EXPERT OPINION VERSUS TRANSACTION EVIDENCE; USING THE REILLY INDEX TO MEASURE OPEN SPACE PREMIUMS IN THE URBAN-RURAL FRINGE

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***Abstract**: Due to economic and population growth farmland and to a lesser extend other undeveloped areas are under pressure in the urban-rural fringe in British Columbia, Canada. The objectives of this paper are to determine if residential property values near Victoria, British Columbia include open-space premiums for farmland, parks or golf courses, and to determine if using assessed values instead of market prices of properties result in the same findings. We estimate a Seemingly Unrelated Regression (SUR) model with two hedonic pricing equations, one with actual market values as the dependent variable and one with assessed property values, and compare the resulting estimates of shadow prices for open space amenities. Furthermore, we take account of spatial autocorrelation and combine Method of Moment estimates of the spatial parameters in both equations.*

1 Introduction

Hedonic pricing models are often used to estimate the value of open space and the externalities that different types of land use impose on one another because these values are at least partly tractable through market values of private properties. In particular, the prices of residential properties in close proximity to positive and negative externalities resulting from nearby land uses can be used to value these non-market amenities.

If we look at open space amenities provided by farmland near urban areas we observe that, as the urban fringe is pushed out, fragmentation of surrounding farmland increases as do incidences of trespass and vandalism. Externalities are also associated with the intensification of agriculture in the rural-urban fringe. Externalities flow in both directions, with urban development impacting farmland and agriculture affecting urbanites. On the negative side, there are nuisance complaints from neighboring urban residents who object to the sounds and smells of farming operations and the added traffic congestion caused by slow-moving farm equipment traversing from one field to another some distance away (with the spatial fragmentation also adding to farming costs) (Hardie, et al. 2004). Nonetheless, Kline and Wichelns (1996) indicate that urban residents enjoy living near open spaces as these provide pleasant agrarian landscapes during commutes, opportunities for recreation and habitat for wildlife that facilitates viewing. Indeed, real estate brokers include farmland views and proximity to natural areas as selling features of houses. For example, a property in our study area was recently listed as follows: "Central Saanich – Victoria: This .28 acre view property … overlook[s] the Marindale Valley and farm fields, …. Only 15 minutes from downtown and 10 minutes from ferry and airport…." (MLS, 2007).

Nature parks and golf courses are other open space providers and both positive and negative externalities can be associated with these land uses. Nearby forest land was found to be negatively associated with house price in Geoghegan et al. (2003), perhaps due to externalities associated with deer (landscape damage, car accidents and the spread of Lyme disease). This negative effect of nearby forest was also found in Paterson and Boyle (2002), indicating people do not enjoy views of trees. However, most studies have found positive impacts from nature areas, such as in Cho et al. (2006) and Irwin and Bockstael (2001). With respect to golf courses, Nicholls and Crompton (2007) found a positive impact of golf courses due to it's popularity as a recreational activity. However, golf courses can also be associated with negative externalities as recognized by Asabere and Huffman (1996). Hedonic pricing studies can be used to study whether people will pay more for a house with these open space amenities.

Hedonic pricing models require actual property transaction data as inputs, because these values reflect property characteristics which can then be decomposed into their constituent parts. However, sales values are not always readily available; therefore, some researchers have employed approximations of sales values in hedonic pricing models. Thus, Chay and Greenstone (2005), and Isgin and Forster (2006), relied on a survey instrument to elicit estimates of property values. For practical reasons, it is very useful to know which approximations of property values will give valid and consistent results when transaction data is not available.

Using assessed values as approximations of market values has the advantage that these values are available for each property in each year. So, the estimation of a hedonic panel data model, including dynamic effects, is possible if this strategy is valid. In addition, the use of assessed values would facilitate non-market valuation since assessed values are much more widely available, at least in jurisdictions where properties are assessed annually for tax purposes. In some jurisdictions, a government agency may collect information on sale prices, but in others, where information on selling price is not readily available for a large data set, it would be helpful if researchers could use assessed values in place of market price with confidence. Some studies support the idea that assessments and market values work in step (Berry and Bednarz, 1975). Nicholls and Crompton (2007) visually compared estimates for the value of open space based on an equation with sales values versus assessed values as the dependent variable. However, they didn't develop test statistics to compare these estimates.

The objective of this paper is therefore to test whether assessed values are good proxies for actual sales values in a hedonic pricing model that is used to estimate the value of open space on the Saanich Peninsula, British Columbia, Canada. The value of open space provided by farmland is compared to that provided by parkland and golf courses. We estimate a Seemingly Unrelated Regression (SUR) model with two equations, one with actual market values as the dependent variable and one with assessed property values, and compare the resulting estimates of shadow prices for open space amenities. Furthermore, we take account of spatial autocorrelation and combine Method of Moment estimates (Kelejian and Prucha, 1999) of the spatial parameters in both equations (Kelejian and Prucha, 2004).

A variety of authors have estimated open space premiums using a proxy variable to measure open space benefits. Irwin and Bockstael (2001) and Irwin (2002) use the percentage of open space within a specified buffer zone around each property, while Ready and Abdalla (2005) construct an index that allows the value of the open space amenity to decrease to zero in a nonlinear fashion as distance increases up to a certain point, beyond which open space is assumed to no longer effect residential property prices. The problem with distance measures, like that used by Ready and Abdalla (2005), is that large and small open space areas are treated equally; the problem with area percentages, like that used by Irwin (2002), is that arbitrary buffer zones around each property have to be specified and open space outside those boundaries is not taken into account. We address this issue by explicitly combining the distance and percentage measures using a Reilly index. In this way, all nature areas, parks, farmland and golf courses are taken into account, insuring that both the size and distance measures are represented.

2 Methods

Given that both the distance to a particular open space and its size influence residential property values, we construct a Reilly index that combines these two aspects of open space. The Reilly index derives from Newton's law of gravitation, where gravity is stronger for larger 'bodies' and gravitational strength is inversely related to the distance between 'bodies'. It was originally applied to the study of retail markets (Reilly, 1931), to reflect the attractiveness of different retail areas (cities) in terms of the tradeoff between consumers' travel costs and the size of alternative retail areas. In this case, Reilly's law is:

$$\frac{R_{xi}}{R_{xj}} = \frac{Pop_i}{Pop_j}\left(\frac{D_{xj}}{D_{xi}}\right)^2, \qquad [1]$$

Where R_{xi} and R_{xj} are the retail sales at location x accounted for by each of the cities i and j; Pop_i and Pop_j are the respective populations (size) of the two cities; and D_{xi} and D_{xj} are the distances from the retail location x to cities i and j, respectively. In this case, it is possible to determine the location of retail center x so as to attract the most customers (Yrigoyen and Otero, 1998). This optimal location or 'breaking point' is given by

$$d_{xj} = \frac{d_{ij}}{1+\sqrt{Pop_i / Pop_j}}, \qquad [2]$$

where the breakpoint lies at distance d_{xj} from the centre j, d_{ij} is the total distance between the two retail centers, and, of course, $d_{xj} < d_{ij}$.

Shi et al. (1997) were the first to employ the concept of gravitation in a hedonic pricing model. However, they modified the concept in order to evaluate the impact of multiple urban centers on farmland values. Their Reilly index is specified as:

$$R_i = \sum_{j=1}^{J}\left(Pop_j / D_{ij}^2\right), \qquad [3]$$

where R_i is the Reilly index for property i, Pop_j is the population of the j-th urban area, and D_{ij} is the distance from property i to the j-th urban center.

We modify the Reilly index to calculate the impact of open space (farmland and parkland) on residential property values. Rather than distance to urban centers, we employ distance to open areas and, rather than population, we use size of the open space (measured in square meters). Thus, we specify

$$R_i = \sum_{j=1}^{J}\left(S_j / D_{ij}^2\right), \qquad [4]$$

where R_i is the value of residential property i and D_{ij} is the distance (in meters) from residential property i to open space j that is of size S_j (in square meters). Thus, we can take all parks and farmland within our research area into account, insuring that both the size and distance measures are represented.

For golf courses we also constructed a measure similar to the Reilly index. The only difference is that instead of using the size of the golf course, we specified S_j as one for nine-hole golf-courses and as two for 18- or 19-hole golf-courses.

2.1 Model specification

To investigate the open space premium associated with residential properties, prices from actual market transactions are usually employed as the dependent variable. However, we also specify a model that uses assessed property values as the dependent variable, as this enables us to investigate the validity of assessed values in lieu of market values in hedonic pricing models. For each of the properties for which actual sales and assessed values are both available, we paired the actual and assessed values and specified a SUR model. By working with both equations in one model, relevant test statistics can be derived to test the hypothesis that parameters in the equation with actual market prices as the dependent variable are equal to the parameters in the equation with assessed values as the dependent variable.

Properties are also spatially related. An assumption of spatial econometrics is that observations that are located closer to each other are more correlated than observations that are farther apart. Spatial autocorrelation is often caused by unobserved variables. For example, if several residences have a beautiful view because they are located on a hilltop, and there is no variable in the model that takes this view into account, then the error terms associated with each of these residences will be correlated.

To address this issue, we first define the spatial SUR model, including a spatial autocorrelation component, as follows:

$$P_m = X\beta_m + \varepsilon_m,\ \varepsilon_m = \rho_m W_m \varepsilon_m + \mu_m,\ \mu_m \sim N(0,\sigma_m^2) \ni (I_N - \rho_m W_m)\varepsilon_m = \mu_m, \qquad [5]$$

where P_m is a vector of property prices, X_m a matrix of property characteristics, β_m a vector of associated parameters to be estimated, and ε_m is the spatially auto correlated error term. Further, m identifies the equations with market values (m=1) and assessed values (m=2) as dependent variables.

We assume that $Cov(\mu_{1i},\mu_{2j}) = \sigma_{12}$ for $i=j$ and $Cov(\mu_{1i},\mu_{2j}) = 0$ for $i \neq j$; where μ_{mi} reflects the i-th error term in the m-th equation. If we define $B_m = I_N - \rho_m W_m$ and $\varepsilon_m = B_m^{-1}\mu_m$, the overall error structure becomes:

$$V = Cov(\varepsilon) = \begin{bmatrix} \sigma_1^2 (B_1' B_1)^{-1} & \sigma_{12}(B_2' B_1)^{-1} \\ \sigma_{21}(B_1' B_2)^{-1} & \sigma_2^2 (B_2' B_2)^{-1} \end{bmatrix}. \qquad [6]$$

Although, it is possible to use maximum likelihood to estimate a model that includes both SUR and spatial dependence (see Anselin (1988b)), we have more than 10,000 observations for the period 2000-2006 which is (depending on the efficiency of the programmed routines) too much for maximum likelihood estimation of spatial models. Maximum likelihood requires the calculation of either the eigenvalues of the spatial weighting matrix or the determinant of B_m, which Kelejian and Prucha (1999) could only do in a reliable way for dimensions up to 400. Bell and Bockstael (2000) restricted their weighting matrices to be sparse and reported problems for dimensions of roughly 2,000 x 2,000. Pace and Barry (1997) were able to work with matrices up to 20,000 x 20,000 by imposing additional restrictions. Huang, et al. (2006), among others, even aggregated their data to the county level, because they were unable to handle the huge weighting matrix caused by spatial dependence within 64,000 observations. Therefore, we use the full information estimator developed by Kelejian and Prucha (2004). This procedure uses the Method of Moments (MM) estimator proposed by Kelejian and Prucha (1999) to estimate ρ_1 and ρ_2 in B_1 and B_2, but extends this method so that these estimates can be used in a system of interrelated cross sectional equations.

If we assume that B_m are known, we can rewrite the two equations as:

$$P_m = X\beta_m + B_m^{-1}\mu_m \Rightarrow B_m P_m = B_m X\beta_m + \mu_m \Rightarrow P_m^* = X^*\beta_m + \mu_m ,$$

where $P_m^* = B_m P_m$ and $X_m^* = B_m X_m$. For this transformed model, it is easy to calculate the inverse of the covariance matrix. Because the covariance matrix is $Cov(\mu) = \Omega = \Sigma \otimes I_N$, where $\Sigma = \begin{bmatrix} \sigma_1^2 & \sigma_{12} \\ \sigma_{21} & \sigma_2^2 \end{bmatrix}$. The inverse of this matrix is very easily calculated by $\Omega^{-1} = \Sigma^{-1} \otimes I_N$ even for large N. We define $\Sigma^{-1} = \begin{bmatrix} \sigma^{11} & \sigma^{12} \\ \sigma^{21} & \sigma^{22} \end{bmatrix}$.

The moment conditions for the spatial error model (Kelejian and Prucha, 1999) are used to estimate ρ_1 and ρ_2. Let $\bar{u}_m = W_m u_m$, $\bar{\varepsilon}_m = W\varepsilon_m$, $\bar{\bar{\varepsilon}}_m = W_m W_m \varepsilon_m$, $u_m = \varepsilon_m - \rho_m \bar{\varepsilon}_m$, and $\bar{u}_m = \bar{\varepsilon}_m - \rho_m \bar{\bar{\varepsilon}}_m$. The moments we use are:

$$E\left[\frac{1}{N}u_m' u_m\right] = \sigma_m^2,\ E\left[\frac{1}{N}\bar{u}_m' \bar{u}_m\right] = \sigma_m^2 \frac{1}{N} Tr(W_m' W_m), \text{ and } E\left[\frac{1}{N}\bar{u}_m' u_m\right] = 0$$

To define the sample analogue of the population moment conditions, we define the following predictors: $\tilde{\varepsilon}_m$ is a predictor for ε_m. Correspondingly $\tilde{\bar{\varepsilon}}_m = W_m \tilde{\varepsilon}_m$ and $\tilde{\bar{\bar{\varepsilon}}}_m = W_m \tilde{\bar{\varepsilon}}_m$. For the sample moments we can define the following conditions:

$$G_N\left[\sigma_m^2, \rho_m, \rho_m^2\right] - g_N = v_N(\sigma_m^2, \rho_m), \qquad [7]$$

where $v_N(\sigma_m^2, \rho_m)$ is the vector of residuals;

$$G_N = \begin{bmatrix} 1 & -\frac{2}{N}\tilde{\bar{\varepsilon}}_m{}'\tilde{\varepsilon}_m & \frac{1}{N}\tilde{\bar{\varepsilon}}_m{}'\tilde{\bar{\varepsilon}}_m \\ \frac{1}{N}Tr(W_m{}'W_m) & -\frac{2}{N}\tilde{\bar{\bar{\varepsilon}}}_m{}'\tilde{\bar{\varepsilon}}_m & \frac{1}{N}\tilde{\bar{\bar{\varepsilon}}}_m{}'\tilde{\bar{\bar{\varepsilon}}}_m \\ 0 & -\frac{1}{N}\left(\tilde{\bar{\bar{\varepsilon}}}_m{}'\tilde{\varepsilon}_m + \tilde{\bar{\varepsilon}}_m{}'\tilde{\bar{\varepsilon}}_m\right) & \frac{1}{N}\tilde{\bar{\bar{\varepsilon}}}_m{}'\tilde{\bar{\varepsilon}}_m \end{bmatrix}; \text{ and } g_N = \begin{bmatrix} -\frac{1}{N}\tilde{\varepsilon}_m{}'\tilde{\varepsilon}_m \\ -\frac{1}{N}\tilde{\bar{\varepsilon}}_m{}'\tilde{\varepsilon}_m \\ -\frac{1}{N}\tilde{\bar{\bar{\varepsilon}}}_m{}'\tilde{\varepsilon}_m \end{bmatrix}$$

Restrictions have to be imposed on the estimates of ρ_m and ρ_m^2. The MM estimator for $\{\sigma_m^2, \rho_m\}$ can be defined as a nonlinear least squares estimator:

$$\left(\hat{\sigma}_m^2, \hat{\rho}_m\right) = \arg\min\left\{v_N\left(\sigma_m^2, \rho_m\right)' v_N\left(\sigma_m^2, \rho_m\right)\right\}. \qquad [8]$$

The OLS residuals for both the assessed and the sales equation can be used as starting values in the MM optimization procedures and the systems can be solved using non-linear least squares. The estimate of ρ_m, $\hat{\rho}_m$, results from MM minimization of $v_N\left(\sigma_m^2, \rho_m\right)' v_N\left(\sigma_m^2, \rho_m\right)$, with respect to those parameters. The standard error for ρ_m is based on Kelejian and Prucha (2008).
After obtaining estimates of ρ_m, EGLS is used to derive estimates for β_m, a measure of its dispersion, and so on, in the SUR model, where $X_m^* = (I - \hat{\rho}_m W_m)X$ and $P_m^* = (I - \hat{\rho}_m W_m)P_m$[1]. We then test whether the restriction that $\beta_1 = \beta_2$ holds, where β_1 are the estimated parameters for the market values equation and β_2 are the estimates for the assessed values equation. Thus, we compare the restricted model to the unrestricted model. The unrestricted model is given by:

$$\begin{bmatrix} P_1^* \\ P_2^* \end{bmatrix} = \begin{bmatrix} X_1^* & 0 \\ 0 & X_2^* \end{bmatrix} \begin{bmatrix} \beta_1 \\ \beta_2 \end{bmatrix} + \begin{bmatrix} \mu_1 \\ \pi_2 \end{bmatrix}, \qquad [9]$$

where P_m is the vector of sales ($m = 1$) or assessed values ($m = 2$); the vector of explanatory variables is the same in both equations; and β_m is the vector of parameters for the m-th model. Finally, ε_m is the vector of errors of the m-th model.

The restricted model is given by:

$$\begin{bmatrix} P_1^* \\ P_2^* \end{bmatrix} = \begin{bmatrix} X_1^* \\ X_2^* \end{bmatrix} \beta + \begin{bmatrix} \mu_1 \\ \mu_2 \end{bmatrix}. \qquad [10]$$

The only difference between models [9] and [10] is that, in the restricted case [10], β is the vector of parameters that is assumed to be the same for the market and the assessment equations.

[1] We used several Matlab functions from the LeSage toolbox (http://www.spatial-econometrics.com/) to implement the estimation procedure to obtain estimate for β_m, ρ_m, σ_{ij} and σ^2_m. First, the function sem_gmm to get estimates of ϱ_m. Next X_m and P_m were transformed to X^*_m and P^*_m, using the estimates of ϱ_m. Next, the function SUR from the toolbox was used to obtain full information estimates.

We can derive a Wald-test with the restrictions described above. If the restriction is valid, the vector of constraint(s) should be close to zero. R is a matrix with restrictions on the parameters in the model, b is a vector of parameters estimated in the unrestricted model, and the size of the matrix R is J by k where k is the number of parameters in b and J the number of restrictions. We test whether $Rb = q$, where q is a vector of zeros. In this case, a Wald test statistic would be: $(Rb)'\{Cov(Rb)\}^{-1}(Rb) = b'R'\{RCov(b)R'\}^{-1}Rb \sim \mathrm{X}^2(J)$, where

$$Cov(b) = \left(X'V^{-1}X\right)^{-1} = \left(\begin{bmatrix} X_1^* & 0 \\ 0 & X_2^* \end{bmatrix}' \begin{bmatrix} \sigma_1^2(B'B)^{-1} & \sigma_{12}(B'B)^{-1} \\ \sigma_{12}(B'B)^{-1} & \sigma_2^2(B'B)^{-1} \end{bmatrix}^{-1} \begin{bmatrix} X_1^* & 0 \\ 0 & X_2^* \end{bmatrix}\right)^{-1}$$

$$= \begin{bmatrix} \sigma^{11}X_1^{*}{}'X_1^* & \sigma^{12}X_1^{*}{}'X_2^* \\ \sigma^{21}X_2^{*}{}'X_1^* & \sigma^{22}X_2^{*}{}'X_2^* \end{bmatrix}^{-1}, \qquad [11]$$

and σ^{ij} are elements of Σ^{-1} (given above).

2.2 Choice of the spatial weighting matrix

The spatial weighting matrices W_1 and W_2 have to be specified for each of the equations a-priori. There are many potential candidates, but the choice is rather limited in this study, because we have more than 10,000 observations in our dataset. We have to specify sparse weighting matrices and not weighting matrices with non-zero weights in each of the elements of the 10,000×10,000 matrices. W_1 and W_2 are the same as they are based on the five nearest neighbors to each observation, with elements for each of the five-nearest neighbors assigned a 1 and all other observations a 0 in the weighting matrices. Further, the weighting matrices are row-standardized (each row sums to 1) for computational reasons.

2.3 Other empirical issues

Another empirical issue to be addressed concerns the choice of functional form, and there is little theoretical guidance regarding this choice (Taylor, 2003). Although goodness-of-fit criteria can be used to choose a functional form, Cassel and Mendelsohn (1985) argue that this strategy does not necessarily lead to more accurate parameter estimates. The debate also concerns the choice of a simpler versus more advanced functional form. While the choice of a simple linear form overlooks statistically significant relationships (Halstead et al. 1997), Rasmussen and Zuehlke (1990) argue that the parameter estimates might be less precise when unnecessary nonlinearities are introduced and the problem becomes over-parameterized. Further, Cropper, et al (1988) found that, when some variables are not observed or proxies are used, simple (linear or double-log) functional forms perform better. Nonlinear functional forms are generally preferred over linear ones because linear functional forms have the disadvantage that they assume that parcel characteristics can be easily repackaged, precluding nonlinearities as a result of arbitrage (Rosen, 1974). Because we already have a high number of explanatory variables (and parameters to estimate), we consider a linear functional form with transformed explanatory variables. An advantage of these simple forms is that interpretation of the results is more straightforward.

Finally, we need to take into account the endogeneity problem identified by Irwin (2002). Endogeneity could result if the open space has development rights so that it could be converted to residential use at any time. If that case, the same factors that determine the value of nearby residential property also influence the likelihood that the open space will be developed. We assume that endogeneity is not a problem because both parks and farmland are under zoning restrictions and cannot be easily converted to residential use. Developments rights on the other hand are more flexible than zoning in allowing for changes in land use.

3 Data and variables

The setting for our study is the Saanich Peninsula, just north of Victoria (on Vancouver Island) – the capital city of the province of British Columbia, Canada. The Saanich Peninsula is an area historically dominated by farms and contains some of Canada's most fertile farmland and best climate for growing a wide range of crops.

Agricultural land in BC is scarce (just 2.7% of the province is considered good farmland) and under increasing pressure (Runka, 2006). Most of the best farmland is coincident with the largest and rapidly-expanding urban areas of Vancouver, Victoria and the Okanagan Valley. In 1973, the provincial government created an Agricultural Land Reserve (ALR) to preserve agricultural land after it was estimated that 6,000 ha of farmland was being lost annually. At its inception, the ALR comprised all land of a certain soil quality, land that municipalities already zoned as agricultural, and land that was already assessed as farmland for tax purposes.[2] Although ALR lands remain privately-owned, they cannot be used for non-agricultural activities, subdivided or developed without the consent of the Agricultural Land Commission (ALC).

In total 511 nature areas and parks were taken into account in the analysis. All parks were either located on the Saanich Peninsula, or within a boundary of 3.5 km of our research area. Of these 511 nature areas, 152 were small parks (less than 2,000 m^2), 301 were medium sized parks between 2,000 and 50,000 m^2 and 58 were parks with an area over 50,000 m^2.

Furthermore, golf seems to be a very popular recreational activity, since there are 16 golf courses on the southern part of Vancouver Island. Of these 16 golf courses only seven are nine-hole golf courses, the others have 18 or 19 holes. Furthermore, eight golf courses are located within the Saanich area and the other eight are located either in Victoria, or further up on Vancouver Island.

The current study employs parcel-level GIS data collected from the Ministry of Agriculture and Lands, data on assessed values and house characteristics from BC Assessment, market values from a private company (LandCor), and other sundry GIS datasets such as

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[2] Since then, the ALR boundaries have been fine-tuned to better reflect actual agricultural usage and capability. The ALC also adjudicates several hundred applications a year from landowners who wish to have their land removed, subdivided or be permitted to use it for non-agricultural purposes.

elevations, roads and parks from the Capital Regional District government and the Federal Government. Relevant characteristics for the hedonic pricing model were obtained by linking properties using their identification numbers (jurols) or spatial location (in GIS). Distance data were constructed using spatial location information from GIS.

Table 1 Reilly index, an example.

	Park size (m^2)	Property 1 Distance (m)	Size / distance^2	Property 2 Distance (m^2)	Size / distance^2
Park 1	1,000,000	1,000	1.00000	1,400	0.51020
Park 2	500,000	2,100	0.11338	400	3.12500
Park 3	200,000	600	0.55556	700	0.40816
Park 4	900,000	1,200	0.62500	900	1.11111
Reilly index		2.29393		5.15448	

An example of the construction and implementation of the Reilly index is given in Table 1 and Figure 1. In Figure 1 two residential properties are shown in proximity to four different parks. Distances between the residential properties and the four parks are given in Table 1. From Table 1 and Figure 1, it is apparent that the Reilly for property 2 much larger is than for property 1 because property 2 is located much closer to one of the parks. Although park 2 is not the largest park, the short distance from property 2 to this park is largely responsible for the larger Reilly score for this property. The Reilly index for parks is constructed for small, medium and large parks. The reason is that small parks are expected to attract only the locals that live nearby while larger parks also attract people that live farther away and therefore are valued differently. With respect to the Reilly index for farmland, we construct separate measures for animal farms and for non-animal farms because animal farms are assumed to impose more negative externalities on their neighbors, such as bad smells from manure.

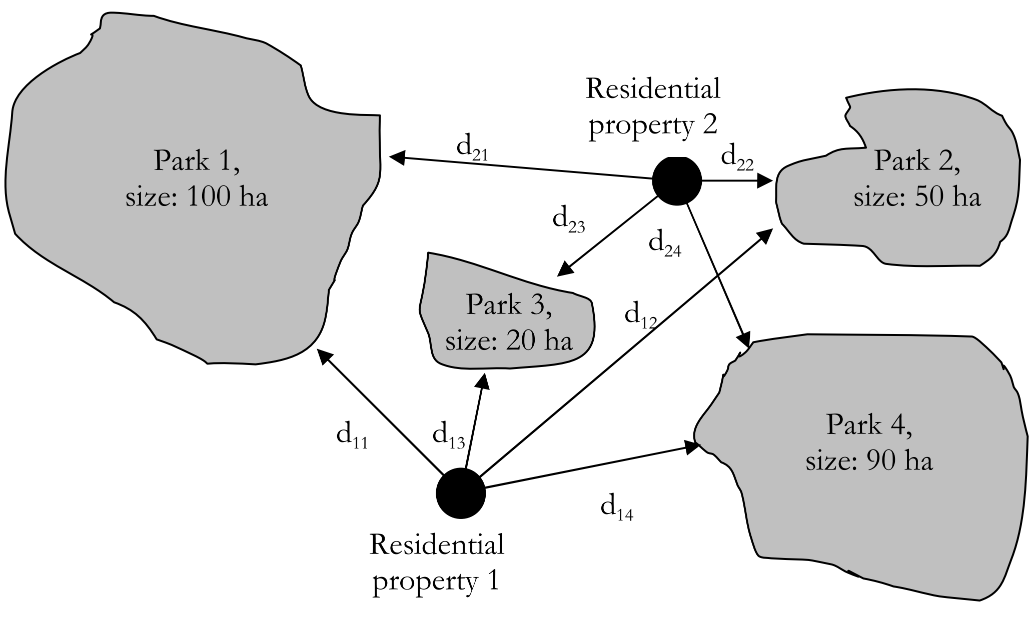

Figure 1 Example of Reilly index.

BC Assessment attempts to value all residential properties at their market value. Although farm properties can qualify for beneficial tax regulations by meeting certain agricultural income thresholds, here we focus on residential uses and ignore other uses. It is important to note that property assessment systems may be very different in other jurisdictions in North America or Europe, which could affect the validity of applying these results to other locations.

In British Columbia assessors take into account many factors when deciding on a property's assessed value. Properties are primarily categorized by the year in which they are built or the year of the last major renovation; whichever it is, we refer to this as the effective year. The reason for using effective year is that building codes and construction materials and methods change over time. Properties are then subcategorized on the basis of age, design and quality. After that, the number of bedrooms and other structural characteristics become important. At this point, market values of properties in the same subcategory and in the same 'market area' (as defined by BC Assessment) enter the equation. An overview of all the variables included in the hedonic pricing model can be found in Table 2. All of the databases used to construct these variables are listed in Appendix.1.

Because properties at the urban-rural fringe are our main interest, we include properties in the municipalities North Saanich, Central Saanich and Saanich in our analysis. Properties in the city of Victoria are excluded as this is an urban area, not part of the urban-rural fringe. The data consist of actual transactions and assessments of residential properties for the period 2000 to 2006. The LandCor and BC Assessment databases record 19,246 transactions for 2000 to 2006 for which both sales and assessed values are available. The data were filtered so that only 'single-cash' transactions are included, because transactions that do not involve cash or involve the sale of multiple properties at once are not suitable for our hedonic analyses. Next, we incorporated only detached family dwellings in the analysis; strata blocks, duplex buildings, seasonal dwellings and apartment blocks were excluded to focus the analysis on more homogeneous properties. This reduced the sample to 13,532 transactions. Upon excluding properties with missing information on some of the variables of interest, and focusing only on transactions between \$100,000 and \$5 million (CA), we are left with 13,254 observations. This number of observations was further reduced if measures of lot size differed by more than 100 m^2 between the two datasets. Properties without three or four piece bathrooms were removed as well. This reduced the number of observations to 12,628.

Table 2 Summary statistics dependent and explanatory variable(s), n = 10,133.

Explanatory variable	Database nr*	Mean	St dev	Min	Max
Sale amount (million CA\$)	1, 14	0.33108	0.15517	0.09625	2.80851
Assessed value (million CA\$)	2, 14	0.27727	0.11651	0.03156	1.71339
Lot size (ha)	3	0.11200	0.11581	0.02190	3.15655
Effective year: last mayor renovation of the property (years)	3	1973.15257	19.21750	1901	2005
Finished area (meters)	3	189.71599	75.51331	35.48894	886.29425

Number of 3- or 4-piece bathrooms	3	1.72525	0.78144	1	7
Number of 2-piece bathrooms (toilet and wash basin)	3	0.46097	0.57808	0	4
Number of bedrooms	3	3.51554	1.08869	1	10
Number of multi car garages	3	0.42149	0.51323	0	3
Number of single car garages	3	0.30662	0.46960	0	2
Number of car ports	3	0.19402	0.39746	0	2
Pool (=1 if there is a pool, 0 otherwise)	3	0.01155	0.10684	0	1
Other buildings (=1 if there are other buildings, 0 otherwise)	3	0.09533	0.29369	0	1
Corner lot (=1 if the lot is at the corner of a street, 0 otherwise)	3	0.10412	0.30543	0	1
Waterfront lot (=1 if the lot is on the waterfront, 0 otherwise)	3	0.01777	0.13210	0	1
Reilly for parks larger than 50,000 square meters	7	35.09508	302.34953	0.15586	12686.22452
Reilly for parks between 2,000 and 50,000 square meters	7	5.12092	23.58490	0.05603	897.14276
Reilly for parks smaller than 2,000 square meters	7	0.07669	0.50439	0.00120	14.34686
Adjacent to a park (=1, 0 otherwise)	7	0.13668	0.34353	0	1
Reilly for farms with animals	4, 5, 6	1.90451	19.36042	0.06026	1002.45573
Reilly for farms without animals	4, 5, 6	6.97171	39.18529	0.16134	1694.97793
Distance (meters) to the ALR boundary if property is located within the ALR boundary, 0 otherwise	10	33.48121	184.41807	0	1657.48386
Distance (meters) to the ALR boundary if property is located outside the ALR boundary, 0 otherwise	10	617.79360	555.62314	0	3042.90310
Reilly for golf courses (multiplied by 1,000)	8	0.00149	0.00418	0.00008	0.16898
Adjacent to golf course (=1, 0 otherwise)	8	0.00484	0.06937	0	1
Distance to Victoria City Hall (km)	8	8.94066	6.73937	2.29488	30.67183
Distance to Pat bay highway (km)	11	2.11177	1.73142	0.00054	8.24230
Pat bay highway within 100 m (=1, 0 otherwise)	11	0.09198	0.28901	0	1
Distance to nearest standard school (km)	8	0.70449	0.48980	0.01359	3.68549
Standard school within 100 m (=1, 0 otherwise)	8	0.00947	0.09688	0	1
Distance to nearest recreational	8	2.09116	1.89975	0.06804	8.88096

centre (km)					
Recreational centre within 100 m (=1, 0 otherwise)	8	0.00089	0.02979	0	1
Distance to Victoria airport (in km)	8	17.04632	6.09687	0.97451	24.98897
Maximum elevation (metres)	9	44.14537	26.42494	0	170
Elevation difference	9	1.58541	4.23425	0	50
Real interest rate (%)	12, 14	1.61825	1.18898	0.31296	4.44841
Real GDP expenditure based Canada (billion (long scale) CA$)	13, 14	1.16039	0.06799	1.07658	1.26543

*For a description of the databases see Appendix 1. The numbers in this column refer to the database identifiers in Appendix 1.

Finally, the number of observations was reduced due to the spatial dependence in the model. In order to construct the spatial weighting matrix, properties cannot be incorporated in the analysis more than once. Therefore, if a property is sold more than once during 2000 to 2006, only the most recent transaction is included in the analysis. This refinement led to a total of 10,133 observations. The locations of these properties are indicated in Figure 2, which also shows the locations of parks and farmland on the peninsula. Because our data span seven years, we had to adjust prices, assessed values, GDP and interest rates for inflation. We used the Consumer Price Index (CPI) to make the appropriate adjustments as others have done in this situation (e.g. Cho, et al. (2006)).

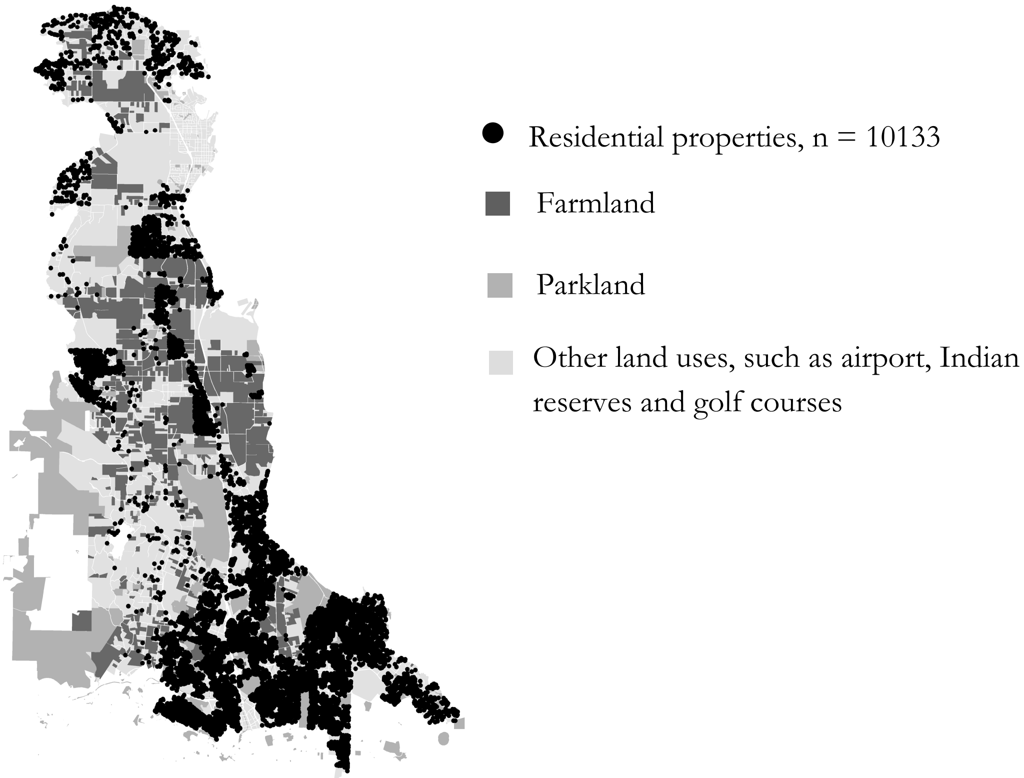

Figure 2 Land use and location of residential properties on the Saanich Peninsula.

4 Empirical results

4.1 Assessed versus sales values

First we consider whether or not there are any significant differences between actual transactions and assessed values. The correlation coefficient between assessed and actual sales values for our 10,133 observations is 0.88. Though this is rather high, the overlap is not perfect. Actual transaction values are generally higher and have a larger standard deviation than assessed values, as indicated in Table 2. This is also apparent from Figure 3 where histograms of both assessed and sales values are provided. The distribution of assessed values has a mean closer to the mode and fewer observations in the tails of the distribution compared to sales prices. Though BC Assessment's stated goal[3] is to have assessments match market prices, we believe the reason assessed values tend to be lower than market values is that the assessment authority wishes to avoid criticism and large numbers of appeals of assessments to reduce tax bills. Because BC Assessment uses sales prices as part of their formula to determine assessed values, we may also see less variation in the assessed values due to the fact that very expensive and very cheap properties are sold less often than average properties. Therefore, there are fewer such reference prices for BC Assessment to use compared to average properties.[4]

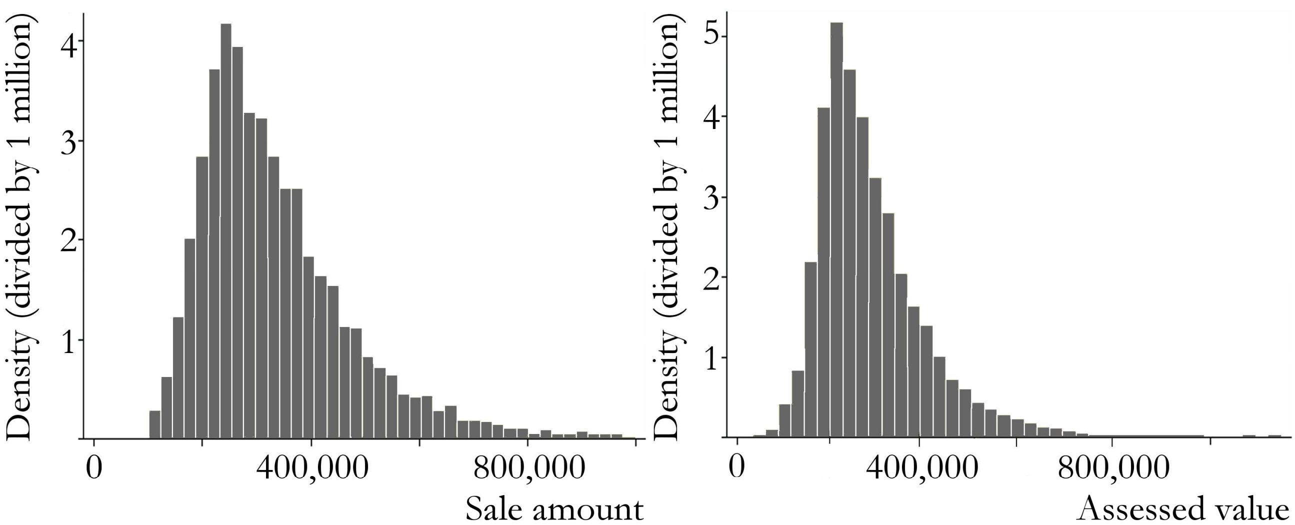

Figure 3 Land use and location of residential properties on the Saanich Peninsula.

In the SUR model, we partly correct for the difference between sales and assessed values by using a scaling factor (a) that minimizes $\sum_{i=1}^{n}(Assess_i - a \times Sale_i)^2$. This factor equals 0.81, so each

[3] See their website http://www.bcassessment.bc.ca/about/index.asp

[4] For instance, the lack of high property value benchmarks may suggest that assessors rate these properties closer to the average values than market prices would predict. There may be nonlinearities in prices for very large and luxurious houses and estates which are not captured well by BC Assessment's assessors.

assessed value was divided by 0.81. The corrected assessed values were then used in the SUR model with results presented in Table 3. A visual inspection of the parameter estimates in the SUR model indicates that all parameters have similar signs in the actual sales and assessed values equations, except for the dummy variable of adjacency to a golf course, the log of distance to the highway and the log of distance to the nearest recreational centre, but these have no significant impact on sales or assessed values.

Based on the SUR model, however, we must reject the hypothesis that all 35 parameters included in the model (excepting the intercept) are equal across the two equations. The Wald statistic is 420.98 and, under the null hypothesis (that all parameters are equal), this is distributed as a $\chi 2$ with 35 degrees of freedom. Therefore, we reject the null-hypothesis with near certainty. We also test for the parameters of particular interest – the Reilly indices for parks, farms and golf courses, adjacency dummy variables for parks and golf courses, and the distances to the ALR boundary. The Wald statistic for this test is 8.59 and is distributed as a $\chi 2$ with 10 degrees of freedom; under these assumptions, we accept the null-hypothesis that the parameter estimates are equal. (The p-value of the statistic is 0.57.) We conclude, therefore, that on first inspection the signs and sizes of estimated parameters look rather similar in the assessed and sales equation. However, they are not similar enough to assume that they are all the same in both equations. Yet, for the parameters of interest, the hypothesis that the estimated effects are the same is accepted.

Table 3 Estimation results for the spatial Seemingly Unrelated Regression (SUR).

Dependent variable	Sales value property (CA$ millions)		Adjusted assessed value property (CA$ millions)	
	Parameter	t-statistic	Parameter	t-statistic
EGLS estimation				
Log of the lot size (meters)	0.064851***	21.41	0.065666***	25.04
Effective year: the last major renovation of the property (year – 1900)	0.000568***	7.33	0.000237***	3.68
Log of the finished area (meters)	0.086742***	20.40	0.082719***	23.66
Number of 3- or 4-piece bathrooms	0.010232***	5.95	0.011233***	7.97
Number of 2 piece bathrooms (toilet and wash basin)	0.008051***	4.38	0.008646***	5.72
Number of bedrooms	-0.002884**	-2.67	-0.003538***	-3.98
Number of multi car garages	0.021264***	7.51	0.023177***	9.95
Number of single car garages	0.006476***	2.60	0.008508***	4.17
Number of car ports	0.002853	1.03	0.002956	1.30
Pool (=1 if there is a pool, 0 otherwise)	0.015698*	1.85	0.042155***	6.07
Other buildings (=1 if there are other buildings, 0 otherwise)	0.015142***	4.78	0.005232**	2.02
Corner lot (=1 if the lot is at the corner of a street, 0 otherwise)	-0.002801	-0.93	-0.003383	-1.37
Waterfront lot (=1 if the lot is on the waterfront, 0 otherwise)	0.334534***	39.31	0.318199***	43.91
Log of Reilly for parks larger than 50,000 square meters	-0.003162**	-2.65	-0.002322**	-2.05
Log of Reilly for parks between 2,000	-0.002640	-2.12	-0.002644**	-2.30

and 50,000 square meters				
Log of Reilly for parks smaller than 2,000 square meters	0.002368**	1.87	0.000277	0.23
Adjacent to a park (=1, 0 otherwise)	0.011378***	2.82	0.009521***	2.76
Log of Reilly for farms with animals	-0.018892***	-9.02	-0.017024***	-8.67
Log of Reilly for farms without animals	-0.001357	-0.87	-0.003341**	-2.27
Inverse squared distance (meters) to the ALR boundary if property is located within the ALR boundary, 0 otherwise	1.566763	0.67	0.026082	0.01
Inverse squared distance (meters) to the ALR boundary if property is located outside the ALR boundary, 0 otherwise	2.768818	1.38	2.724761	1.62
Log of Reilly for golf courses	0.011200***	5.26	0.009621***	4.57
Adjacent to golf course (=1, 0 otherwise)	0.001560	0.10	-0.001479	-0.11
Log of distance to Victoria City Hall (meters)	0.079979***	10.26	0.086910***	11.35
Log of distance to Pat bay highway (meters)	-0.00864	-0.50	0.001407	0.87
Highway within 100 m (=1, 0 otherwise)	-0.024874	-3.03	-0.015488**	-2.06
Log of distance to the nearest standard school (meters)	0.014787***	5.91	0.013165***	5.38
Standard school within 100 m (=1, 0 otherwise)	0.009155	0.83	0.012275	1.31
Log of distance to nearest recreational centre (meters)	-0.002415	-0.82	0.000078	0.03
Recreational centre within 100 m (=1, 0 otherwise)	-0.037487	-1.08	-0.008156	-0.28
Log of distance to Victoria airport (meters)	0.079422***	12.08	0.085155***	13.18
Maximum elevation (meters)	0.000395***	6.04	0.000523***	8.22
Elevation difference (meters)	-0.000328	-1.00	-0.000423	-1.51
Real Interest rate (%)	0.003126***	4.06	0.012003***	19.07
Real GDP expenditure based Canada (billions (long scale) of CA$)	1.104587***	81.64	1.039136***	93.92
Constant	-3.321660***	-30.26	-3.383954***	-31.44
R^2	0.5754		0.6289	
Adjusted R^2	0.5740		0.6276	
System R^2	0.4880		0.4880	
Number of observations	10133		10133	
Σ				
σ_1^2	0.0084			
σ_{12}	0.0045			
σ_2^2	0.0057			
MM estimation				
ρ	0.3363	30.08	0.4544	46.58

*** indicates significance at the 1%, ** at the 5%, and * at the 10% critical levels.

4.2 Impact of open space and the ALR

The impact of open space on property prices is rather mixed (see Table 3). Residents assign positive value to being adjacent to open space provided by parks and they also enjoy small open spaces in their neighborhood. Small parks are frequently used by parents if there is a children's playground and by pet-owners to exercise their dogs. Larger parks, which frequently provide recreation benefits (such as hiking, picnicking and wildlife watching), are also valued but these parks are often used by citizens outside the immediate neighborhood who access the park with a car. Larger parks therefore result in negative externalities associated with noise, parked cars, and so on. This explains the finding of non-significant signs for the medium sized parks and a significant negative impact of the Reilly index for large parks.

The impact of nearby farms on residential properties is negative. The parameter for the Reilly score for farms with animals is negative indicating that the detrimental impacts of noise, odors, dust and other negative spillovers are more prominent than the positive, open-space attributes of farmland. The Reilly index for non-animal farms has a negative impact on residential property values, though it is insignificant in the market sales equation. This may indicate that there is a lot of variation in the value people attach to open space provided by farmland, perhaps reflecting the variation in the types of externalities generated by agricultural activities. Another interpretation of these findings is that, although property owners value open space provided by agriculture, they do not have confidence that the farmland will remain in agriculture, or even worse, that farmland could be converted to a less desirable use in the future (e.g, a shopping center, high-rise apartment, industrial park). Nelson (1992) hypothesized that, if buyers of residential properties expect farmland to remain in agriculture, an open space premium should be observed, but if buyers expect that neighboring land will be developed in the future, no such premium should exist. Given that speculation is happening on the Saanich Peninsula, this is not an implausible explanation.

The two variables that indicate the distance to the ALR boundary from inside and outside the ALR are both insignificant, indicating that the ALR boundary has no impact on residential property prices. The reason is that proximity to farmland is already taken into account directly in the model.

The final open space indicators are provided by the Reilly index for golf courses and whether the property is adjacent to a golf course. While the Reilly score has a significant and positive effect on the sales prices of properties, the adjacency dummy is not significant (and even negative but still not significant for assessed values). This is contrary to the findings of Nicholls and Crompton (2007) who found positive impacts on properties that were adjacent to golf courses. The insignificance of this variable in our model may result from negative spillovers caused by parked cars, noise from the clubhouse, and so on. On the other hand, golf is a popular recreational activity, especially with older demographics (which comprise a significant proportion of the area's population). Golf courses nearby seem to be desirable as evidenced by the positive impact on property prices by the Reilly for golf courses. Both distance to the golf course and the number of holes matter in the Reilly index. Therefore, we can conclude that golf courses are less attractive land uses as providers of open space than as providers of recreational activities. This is contrary to findings of Asabere and Huffman (1996) who found a positive impact of adjacency to golf courses, but a negative impact of the reciprocal of distance to the entry gate of the golf course.

4.3 Spatial allocation

It is important to be aware of potential problems concerning multicollinearity of the explanatory variables in hedonic pricing models. In the current data we find that some of the explanatory variables are correlated. This correlation is mainly due to the spatial location of properties and the time properties were developed. For example, newer and larger properties with multi-car garages instead of single-car garages are found farther north on the peninsula. Properties on hill tops were generally developed later than properties at lower elevation levels. Newer properties tend to be located farther out from the city centre, in areas where population rates are (currently) low, and tend to be more spatially distant from standard schools and recreational centers.[5] However, we do not find symptoms of severe multicollinearity in our data, such as low significance of explanatory variables and high R^2s at the same time. Therefore, we will discuss individual findings separately to illuminate the impact that the correlation between variables has in our model.

Examining the findings of other studies (e.g. Ready and Abdalla (2005)) we would expect that distance to Victoria would be inversely related to residential property prices because people value a shorter commute to work. Other spatial features, such as the Swartz Bay ferry terminal (which provides access to the mainland), the main commuting corridor (the Patricia Bay highway) and schools, are expected to have a positive effect on sales price. However, we find a negative effect of proximity to the main business district of Victoria. There are two explanations for this. The first is that the distance to the Swartz bay ferry terminal and the distance to Victoria are almost perfectly negatively correlated. The ferry terminal is located at the northern tip of the peninsula and the city centre is located at the southern end. These are opposite effects, and currently the positive effect of Swartz bay seems to be stronger than the positive effect of being close to the city centre. Another explanation is that in general more expensive properties are built farther north on the peninsula, both farther away from the city centre and most other facilities. This automatically influences the prices in different regions of the peninsula. Furthermore, being within a region of 100 meters from the highway has a negative effect on property prices, due to negative externalities of the highway such as noise and pollution. Proximity to standard schools also seems to have a significant negative impact on property values perhaps due to the vandalism and loitering associated with some schools.

We did not only incorporate spatial explanatory variables in our model, we also included spatial error dependence. Sure enough, we did find evidence for this type of spatial dependence, meaning that the error terms of relatively close properties are correlated (though error terms of properties which are relatively farther away from each other do not show the same effects). This

[5] Presumably, once the density is high enough and the population demographics demand it, schools and recreation centers will be built in areas of new subdivisions.

type of correlation is higher for assessed values than for sales values, which makes sense as assessments specifically take neighboring property values in account while sales prices don't.

4.4 Housing characteristics

Most housing characteristics in our model have the expected sign that past literature and intuition dictates. Lot size, finished area and the number of bathrooms all positively indicate a more valuable house as does the effective year. Beyond size and newness, there is a puzzling finding though. One would expect the number of bedrooms to positively affect housing value as they can be seen as indicators of property size and degree of luxury. However, we found negative effects. Perhaps buyers do not regard a bounty of bedrooms as positive because, for a given house size, they prefer fewer but larger bedrooms as opposed to more numerous and smaller rooms.

The impact of garages is fairly predictable with multi-car garages being more highly valued than single-car garages which are more highly valued than car ports. Car ports are more valued than no parking structures (though this is not significant). Also as expected, water front lots are significantly more valued than non-water front, owing to the views and the recreational opportunities. Similarly, the presence of other buildings or a pool on the lot adds to the overall property value. Though they tend to be slightly larger, corner lots are less private and experience more traffic and noise externalities, and so it is not surprising that they are not valued significantly different than non-corner lots.

4.5 Other characteristics

With respect to elevation levels, we find that properties that are located higher up on a hill sell and are assessed for more than similar properties located at lower elevations. Hilltop locations in this area afford views of farmland and the ocean and buyers are willing to pay a premium for these properties. Elevation differences per property have a slightly negative though non-significant effect.

Because our data span about seven years, we included macroeconomic information (interest rates and GDP) to reflect the general state of the economy. To correct for inflation over this time period, both variables where adjusted by the Consumer Price Index (CPI). Real GDP has a significantly positive impact on property prices, indicating that the higher GDP rises, the higher the demand for houses is, which directly translates into increases in property prices. The impact of interest rates is also positive, which seems counterintuitive as mortgage rates and interest rates are linked and higher mortgage rates mean housing is less affordable. However, a possible explanation could be that the real interest rates were not very high during this period (varying between 0.31% to 4.45%). Therefore, paying a slightly higher interest rate did not scare people off from buying properties as the rate of increase in housing prices more than compensated for the money spent on interest payments on loans and mortgages. Another explanation could be that in times of recession the central banks tend to decrease their interest rates.

5 Conclusion and discussion

In this research we investigate whether assessed values were good proxies for actual sales values in a hedonic pricing model that we use to estimate the value of open space on the Saanich Peninsula, British Columbia, Canada. In particular, open space provided by farmland, parkland and golf courses is examined and also open space under semi-permanent protection in the Agricultural Land Reserve.

A spatial Seemingly Unrelated Regression model is estimated to construct a test statistic for the comparison of the parameters in the assessment and sales equations. The results indicate that although not all parameters in the assessment and sales equations are the same, we accept the hypothesis that the impacts of open space on property values are valued in the same way in both equations. However, we do observe some differences between the distributions of assessed versus sales values. Specifically, we observe that average assessed values are lower than average sales values and the variation in assessed values is smaller than in the sales prices. To overcome the difference in means, we divided the assessed values by a factor 0.81, resulting from the factor, *a,* that minimized [12]. These findings imply that assessed values may be used in place of market values as the dependent variable in hedonic pricing models if one is interested in the impact of open space on property values. Though it may be necessary to scale the distribution of assessed values. To do this, average sales values can be used to scale assessed values. In our research the factor assessed / sales values results in 0.84, which is rather close to the factor we used (0.81). Using average sales values is not necessarily an insurmountable problem because these values are much more accessible than parcel-by-parcel information. Furthermore, it is important to note that property assessment systems may be very different in other jurisdictions in North America or Europe which could affect the validity of applying these results to other locations.

With respect to open space we find somewhat mixed results. The reason is that open space in all three capacities (nature, agriculture and golf courses) imposes both positive and negative externalities on surrounding residential properties. Properties adjacent to nature parks sell for a premium, but people seem to prefer smaller parks instead of larger parks close to their homes. The smaller parks can be used for short term recreation but do not cause the inconveniences that large parks do when people visit them by car. Furthermore, open space provided by agricultural land is not valued positively by residents, at least as far as housing prices go. The negative externalities associated with farmland seem to override the positive externalities, especially for animal farms. The uncertainty surrounding future land uses of undeveloped land may also play a part in this finding. Finally, we find that golf courses provide positive benefits for residents. Residents pay higher prices for houses that are located closer to (larger) golf courses, although having a house adjacent to a golf course does not increase its value ceteris paribus.

The inclusion of spatial autocorrelation in the model is very important. Spatial autocorrelation was taken into account in both the sales and the assessment equation with the Method of Moment estimator as specified by Kelejian and Prucha (2004). We found highly significant positive spatial correlation between the error terms of properties that are located close to each other. With respect to spatial explanatory variables, we found that some are correlated with property characteristics. Newer properties are built further north on the peninsula, on higher elevation levels, are larger on average and more often come with multi car garages.

This research provides a geographic example of how housing prices respond to open space at the urban fringe and how agricultural land preservation systems (in this case zoning) interact with price. Answers to these questions can be used to inform urban planners, geographers, policy makers and others about issues related to taxes, urbanization and the preservation of agricultural land and parkland.

Appendix 1

Table A.1 Data sources used in this research.

Nr	Name database	Data source	Year data
1	Sales history	LandCor	1974-2006
2	Assessment information	LandCor (originating from BC Assessment)	2000-2006
3	Property information	LandCor	2006
4	Actual use codes	BC Assessment	2006
5	Cadastral information	Capital Regional District (CRD)	2005
6	Cadastral information	Ministry of Agriculture	2004
7	Nature parks	Capital Regional District (CRD)	2006
8	Points of interest (schools, airport, Victoria city centre, golf courses, ferry terminal, recreational centers)	Capital Regional District (CRD)	2005
9	Elevation data	Municipalities (Saanich, Central Saanich and North Saanich)	2005
10	ALR	BC Assessment (originating from Agricultural Land Commission (ALC))	2005
11	Road Network	Statistics Canada	2005
12	Interest rates Canada	Bank of Canada	1951-2005
13	GDP annual data Canada	Statistics Canada	1961-2005
14	CPI Canada	Statistics Canada	1981-2006