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, BC include open-space premiums for farmland or parks or both, and to determine if using assessed values instead of market prices of the property result in the same findings. We estimate a SUR (Seemingly Unrelated Regression) 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.

Key words: Hedonic pricing models, Assessed property values, Value of open space, Geographical Information System, Reilly, GMM, Spatial dependence

1. Introduction

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

Open space amenities are provided by farmland, nature parks and golf courses. However, these providers of open space also impose negative externalities on surrounding residential properties. Examples of positive externalities are attractive views and recreational opportunities. Negative externalities differ for different providers of open space. Those associated with agriculture can be dust, noise and smell. For golf courses and nature parks noise and parked cars are examples of negative externalities. Hedonic pricing models can be used to determine the net effect of externalities for each of the open space providers.

Hedonic pricing models require actual property transaction data as inputs, because these values reflect property characteristics which can then 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.

The current research investigates 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 SUR (Seemingly Unrelated Regression) 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*, et al.*, 1999) of the spatial parameters in both equations (Kelejian*, et al.*, 2004).

Using assessed 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*, et al.*, 1975).

A variety of authors have estimated open space premiums using a proxy variable to measure open space benefits. Irwin (2002) uses 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. 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 and farmland areas 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 a study of retail markets (Reilly, 1931).

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 centres on farmland 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 metres). Thus, we specify $R_i = \sum_{j=1}^{J} \left(S_j \big/ D_{ij}^2 \right)$, 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 meters squared). Thus, we can take all parks and farmland areas 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 1 for 9-hole golf-courses and 2 for 18-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 seemingly unrelated regression (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 their error terms will be correlated.

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

$$P_m = X\beta_m + \varepsilon_m,\ \varepsilon_m = \rho_m W_m \varepsilon_m + \mu_m,\ \mu_m \sim N(0,\sigma_m^2) \ni \left(I_N - \rho_m W_m\right)\varepsilon_m = \mu_m, \qquad [1]$$

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. The characteristics of properties are classified into several main categories: lot size, characteristics of the residence/structure, neighbourhood features, and location descriptors (Taylor, 2003).

We assume that $Cov(\mu_{1i}, \mu_{2j}) = \sigma_{12}$ for i=j and $Cov(\mu_{1i}, \mu_{2j}) = 0$ for i≠j. If we define $B_m = I_N - \rho_m W_m$ and $\varepsilon_m = B_m^{-1}\mu_m$, the overall error structure becomes:

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

Although, it is possible to use maximum likelihood to estimate a model that includes both SUR and spatial dependence (see Anselin (1988)), we have more than 10,000 observations for the period 2000-2006 which is simply too much for maximum likelihood estimation of spatial models. Therefore, we use the stepwise generalized spatial three-stage-least-squares estimator (GS3SLS) developed by Kelejian and Prucha (2004). This procedure uses the method of moments (MM) 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. After obtaining parameter estimates we 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.

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. W_1 and W_2 are the same as they are based on the five nearest neighbours to each observation, with elements for each of the five-nearest neighbours 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.

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 B.C. 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. 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).

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

B.C. 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, which could affect the validity of applying these results to other locations.

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 B.C. Assessment) enter the equation.

Because properties at the urban-rural fringe are the main interest of this paper, we include properties in the municipalities North Saanich, Central Saanich and Saanich in our analysis. Properties in the city of Victoria are not included in the current research as this area lies south of Saanich and does not abut any farmland. The data consist of actual transactions and assessments of residential properties for the period 2000 to 2006. The LandCor and B.C. Assessment databases record 19,246 transactions for 2000-2006 for which both sales and assessed values are available. The data were filtered so that only 'single-cash' transactions are included. Next, we incorporated only detached family dwellings in the analysis. 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 was further reduced because measures of lot size differed between two datasets. Observations were removed from consideration if the measures differed by more than 100 m^2. Properties without three or four piece bathrooms were removed as well. 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 2000-2006, only the most recent transaction is included in the analysis. This refinement led to a total of 10,133 observations.

4. Empirical results

First we consider whether or not there are any significant differences between actual transactions and assessed values, using a test statistics based on the SUR model to test for differences. 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. Though B.C. Assessment's stated goal[1] 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 B.C. 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

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

very expensive and very cheap properties are sold less often than average properties. Therefore, there are fewer such reference prices for B.C. Assessment to use compared to average properties.

In the SUR model, we correct for the difference between sales and assessed values by using a scaling factor (a) that minimizes $\sum_{i=1}^{n}(Assess - a \times Sale)^2$. This factor comes out as 0.81, so each assessed value was divided by 0.81. The corrected assessed values were then used in the SUR model with results presented in Table 1. 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 variables have no significant impact on sales or assessed values.

Table 1. Estimation results for the spatial Seemingly Unrelated Regression (SUR)

Dependent variable	Sales value property ($C millions) adjusted for inflation			Adjusted assessed value property ($C millions) adjusted for inflation		
	Parameter		t-stats	Parameter		t-stats
EGLS estimation						
Log of the lot size (meters)	0.064851	***	21.4097	0.065666	***	25.0353
Effective year: the last major renovation of the property (year – 1900)	0.000568	***	7.3301	0.000237	***	3.6750
Log of the finished area (meters)	0.086742	***	20.4018	0.082719	***	23.6633
Number of 3- or 4-piece bathrooms	0.010232	***	5.9525	0.011233	***	7.9720
Number of 2 piece bathrooms (toilet and wash basin)	0.008051	***	4.3814	0.008646	***	5.7215
Number of bedrooms	- 0.002884	**	-2.6650	-0.003538	***	-3.9798
Number of multi car garages	0.021264	***	7.5117	0.023177	***	9.9512
Number of single car garages	0.006476	***	2.5965	0.008508	***	4.1655
Number of car ports	0.002853		1.0313	0.002956		1.3043
Pool (=1 if there is a pool, 0 otherwise)	0.015698	*	1.8458	0.042155	***	6.0738
Other buildings (=1 if there are other buildings, 0 otherwise)	0.015142	***	4.7761	0.005232	**	2.0176
Corner lot (=1 if the lot is at the corner of a street, 0 otherwise)	- 0.002801		-0.9297	-0.003383		-1.3700
Waterfront lot (=1 if the lot is on the waterfront, 0 otherwise)	0.334534	***	39.3144	0.318199	***	43.9050
Log of Reilly for parks larger than 50,000 square meters	- 0.003162	**	-2.6540	-0.002322	**	-2.0542
Log of Reilly for parks between 2000 and 50,000 square meters	- 0.002640		-2.1195	-0.002644	**	-2.2972
Log of Reilly for parks smaller than 2000	0.002368	**	1.8652	0.000277		0.2253

square meters						
Adjacent to a park (=1, 0 otherwise)	0.011378	***	2.8170	0.009521	***	2.7589
Log of Reilly for farms with animals	-0.018892	***	-9.0213	-0.017024	***	-8.6711
Log of Reilly for farms without animals	-0.001357		-0.8662	-0.003341	**	-2.2728
Inverse squared distance (meters) to the ALR boundary if property is located within the ALR boundary, 0 otherwise	1.566763		0.6679	0.026082		0.0134
Inverse squared distance (meters) to the ALR boundary if property is located outside the ALR boundary, 0 otherwise	2.768818		1.3849	2.724761		1.6193
Log of Reilly for golf courses	0.011200	***	5.2604	0.009621	***	4.5708
Adjacent to golf course (=1, 0 otherwise)	0.001560		0.0978	-0.001479		-0.1087
Log of distance to Victoria City Hall (meters)	0.079979	***	10.2620	0.086910	***	11.3541
Log of distance to Pat bay highway (meters)	-0.00864		-0.4978	0.001407		0.8677
Highway within 100 m (=1, 0 otherwise)	-0.024874		-3.0334	-0.015488	**	-2.0594
Log of distance to the nearest standard school (meters)	0.014787	***	5.9096	0.013165	***	5.3807
Standard school within 100 m (=1, 0 otherwise)	0.009155		0.8319	0.012275		1.3147
Log of distance to nearest recreational centre (meters)	-0.002415		-0.8181	0.000078		0.0268
Recreational centre within 100 m (=1, 0 otherwise)	-0.037487		-1.0773	-0.008156		-0.2754
Log of distance to Victoria airport (meters)	0.079422	***	12.0778	0.085155	***	13.1826
Maximum elevation (meters)	0.000395	***	6.0413	0.000523	***	8.2245
Elevation difference (meters)	-0.000328		-1.0028	-0.000423		-1.5112
Real Interest rate (%)	0.003126	***	4.0594	0.012003	***	19.0720
Real GDP expenditure based Canada (billions (long scale) of CA$)	1.104587	***	81.6363	1.039136	***	93.9249
Constant	-3.321660	***	-30.2553	-3.383954	***	-31.4429
R-squared	0.5754			0.6289		
Adjusted R-squared	0.5740			0.6276		
System R-squared	0.4880			0.4880		
Number of observations	10133			10133		
Σ	$\sigma_1^2 =$ 0.0084		$\sigma_{12} =$ 0.0045	$\sigma_2^2 =$ 0.0057		
MM estimation						
ρ	0.3363		30.0842	0.4544		46.5766

*** significant at 1%. ** significant at 5%. * significant at 10%.

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), is distributed as a χ^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 χ^2 with 10 degrees of freedom; under these assumptions, we could not reject the null-hypothesis that the parameter estimates are equal.

4.1. Impact of open space and the ALR

The impact of open space on property prices is rather mixed (see Table 1). 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 one's 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 which may seem counterintuitive at first given that open space has been found to usually carry a premium. The parameter for the Reilly for farms with animals is negative indicating that the detrimental impacts of noise, odors, dust and other negative spillovers are more prominent than positive impacts such as open space and a country feeling. The Reilly for non-animal farms is also negative, though it is insignificant in the sales equation of market values. This may indicate that there is variation in the value people attach to open space provided by farmland (perhaps reflecting the variation that exists in farmland operations which result in the negative externalities). 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 they are concerned that farmland could be developed into a land use that is undesirable (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. However, if buyers expect that neighbouring land will be developed in the future, no such premium should exist. Given that speculation is happening on farmland on the Saanich Peninsula (Cotteleer, et al., 2007), 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. This also may mean that people think this boundary is not credible.

The final open space indicators are provided by the Reilly for golf courses and the adjacency to golf courses. While the Reilly has a significant and positive effect on the sales prices of properties, the adjacency dummy is not significant (and is even negative, though still insignificant, 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 also be caused by negative spillovers from the adjacent land use such as parked cars, noise from the golf clubhouse, etc. 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 then as providers of recreational activities.

4.2. 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. However, we do not find symptoms of 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.

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 island. Farther away from the city centre of Victoria 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. Although we found a slight (non-significant) positive effect if schools are on walking distance (within 100 meters) from the property.

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 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.

5. Conclusion and discussion

In this research we investigated whether assessed values were good proxies for actual sales values in a hedonic pricing model that was used 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 and the location in relation to the Agricultural Land Reserve were analyzed. A spatial Seemingly Unrelated Regression model was estimated to construct a test statistic for the comparison of the parameters in assessment and sales equations.

The results indicate that although not all parameters in the assessment and sales equations are the same, we did not reject the hypothesis that the impacts of open space on property values are valued in a different way in both equations. However, we did observe some differences between the distributions of assessed versus sales values. Moreover, we observed that average assessed values were lower than the average sales values and the variation in assessed values was smaller than in the sales prices. To overcome the first difference, we increased the assessed values by a factor 1.23. To generalize these findings, we would recommend that at least average sales and assessed values are compared if one intends to use assessed values as the dependent variable in a hedonic pricing model. But this is not necessarily a problem, because average sales values are much more accessible than individual sales observations. 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.

The inclusion of spatial autocorrelation in the model was 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 error terms of properties that were located close to each other. With respect to spatial explanatory variables, we found that these were correlated with property characteristics. Newer properties were built further North on the peninsula and on higher elevation levels. And these properties were on average larger and contained more often multi car garages.

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 are valued higher. Furthermore, people rather have smaller parks instead of larger parks close to their homes. The smaller parks can be used for short term recreation but do not cause as much inconvenience because less people visit the smaller parks by car. Furthermore, open space provided by agricultural land is not valued positively by residents. The negative externalities associated with farmland such as smell, noise and dust, overrate the positive externalities, such as open space, especially for animal farms. Finally, we found 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 is also associated with nuisances.

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