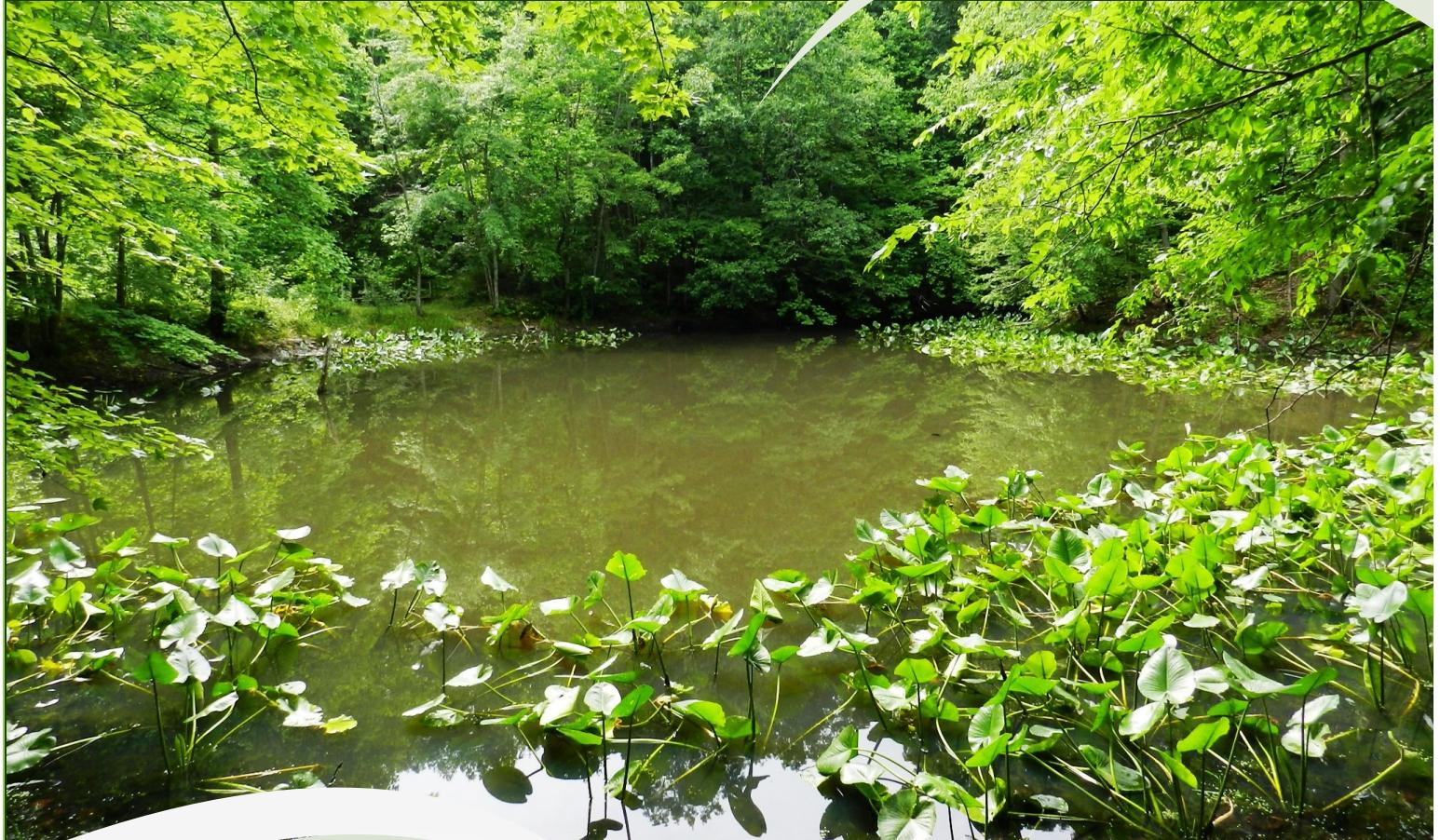


The Value of Preserved Land

A Hedonic Pricing Analysis of Land Use in Calvert County, Maryland



Anne Sundermann (2013)

Laura Kruse
Samuel Rosenblatt
Emily Lohff

May 2016



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Introduction

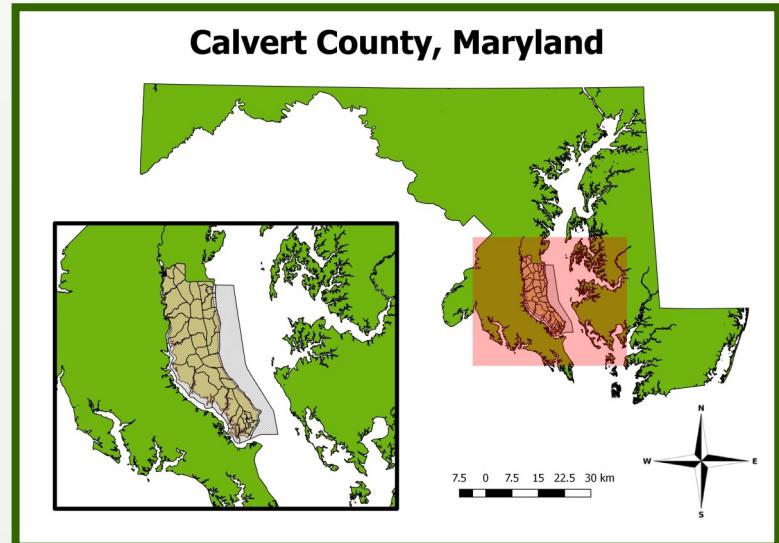
This project was completed in conjunction with ECON 459: Experiential Statistics, a course taught by Dr. Amy Henderson at St. Mary's College of Maryland. If there are any questions regarding our research, please feel free to contact us or Dr. Henderson using the following:

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Map of Calvert County, Maryland



Their Natural Parks

Battle Creek Cypress Swamp Park

Prince Frederick, Maryland

Flag Ponds Nature Park
Lusby, Maryland

Kings Landing Park
Huntingtown, Maryland

Biscoe Gray Heritage Farm
Prince Frederick, Maryland

Hughes Tree Farm
Prince Frederick, Maryland

Ward Farm Recreation and Nature Park
Dunkirk, Maryland

What is the Calvert Nature Society?

The Calvert Nature Society was originally founded in 1985 as the Battle Creek Nature Education Society.

Mission Statement:

“Calvert Nature Society is dedicated to the protection and preservation of Calvert County’s natural heritage and the creation of an environmentally literate and aware community. We provide opportunities for appreciation and understanding of our natural world through our outreach initiatives and in support of the mission of the Calvert County Natural Resources Division.”

Notable Accomplishments:

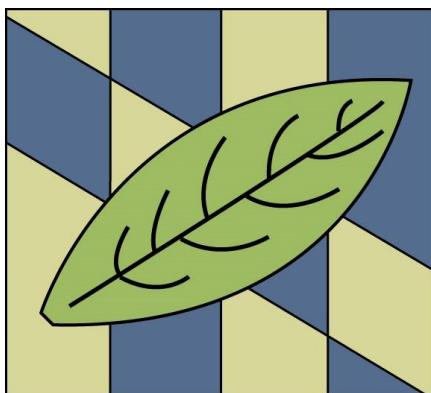
- ◆ The Calvert Nature Society (CNS) both actively and successfully supports the government of Calvert County through its teaming with the county’s Natural Resource Division.
 - ◆ CNS is the recipient of several major grants from the Maryland Historical Trust, the African American Historical Preservation Programs, and the Maryland Heritage Authorities.
 - ◆ In the past three and a half years, membership of the organization has doubled to over 700 members.
-

Organization Contact:

Anne Sundermann

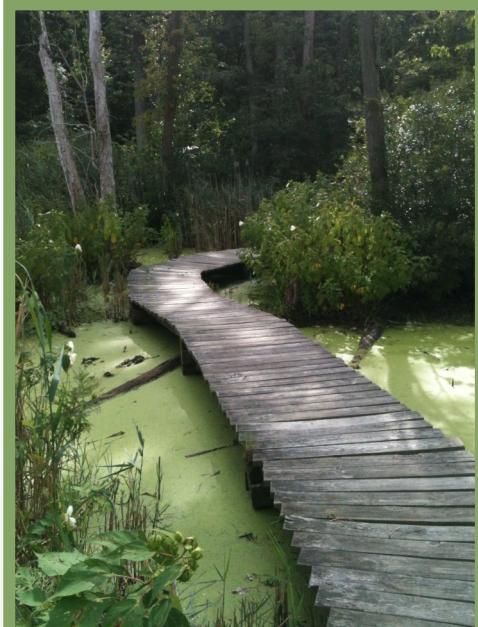
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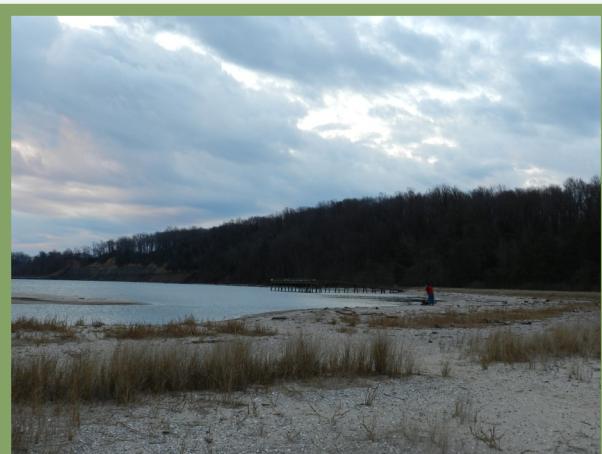


Flag Ponds Nature Park

Lusby, Maryland



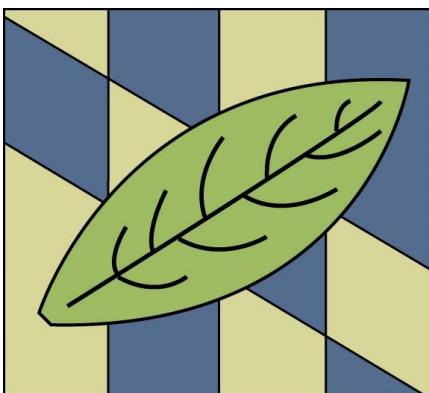
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Background:

The Flag Ponds Nature Park is unique in that it offers many different natural landscapes. The park has uplands areas, Calvert Cliffs, preserved beach habitats, and several freshwater ponds. The park also offers visitors connections to both Maryland's cultural and natural history. The location was once home to three fisherman shanties and a thriving fishery that supplied fish as far north as Baltimore. Calvert Cliffs is also known as the home of a great many fossils and shark teeth, as the waters used to be home to ancient shark breeding grounds.



Battle Creek Cypress Swamps

Prince Frederick , Maryland

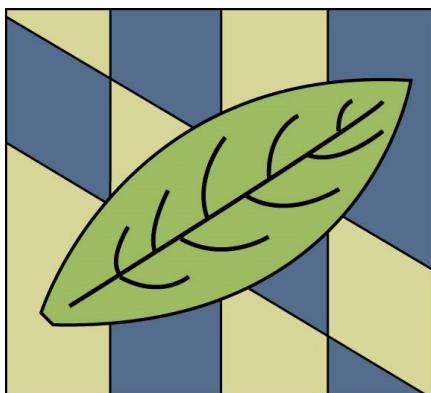
Background:

Battle Creek Cypress Swamps was first protected by the Nature Conservancy in the 1950's; indeed it was the Nature Conservancy's first preserve in Maryland. It has been operated by Calvert County, as part of the park system, since 1977. The park is home to one of the northernmost stands

of bald cypress trees, as well as an expanse of wetlands and swamplands. The acquisition of this property shows a tremendous amount of foresight, as it was taken over during a time when people did not understand the benefit in preserving wetland areas; many wetlands were filled in so that the area could be developed. Wetlands and swamplands provide beneficial functions in ecosystems such as water purification, habitats for flora and fauna, as well as protection from flooding. In recent years the Maryland state government has even instituted legislation that prevents the net loss of wetland areas over the course a year.



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Kings Landing Park

Huntingtown , Maryland

Background:

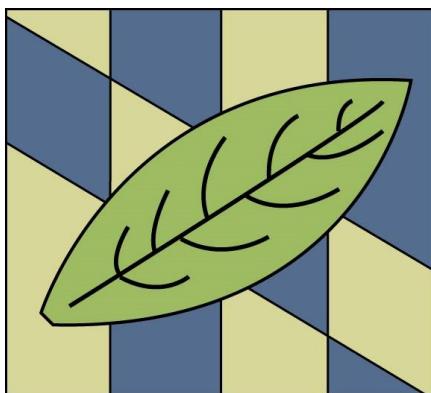
The land that Kings Landing Park now covers was once an active farm. During the 1950's it was home to Camp Mohawk, a YMCA camp which served underprivileged children from inner-city Baltimore. In 1984, the YMCA sold the property to the state of Maryland, which then converted it into a park. The park now offers a great variety of recreational and educational opportunities. Visitors to the park can enjoy learning about the cultural significance and history of the land; several exhibits teach about the environmental significance of the Patuxent River and its inhabiting wildlife. The park also offers equestrian activities, hiking, camping, canoeing, kayaking, and stand-up paddle boarding.



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Biscoe Gray Heritage Farm

Prince Frederick , Maryland

Background:

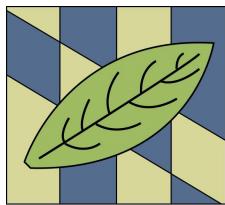
Biscoe Gray Heritage Farm serves as a living laboratory that exposes visitors, especially children, to the agricultural history of Calvert County, Maryland. The natural and cultural significance of this location range from the time of habitation by Native Americans up to 20th century tobacco farming. The archaeological preservation, and specialized development of the farm, allows visitors to experience how farming techniques in the area have evolved from transitory settlements, to colonial farming, and then to contemporary farming. The hands-on education style of Biscoe Gray Heritage Farm adds to the unique beauty of the property.



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Hughes Memorial Tree Farm

Prince Frederick , Maryland

Background:

Calvert County was given the land for Hughes Memorial Tree Farm in 1986 when the Bennett O. Hughes estate donated it. The Hughes estate asked that the county preserve 196-acres of the land to be used as a tree farm to promote sustainable forest management. Though they are currently unmarked, there are numerous trails on the property that visitors can hike along to see the multiple stages of forest development as well as a bucolic fishing pond. However, in 2016 public access will be limited due to dam construction to repair the lake.



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Ward Farm Recreation and Nature Park

Dunkirk , Maryland



Background:

The land for Ward Farm was acquired by Calvert County, Maryland in 2014. Though the property is still being developed, it is proposed to include several amenities such as recreation fields, a dog park, trails, and educational opportunities for visitors. Once the park has been fully approved and funded, CNS will be able to begin the development process.



What is a hedonic pricing analysis?

When an individual buys a home, they are essentially buying a set of attributes, such as the home's square footage, number of bathrooms, fireplaces, and so forth. Hedonic pricing analysis allows us to determine the value that homebuyers place on each specific attributes. Just as this techniques enables us to estimate willingness to pay for an additional fireplace, hedonic pricing analysis also allows us to estimate willingness to pay for non-market goods relevant to home buying decisions, such as the quality of the local school district, or, such as in this study, proximity to preserved land.

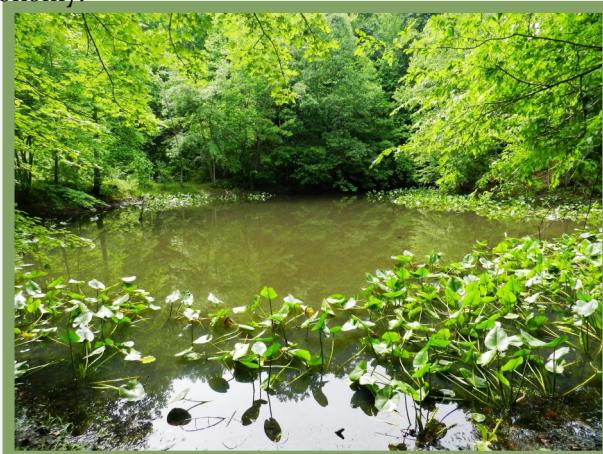


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Project Overview

Objective:

Our project aims to utilize the hedonic pricing method in order to determine the extrinsic worth that individuals in Calvert County place on their proximity to preserved areas of land. Close proximity to preserved land offers an array of potential benefits to a home buyer; these benefits include, but are not limited to, lower levels of congestion, increased flora and fauna, more open space, and easier access to park amenities such as outdoor and recreational activities, as well as educational opportunities offered by parks. In our study, we analyze three alternative sets of preserved land. The first set, which is the primary focus of our analysis for CNS, is defined as Calvert County's natural parks. The second analysis includes all Calvert County parks, including recreational parks. We also conducted an analysis on historical sites in the county, as these were also of interest to CNS. The analysis of historical sites includes nearby sites in neighboring counties. All of these preserved lands are protected by or under the domain of either the Calvert Nature Society, the Calvert County Natural Resources Division, or the Maryland State Government. If our analyses determines that increased proximity to these preserved lands increases the consideration of a home, then by extension, we will be providing quantitative support for the economic value that these preserved lands hold and therefore their benefit to the local economy. Additionally, this would also support the idea that land left unprotected or developed upon would negatively impact the health of the local economy.

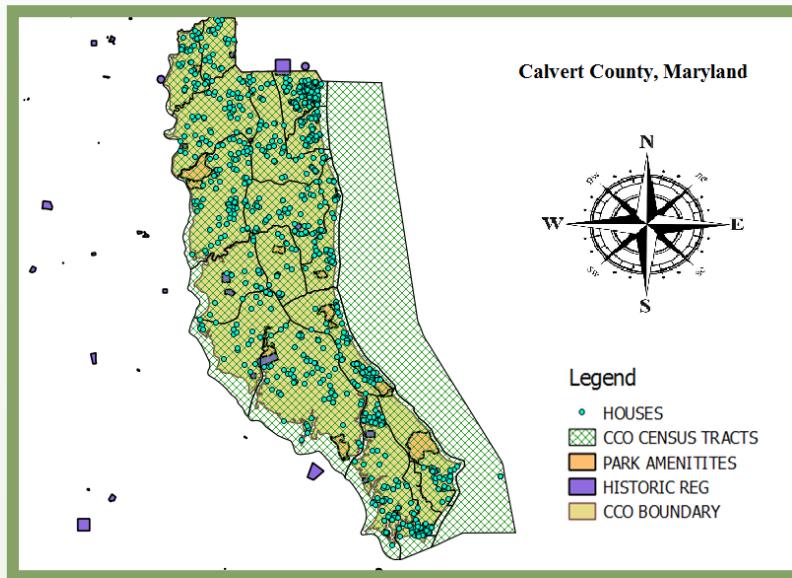


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Work in QGIS Software

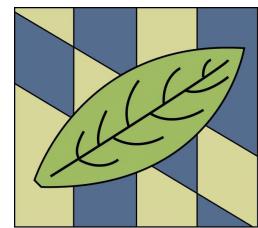


Using QGIS software, we were able to create multilayer maps that plot the properties being used in our analysis, as well as layers containing economic and demographic data for census tracks within Calvert County, and the preserved lands and historical sites that we are concerned with in our analysis. While providing visual representations for our data is useful, the QGIS software also allowed us to generate new variables that calculate the distance of a home to the nearest area of interest as well as variables that allow us to control for external factors such as race and income.



The map above illustrates some of the graphical work that was completed in the QGIS software. The map includes outlines of the county boundaries (including water under Calvert County's domain) as well as the boundaries that correspond with each census tract within the county. Each blue circle represents a home that was sold in 2015 , purple areas represent historical sites, and orange areas represent the parks of interest to our study.

Initial Real Estate Model

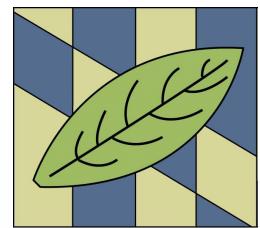


Age
Brick Exterior
Building Area
Fair Condition
Finished Basement
Number of Full Baths
Number of Half Baths
Land Area
Median Household Income
Number of Fireplaces
Number of Stories
Percent White
Poor Condition
Vacancy Status
Water Adjacency
Water View

The first step in conducting an hedonic pricing analysis is building a strong real estate model — that is, one that explains home prices as a function of home and location attributes. Our basic real estate model was highly statistically significant, and explained a total of 66.7% of the variation in home prices in Calvert County in 2015.

The adjacent graphic illustrates the estimated relationships obtained from this initial real estate model. The variables that had a positive relationship with sale price, such as building area and number of fireplaces, are highlighted in green. These variables increase an individual's willingness to pay for a property. The variables colored red, on the other hand, are ones that have an inverse relationship with sale price. Older homes or ones in poor condition have a tendency to be less desirable to potential homebuyers. The graphic also demonstrates a spectrum of significance levels based on the gradation of the two colors. Deeper shades of red or green go along with higher levels of significance while the opposite is true for lighter shades of the two colors.

Natural Parks Model



This model was created using a parks dataset that only included natural parks. This dataset includes the six parks under the Calvert Nature Society's domain as well as twelve other parks in the county including but not limited to Calvert Cliffs State Park and parks run by the American Chestnut Land Trust. This model is also the most pertinent to the goals of our client organization, the Calvert Nature Society. The results of this model will allow us to determine whether the residents of Calvert County value the presence of these parks by determining the extent to which individuals are willing to pay to live closer to a natural park.



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Natural Parks Results (continued)

Does distance to natural parks matter?

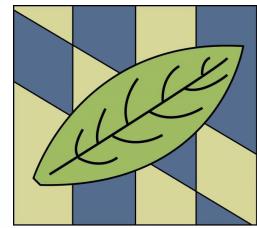
The addition of the “PARKDIST” to our model can be considered extremely significant due to the p-value of 0.0004 for its t-test. This means that there is less than a 0.04% chance that the coefficient is actually zero and the distance to the natural parks has no impact on home price. Because this is a nonlinear relationship, the slope is not constant; this means the relationship between proximity to a park and willingness to pay changes based on how far a home is to a park. We use the mean of “PARKDIST” to understand the general relationship that the two variables have. At the mean of “PARKDIST”, we found the slope to be -2.08 meaning that for every additional meter that a home is from a natural park, there is an average of a \$2.08 decrease in consideration. While this may not seem like a significant impact, if one considers that there are about 1,609 meters in a mile then that means that every additional mile that a home is from a park decreases home sale price by about \$3,350. Overall, our model explained 67.6% of the variation in home prices and was highly statistically significant ($F=122.21$).

Age
Brick Exterior
Building Area
Fair Condition
Finished Basement
Number of Full Baths
Number of Half Baths
Land Area
Median Household Income
Number of Fireplaces
Number of Stories
Percent White
Poor Condition
Vacancy Status
Water Adjacency
Natural Park Distance

The graphic above shows the addition of the variable that considers distance to the nearest natural park into the initial real estate model. Note that the variable is colored in red, meaning it is inversely related to predicted sale price. The deep shade of red also denotes that there was a high level of significance for the variable.

Although no regression model can prove causality, the fact that we obtain a statistically significant relationship between willingness to pay and proximity to a park after having controlled for typically relevant variables provides a strong indication that Calvert County residents are willing to pay for proximity to natural parks. that there is a significant relationship present between the two variables.

All Parks Model



This model was created using a dataset of all parks and recreational facilities in Calvert County. This dataset includes locations such as ball parks, boat ramps, and other amenities that are outside of the Calvert Nature Society's domain and interest, which were taken out when running the previous model. This model was created, although not directly relevant, due to the fact that a willingness to pay to be close to parks in a more general sense still shows a desire to close to outdoor amenities and open space as opposed to land developments and shopping centers.



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Age
Brick Exterior
Building Area
Fair Condition
Finished Basement
Number of Full Baths
Number of Half Baths
Land Area
Median Household Income
Number of Fireplaces
Number of Stories
Percent White
Poor Condition
Vacancy Status
Water Adjacency
Water View
All Parks Distance

The graphic above shows the addition of the variable that considers distance to the nearest park into the initial real estate model. Note that the variable is colored in red, meaning it is inversely related to predicted sale price. The deep shade of red also denotes that there was a high level of significance for the variable.

All Parks Results (continued)

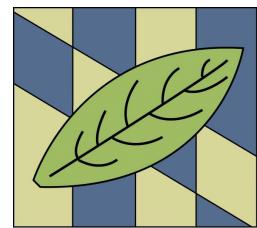
Does distance to parks matter?

The addition of the “ALLPARKSDIST” to our model can be considered significant due to its p-value of <.0001 for its t-test. This means that there is less than a 0.01% chance that the coefficient is actually zero and the distance to the parks has no impact on consideration. In order to interpret the coefficient, we need to take into account that the coefficient is for the natural log of “ALLPARKDIST.” Because the relationship between “ALLPARKDIST” and “CONSIDERATION” has deemed to be logarithmic instead of linear, the effect that park distance has on consideration will be different at each point. This also means that distance has a diminishing impact on consideration. This means that the impact that an additional mile has on consideration will decrease as distance from the parks increase.

We again evaluate the coefficient at the mean of “ALLPARKDIST”; we find the slope to be -3.36 which means that for each additional meter that a home is away from one of these parks of interest, home value is predicted to drop \$3.36. This means that every additional mile that a home is from a park willingness to pay is predicted to drop about \$5,400.

One may notice that “PARKDIST” — the distance from one of the natural parks — is predicted to have a smaller impact on sale price than “ALLPARKSDIST” — which includes recreational parks as well as natural parks. This is to be expected given the nonlinear nature of the relationship and the fact that the dataset which includes recreational parks has a lower average distance to a park.

Historical Sites Model



This last model was created using a dataset consisting of 287 different historic buildings and sites in not only Calvert County but the neighboring counties of Anne Arundel, St. Mary's, and Charles County. We included properties from neighboring counties given that they were close to the borders of Calvert County and still may prove impactful to the decision-making processes of homebuyers in Calvert County. This model was seen as a supplementary analysis due to the slightly different implications of its results. The dataset included not only historical buildings, but also historical districts and archaeological sites. These sites do not necessarily correlate to open space but could actually be associated with developments. Historical towns tend to draw in a different demographic than natural parks would. This model also in its nature is not specific and unique to Calvert County. The state of Maryland as a whole has a rich history and so this model may speak to the draw of the area in a larger sense. It does, however, illustrate that residents of Calvert County do place value on being a part of Maryland's rich cultural heritage.



Anne Sundermann (2013)



Historical Sites Results (continued)

Does distance to historical sites matter?

The addition of the “HISTDIST” to our model can be considered significant due to its p-value of 0.0006 for its t-test. This means that there is less than a 0.06% chance that the coefficient is actually zero and the distance to the natural parks has no impact on consideration. Once again, we transform the coefficient produced by our regression output in order to produce a slope of -1.76 meaning that for every additional meter away from a historical site, a home's sale price decreases an average of \$1.76. This result is the least substantial of the three preserved land models that we ran. But converted to miles, it still predicts that each additional mile of distance from a historical site decreases consideration by about \$2,830.

One speculation as to why historical sites may have a lower impact is the nature of the properties within the dataset. Nature and recreational parks provide activities and amenities that draw in visitors and therefore exists a greater awareness of their presence. A great deal of the historical sites, on the other hand, include properties whose significance do not appear to be widely known and therefore may not have as large of an impact on a home buyer's willingness to pay. You also do not necessarily have the environmental benefits such as lower congestion and more open space that natural areas have. Some of these historical sites correspond to historical districts in Maryland which may actually be more congested and developed areas. Again, this is speculative and would require further research and consideration.

Our adjusted R² maintained essentially the same level of variability explanation and the model also again passed the f-test which suggests the model is overall significant. The results from performing this regression suggest that there is a significant relationship between a home buyer's willingness to pay and its distance to these various historic areas of interest.

The graphic above shows the addition of the variable that considers distance to the nearest historical into the initial real estate model. Note that the variable is colored in red, meaning it is inversely related to predicted sale price. The deep shade of red also denotes that there was a high level of significance for the variable.

Age
Brick Exterior
Building Area
Fair Condition
Finished Basement
Number of Full Baths
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Land Area
Median Household Income
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Number of Stories
Percent White
Poor Condition
Vacancy Status
Water Adjacency
Water View
Historical Sites Distance

Research Implications

Before we delve into the meaning derived from our study, we would like to acknowledge the fact that our research does not prove any causal relationships between proximity to preserved land and home values. Proximity to preserved land is one of many factors that contribute to home values in Calvert County, Maryland and that therefore has to be considered when looking at the results of our study.

The implications of our study, however, do strongly *support* the idea that there is a significant relationship between presence of preserved land and home value, one that cannot and should not be ignored. The results from each of our models demonstrate that in Calvert County, with all else equal, as a home grows further from preserved land, the value of the home and a person's willingness to pay for a home decreases. Furthermore, the p-values for each of the proximity variables show that it would be incredibly unlikely for the relationships we found to be statistical anomalies.

What this implies for the Calvert Nature Society, local, and state governments is also easy to discern. The efforts of the Calvert Nature Society have extrinsic value in increasing and maintaining the property value of homes in Calvert County as well as any economic benefits which result from higher property values in the area. Based on these results, we would encourage that current preserved land continue to be preserved, that efforts to further preserve lands be continued, and that funding for projects and efforts of the Calvert Nature Society as well as similar organizations be supported by local and state governments.

Also, more specifically, and perhaps more pressing, we would like to draw attention to a particular type of situation in which the results of this analysis should be considered by local and state governments. When considering a plot of land, and deciding whether to preserve it, or allow it to be developed upon: We urge those responsible for making this decision to consider not only the short-term tax and fee benefits that would be received from the developers and future owners of whatever is built upon the land. Consider also the long-term losses in the property value of nearby homes and the negative economic externalities that lower home prices may bring in time.

Suggestions for Future Research

"There are no formal markets for such things as recreation opportunities, clean air, and wildlife habitat so there are no clear 'prices' for these goods as there are for market goods like clothing... Economists must measure the value of non-market goods using techniques which don't rely on market prices"- (Haefele, Loomis, Bilmes, Quay)

Our study was conducted as a means of providing quantifiable support for the economic value of natural parks and historic locations. Hedonic pricing analysis is but one way to go about this. The aspect of the economic value of these resources that we quantified in this analysis was individual's willingness to pay for these resources. However, these shared resources have many other aspects that offer economic value, and other types of statistical analysis can quantify these aspects. Had we more time to work with CNS, the following are additional research projects we would have conducted to assess these values.

Differences in home prices only reveal part of citizen's willingness to pay, and in fact, only reveal these preferences about homeowners in the immediate area. A different type of analysis that would reveal an additional portion of citizen's willingness to pay would be the travel cost method of analysis. In short, this method evaluates willingness to pay by surveying park-goers to assess the costs of their travel to the parks (direct expenses plus the value of travel time). If someone were to continue our research, we would suggest that they conduct this analysis and add it to the data that we have already found on how much citizens are willing to pay for these resources. This would involve designing a travel costs survey and a method of administering the survey that would be as random a sampling as possible, then conducting this survey over as long a time period as is reasonable for the researchers.

Citizen's willingness to pay is mostly based on the amenities of these resources that are obvious to the average denizen. These include recreational and educational opportunities for both parks and historic locations, and in the case of homeowners living near natural parks, these include living in areas with lowered congestion, more open space, and more flora and fauna. However, there are additional economic benefits of natural parks that cannot be revealed through citizen's willingness to pay. The main additional economic benefit is the value of the ecosystem services that are provided by the natural parks. These services include carbon sequestration, sustainment of vital animal and plant species, prevention of erosion, and filtration of air and water. Analyses that could be done by future researchers to evaluate the economic impact of Calvert's natural parks through ecosystem services would fall under the category of ecosystem service replacement cost methods of analysis. Essentially this involves measuring the beneficial environmental impact the parks provide, and then estimating the costs that would be incurred if the ecosystem services are degraded or disappear. In the case of Calvert parks, this might involve for example, measuring CO₂ levels near parks versus away from them, looking at water quality near parks versus away from them, and the like, and then estimating the costs of man-made air and water filtration services. An example of costs incurred for environmental degradation occurs in China where CO₂ levels have risen so high that businesses and schools are often forced to shut down, losing valuable work hours.



Anne Sundermann (2015)



Anne Sundermann (2015)

Suggestions for Future Research (continued)

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Another way to get a more exact measure of the economic value of these parks would be to conduct versions of our original analysis on data spanning a range of time greater than, say, 20 years. It may be the case that as Calvert County becomes more heavily populated and urbanized, that the value to homeowners of proximity to parks and historic locations increases over time. If this were the case, then it would provide an even more convincing argument as to whether the investment of funds into preservation is important for the county.

Another statistical analysis that would likely reveal information that would benefit the cause of the Calvert Nature Society and other organizations like it, would be to measure how effective local governments and organizations like the Calvert Nature Society are at leveraging state and federal land protection programs based on how sufficiently these efforts are funded. State and federal land protection programs can bring large sums of money into the county through allocations from state and federal budgets for park expansion and upkeep. Now that we have shown that indeed these parks do have economic value, it is all the more reason why Calvert County should focus their efforts on the allocation of these funds. However, to do so, funds need to be allocated to CNS and the parks services that cover the costs of writing the grant proposals and other costs associated with this process (new hires, employee hours, office space, etc.). A future researcher might consider looking at how effective at receiving grants that Calvert County was during a certain period of time based on how well-funded the Calvert Nature Society was during a period of time slightly before that.



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