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# Urban environmental amenities and property values: Does ownership matter?

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ABSTRACT

This study examines if open space ownership, and ownership of the land on which water resources are located, has a different effect on the sale price of nearby single-family residential properties using an OLS and spatial lag modeling approach. Estimated coefficients for the percentage of land with publicly and/or privately owned water resources in the spatial lag model are mixed with significantly negative coefficients for privately owned land with wetlands or streams and a significantly positive coefficient for publicly owned land with wetlands. These results may reflect differences in accessibility, the current quality of these resources, and beliefs about future management. The spatial lag model has fewer significant coefficients than the OLS model, but the signs of key parameters are consistent across models. The average absolute difference between coefficients in the OLS and spatial lag models is 30.2%.


## Introduction

The preservation of open spaces and protection of water resources is a policy focus for local, regional, and state governments, the federal government, and non-profits such as The Nature Conservancy and The Trust for Public Land. Between 2005 and 2010, 470 bond measures were passed nationwide raising over $21 billion to support "parks and playgrounds, farmland preservation, watershed protection, trails and greenways, forests, and wildlife habitat" (The Trust for Public Land, 2010, 2011).

Metro, a regional government that serves 1.5 million residents in the Portland, Oregon metropolitan area, protected over 8000 acres and more than 74 miles of stream and river frontage using $135.6 million from a 1995 natural areas bond measure (Metro, 2010a). An additional 2356 acres and 11 miles of streams and rivers have been protected using $227.4 million raised by a 2006 natural area bond measure (Metro, 2010b).[1] These acquisitions, which are intended to "protect water quality, improve parks and natural areas, preserve wildlife habitat and provide greater access to nature for people all over the region," (Metro, 2010a) raise an important question: does the ownership of an urban environmental amenity by a public agency or a private organization have a different effect on the sale price of nearby properties?

Federal, state, regional or local governments can own golf courses, natural areas, cemeteries, and specialty parks. Public ownership may provide benefits such as recreation access, flood control, pollution abatement, desirable views, and fish and wildlife habitat that may not be provided, or not provided at the same level and spatial distribution, by private landowners.[2] Additionally, residents may feel greater certainty about the future use and maintenance of publicly owned lands because of greater support for regulating these properties (Larson and Santelmann, 2007).

The effect of public open space ownership on the sale price of nearby residential properties is mixed with some studies finding positive effects (Lutzenhiser and Netusil, 2001; Anderson and West, 2006; Bolitzer and Netusil, 2000) and others finding negative effects that are attributed to noise and congestion from recreation activities (Espey and Owusu-Edusei, 2001; Shultz and King, 2001). Bolitzer and Netusil (2000) find a significantly positive coefficient on the sale price of properties within 1500 feet of a public park in Portland, Oregon and a negative but insignificant effect if a property is within 1500 feet of a private park. Golf courses, regardless of ownership, have been found to positively affect the sale price of nearby properties (Do and Grudnitski, 1995; Asabere and Huffman, 2009).

Water resources, such as streams and wetlands, may be located on privately or publicly owned land. Netusil's (2005) study on the effect of environmental zoning on property values in Portland, Oregon uses dummy variables to capture the presence of amenities

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[1] In addition to the streams and rivers protected under Metro's natural areas acquisition program, Portland's Bureau of Environmental Services (BES) revegetated 2326 acres and restored 645,004 feet of stream bank within the City of Portland between fiscal years 1996 and 2010 (Chomowicz, 2011).

[2] Many publicly owned open spaces in the study area use environmentally friendly practices (Baur, 2003; Mortenson, 2009).

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such as trails, rivers, open spaces, and streams that flow on private or publicly owned land, within 200-ft, 200-ft to ¼ mile, and ¼ mile to ½ mile buffers surrounding a property. Estimated coefficients for the dummy variables representing streams on publicly owned land were not statistically significant at any distance. The dummies for streams on privately owned land were significantly negative for both modeling approaches (semi-log and log–log functional forms) for the 200-ft buffer, significantly negative for the semi-log model for the 200 ft to ¼ mile buffer, and significantly positive for both models for the ¼ mile to ½ mile buffer.

This research differs from Netusil (2005) in several ways. Netusil (2005) did not test to see if the estimated coefficients on the stream dummy variables differed by ownership, the stream variable was the only one that was differentiated by ownership, and amenities were modeled using dummy variables. Additionally, no tests were conducted to check for spatial autocorrelation.

This research contributes to the literature in several ways. First, while the majority of research has examined the relationship between the sale price of properties and a specific amenity, such as proximity to a publicly owned park, we calculate the proportion of all privately and publicly owned open space types and water resources within a ¼ mile buffer for each of the properties in our data set. Second, the city of Portland, Oregon is the most highly urbanized area of the studies reviewed, so estimated coefficients will provide insight into how ownership of urban amenities in similar areas may influence the sale price of nearby properties. Third, we estimate coefficients using ordinary least squares and a spatial lag model thereby contributing to the literature that explores if correcting for spatial dependence results in economically meaningful differences in estimated coefficients. This paper is organized as follows. The study area is described in the section “Study area” with the theory and empirical approach used in this paper, the hedonic price method, described in the section “Methods”. This is followed by a description of the data and an analysis of results in the section “Data”. The final section offers policy implications and conclusions.

## Study area

The study area includes the part of the city of Portland, Oregon located in Multnomah County, an area of approximately 92,150 acres. Approximately 18,400 acres of open spaces in the study area are publicly owned open space and 2000 acres are privately owned (Metro Data Resource Center, 2003). The city is divided into five areas. Northwest is divided by the Willamette River, which flows north into the Columbia River. Streets east of the Willamette are labeled “North” while those west of the river are labeled “Northwest” (Fig. 1).

Oregon’s statewide land use planning Goal 14 requires the establishment of urban growth boundaries for all cities and metropolitan areas in the state (Oregon Department of Land Conservation and Oregon Department of Land Conservation and Development, 2006). The urban growth boundary for the Portland metropolitan area, which is managed by Metro, “is required by state law to have a 20-year supply of land for future residential development inside the boundary” (Metro, 2010c). This boundary encourages compact urban development by preventing sprawl; lots available for residential development are generally small with recent development focused on infill and rebuilding on existing lots.

Poor water quality ratings in the Portland metropolitan area, and the presence of three salmonids listed under the Endangered Species Act, has made the protection and restoration of water resources a major policy focus (Portland Bureau of Environmental Services, 2011; Oregon Department of Environmental Quality, 2009; Metro, 2010a). Approximately 56 miles of streams and rivers in the study area were classified as water quality limited in 1998 (Oregon Department of Environmental Quality, 2010). Total Maximum Daily Loads for temperature, bacteria, and mercury have been developed for the Lower Willamette Subbasin, which includes the water bodies in our study area (Oregon Department of Environmental Quality, 2007). Major sources of pollution include combined sewer overflows, construction activities, vehicular traffic, fertilizers and pesticides.

## Methods

The statistical technique used in this study, the hedonic price method, relates a property’s sale price to its structural ($S$), neighborhood ($N$) and environmental ($E$) characteristics. Assuming that housing choices are the result of utility-maximizing decisions, that prices clear the market, and that the study area represents a single housing market, the price of the $i$th property location ($P_{hi}$) is represented by Eq. (1):

$$P_{hi} = P_h(S_i, N_i, E_i) \tag{1}$$

Theory does not provide guidance on the correct functional form for the hedonic price function, so researchers have used linear, quadratic, double-log, semi-log, and Box Cox transformations to estimate the hedonic price function (Freeman, 2003; Cropper, Deck, and McConnell, 1988). Research using the same data set (Netusil, 2005) compared a semi-log functional form to a double-log functional form that uses natural logs of several explanatory variables (lot square footage, building square footage, age, and median income at the census tract level). The double-log model was preferred, so we incorporate that modeling approach into this paper.

Recent research (Anselin and Lozano-Gracia, 2009; Mueller and Loomis, 2008) emphasizes the importance of testing and correcting for spatial relationships since failing to do so may result in biased estimated coefficients (spatial lag) or biased standard errors and $t$-statistics (spatial error). A spatial autoregressive model, shown in Eq. (2), is used if data exhibit a spatial lag process. $Y$ is the dependent variable, $\rho$ is the spatial lag operator, $\mathbf{W}$ is an $n \times n$ weighting matrix, $\mathbf{X}$ is a vector of explanatory variables, $\boldsymbol{\beta}$ is a vector of estimated coefficients and $\varepsilon$ is a normally distributed error term with a mean of zero and constant standard deviation.

$$\mathrm{Y} = \rho \mathbf{W} Y + \mathbf{X}\boldsymbol{\beta} + \varepsilon \tag{2}$$

Measurement errors related to location, or a mismatch in the data related to space, may produce spatially correlated errors. The spatial error model is specified as follows:

$$\mathrm{Y} = \mathbf{X}\boldsymbol{\beta} + \mu \tag{3}$$

where

$$\mu = \lambda \mathbf{W} \mu + \varepsilon$$

where $\lambda$ is a coefficient on the spatially weighted errors. Weights in our regressions are based on the nearest neighbor (NN) approach which means that the weighting matrix has nonzero values for the number of neighbors specified, for example, a 4-nearest-neighbor (4NN) weighting matrix means that there are four nonzero values for the 4-nearest neighbors for each observation. The weight matrix is standardized so that the values of each row sum to one, so the four nearest neighbors of an observation have a weight of ¼, while other observations are given a weight of zero.

We follow the spatial regression decision process described by Anselin (2005a) and Mueller and Loomis (2008) using a four and eight nearest neighbors (NN) weighting matrix generated in MATLAB. LM-Error and LM-Lag test statistics were significant, so robust