an explanatory variable.

Table 2 presents the explanatory variables used in the selected studies. Although the researchers evaluated a large array of explanatory variables with different categories of predictors as measures of housing price effects, the variables can be grouped into four categories: 1) housing structure attributes; 2) location and neighborhood characteristics; 3) environmental and amenity variables, and 4) sales-related variables. Common structure variables include floor size, lot size, number of rooms and bathrooms, house age, parking space, and dummy variables such as availability of a spa, fireplace, or balcony. Location and neighborhood variables varied widely, including accessibility to schools, parks, transport facilities such as bus stops, railway stations, and highway entrances, and the CBD and sub-centers. A few studies also introduced socio-economic variables such as percentage of African Americans, median household income, population density, and population growth rate (Lindsey, Man, Payton, & Dickson, 2004; Payton, Lindsey, Wilson, Ottensman, & Man, 2008; Deaton & Vyn, 2015; Visser, Van, & Hooimeijer, 2008; Saphores & Li, 2012). Two dominant types of environmental and amenity variables were a continuous measure of distance to green areas and distance bands to green spaces (Nicholls & Crompton, 2005; Lindsey et al., 2004; Tyrväinen & Miettinen, 2000; Gibbons et al., 2011; Herath et al., 2015; Bolitzer & Netusil, 2000; Melichar & Kaprova, 2013; and Morancho, 2003). Other studies used the proportion (or percentage) or size of the GB (or green spaces) in a neighborhood (Gibbons et al., 2011; Kadish & Netusil, 2012; and Morancho, 2003), and Payton et al. (2008) and Saphores and Li (2012) used the Normalized Difference Vegetation Index (NDVI) and tree canopy (grass cover) as a measure of urban vegetation, respectively.

All of the studies we reviewed estimated the price effects of green spaces using traditional or spatial hedonic price models. A few studies have criticized use of the traditional approach, arguing that it lacks consideration of spatial variation in dependent and independent variables. As an alternatives to the ordinary least square (OLS) approach, four studies suggested using spatial hedonic price models, such as the spatial error model (SEM) (Kadish & Netusil, 2012); spatial lag model (or spatial autoregressive model: SAR) (Payton et al., 2008); spatial Durbin model (SDM) (Herath et al., 2015); or Cliff-Ord model (Saphores & Li, 2012), arguing that spatial hedonic models outperform OLS in terms of explanatory power and predictive accuracy.

Kadish and Netusil (2012) used SEM to examine whether land cover types—trees, shrubs, water, and impervious surface areas—affect the sale price of single-family residential properties in Multnomah County, Oregon, US. After they conducted Lagrange multiplier (LM) tests with a four, eight, and sixteen-nearest neighbors (NN) weighting matrix with the SEM and SAR models, they perform SEM over SAR.

Payton et al. (2008) investigated the effects of an urban forest on housing prices in Indianapolis/Marion County, US, using a spatial lag regression to adjust spatial autocorrelation. They found that SAR's robust LM lag and LM error statistics are significant and suggest including the spatial lag term to mitigate the spatial autocorrelation of neighborhood location variables. In their analysis, the spatial lag coefficient indicates that 36–37% of the variance explained by the models is already represented in the value of neighboring houses.

Herath et al. (2015) used SDM to examine whether a GB's implicit value is capitalized into apartment prices in Vienna, Austria. They tested six spatial weight matrices for spatial hedonic price models: three distances (circles of 0.5 km, 1 km, and 2 km to a specific apartment) and three *k*-Nearest Neighbors (*k*-NN) (one-, three-, and five-NN). They suggest that SDM is the best performing model over SEM and SAR because it indicates the existence of small-scale neighborhood effects, and they present a solid case for the consideration of SDM in the valuation of green amenities.

Saphores and Li (2012) used the Cliff-Ord model to investigate the effects of urban trees, irrigated grass, and non-irrigated grass areas on the sales price of single family detached houses in Los Angeles, CA, and compared the analysis results with those of a GWR model. They advocate their model over simpler spatial models with jointly statistically significant estimates in the coefficients of the spatial dependence between property values (λ) and spatially lagged autoregressive errors (ρ), lagged structural/location variables, and land cover variables.

Second, all the studies we reviewed found that proximate green areas created price premiums with varying degrees of intensity. An exception is Deaton and Vyn (2015), who concluded that Ontario's GB negatively influenced vacant farmland values in close proximity to urban areas. However, the reviewed studies use significantly different types of green spaces (5 GBs, 6 greenways or urban forests, 3 urban

[i] See Bae (1998) and Bengston and Youn (2006)for the detailed discussion on the effects of GB on land and housing markets and social and political issues including property right issues.

[ii] Saphores and Li (2012) published an extensive review of urban land cover studies from 2001 to 2011.