Maintaining Public Goods: Household Valuation of New and Renovated Local Parks

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Selected Paper prepared for presentation at the Agricultural & Applied Economics Association's 2013 AAEA & CAES Joint Annual Meeting, Washington, DC, August 4-6, 2013.

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Abstract

This study re-examines household valuation of local parks to assess the values afforded to specific amenities contained within parks and how those amenities change over time. A large body of existing literature studying local parks has found single family residential homeowners are surprisingly willing to pay very little to live in close proximity to these parks. Building on this research, we hypothesize that these results are driven by bundling both positive and negative features of local parks into a single amenity and that these amenities are likely to degrade over time reducing their value. We implement property fixed effects models to investigate if unbundling park attributes leads to significantly different willingness to pay insights relative to much of the existing literature using a unique dataset on park renovations. Using renovation data and a rich set of housing transactions, we further explore whether the values placed on specific park attributes change over time, consistent with a depreciating public asset.

Keywords: Hedonic; Open space; Local parks; Renovation; Repeat sales;

JEL Codes:

* This research was partially supported by the National Science Foundation award CBET-1160961.

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1. Introduction

The recent economic downturn across the United States has severely constrained the budgets of many local municipalities tasked with providing local public goods. One common type of locally provided public good is the provision of open space through local parks and the playgrounds and other amenities associated with those parks. While surveys of voter referenda on open space preservation consistently find that the public is willing to vote for public open space (Kotchen and Powers, 2006), the empirical literature on the valuation of local public parks is at best mixed (McConnell and Walls, 2005). In addition to their provision, local public parks also require routine maintenance, further taxing the limited budgets of local authorities. As a result, understanding the value attributed to those parks when renovated or maintained is important for sound policymaking and planning by local authorities. This paper investigates two questions that can help to explain the mixed results of local park valuation in the broader literature. First, is the absence of statistically significant park value in many previous studies likely a consequence of heterogeneity in local park amenities; and, second, does the value of park amenities vary with time consistent with a public asset that may be depreciating in value.

Local parks are routinely incorporated into long-run planning and zoning associated with expected population changes and new housing construction by local land use planners. These parks frequently contain multiple specific amenities such as playgrounds, ball fields, courts, and trails, among others. Each of these amenities requires different types of maintenance and is likely to be viewed differently by the public.

Playgrounds are one of the most common amenities contained in local parks and are estimated to have an engineering lifespan of approximately 20 years (The Maryland-National Capital Park and Planning Commission, 2013) before needing replacement or major renovation. In addition to major renovations and replacement, routine maintenance such as re-mulching is needed to maintain safety and functionality. These routine maintenance activities come at a significant cost to local municipalities, particularly when a single municipality is responsible for many parks.[1] As a result, there is a need to provide estimates of the value of renovations and maintenance to not only local parks as a whole, but the specific amenities within local parks to aid policymakers in deciding the extent and timing of these expenditures.

Combining data on single family residential transactions assembled for Baltimore County, Maryland spanning the years 2000 through 2007, with detailed data provided by the Baltimore County Parks and Recreation Department on park renovation activities and costs, we estimate a series of hedonic models to explore household valuation of local park attributes, with a specific emphasis on playgrounds. We control for potential unobservable factors that may be correlated with local park amenities in traditional cross-sectional analysis by exploiting time variability in renovations to estimate property fixed effects models. Further, our large sample of homes and relatively long time period of sales in the Baltimore metro region helps us to limit concerns about sample selection in focusing our study on homes with multiple sales.

Using detailed renovation data allows us to examine household valuation of specific maintenance dimensions of parks, such as playground upkeep and renovation. We use the

[1] For example, the average cost for each playground renovation is $23,045.49.

associated renovation cost data to provide an approximate cost-benefit analysis for several of these maintenance and renovation activities. Given the large number of renovation types and local park amenities, we carry out an internal meta-analysis to determine the sensitivity of our results to different assumptions on model specification. Previewing our findings, we find that a cross-sectional hedonic model with an aggregate indicator for renovations that does not distinguish among types of amenities is insufficient to determine the effects of renovations on nearby home sale prices. In contrast, with property fixed effects models we find homes within one mile of a park have a positive willingness to pay for playground replacements and field renovations, while lighting and court renovations are associated with a negative willingness to pay. These willingness to pay values decrease in magnitude as the number of years since renovation increase, and all renovations, with the exception of playground replacements, become insignificant four years after the renovation is complete.

The next section of the paper briefly reviews the literature on local public parks. Section three presents our econometric model. Section four discusses data, and is followed by a discussion of our hedonic and internal meta-analysis results in section five. Lastly, section six presents a discussion of costs and benefits associated with local public park maintenance and renovation, and section seven concludes.

2. A Review of Local Public Open Space

The hedonic method is frequently used to determine the value of urban and suburban parks. Rosen (1974) and Lancaster (1966; 1979) introduced the hedonic method as a tool for measuring the value of non-market goods. This method, in addition to increased computing power and access to large housing data-sets, has been a major impetus for the recent increase in non-market valuation research on open space. While recent papers have used similar hedonic methods to study the value of public parks, the results are not consistent across studies. For example, Boltizer and Netusil (2000) and Lutzenhiser and Netusil (2001) use the same data for Portland, Oregon, but differ on how parks are categorized. As a result, the studies find opposite results on the effect of urban public parks on house values. This difference in the sign of park value, through conflicting park definitions, is evidence that the value of parks may be sensitive to the treatment of park attributes and general characterizations.

To credibly estimate the value of local parks, one must confront the potential for omitted variables that are correlated with the local park amenities one wishes to value. One approach to control for these unobservables is through the use of repeat sales and property fixed effects models (Palmquist, 1982). These approaches control for omitted variables, albeit at the potential cost of introducing selection concerns in small samples, and obtain identification by exploiting time-varying changes in the amenities of interest. Two examples of this approach applied to hedonics studying land use are Kousky (2010) who uses a repeat sales model, in addition to a property fixed effects model, to explore the effect of the 1993 Mississippi and Missouri Rivers flood on home prices near St. Louis, MO; and Parsons (1991), who investigates the effect of development restrictions in the Chesapeake Bay area of Maryland. In both of these studies, attention has focused on singular events generally occurring over a short time period rather than more dynamic events such as the ongoing renovation of discrete park amenities, as is the focus of this paper.

Open space and local parks are almost universally included in local planning and zoning activities. When put to a vote of the public, there is a large demand and significant public support for acquiring and maintaining these amenities (Kotchen and Powers, 2006). Despite this enthusiasm, the value added of increased proximity to existing open space, specifically local parks, is generally found to be small, which creates a puzzle as to why there is such support for these activities if they are of relatively little value to homeowners.[2] A majority of the existing literature on open space valuation has been framed in the context of existence value of the open space as a whole, and has not agreed on the sign of value for local public park proximity (e.g. Irwin, 2002; Smith et al. 2002; Anderson and West, 2006). To explain some heterogeneity in open space valuation, select studies disaggregate park value through neighborhood density and type. Acharya and Bennett (2001) use indices of land use surrounding a household to determine the value of open space for a given household. They find that nearby open space has a positive effect on the value of a house, but the rate of increase is a decreasing function of open space amount. In addition, other authors have addressed the possible problems resulting from omitted spatial characteristics (Irwin and Bockstael, 2001; Cheshire, 1995). Despite the large and growing body of literature on local public parks there has been little work that attempts to disentangle the value of the attributes that make up these open space features, or how valuations of those features change over time as the features age. Understanding how the components of a local park are valued and how those values change over time may help provide additional insights into the frequently small values afforded local public parks in much of the existing literature.

[2] McConnel and Walls (2005) provide an overview of hedonic paper on public parks. Generally, the estimated value of being near a park has been small.

3. Econometrics

Local public goods have long been known to comprise important components of the bundle of housing attributes and services afforded households who locate near those goods. As such, the study of local public goods has frequently taken the form of first-stage hedonic analysis (Rosen, 1974). This model is derived from a utility maximization problem where a households' utility is defined to be:

(1) $$U_k = U(H_i, N_j, O_{jt}, b, \alpha_k)$$

where k indexes a household, i indexes a house, t indexes time, and j is an index for neighborhood. H is a vector of structural housing attributes, N is a vector neighborhood attributes and public goods common to an area, O_{jt} is a vector of local park attributes which vary by location and time, as a function of renovation and maintenance, b is a numeraire good, and α_k are preference parameters.

The result of utility maximization of equation (1) subject to a budget constraint gives the well-known first-stage hedonic price function given as:

(2) $$P_i = f(H_i, N_j, O_{jt})$$

where the functional form used is specified by the researcher. Following the discussion in Cropper et al. (1988), who show linear, semi-log, and log-log hedonic specifications produce the lowest mean estimation errors, and the discussion in Kuminoff et al. (2010b), we experimented with a variety of function forms shown in Appendix 1, and ultimately settled on a semi-log specification for our subsequent analysis given by:

(3) $$\ln P_i = \beta_o + \beta_H H_i + \beta_N N_j + \delta_O O_{jt} + \epsilon_{ijt}$$

Estimation of equation (3) proceeds by assuming an idiosyncratic error, ϵ_{ijt}, and is subject to potential errors due to unobservable spatial attributes that may be in this error term and are correlated with the key open space attributes of interest O_{jt} and prices. Irwin and Bockstael (2001) discuss possible errors from the use of a hedonic function to estimate the value of open space and find ordinary least squares estimates may be biased when the unobserved open space surrounding a house is correlated with its value. A common approach to this problem is the inclusion of spatial fixed effects designed to capture time-invariant sources of unobservables in an area (e.g., Abbott and Klaiber, 2010; Abbott and Klaiber, 2011). However, the use of spatial fixed effects alone may not fully account for other sources of unobservables, particularly those which are idiosyncratic to specific houses.

To address house and spatially time-invariant sources of unobservables we estimate a property fixed effects variation of (3) to exploit the large dataset of transactions in Baltimore County, which includes numerous repeat sales of the same homes as well as time-varying measures of the amenities of interest. As most housing attributes are assumed constant across time, econometric identification is obtained from time varying attributes, including our measures of park renovations. While fixed effect models have the advantage of removing unobservables, they potentially represent a non-representative sample of the housing market because only homes sold more than once are included in the data. To mitigate this selection effect, we employ a large dataset of transactions over many years as described in the data section that follows.

Our baseline property fixed effects model is an amended version of equation (3) that includes house specific fixed effects as follows:

(4) $$\ln P_{it} = \beta_o + \beta H_i + \gamma N_j + \delta_O O_{jt} + \xi_i + \epsilon_{ijt}.$$

In addition, we altered the notation of subscripts slightly to make clear that house i sells in time period t, and capture time-constant unobservables associated with house i through the fixed effects ξ_i. This model is similar to that estimated by Kousky (2010), and applied to the effect of severe floods on floodplain property values where identification comes from differences in house prices and attributes across sales of a single property. As such, time constant attributes of both house and neighborhoods are captured in the property fixed effects and only time varying attributes are identified, which in our application are measures of park renovations and maintenance activities. One advantage of this specification over the repeat sales model is the ease of handling more than two sales of a single property when one considers that open space amenities may degrade over time.[2]

To investigate the time consistency of park benefits, we also estimate additional variations of (4) that include time interactions with renovations to measure the length of time since renovation at each sale. These specifications are given by:

(5) $$\ln P_{it} = \beta_o + \beta_H H_i + \beta_N N_j + \delta_{Ot} O_{jt} T_t + \xi_i + \epsilon_{ijt}$$

where O_{jt} is a park amenity renovated or maintained at location j in period t, and T_t is a measure of years since renovation indexed by t. A positive coefficient on the renovation time interaction term, δ_{Ot}, indicates the renovation is associated with a positive willingness to pay at that point in time. In addition to the dummy variable model in (5) for each interaction, we also estimate a more parsimonious model using inverse time since renovation for each amenity given as:

[2] A repeat sales model is presented in Appendix 2. The use of property specific fixed effects comes at a greater loss of degrees of freedom compared to the repeat sales model, but allows us to more easily consider more than two sales of a single property.

(6) $$\ln P_{it} = \beta_o + \beta_H H_i + \beta_N N_j + \delta_O O_{jt} T_t^{-1} + \xi_i + \epsilon_{ijt}$$

Both models measure the depreciation effect through time, but the former allows us to determine when the effect of renovation is no longer present. We experimented with varying cutoffs in which we truncate the interaction effect with time, and determined four years is the optimal time cut-off.[4]

In addition to investigating the bundled nature of park amenities and the time decay of the value of these amenities, we are also interested in determining if our results are robust to omitted variables within our specification. Following Banzhaf and Smith (2007) and Kuminoff et al. (2010a), we perform an internal meta-analysis to conclude if our results are robust to the choice of park attributes included in our specification. The internal meta-analysis allows us to take a uniform distribution of our renovation variables to estimate the willingness to pay estimates from a multitude of models containing varying compositions of the renovations studied. These estimates, when aggregated, show the sensitivity of our results to differences in specification of renovation variables. Using the meta-analysis provides a robustness check to our estimates, showing the spread of willingness to pay estimates when different renovations variables are included or excluded.

4. Data

The data used in this study are primarily collected from officials in Baltimore County, Maryland, and includes information on residential transactions from Maryland Property View

[4] Appendix Table 3 shows the model specifications using 0.5 mile, 1 mile, and 2 mile distance cutoffs as well as four and six year time windows. Results are consistent with those presented in the results section.

and park renovations from the Department of Recreation and Parks. Baltimore County presents an ideal area for study because it contains a large amount of county-level government funded parks and a large database of home sales surrounding those parks. Baltimore County is largely suburban and exurban, with Baltimore City serving as the nearest major city. Although some residents in the extreme southern portions of this area commute to Washington D.C., the majority of the housing market studied serves households working in either Baltimore County or Baltimore City County. Therefore, for this paper, the housing market studied is assumed to be a single market.

Figure 1 illustrates the distribution of single family housing sales in Baltimore County for the period between 2000 and 2007. From Figure 1, we see the majority of the transactions occurred in the areas nearest Baltimore City County, which is the densest area of the county. While the entire dataset is used for the baseline hedonic model, results for the property fixed effects models are driven by homes that sold more than once in our sample period. Figure 2 displays the homes used in the property fixed effects models. Comparing the homes with repeat sales to the entire sample, the location and density of the sales are comparable between the two maps. This similarity lessens the possible selection bias that could result from only using homes with multiple sales.

Data on housing transactions and housing attributes was collected from Corelogic, a private data vendor, and Maryland Property View, a state database on housing sales and attributes. The Maryland Property View dataset contains parcel information, house attribute information, and sales prices and dates. Similarly, the Corelogic data also contains parcel and house attribute data as well as data on the seller, buyer, and lender for the transaction. This additional Corelogic data was used to confirm the data from Maryland Property View, and fill in any missing attribute information. As is common in the literature, we restrict our study to arms-length single-family home transactions.[5] Examples of the cleaning implemented to eliminate outliers, in addition to dropping homes with missing information, include eliminating homes with a price per square foot below $15 and above $500, homes with less than 300 square feet, and homes with a sale price above $5,000,000. The summary statistics for each of the house-specific attributes used in our models are presented in Table 1. The data in Table 1 are split into sections for the entire sample and the property fixed effects sample. Comparing the data, the differences are small, suggesting the samples are of similar houses. Data from 2000 to 2007 was chosen to avoid much of the housing market collapse that occurred late in the decade.

Information on local parks and renovations was obtained from the Baltimore County Department of Recreation and Parks. Since Baltimore County does not contain any incorporated municipalities, the list of county parks includes all local public parks within the county. There are 1,683 county-level open space designations in Baltimore County. These areas include neighborhood parks, community parks, school recreation areas, reservoirs, undeveloped open space, among others. For this paper, we focus on neighborhood and community parks, which are the focus of the vast majority of renovations carried out by the Department of Recreation and Parks. In addition, these two types of public open space are generally in the more dense areas of the county, and they are unlikely to be associated with a larger bundle of non-park amenities or unique landscape features. In total, there are 146 neighborhood and community parks (henceforth

[5] Studying other types of housing transactions is an interesting area for future study due to the potential for different tradeoffs between private and public open space.

referred to as neighborhood parks) in the county.

The Baltimore County Department of Recreation and Parks provided data on all capital projects over $5,000 from 1997 to 2012. The majority of these projects were renovations and replacements of existing amenities. Park renovation and maintenance data are collected on a multitude of categories including, but not limited to: playground replacement, playground renovation, playground mulch, court renovation, fields, and lighting. For the years between 1997 and 2007, the number of renovations per neighborhood park ranges from zero to nine, with each park having an average of 2.671 renovations over the period. For our sample of neighborhood parks, there were 203 renovations over 75 parks between 1997 and 2007. Figure 3 presents neighborhood parks with renovations. As Figure 3 illustrates, most of the county provided neighborhood parks are small and located near Baltimore County. The distribution of renovations is relatively even throughout the county, with regions experiencing the most renovations corresponding to regions with the highest population density. Summary statistics for park renovations, by renovation type, appear in Table 2. The other renovations variable includes all projects that do not fit with one of the defined renovation categories. These projects were aggregated because each individual category did not have sufficient observations for appropriate identification, or the variable was not specific enough to interpret. For example, this variable includes renovations classified by the county as miscellaneous renovations and major improvements. To match with our housing sample, only renovations between 1997 and 2007 are used in the models.[6]

[6] Renovations beginning in 1997 are used to produce a sample of renovations prior to the first home sale in our housing sample, which begins in 2000.

Examining summary statistics for renovations, playground renovations and court renovations are the most common, while playground mulch and field renovations are the least common. The remaining variables have similar rates of occurrence. There is a large spread in cost between the renovation types. Lighting renovations have the highest cost with an average of $317,079.30 per project, while fence renovations have the lowest cost with an average of $11,962.20 per project. In general, cost and frequency of renovation are inversely proportional; that is, renovations with a higher cost are more infrequent.

While there are non-neighborhood county level and state parks in Baltimore County, they are located in less dense areas, and their amenities are more natural and less man-made, such as water features and forest lands. Therefore, these parks are not included in this study. In contrast to our definition of neighborhood parks which are largely walkable, many of these more regional parks are destination parks and serve a different function. The use of property fixed effects will account for the time-constant amenities provided by these open space features.

5. Estimation Results

To assess the robustness of our estimates of willingness to pay for various park renovation and maintenance activities, we present multiple models and compare results across specifications to determine the most appropriate model. For all of the models presented below, only neighborhood parks whose centroid is within a mile of the housing parcel centroid are included. In addition, when there are multiple neighborhood parks within one mile of a home, only the two nearest parks are used in the models.[7] Each dummy variable signifies the existence of a

[7] In our sample of all housing sales, only 8% of homes are near more than two parks using a 1 mile distance cutoff.

renovation of that type of amenity within one mile of the house over the past four years. The timing calculations are exact to the month of completion and the month of sale.

a. Hedonic and Property Fixed Effects Models

A standard hedonic approach with a single measure of parks is ideal for measuring the aggregate value of all park amenities, although it may not accurately represent the value of specific features of parks, and may be subject to measurement error if the suite of amenities varies across parks in the sample. For purposes of comparison, Table 3 presents the results for a common semi-log hedonic model with a single indicator variable for proximity to a neighborhood park renovation using (1) census tract fixed effects, (2) block group fixed effects, and (3) property fixed effects. As is common in much of the existing literature, we find little value associated with proximity to a local park. Using a single measure of renovations, we are exploiting the time-varying nature of renovations for identification and turn the renovation indicator on if a renovation occurred within the previous four years of a home sale. Only the census tract model, which includes the most unobservables, has a significant variable for park renovation, and it appears that ignoring heterogeneity in amenities results in a bundled renovation value that is not significantly different from zero.

All models in Table 3 appear similar and results for standard housing attributes are consistent with previous literature. Examining the linear terms, we find positive coefficients for lot size (acres), square feet, baths, garage, fireplace and pool. Age and stories are negative, suggesting that homeowners prefer newer homes and single story homes, holding the other housing characteristics constant. In addition to the linear terms, we find intuitive results for the squared terms. In the census tract and block group models, the squared terms for lot size (acres) and square feet are negative, while the coefficient for age squared is positive. The property fixed effects model omits the home characteristics because they are constant across time. The age and age squared terms in this model serve as a price index and, as a result, are estimated to be positive. Year and census tract, block group, and property fixed effects are included in the models to control for variation across time and across space. While these estimates are omitted from the table, they are generally significant. Since we are using a semi-log specification, all variables are interpreted as the percentage change in the sales price for an increase of one unit for the independent variable.

Table 4 decomposes the renovations into specific amenities and carries out estimates with tract, block group, and property fixed effects similarly to Table 3. The first column of Table 4 uses census tract fixed effects, the second column uses block group fixed effects, and the third column uses property fixed effects. The property fixed effects should provide greater control for potential unobservables that are unique to homes and locations, as opposed to the census tract and block group models which only control for common unobservables across groups of homes. While qualitatively similar, there are differences in significance across these three specifications. For our preferred model using property fixed effects, we find a positive and significant coefficient on playground replacements and field renovations, and a negative and significant coefficient for court and lighting renovation. We find no significant effect for mulch, playground renovation, trails, fence, or the miscellaneous category. The presence of both positive and negative willingness to pay may explain the loss of significance in the single dummy variable model in column three of Table 3.

Interpreting the results in Table 3, courts are often associated with noise and light pollution, and renovations to a court can increase these potential negative externalities if they result in increased usage. Also, lighting renovations and additions introduce or expand light pollution into an area. Increased nighttime activity is also associated with an increase in lights, and this can be undesirable for nearby homeowners. In contrast, playground replacement and field renovations are estimated to be positive and significant. The replacement of a playground is expected to be positive because the entire structure is potentially safer, and may increase the desirability of the area to families. Field renovations are believed to have a positive effect on home prices through the improvement in the park's green space. That is, a renovated field is likely more useable and aesthetically pleasing than an older field.

Comparing the models from left to right in Table 4, the potential for unobservables that may confound our estimates decreases as we move from census tract fixed effects, to block group fixed effects, to property fixed effects. Investigating the renovation terms, there is a distinct pattern in the coefficients as the spatial scope of the fixed effects decreases. For example, mulch playground and replace playground become more positive as the scope of fixed effects becomes smaller. This pattern is the result of the unobservables decreasing. From these models we conclude that decomposing park renovations, as opposed to using a single variable, is necessary to determine the effect of renovations on sale price, and that smaller fixed effect levels decrease the unobservables of the model, increasing the accuracy of the results.[8]

b. Time Decay Property Fixed Effects Models

While the log-price property fixed effects model results in Table 4, column three, show

[8] Appendix Table 2 presents the repeat sales model. It produces results similar to property fixed effects model, but with some slight differences in significance on some of the estimates.

renovations are associated with statistically significant willingness to pay, the effect of time on this impact is unclear. To explore the impact of time on the willingness to pay for renovations we estimate two time decay models in Table 5. The year decay model uses inverse year to determine the change in value over time following equation (6), and the year-by-year interaction model uses dummy variables to represent the inverse year, in terms of the home sale year, the renovation was completed as in equation (5). Each model is regressed against log-price and includes property and year fixed effects.

Focusing on the year decay model in the first column, the age and age squared terms are positive and significant. As expected, playground replacement year is positive, less than one, and significant in this model, suggesting the positive effect of a playground replacement on the value of nearby households decreases as time increases. Lighting year and court renovation year are negative, greater than negative one, and significant. These estimates are consistent with our earlier results, and show these renovations have a negative, but decreasing in time effect on the sales price of homes near them.

The year-by-year interaction model in the second column mirrors the results in the inverse time model of column one, but allows us to determine the length of time a renovation has an impact on the nearby household’s willingness to pay. For the playground replacement variables, we see an initial significant increase in sale price in year two, and then a gradual decrease until the fourth year. Courts have a significant and negative coefficient for the first three years, confirming the estimates from the log-price and year decay models. Lighting is significant and negative during the second year, but is insignificant in other years. Field, significant in the dummy model but insignificant in the year interaction model, is significant, positive, and decreasing in the second and third year before becoming insignificant in the fourth year.

For all of the year-by-year interaction estimates, the coefficients typically decrease in magnitude as the time since renovation increases. This is expected, as the amenities are likely to degrade in quality over time due to exposure to weather and use. The insignificance of some attributes in year one may result from the timing of construction and its associated externalities, as well as the time it takes for the renovated amenity to be fully functional.

c. Meta-Analysis Results

An internal meta-analysis allows us to determine if the results presented above, specifically those of the amenity property fixed effects model, are robust to specification decisions regarding which renovations to include in the model. To carry out this robustness check, we randomly sample a number of renovations and the type of renovations to include in different hedonic models. Here, we perform the meta-analysis on the dummy variables in the amenity log-price property fixed effects model in Table 4, column three.

Table 6 presents the results from the meta-analysis using 200 random model specifications. The mean values are willingness to pay in dollars, and there is little spread for the majority of the park renovation and maintenance attributes. Of the significant variables in the amenity property fixed effects models, all have means close to the estimated values in Table 4. Further, the minimums and maximums for court, replace playground, lighting, and field do not contain zero. Histograms illustrating the distribution for playground replacement and court renovations, two of the variables significant in the property fixed effects and year decays models, are presented in Figure 4. The distributions are relatively normal, and the spread of each variable is small, with a range of roughly $1,000 for each variable. These results provide evidence that our specification is robust to omitted renovations or changes in the grouping of renovations.

6. Policy and Cost-Benefit Analysis

a. Discussion of Local Finance and Renovation in Baltimore County

In recent years, city, county, and state budgets have become strained due to decreasing tax receipts brought on by falling incomes and property prices. Because of this decrease, many areas have been forced to cut outlays on public goods. Therefore, our analysis can provide information on which projects will likely net the highest returns to local communities. Before we delve into the policy implications of this study, it should be noted that this analysis only extends to single-family residential homes within one mile of each park. Therefore, it is possible that some renovations have effects outside of the one mile radius that are not captured in our models or that accrue to multi-family residential residents. For example, a court renovation may introduce negative externalities to the nearby households, but the presence of a renovated basketball court in the community may provide positive value to residents further from the court or without private open space in the form of private lots.[9]

Our sample of 203 neighborhood park renovations had an average cost of $89,032.70 per renovation. With almost two million dollars spent on neighborhood park renovations each year, the allocation of these funds toward projects expected to result in the highest returns to homeowners may be a desirable policy outcome. Playground replacement has a positive coefficient in each of our dummy-variable models and maintains a significant effect through

[9] See Appendix 3 for models varying the distance threshold.

each of the first four years measured in the year-by-year interaction models. Comparing the playground renovation and playground replacement estimates, replacement is positive and significant in all of the models while renovations are not significant. Therefore, it may be beneficial to delay any unnecessary playground work until a replacement can be procured. Conversely, court renovations are negative and significant, which may reflect the potential for negative externalities such as noise, light, and congestion introduced by increased use and modernization of tennis and basketball courts. As a result, focusing court renovations on areas with fewer single family homes could mitigate the negative impact on the surrounding housing stock and more attention to sound or noise buffering may be warranted.

b. Cost-Benefit Analysis

In addition to the above analysis on how a county can improve its decision making on where to locate projects and which projects to fund, providing a simple break-even analysis on this data can inform governments on where they can generate the most value from a project. In order to achieve these estimates, we focus on the means for sale price and the estimates derived in the log-price property fixed effects model from Table 4, column 3.

As an example, we will focus on playground replacement because the variable is positive and significant across all models. For playground replacement, we have an average cost of $34,858.15 and an estimated coefficient of 0.0455 in the property fixed effects model. From our data, the average sales price for a home in Baltimore County between 2000 and 2007 is $229,177.50. Examining the return from a playground renovation, we have an average willingness to pay of $10,427.58 for each home at the average sales price within a mile of the renovation, and within four years of the renovation completion date. Therefore, nearly one-third of the cost of renovation is captured in the willingness to pay of a single homeowner surrounding the renovation.

To provide a back of the envelope measure of potential tax receipts, we assume that assessed values increase along with household willingness to pay.[10] According to the Baltimore County Office of Budget and Finance, the property tax rate is $1.10 per $100 of assessed value. At the mean price level, there would be an approximate increase of $94.80 in tax revenue for each home near the renovation. Therefore, if we assume that each house has an assessed value equal to the post-renovation price, there would need to be 350 homes within one mile of the park for the project to be funded through property taxes in one year. This seems reasonable if the park is located in a densely developed area.

From the above analysis, we see the increase in sales price for a home within one mile of a recent playground replacement is significant. While the entire cost of the renovation is unlikely to be reflected in the new sales prices, approximately one-third of the project cost could be added to surrounding sales prices. Further, if the county were to account for this variation in the assessed value of a property, the entire cost of the project could be recouped in many of the more dense areas of the county. However, property assessments do not match the dynamic nature of the park renovation effects. Therefore, unless assessed value can be altered dynamically as these projects occur, it is unlikely that property tax increases will account for the renovation cost.

[10] This assumption is unlikely to be true in practice, but provides a useful ballpark for the ensuing analysis. For further discussions of capitalization vs. willingness to pay see Klaiber and Smith (2013) and Kuminoff and Pope (2013).

7. Conclusions

With decreasing budgets, municipalities are increasingly financially strained to invest in public goods. Despite the significant use of public monies, many studies have found low or insignificant values associated with proximity to local parks. This study is the first known to these authors where an extensive list of specific park attributes are used to recover willingness to pay measures that vary across specific park attributes. Through estimating the value of park amenities separately, we show homeowners have robust, significant willingness to pay, both positive and negative, for park amenity renovations. In comparison, estimating renovations as a single, aggregated value results in an estimate that is not significantly different from zero. This finding may partially explain the differing values associated with local parks seen in the literature. Significant expenditures, like those in Baltimore County, are common in many municipalities to maintain and increase the value of public parks, and this study provides evidence that the value from improving existing parks is heterogeneous across amenities.

In addition to the finding that park attributes need to be disaggregated for accurate value estimates, we also find that attribute renovations have a decreasing effect on the sales price of nearby homes as time increases. With the exception of playground replacements, each amenity has no statistical value, positive or negative, after three years. Because of the small time period that households within one mile of the renovation maintain a positive willingness to pay for the project, the cost of most renovations are unlikely to be fully recovered through tax receipts unless assessments are frequent and highly heterogeneous.

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Figures

Figure 1: Map of housing sales in Baltimore County between 2000 and 2007

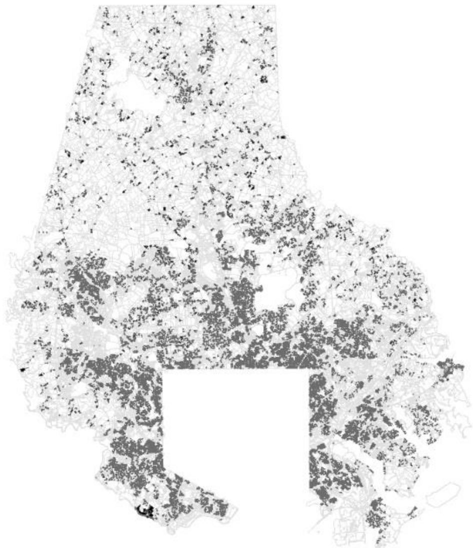


Figure 2: Map of repeat housing sales in Baltimore County between 2000 and 2007

Figure 3: Map of Renovated Parks in Baltimore County between 1997 and 2007

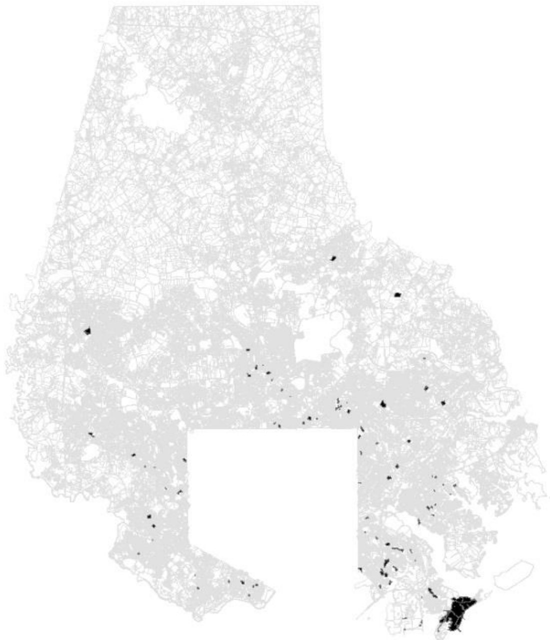
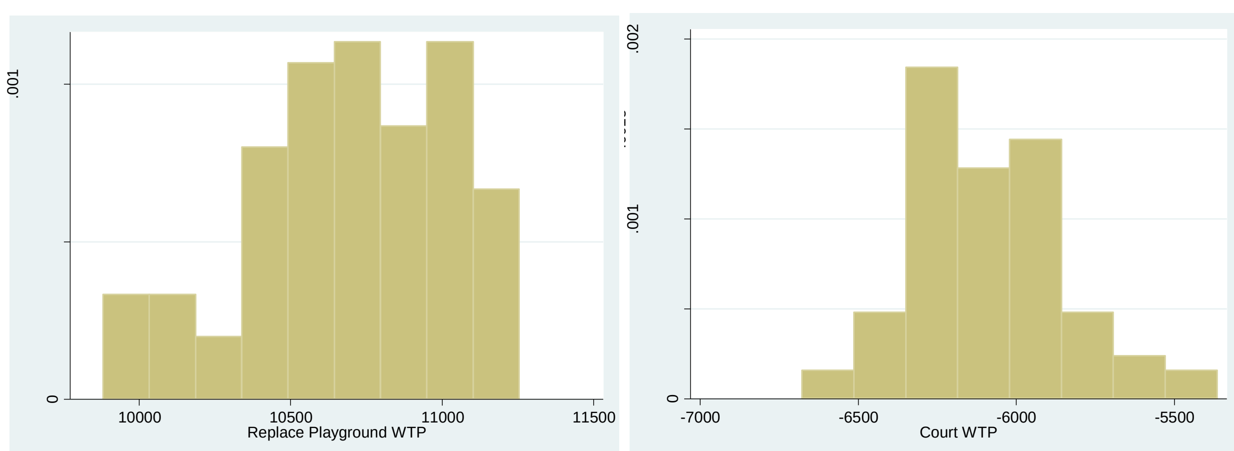


Figure 4: Meta-analysis graphs of Replace Playground and Court Willingness to Pay



Tables

Table 1: Summary statistics for houses sold in Baltimore County from 2000-2007

	Whole Sample				**Property FE Sample**			
Variable	**Mean**	**Std. Dev.**	**Min**	**Max**	**Mean**	**Std. Dev.**	**Min**	**Max**
sale_price	229177.5	161942	15000	2805000	218833	142013	15000	2050000
age	35.02378	22.5507	0	100	34.3235	22.6073	0	100
acres	0.327284	0.78864	0.002	20	0.25153	0.60032	0.002	13.3
sqft	1692.765	738.958	364	9772	1618.87	623.834	562	9189
baths	2.020968	0.83629	1	8	2.07178	0.83544	1	6.5
garage_total	0.3435841	0.47491	0	1	0.29629	0.45663	0	1
stories	1.787035	0.39017	1	3	1.82388	0.36259	1	3
age	35.02378	22.5507	0	100	34.3235	22.6073	0	100
fireplace	0.3556447	0.47871	0	1	0.36761	0.48216	0	1
pool	0.0285179	0.16645	0	1	0.02261	0.14865	0	1
sale_year	2003.476	2.19235	2000	2007	2003.61	2.23355	2000	2007
Observations	83,246				26,275			

Table 2: Summary statistics for neighborhood park renovations from 1997-2007

Variable	**Mean**	**Std. Dev.**	**Min**	**Max**	**Mean Cost**
Cost	$89,032.72	$248,836.10	$5,000.00	$2,593,226.00	—
mulchplayground	0.0048077	0.0693375	0	1	$71,200.00
renoplayground	0.2932692	0.4563591	0	1	$23,045.49
replaceplayground	0.0625	0.2426454	0	1	$34,858.15
trails	0.0432692	0.2039534	0	1	$42,005.56
renocourt	0.1490385	0.3569856	0	1	$20,694.85
renofence	0.0769231	0.2671122	0	1	$11,962.20
lighting	0.0384615	0.1927716	0	1	$317,079.30
field	0.0336538	0.1807716	0	1	$204,637.10
otherreno	0.2740385	0.4471045	0	1	$195,597.50

Table 3: Estimates for dummy renovation effect

Dependent Variable: Ln(Price)

Variable	**(1)** **Cencus Tract FE**	**(2)** **Block Group FE**	**(3)** **Household FE**
age	-0.0094***	-0.0097***	0.1040***
	(0.0007)	(0.0007)	(0.0017)
age2	0.0001***	0.0001***	0.0002***
	(0.0000)	(0.0000)	(0.0000)
acres	0.1507***	0.1401***	
	(0.0187)	(0.0113)	
acres2	-0.0092***	-0.0083***	
	(0.0016)	(0.0010)	
sqft	0.0003***	0.0003***	
	(0.0000)	(0.0000)	
sqft2	-0.0000***	-0.0000***	
	(0.0000)	(0.0000)	
baths	0.0611***	0.0590***	
	(0.0049)	(0.0041)	
garage_total	0.1752***	0.1616***	
	(0.0089)	(0.0083)	
stories	-0.1036***	-0.0886***	
	(0.0100)	(0.0091)	
fireplace	0.0602***	0.0566***	
	(0.0060)	(0.0052)	
pool	0.0685***	0.0609***	
	(0.0083)	(0.0073)	
reno_occur	-0.0143**	-0.0073	-0.0107
	(0.0068)	(0.0062)	(0.0068)
Constant	11.4572***	11.4761***	8.2170***
	(0.0305)	(0.0257)	(0.0366)
Year FE	Yes	Yes	Yes
Spatial FE	Census Tract	Block Group	Property
R-squared	0.695	0.695	0.828
N	83122	83246	26275

Clustered standard errors in parentheses
* p<0.10, ** p<0.05, *** p<.01

Table 4: Estimates for amenity renovation effect

Dependent Variable: Ln(Price)

Variable	(1) Census Tract FE	(2) Block Group FE	(3) Household FE
age	-0.0095***	-0.0097***	0.1038***
	(0.0007)	(0.0007)	(0.0018)
age2	0.0001***	0.0001***	0.0002***
	(0.0000)	(0.0000)	(0.0000)
acres	0.1508***	0.1401***	
	(0.0187)	(0.0113)	
acres2	-0.0092***	-0.0083***	
	(0.0016)	(0.0010)	
sqft	0.0003***	0.0003***	
	(0.0000)	(0.0000)	
sqft2	-0.0000***	-0.0000***	
	(0.0000)	(0.0000)	
baths	0.0609***	0.0588***	
	(0.0049)	(0.0041)	
garage_total	0.1749***	0.1615***	
	(0.0089)	(0.0083)	
stories	-0.1038***	-0.0886***	
	(0.0100)	(0.0091)	
fireplace	0.0603***	0.0566***	
	(0.0060)	(0.0052)	
pool	0.0691***	0.0612***	
	(0.0083)	(0.0073)	
mulchplayground_dummy	0.0103	0.0118	0.0412
	(0.0188)	(0.0141)	(0.0429)
renoplayground_dummy	-0.0127*	-0.0080	-0.0062
	(0.0067)	(0.0055)	(0.0078)
replaceplayground_dummy	-0.0083	0.0038	0.0455***
	(0.0101)	(0.0077)	(0.0112)
trails_dummy	0.0532**	0.0524***	0.0233
	(0.0207)	(0.0164)	(0.0144)
court_dummy	-0.0136	-0.0148*	-0.0260**
	(0.0099)	(0.0078)	(0.0108)
fence_dummy	0.0139	0.0094	0.0009
	(0.0160)	(0.0122)	(0.0111)
lighting_dummy	-0.0142	-0.0096	-0.0336***
	(0.0123)	(0.0112)	(0.0128)
field_dummy	0.0374***	0.0402***	0.0320**
	(0.0125)	(0.0121)	(0.0161)
otherreno_dummy	0.0085	0.0038	-0.0029
	(0.0084)	(0.0073)	(0.0079)
Constant	11.4556***	11.4747***	8.1964***
	(0.0306)	(0.0256)	(0.0373)
Year FE	Yes	Yes	Yes
Spatial FE	Census Tract	Block Group	Property
R-squared	0.695	0.695	0.829
N	83122	83246	26275

Clustered standard errors in parentheses

* p<0.10, ** p<0.05, *** p<.01

Table 5: Year Decay Models

Dependent Variable: Ln(Price)

Variable	(1) Year Decay	(2) Year-by-Year Interaction
age	0.1037***	0.1039***
	(0.0017)	(0.0018)
age2	0.0002***	0.0002***
	(0.0000)	(0.0000)
mulchplayyr	0.1237	
	(0.0992)	
renoplayyr	-0.0204	
	(0.0166)	
replaceplayyr	0.1057***	
	(0.0246)	
trailsyr	0.0277	
	(0.0238)	
courtyr	-0.0667***	
	(0.0198)	
fenceyr	-0.0018	
	(0.0209)	
lightingyr	-0.0458**	
	(0.0219)	
fieldyr	0.0363	
	(0.0292)	
otherrenoyr	-0.0134	
	(0.0161)	
mulchplayyr_y1		0.1523
		(0.1019)
mulchplayyr_y2		0.0356
		(0.0312)
mulchplayyr_y3		-0.0357
		(0.0554)
mulchplayyr_y4		0.0289
		(0.0369)
renoplayyr_y1		-0.0084
		(0.0103)
renoplayyr_y2		-0.0094
		(0.0101)
renoplayyr_y3		-0.0052
		(0.0096)
renoplayyr_y4		0.0066
		(0.0100)
replaceplayyr_y1		0.0128
		(0.0184)
replaceplayyr_y2		0.0720***
		(0.0211)
replaceplayyr_y3		0.0582***
		(0.0187)
replaceplayyr_y4		0.0341**
		(0.0164)
trailsyr_y1		-0.0032
		(0.0191)
trailsyr_y2		0.0174
		(0.0194)
trailsyr_y3		0.0219
		(0.0257)
trailsyr_y4		-0.0061

Variable	(1) Year Decay	(2) Year-by-Year Interaction
		(0.0241)
courtyr_y1		-0.0482***
		(0.0133)
courtyr_y2		-0.0229*
		(0.0134)
courtyr_y3		-0.0303**
		(0.0150)
courtyr_y4		0.0102
		(0.0165)
fenceyr_y1		-0.0055
		(0.0149)
fenceyr_y2		0.0171
		(0.0149)
fenceyr_y3		-0.0078
		(0.0151)
fenceyr_y4		-0.0185
		(0.0191)
lightingyr_y1		-0.0234
		(0.0188)
lightingyr_y2		-0.0675***
		(0.0217)
lightingyr_y3		-0.0401
		(0.0277)
lightingyr_y4		-0.0156
		(0.0266)
fieldyr_y1		0.0089
		(0.0226)
fieldyr_y2		0.0900***
		(0.0318)
fieldyr_y3		0.0515**
		(0.0261)
fieldyr_y4		-0.0012
		(0.0271)
otherrenoyr_y1		-0.0054
		(0.0104)
otherrenoyr_y2		-0.0195
		(0.0119)
otherrenoyr_y3		-0.0152
		(0.0110)
otherrenoyr_y4		0.0194*
		(0.0114)
Constant	8.2048***	8.1983***
	(0.0369)	(0.0380)
Year FE	Yes	Yes
Spatial FE	Property	Property
R-squared	0.829	0.829
N	26275	26275

Clustered standard errors in parentheses
* p<0.10, ** p<0.05, *** p<.01

Table 6: Meta-Analysis Results

Variable	Obs.	Mean	Std. Dev.	Min	Max
fence_dummy	78	-$471.63	$628.41	-$1,684.43	$1,040.54
otherreno_dummy	85	-$880.66	$370.05	-$1,598.61	-$125.39
mulchplayground_dummy	71	$11,987.49	$2,336.36	$8,638.38	$14,701.51
renoplayground_dummy	86	-$1,873.87	$302.17	-$2,397.12	-$1,342.51
replaceplayground_dummy	82	$10,662.64	$303.94	$10,087.09	$11,227.41
court_dummy	84	-$5,963.40	$254.48	-$6,547.74	-$5,363.15
trails_dummy	81	$6,162.16	$397.96	$5,179.45	$6,877.59
lighting_dummy	93	-$6,752.91	$1,908.38	-$10,237.60	-$3,740.25
field_dummy	87	$7,166.28	$2,562.19	$3,142.47	$10,931.67

Appendix

Appendix 1: Model Specification Comparison

Variables	(1) Log-Price	(2) Level	(3) Log-Log
age	0.1038***	26852.7185***	
	(0.0018)	(860.4675)	
age2	0.0002***	-44.9910***	
	(0.0000)	(9.4611)	
mulchplayground_dummy	0.0412	1.42e+04***	0.0480
	(0.0429)	(4672.7541)	(0.0418)
renoplayground_dummy	-0.0062	876.1240	-0.0049
	(0.0078)	(2552.1777)	(0.0079)
replaceplayground_dummy	0.0455***	2.52e+04***	0.0465***
	(0.0112)	(3679.9974)	(0.0114)
trails_dummy	0.0233	-9.96e+03**	0.0184
	(0.0144)	(4438.6693)	(0.0141)
court_dummy	-0.0260**	-9.96e+03***	-0.0233**
	(0.0108)	(2921.5297)	(0.0108)
fence_dummy	0.0009	6006.9899	0.0022
	(0.0111)	(4713.1777)	(0.0116)
lighting_dummy	-0.0336***	-4.22e+03	-0.0358***
	(0.0128)	(5947.6954)	(0.0125)
field_dummy	0.0320**	-9.10e+03	0.0305*
	(0.0161)	(8535.5137)	(0.0166)
otherreno_dummy	-0.0029	-1.34e+04***	-0.0062
	(0.0079)	(2882.9209)	(0.0079)
lnage			-0.7437***
			(0.1064)
lnage2			0.2135***
			(0.0373)
Constant	8.1964***	-6.21e+05***	12.7261***
	(0.0373)	(1.76e+04)	(0.1099)
Year FE	Yes	Yes	Yes
Spatial FE	Property	Property	Property
R-squared	0.829	0.756	0.829
aic	-38860.43	614785.1	-38536.59
bic	-38721.43	614924.1	-38389.9
N	26275	26275	25579

Clustered standard errors in parentheses
* p<0.10, ** p<0.05, *** p<.01

Appendix 2: Repeat sales model

While property fixed effects models are used thorough the paper, the repeat sales model is an alternative specification. Combining the time-varying nature of the amenity of interest with a large database of repeat sales gives rise to a repeat sales model of housing as described by

Palmquist (1982) and given by:

(A1) $$\ln(\frac{P_{i,t+l}}{P_{i},t}) = \beta_o + \Delta\, \delta_O O_{jt} + \Delta\epsilon_{ijt}$$

where the dependent variable is the log fraction of the price for home i at time t+l in the numerator, and the price for home i at time t is in the denominator. The housing, neighborhood, and park variables are defined as in Section 3.

Dependent Variable: Ln(Sale Price Ratio)	
Variable	**Repeat Sales Model**
sale_year_diff2	0.0670***
	(0.0041)
mulchplaygrounddiff	0.0149
	(0.0351)
renoplaygrounddiff	0.0005
	(0.0069)
replaceplaygrounddiff	0.0336***
	(0.0114)
trailsdiff	0.0118
	(0.0173)
courtdiff	-0.0067
	(0.0094)
fencediff	-0.0065
	(0.0114)
lightingdiff	-0.0089
	(0.0141)
fielddiff	0.0249
	(0.0184)
otherrenodiff	-0.0229***
	(0.0064)
Constant	0.1519***
	(0.0229)
Year FE	First and Last
Spatial FE	Property
R-squared	0.348
N	13773
Clustered standard errors in parentheses	
* p<0.10, ** p<0.05, *** p<.01	

Appendix 3: Time and distance models

Dependent Variable: Ln(Price)	(1)	(2)	(3)	(4)	(5)	(6)
	4yr, .5 mi	**4yr, 1mi**	**4yr, 2mi**	**6yr, .5mi**	**6yr, 1mi**	**6yr, 2mi**
age	0.1035***	0.1038***	0.1038***	0.1035***	0.1035***	0.1027***
	(0.0017)	(0.0018)	(0.0018)	(0.0017)	(0.0017)	(0.0018)
age2	0.0002***	0.0002***	0.0002***	0.0002***	0.0002***	0.0002***
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
mulchplayground_dummy	-0.0068	0.0412	0.0581	-0.0159	0.0503	0.0600
	(0.0281)	(0.0429)	(0.0426)	(0.0131)	(0.0579)	(0.0584)
renoplayground_dummy	-0.0016	-0.0062	0.0041	-0.0110	-0.0082	0.0074
	(0.0104)	(0.0078)	(0.0064)	(0.0107)	(0.0078)	(0.0072)
replaceplayground_dummy	0.0174	0.0455***	0.0469***	-0.0062	0.0133	0.0159
	(0.0164)	(0.0112)	(0.0100)	(0.0150)	(0.0108)	(0.0099)
trails_dummy	0.0205	0.0233	0.0180	0.0198	0.0430***	0.0333**
	(0.0184)	(0.0144)	(0.0129)	(0.0205)	(0.0153)	(0.0148)
court_dummy	-0.0269*	-0.0260**	-0.0092	-0.0207	-0.0245**	-0.0108
	(0.0154)	(0.0108)	(0.0086)	(0.0146)	(0.0105)	(0.0083)
fence_dummy	0.0063	0.0009	0.0083	0.0136	0.0020	0.0095
	(0.0165)	(0.0111)	(0.0102)	(0.0192)	(0.0124)	(0.0110)
lighting_dummy	-0.0520**	-0.0336***	-0.0245*	-0.0548***	-0.0316**	-0.0234*
	(0.0229)	(0.0128)	(0.0135)	(0.0207)	(0.0128)	(0.0126)
field_dummy	0.0638**	0.0320**	0.0315**	0.0567**	0.0292*	0.0317**
	(0.0256)	(0.0161)	(0.0135)	(0.0227)	(0.0160)	(0.0132)
otherreno_dummy	-0.0062	-0.0029	-0.0111	0.0081	0.0146	0.0001
	(0.0121)	(0.0079)	(0.0068)	(0.0155)	(0.0094)	(0.0077)
Constant	8.2159***	8.1964***	8.2058***	8.2162***	8.2020***	8.2334***
	(0.0365)	(0.0373)	(0.0385)	(0.0370)	(0.0376)	(0.0389)
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Spatial FE	Property	Property	Property	Property	Property	Property
R-squared	0.828	0.829	0.829	0.828	0.829	0.828
N	26275	26275	26275	26275	26275	26275

Clustered standard errors in parentheses
* p<0.10, ** p<0.05, *** p<.01