REVEALED WILLINGNESS TO PAY FOR CONSERVATION ACROSS THE U.S.

BY

RICHA NIRAULA

THESIS

Submitted in partial fulfillment of the requirements
for the degree of Master of Science in Agricultural and Applied Economics
in the Graduate College of the
University of Illinois at Urbana-Champaign, 2017

Urbana, Illinois

Adviser:

Professor Amy Ando

ABSTRACT

This paper generates new estimates of the benefits of conservation of different kinds of lands at across the entire U.S. with a novel application of choice experiment methodology in which communities reveal themselves willing (or not) to pay for conservation initiatives. We use the local referenda data from Trust for Public Land from 1988 to 2015 over the entire U.S. at the county level and estimate how the communities value different land types and conservation purposes. We analyze 458 referenda to understand how voting behavior changes with referenda attributes and socio-economic characteristics of the participating communities. Because the communities have already voted for conservation referenda, the estimates reveal their actual WTP for different land use types. Using a logit model, we find that communities value open space, recreation, and endangered species more than conservation projects with other characteristics. The results will help conservationists and policy makers alike to understand how the communities value open spaces and use the knowledge for making informed decisions.

ACKNOWLEDGEMENTS

I would like to thank my advisor, Prof. Amy Ando for all her guidance, help, support, and encouragement throughout the project. I would also like to thank my committee members, Dr. Katherine Baylis and Dr. Erica Myers, for their insight and input throughout this process.

Special thanks to Fulbright Nepal for sponsoring my studies. The grant made it possible for me to study and expand my knowledge. I will always remain grateful.

Sincere gratitude to my friends for their continuous support, their help is much appreciated. Finally, nothing could have been achieved without continuous support from my family, I would like to thank my family for their love and support.

TABLE OF CONTENTS

CHAPTER 1

INTRODUCTION

1.1 Overview

Estimates of the value of conservation are important for many reasons; they inform cost-benefit analyses of government conservation programs (Vincent 2015), and they help conservation planners to target their investments to protect resources with relatively high value (Ando and Shah 2016). This paper generates new estimates of the benefits of conservation of different kinds of lands across the entire U.S. with a novel application of conjoint analysis methodology to a well-known dataset on local referenda in which communities reveal themselves willing (or not) to pay for conservation initiatives.

Since the 1990s, we have observed an entirely non-hypothetical wave of local referenda; between 1988 and 2016, a total of 2,524 referenda to spend local financial resources on open space and conservation have resulted in 1,902 such initiatives passing and more than $70 billion being devoted to conservation at the local level (TPL 2016). Early research explored these data to uncover patterns in the kinds of communities that tend to support local conservation spending (Banzhaf, Oates and Sanchirico, 2010; Kotchen and Powers 2006; Nelson, Uwasu and Polasky, 2007). More recent work has moved toward valuation of open space by studying the impacts of these referenda on property values (Heintzelman, Walsh and Grzeskowiak, 2013; Lang 2016), however, most of those studies are very localized and capture only the use values, which makes it difficult to generalize them to other parts of the country. Burkhardt and Chan (2016) use referenda data to estimate values for conservation that could include non-use values, but only for a small number of referenda in the state of California. There is a substantial research gap on how

the voters value different land use types for open space and the factors affecting those estimates across the U.S. This research, to our knowledge, is the first of its kind to estimate the benefits of open space conservation throughout the nation at county level. The measurement of willingness to pay (WTP) for different kinds of open spaces can help the policy makers to evaluate voters' preference towards different forms of conservation and design referenda and target other investments in conservation accordingly.

This research uses data on all county level referenda in the U.S since 1988 to estimate the use and non-use values of the conservation projects proposed by them. We estimate values of different kinds of open spaces and assess how those values are affected by different socio-economic characteristics of the voters, the presence or absence of endangered species in those areas and the land values associated with them.

This work makes three specific contributions to the existing open space conservation literature. First, we estimate the marginal WTP of communities for conservation at county level using four different datasets. Second, we identify how some specific socio-economic characteristics affect WTP. Third, we dig into the specific characteristics of the referendum itself that affect WTP for it.

We use data on a set of county level conservation referenda in the U.S., and estimate whether a given referendum passed as a function of the stated conservation purposes of the project, the presence of endangered species in the area, the amount of area that would be protected if the referendum passed, and socioeconomic characteristics of people in the area. Our results indicate that communities' preference towards open space attributes differ with the types of open space and with the education and racial composition of the community itself. Our results indicate that communities, in general, prefer open space and recreation to other types of

conservation. We also find that African-American communities place higher value than other groups on farmland conservation, whereas Hispanic/Latino communities seem to place higher value than other groups on open space and recreation. Our results show that Hispanic/Latino communities are more likely to vote 'no' for referenda that include farmland or endangered species. Our results also reveal that communities with more highly educated people are more inclined towards recreation than other conservation forms. We do not find any evidence of income effects in marginal WTP.

1.2 Literature Review

WTP for Conservation

Conservation is an expensive process and hence requires a lot of planning in order to strike the socially optimal balance between the benefits of conservation and its costs. Conservation economists have done much research to estimate the values that individuals and communities place on different land types, species, and forms of conservation. Policy documents like OECD 2001 and CBD conference of Parties' decision IV/10 have recognized economic valuation of biodiversity and biological resources as important tools in the process of conservation planning.

Valuation research uses several different types of tools. Hedonic pricing has been used for open space valuation since 1970s. The estimations in hedonic pricing models assume that implicit price function is differentiable and continuous. Most research carrying out valuation of open space with hedonic pricing has focused on natural preserves, wetlands, forests, parks, greenbelts, and farmlands (McConnell and Walls 2005). Stated preference methods like contingent valuation (CV) and choice experiments (CE) have also been used to estimate the values of species and open space conservation. While stated preference methods have the

disadvantage of being hypothetical, they have an advantage over the hedonic pricing method in that they can capture non-use as well as use values of non-market goods and services. Here we review some of the previous research that has estimated the benefits of species conservation, habitat conservation, and open space.

Species: A lot of research in conservation has focused on the species conservation, especially for management of endangered species (Bandara and Tisdell 2002). Christie et al. (2005) use the contingent valuation method to study the WTP of the locals for biodiversity enhancement in the UK farmlands. They find that two-thirds of the respondents had WTP for biodiversity enhancements and one-third had no WTP at all for the biodiversity changes. They also find that people value different biodiversity aspects differently based on whether the species in question are familiar, rare and unfamiliar, and habitat and ecosystem services; those ecosystem services that had direct effects on humans were valued both positively and significantly than those that did not have such direct impacts.

Loomis and White (1996) conduct a meta-analysis to quantify the importance of endangered species to the public. They estimate the economic value of eighteen endangered, rare and threatened species using CV method. They find a wide range of WTP values depending upon the type of species. Households reveal a meagre WTP of $6 for a fish species, the striped shiner, whereas they have high WTP of $95 for the northern spotted owl and its habitat. They also find difference in WTP values based on the nature of species, payment period, and the nature of respondents themselves, whether they are visitors to these species' habitats or non-users. The authors make a special point that the results are anthropocentric and hence are incomplete. They further add that the knowledge of the ecological roles these species play is more important from

the policy perspective. This study is an important bridge which concludes with the fact that economists and biologists need to work together for conservation.

Kotchen and Reiling (1999) use CV to assess the relationships among the perceptions of environmental amenities and WTP to protect endangered species. The authors discover that respondents having higher preference towards better environment have strong 'yes/no' response to the hypothetical questions compared to those who do not have such a pro-environment attitude. Respondents with positive environmental attitudes also have place higher value on species conservation. For the two endangered species considered in the research, the peregrine falcon and the sturgeon, the authors find mean WTP to be $26 and $27 respectively. However, this value fluctuates largely with the general perception towards environment. The respondents with lowest environmental attitude reveal WTP less than $5 for both the species whereas WTP of the pro-environment respondents is found to be $40 and $50 for the peregrine falcon and sturgeon, respectively.

Habitat: Some studies also focus on broader arena and analyze the WTP for not only endangered species but also for habitat types such as forests and wetlands. Most such studies focus on WTP for different types of natural amenities and how factors such as socio-economic characteristics, location, and environmental attitudes affect the WTP of the respondents for such habitats.

In one such study of the Kushiro watershed in northern Japan, Shoyama, Managi and Yamagata (2013) find that public prefers avoiding the extinction of endangered species over climate change mitigation through carbon sequestration and forest management and their WTP varies for different conservation agendas. They find that public had higher WTP for restoring wetland and forest for endangered species' conservation, 298 and 157 JPY respectively, whereas

carbon sequestration through forest management had lower WTP of 109 JPY. Brey, Riera and Mogas (2007) also find support for forest conservation in Spain, estimating that individuals are WTP pay 11.79 euros each year for 68,000 tons of carbon-di-oxide sequestration from forests and 0.12 euros to delay land productivity loss for ten years.

Wetland habitat has also been a frequent topic of valuation research. For example, Stevens, Benin and Larson, (1995) use CV to find the average WTP for wetland preservation in New England in a span of 5 years to be between $74 and $80 for protection against flood, supply of water and control of water pollution. They find slightly higher WTP over the same span, between $81 and $96 for the protection of wetlands that are rich in rare plant species. Lupi, Kaplowitz and Hoehn, (2002) analyze the trade-offs people are willing to make between natural and restored wetlands using a CE survey. They ask 58 respondents if the restored wetland can make up for a natural wetland, and find that the respondents can accept the restoration despite the reduction in wetland area if other attributes like habitat protection is restored.

Brander, Florax and Vermaat (2006) perform a meta-analysis of 190 wetland valuations studies. They find that research using the CV method tends to produce higher WTP values. In this worldwide analysis, they find highest average wetland value in Europe. Amongst wetland types, unvegetated sediment wetland has the highest WTP, a little over $9,000 per hectare per year with mangrove having the lowest value of a little over $400 per hectare per year. They also find high estimates for the wetland biodiversity with a WTP around $17,000 per hectare per year. Their analysis reveals that WTP varies with different wetland types and geographic locations.

In similar meta-analysis on forest valuation, Barrio and Loureiro (2010) dig into 35 studies over the range of 30 years using ordinary least squares regression model and Huber-White clustered standard errors with WTP as the dependent variable. They find that the presence

of direct benefits or uses and the timing of payments affect WTP. Interestingly, WTP for forests is higher in the United States than in European countries excluding Scandinavia. Forest size also tends to have a negative effect on WTP; and the authors hypothesize this as the outcome of decreasing marginal utility. Not surprisingly, people in developed countries have higher WTP than in developing countries.

Garrod and Wills (1992) explore the environmental gain of rural England and discover that when the area around a house has more than 20% of forest, housing prices increase but woodland view have negative effects. In another research in western France, in rural Britanny, Le Goffe (2000) explores how weekly rental prices in guest houses change with forest, grassland, cereal and fodder crops and livestock concentration. He discovers that grassland has positive impact on the rental prices but all other amenities affect the price negatively.

Open space: Undeveloped land provides many benefits to the people who live near it, mitigating many of the negative effects of rapid urbanization. However, not all of those benefits are direct but rather are accrued at broader level as improved water quality, habitat preservation and improved scenery. Furthermore, the benefits of open space do not accrue only to nearby private landowners, but also to other community members. Economists have developed different methods and tools to estimate environmental goods. Most research on open space valuation has deployed hedonic price analysis even though that tool can only capture use values (McConnell and Walls 2005).

In research of single family residences around five parks in Columbus, Ohio, Weicher and Zerbst (1973) find higher housing prices for the houses facing the park, *ceteris paribus*. The prices are lower when the houses are on the back or across crowded park or park building. Brown and Pollakowski (1977) also find similar results in their research in Seattle where open

space in front of lakefront communities have higher housing prices when the open space was bigger, assuming all else remains the same. As in other open spaces, this lake was also accessible to public. Several other researchers find the similar effect on the housing prices due to the proximity (or not) to the parks or open spaces. Lutzenhiser and Netusil (2001) use home sales data from 1990-1992 in Portland, Oregon to assess how the proximity of natural areas increase the housing prices. They find that bigger the natural area, the higher the prices. They further find that closeness to the urban park, however, decreases the price.

Open space with wetlands, however, seems to have more mixed effects on housing prices. Reynolds and Regalado (2002) explore the effects of wetlands in rural Florida and discover that forested and palustrine wetlands affect property values negatively whereas shallow and wetlands with scrub and shrub have positive effects. Doss and Taff (1996) estimate the effects of four types of wetlands in property values in Ramsey County, Minnesota and find that values are directly proportional with decrease in the distance from forested wetlands but inversely related to other wetland types. Mahan, Polasky and Adams (2000) consider the effects of wetland in the housing market in Portland, Oregon where they find that the housing price increases with size and proximity of the wetland, but they do not find any effect of the type of wetland in the housing prices.

Benson, Hansen, Schwartz and Smersh (1998) estimate the value of scenic view in Bellingham, Washington, residential market using the hedonic method. Their maximum-likelihood Box Cox model uses the data of the properties sold over the range of eleven years. The scenes in the study include views of mountain, lake and ocean. They find that the best oceanic view increase the housing prices almost by 60% and even the poorest oceanic view

increase the prices by 8%. They also find that housing prices decrease as the distance from the ocean increases.

Breffle, Morey and Lodder (1998) estimate the value of a preserved undeveloped land parcel using CV in Boulder, Colorado. The attributes associated with the land are scenic values and habitat protection. Administering the survey in person to the households living within a mile of the research area, the authors find the median WTP of the 72 households to be $234. Extrapolation of the WTP gives a very large total value of $774,000, an amount higher than the actual land value of $600,000.

In a research in Connecticut, Bates and Santerre (2001) look into the public demand for open space and how demand varies with price and income. They discover that demand is highly income elastic but comparatively less sensitive to the price. Their results also suggest that private open space cannot well replace public open spaces.

Referenda and Voting Behavior

The valuation research described above develops value estimates for conservation. Other empirical research has answered positive questions about what factors influence the likelihood that people in a community will vote in favor of conservation efforts.

The earliest paper on voting behavior related to conservation came from Deacon and Shapiro (1975) where they analyzed the voting behavior of California residents in controlling development in the coastal region. They found conservation to be a normal good and found evidence that voting for conservation increased with education. Not surprisingly, they also found evidence that the people employed in construction industries had lower preference towards conservation as they feared their jobs might be affected by increased conservation. Similar

research on referenda and voting outcomes conducted by Kahn and Matsusaka (1997) also found environment to be a normal good. They also found that voters considered the opportunity cost for environmental goods to be high if they were in construction, forestry, manufacturing and farming industries. They emphasize the role of income and price in the voting outcomes.

A big wave of local conservation referenda has passed in recent decades. Most of the open space referenda in that era surpass the simple required majority required to pass with the median measure receiving almost 61% of votes and three quarters being passed annually (Banzhaf, Oates and Sanchirico, 2010). Because of this high success and direct public involvement, several papers have analyzed voting patterns and factors affecting conservation referenda results (Nelson, Kotchen and Powers, 2006; Nelson, Uwasu and Polasky, 2007; Banzhaf et al. 2010; Heintzelman 2010). Nelson, Uwasu and Polasky, (2007) in their municipality-level analysis found that bigger population, low population density, higher education, and growth in the neighboring areas affected referenda. They also found that voting for open space conservation increased with the median household income but this likelihood decreased once the income was beyond $100,000. They attributed this to the fact that people beyond $100,000 income could afford their own open space.

Kotchen and Powers (2006) analyze the factors that affect referenda appearance and success for open space conservation. They find evidence of voters' preference towards bonds in comparison to tax increment. Moreover, they reveal the referenda holding jurisdictions have higher population growth, household incomes, home ownership rates and home values than jurisdictions that do not hold any referendum. Banzhaf, Oates and Sanchirico (2010) analyze referenda made in the ecologically valuable areas focusing more on conservation, exploring the effects of funding mechanism in voting outcomes. Burkhardt and Chan (2016) combine voting

data with household tax estimates in California to identify WTP for public goods, and provide a framework to estimate the non-use values of such goods.

Contribution to the Literature

Valuation research has estimated many benefits of conservation, but the CE and CV studies necessarily suffer from hypothetical bias and the hedonic studies cannot estimate non-use values. A few papers have used non-hypothetical data on referenda to estimate combined use and non-use values (Kotchen and Powers, 2006; Burkhardt and Chan, 2015; Lang, 2016), but those studies were limited in geographic scope, and previous research on conservation benefits has found that WTP varies widely across different regions. This paper fills a gap in the literature by using non-hypothetical referenda to estimate WTP for conservation across the entire U.S. at county level.

CHAPTER 2: METHODS

2.1 Model

In order to carry out a national multi-year analysis of many referenda, we must abstract from detail more than Burkhardt and Chan (2016). Our approach adapts the random utility model (RUM) used in individual CE valuation methodology. Our model conceptualizes each community *i* as a single decision maker. In year *t*, community *i* is presented with a conservation referendum on its ballot. That referendum has multiple non-cost attributes, *X*, including how many acres of land will be protected, and what kind of ecosystems and species are likely to be represented in that land; it also has a cost attribute, *P*. The community itself has features *Y* (such as wealth and racial/ethnic composition) that may affect the marginal value it places on attributes *X*. We assume a RUM such that the utility community *i* receives from referendum *j* is given by,

$$U_{ij} = U\left(X_j, P_j \middle| Y_j\right) + \varepsilon_{ij} \quad (1)$$

The community votes to decide whether to pass the referendum or stick with the status quo of no referendum. While passing the referendum would allow us to differentiate the attributes and assigning the values to them, remaining in the status quo would mean that the community has values of zero for each of the referenda purpose dummies, 0 for endangered species, 0 acres of land, and 0 cost. Community will pass the referendum if and only if the utility it gains from the referendum is greater than the utility it will have with the status quo in that community at that point in time:

$$Prob(\text{referendum passes}) = Prob\ (U_{ij} > U_{0it}) \quad (2)$$

This is functionally equivalent to a choice experiment in which individuals are asked to choose between a single choice bundle and a status quo option, and we estimate the parameters

on the attributes (and hence the value people place on them) using discrete-choice econometric tools from Adamowicz et al. (1998). In this model, the errors are assumed to be distributed independently and identically which allows the probability of the given alternative being chosen to be expressed through logit distribution (McFadden 1973).

However, because the attributes in this model are not hypothetical, we do understand that separating the effects of individual attributes might not be entirely possible. We, therefore, have used the combination of attributes following Peterson (2003). Peterson (2003) suggests that attributes in an environmental valuation can be highly correlated naturally making it almost impossible to separate them. He further suggests using the combination of relatable attributes which can provide dissociable properties and might be the safest approach in such valuation studies.

We then estimate marginal WTP as the ratio of the parameter of attributes (β_x) to the parameter of cost (β_p),

$$MWTP = -\beta_x / \beta_p \quad (3)$$

For the regression, we use the binary logit model where the dependent variable is whether the referendum passed. Deacon and Shapiro (1975) developed a logit model specifically to analyze the voting behavior of the people in California. Similarly, in his paper, Fischel (1979) found that there was only a small difference between average voting results and individual preference in referenda related to environment.

Our independent variables include non-cost attributes of the conservation referenda and socio-economics characteristics from census at the county level. Table 2 gives hypothesized effects of different variables. The referenda purposes include many different forms of protected area use: open space, recreation, watershed, forest, wetland, wildlife, trails and farmland. These

purposes can come singly or together with other purposes. For instance, open space is repeated in almost all referenda whereas farmland or watershed do not share similar repetition. Including dummy variables for conservation functions allows us to analyze communities' preferences towards particular conservation purposes. We also use variables from the Census to describe the counties in which the referenda were held, including percentages of the population in racial minority groups (African-American and Hispanic/Latino), percentage of the population with a bachelor's degree or higher, population density and median household income. Interacting county characteristics with referenda attributes allows us to identify heterogeneity across different groups of people in their WTP for different kinds of conservation. We assume that the preferences of the communities regarding the conservation referenda are constant over time.

Our regression equation is as follows:

$$\mathrm{Ln}\left(\frac{P}{1-P}\right) = \beta_0+\beta_1 X_1+\beta_2 X_2+\ldots.+\beta_k X_k\,. \qquad (4)$$

2.2 Data

To estimate communities' WTP and the ways different socio-economic factors affect it, we use county level data from four different sources. Voting data on referendum comes from the Trust for Public Land. Land values data come from the United States Census of Agriculture. Endangered species data comes from the U.S. Fish and Wildlife Service. Socio-economic characteristics of the voters in different counties come from the decennial census. We discuss these data and their relevance to the research one by one.

TPL data on referenda

The Land Vote database maintained by the Trust for Public Land (TPL 2016) compiles information about conservation referenda characteristics and vote outcomes at different

jurisdictional levels i.e. state, municipality, county and special district. The data on open space referenda ranges from 1988 to 2015 and provides descriptions about the type of conservation to be supported, the date when voting took place, the conservation cost, the finance mechanism, and whether the referendum was passed or not. For our analysis, we use referenda at the county level. In general, one referendum can have multiple attributes that do come together. For our purpose, based on the correlation between the variables, we have we use dummy variables for the different possible purposes of conservation as attributes of the open space that people are choosing (or not) to protect: open space (OpenSpace==1|Greenways==1), nature (wildlife habitat==1|watershed==1|Forests==1), recreation (Recreation==1|Trails==1|Parks==1), and agriculture (Farmland==1|Ranchland==1|AgriculturalPreservation==1). These dummy variables are equal to 1 if referenda include them as an attribute, 0 otherwise. By including these attributes as variables in the regression, we can identify how WTP varies with conservation purpose, area, and cost.

Land Values Data

We use two different sets of data for land values. One set from the USDA Census of Agriculture (USDA) provides county level land rent values for 2002, 2007, and 2012. In order to obtain reasonable county level land values for the years in between those three years, we obtain average state-level land values for every year (LLI 2016) and apply the annual percent land value changes in the LLI data for a given state to the Census land values for every county in that state.

A given amount of conservation expenditure will result in different quantities of land protected in heterogeneous counties depending on how costly land is in those counties. We estimate a proxy for the land that would be protected by a referendum as the total conservation

cost divided by the land value in that county in that year. We expect WTP to be higher for referenda that will protect more land.

We use the discount rate of 5% to calculate the discounted present land values. Since conservation is expensive and ongoing process, we assume that land is conserved permanently and rental value must be paid every year.

Endangered and Threatened Species Data

Data on the number of different threatened and endangered species present in each county come from the Department of U.S. Fish and Wildlife Service (USFWS 2016). This endangered species variable allows us to assess whether voters have a higher WTP for conservation in areas where threatened and endangered species depend on undeveloped land for habitat. The presence of such species might increase the benefits of land conservation, given the results of earlier research that show that people place significant value on endangered species conservation (Banzhaf, Oates and Sanchirico,2010). The dummy variable for endangered species get 1 if purpose includes endangered species and 0 if otherwise.

Census Data

We gather U.S. Census data from 1980, 1990, 2000, and 2010 (USCB 2017) on median household income, population density, percent of the adult population in the county with a bachelor's degree or higher, and racial composition of the county (percent of the population that is African-American and that is Latino/Hispanic). We generate values for each year from the decennial censuses using STATA 14 through linear extrapolation. The referenda research surveyed in section 1 found that these socio-economic characteristics play important roles in the success of conservation referenda. We interact these variables with the features of the

conservation project (cost, conservation type) in order to estimate how WTP for different kinds of conservation varies with income, education, and race. We can also identify whether conservation is valued more highly by urban than by rural voters.

CHAPTER 3

RESULTS

3.1 Summary Statistics

The total number of counties that held referenda between 1988 and 2015 is 499. We dropped 40 observations that did not include conservation expenditure as it is a variable required in our analysis.

Several counties had multiple referenda during that time period. In only one case was an observation dropped. DuPage County in Illinois held two referenda in 1992; the first one in March did not pass, while the second one in November did pass. The second referendum was the same as the first one, but might have passed through additional campaigning, affecting the voters' behavior. To avoid duplicating observations, we dropped the second observation.

Pima County, Arizona held two referenda in May 2004; the first referendum was for open space, habitat protection and forests, and the second one was for the improvement and acquisition of land for parks, trails, and recreation. Pima County again held referenda three times in November 2015; as in the first case, the purposes were different. The first referendum was for natural area conservation and historic preservation, the second one for economic development of open space, and the third one for flood control and damage in the watershed level.

Miami-Dade, Florida had three referenda for open space conservation in November 2004. The general purpose of all three referenda mentions parks, recreation and open space but all these have completely different finance mechanism and motives. Hence, all three referenda are analyzed as individual referenda in our data analysis.

Another repetition is in Mecklenburg County, North Carolina which held referenda twice in November, 1999. Both these referenda have different purposes; the first one was for open

space and the second was for parks and recreation. Since their purposes were not the same, we include both. Bernalillo County in New Mexico also held two different referenda in November 2000. The last county to have multiple referenda in the same year is Charleston County, South Carolina. It held two referenda in November 2000, for two different purposes. One was for parks and the other was for farmland, forests and open space. The latter did not pass.

Table 3 provides summary statistics of the variables from referenda and the census. Most of the referenda pass – fully 78% of the referenda in the TPL dataset were successful. All the conservation purposes are reasonably common, with open space having the highest rate of occurrence (present in 75% of referenda) and farmland occurring in the smallest percent of referenda (only 24%). The conservation expenditures at stake average $52 million, but range from less than $1 million (in several counties) up to $895 million for a referendum in Los Angeles, CA in 2014. Area protected is similarly heterogeneous, with a mean of 894 acres and variation from just 2 acres to over 32,000 acres after discounting for the rental value of 5%.

The average median household income for the counties holding referenda was about $51,000, and the average percentage of the adults over 25 and with a bachelor's degree or higher was 32%. On average, the percent of people in the counties holding referenda that are Hispanic/Latino and African-American are 11% and 9%, respectively. The average population per square mile was around 800.

It is interesting to note the differences in socio-economic variables in the counties holding referenda with the average values of the same variables throughout the country. We use census 2000 as the middle point for comparing the values and the differences are quite interesting. Table 4 shows the average values of all five socio-economic variables in the year 2000. We can see that there is not a substantial difference between the percentage population of

Hispanic/Latino and African/American which were found to be 11 and 9 respectively. There are, however, stark differences in other components. While the average percentage of people having bachelor degree or higher and above 25 years of age is 15.5 at the national level, it is more than double that (32) for the counties that held referenda from 1988-2015. Similarly, median household income at the national level is $41,994 which is less than that of the counties that held referenda which is $51,000. Population density of the counties holding the referenda is also much higher than the average national population density with the former being 800 and the latter being 79.6.

3.2 Regression Results

Table 5 provides the logit regression estimates for referenda attributes. Our results indicate that the communities have a statistically significant additional WTP for conservation referenda that have open space as a purpose. However, none of the other variables were significant; this may be due to the limited number of referenda that did not pass, and resulting low level of variation in the outcome variable. However, the coefficient of area protected is positive and the coefficient on conservation cost (in millions) is negative, both results consistent with economic theory.

Table 7 uses the coefficients on open space, recreation, and conservation cost (despite the insignificance of the latter variable) in equation (3) to calculate MWTP for the three attributes. The result implies that MWTP for open space status is over 5,500 million, and MWTP to bring an additional acre of land in conservation is 0.29 million.

Inclusion of the interaction variables provide a different set of results (Table 7). We find a negative estimate for Recreation alone, but the interaction of Recreation with the higher education variable is positive; at levels of higher education around the mean, the net coefficient

becomes positive. Previous research found education as a strong predictor of success and failure of the referenda (Nelson, Uwasu and Polasky, 2007; Banzhaf, Oates and Sanchirico, 2010), so it is only surprising that education did not have significant interactions with any other variables. Our results also indicate that communities with large Latino populations have an even higher WTP for recreation in protected areas than other types of projects.

The coefficient on endangered species alone is significant and positive; this is consistent with results from Banzhaf, Oates and Sanchirico, (2010). However, Latino populations seem to have a lower value for endangered species than other groups.

Neither the agriculture nor the open space dummy variables are significant alone. However, agriculture is positive and significant when interacted with percent African American, and negative and significant when interacted with Latino. These two groups of people have very different WTP for a conservation project aimed at preservation of agricultural lands. And the open space variable has a positive and significant coefficient when interacted with the percent Latino variable.

Several studies have found that the preference for or against leisure settings differ across racial and ethnic groups. Both the reasons to visits such spaces and the activities performed in natural areas vary among group (Byrne and Wolch, 2009). Some researchers have suggested that African-American visitors might be threatened in the wilderness (Floyd, Outley, Bixler and Hammitt 1995; Virden and Walker, 1999); this might help explain the preference of African-American communities for agricultural preservation relative to other types of projects. Gobster (2002) and Byrne and Wolch (2009) find that Latinos tend to visit natural areas in groups and engage in social activities such as picnicking; this helps explain the greater WTP of Latino

communities for recreation and open space rather than nature and agriculture. Further, this behavior also varies with ethno-racial preferences.

CHAPTER 4

CONCLUSION AND LIMITATIONS

The purpose of this research was to estimate WTP for conservation in the U.S. at county level and how it varies with socio-economic variables. We find that on average, WTP for conservation is highest for projects that produce open space and recreation (relative to farmland and nature). Furthermore, we find that different communities have different utilities for open space types. Latino communities have higher WTP for recreation and open space than other groups, while African-American communities have a positive WTP for farmland (in contrast to Latino populations, for whom the farmland attribute is a disamenity). The value of recreational focus in protected areas is also increasing in the percent of the population that has a college education or more.

These findings are intriguing, but the usefulness of these results is limited by the inefficiency of the estimates of the coefficients on conservation cost and numbers of acres. More robust results could be gained in future research by addition of municipal and state level referenda to the data set; county level referenda are only 20% of the conservation referenda in the country. Future research with the bigger data set that could also explore spatial autocorrelation and regional heterogeneity in preferences and voting patterns.

We also need to note that because both the referendum and conservation are complex and expensive, TPL makes an effort to choose the counties where the likelihood of passing the referendum is higher than those that are not chosen. This can clearly be seen through the differences in education, median income, and population density at the national level and the counties holding the referenda. The deliberate choosing of the counties for passing the

conservation referenda makes it difficult to generalize the results to other counties in the States as there might be a bias in county selection at the first place.

TABLES AND FIGURE

Table 1: Definitions of variables

Variable	Description
Pass	Dummy for whether the referendum passed
Open space	Dummy for referenda purpose that is Open space or Greenways
Agriculture	Dummy for referenda purpose that is Farmland, Ranchland, or Agricultural Preservation
Nature	Dummy for referenda purpose that is Watershed Protection Wetland Preservation, Wildlife Habitat, Wildlife, Habitat, or Forests
Recreation	Dummy for referenda that included that included Recreation, Trails, or Parks as one of the purposes
Conservation cost	Funds at stake for conservation in referenda, in millions of dollars
Endangered species	Endangered and threated species in the county
Area protected	Area that would be protected as open space through referendum
Median income	Median household income in the county
Population density	Population density in the county per square miles
% African American	Percentage of population that is African American in the county
% Latino	Percentage of population that is Hispanic/Latino in the county
% Higher Ed	Percentage of population over 25 with bachelor degree or more

Note: Area protected is calculated as conservation cost divided by the average land value in the county.

Table 2: Hypothesized effects of different variables

Variable	Expected Sign
Open space	+
Agriculture	+
Nature	+
Recreation	+
Endangered species	+
Area Protected (Acres)	+
Conservation cost	-
Median income*Conservation cost	+
Population density*Conservation cost	+
% African American*purpose dummies	?
% Hispanic/Latino*purpose dummies	?
% Higher Ed*purpose dummies	+

Table 3: Summary statistics for selected variables

Variable	Mean	S.D.	Min	Max
Open space	0.75	0.43	0.00	1.00
Agriculture	0.24	0.43	0.00	1.00
Recreation	0.68	0.47	0.00	1.00
Nature	0.32	0.47	0.00	1.00
Area protected (acres)	894	2417	2.40	31348.92
Endangered species	11.44	18.97	0.00	203.00
Median income	50628	13964	22783	107075
% African American	9.22	10.02	0.08	54.25
% Hispanic/Latino	10.77	11.54	0.23	60.38
Population density (square miles)	806.58	1159.78	3.36	16526.20
% Higher ed	31.77	10.70	8.47	62.70
Conservation Cost	52500000	93900000	200000	895000000

Note: N=458.

Table 4. Summary Statistics of the Census Variables for year 2000

Census Variables	Average Value
% Higher ed	15.5
%Hispanic/Latino	12.5
%African American	12.3
Median Income	41,994
Population density	79.6

(Source: U.S. Census Bureau, Census 2000)

Table 5. Logit regression coefficients with referenda attributes

Variable	Coefficient
Open space	0.699**
	(0.251)
Agriculture	-0.194
	(0.276)
Nature	0.0418
	(0.250)
Recreation	0.0408
	(0.262)
Area protected	0.000038
	(0.000064)
Endangered species	-0.000444
	(0.00627)
Conservation Cost	-0.000127
	(0.00130)

N = 458. Standard errors in parentheses.

* = 10% significance, **=5% significance, ***=1% significance.

Log likelihood = -242.0977, LR Chi^2 (7) = 8.96, Prob > Chi^2 = 0.2556 Pseudo R^2 = 0.0182

Table 6: Marginal WTP for features of referenda

Conservation/Land Use Type	MWTP (million $)	Interpretation
Open space	5,504	Additional WTP for an average sized project to have open space as an attribute
Protected area (acre)	0.29	Additional WTP for an average sized project to have an additional acre of land for conservation

Note: We only find open space as significant, hence, we do not use other attributes and stick to open space only.

Table 7: Logit regression coefficients with both referenda and census variables

Variable	Estimates
Open space	0.0203 (0.786)
Agriculture	-0.273 (1.038)
Nature	0.480 (0.884)
Recreation	-2.187** (0.730)
Area protected	-0.000208 (0.000394)
Endangered species	0.0788* (0.0360)
% African American * Open space	0.0467 (0.0295)
% African American *Agriculture	0.105* (0.0435)
% African American * Nature	-0.0770 (0.0395)
% African American * Recreation	0.0210 (0.0190)
% African American *Area protected	-0.0000058 (0.0000132)
% African American * Endangered species	-0.000613 (0.00178)
% Hispanic/Latino * open space	0.0507* (0.0248)
% Hispanic/Latino * Agriculture	-0.0905* (0.0376)
% Hispanic/Latino * Nature	0.0181 (0.0292)
% Hispanic/Latino * Recreation	0.0676** (0.0233)
% Hispanic/Latino * Area protected	-0.000000658 (0.00000850)
% Hispanic/Latino * Endangered species	-0.00261** (0.000954)
% Higher ed* Open space	0.00242 (0.0237)
% Higher ed * Agriculture	0.000664 (0.0307)

Table 7 continued

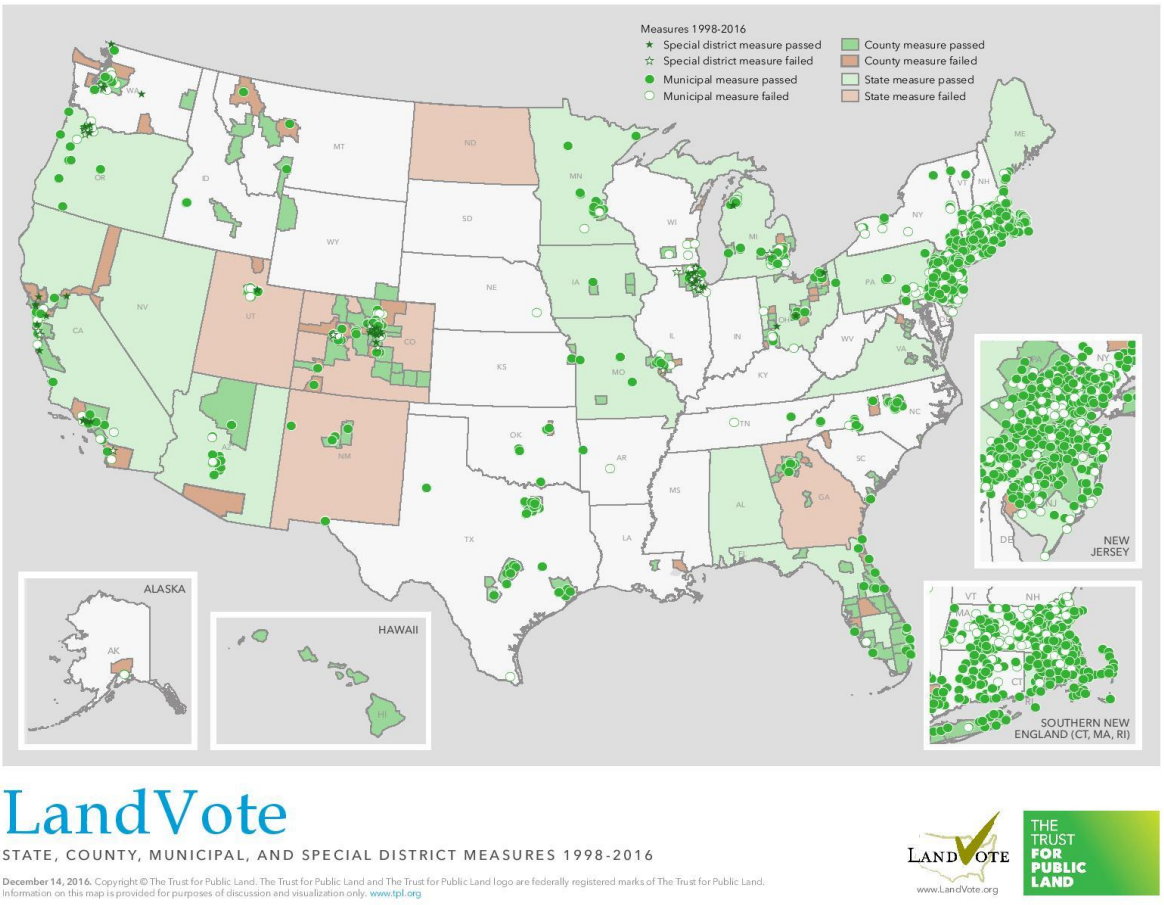
Higher ed *Nature	0.00557 (0.0270)
% Higher ed *Recreation	0.0603** (0.0205)
% Higher ed * Area protected	0.00000843 (0.0000117)
% Higher ed * Endangered species	-0.00178 (0.00102)
Population density * Conservation cost	-0.00000134 (0.00000123)
Median income * Conservation cost	0.000000413 (0.000000662)
(Median income)^2 * Conservation cost	-3.13e-12 (5.32e-12)
Conservation cost	-0.00964 (0.0200)

N = 458. Standard errors in parentheses.

* = 10% significance, ** = 5% significance, *** = 1% significance.

Log likelihood = -210.378 LR Chi^2 = 72.40 Prob> chi^2 = 0.0000 Pseudo R^2 = 0.1468

Figure 1: Land Vote Measures (1988-2016)



Source: TPL 2016

REFERENCES

Adamowicz, Wiktor, Peter Boxall, Michael Williams and Jordan Louviere. 1998. Stated preference approaches for measuring passive use values: Choice experiments and contingent valuation. *American Journal of Agricultural Economics* 80(1): 64-75.

Ando, Amy W. and Payal Shah. 2016. The Economics of Conservation and Finance: A Review of the Literature. *International Review of Environmental and Resource Economics*.

Bandara, R. and Tisdell, C. (2003). The Net Benefit of Saving the Asian Elephant: A Policy and Contingent Valuation Study. Working Paper No. 87. Economics, Ecology and the Environment.

Banzhaf, H. S., Oates, W. E., & Sanchirico, J. N. (2010). Success and design of local referenda for land conservation. *Journal of Policy Analysis and Management*, *29*(4), 769-798.

Barrio, M., & Loureiro, M. L. (2010). A meta-analysis of contingent valuation forest studies. *Ecological Economics*, *69*(5), 1023-1030.

Bates, L. J., & Santerre, R. E. (2001). The public demand for open space: the case of Connecticut communities. *Journal of Urban Economics*, *50*(1), 97-111.

Benson, E. D., Hansen, J. L., Schwartz, A. L., & Smersh, G. T. (1998). Pricing residential amenities: the value of a view. *The Journal of Real Estate Finance and Economics*, *16*(1), 55-73.

Brander, L. M., Florax, R. J., & Vermaat, J. E. (2006). The empirics of wetland valuation: a comprehensive summary and a meta-analysis of the literature. *Environmental and Resource Economics*, *33*(2), 223-250.

Breffle, W. S., Morey, E. R., & Lodder, T. S. (1998). Using contingent valuation to estimate a neighbourhood's willingness to pay to preserve undeveloped urban land. *Urban Studies*, *35*(4), 715-727.

Brey, R., Riera, P., & Mogas, J. (2007). Estimation of forest values using choice modeling: an application to Spanish forests. *Ecological Economics*, *64*(2), 305-312.

Brown, G. M., & Pollakowski, H. O. (1977). Economic valuation of shoreline. *The review of Economics and Statistics*, 272-278.

Burkhardt, J., & Chan, N. W. (2017). The dollars and sense of ballot propositions: estimating willingness to pay for public goods using aggregate voting data. *Journal of the Association of Environmental and Resource Economists*, *4*(2), 479-503.

Byrne, J., & Wolch, J. (2009). Nature, race, and parks: past research and future directions for geographic research. *Progress in Human Geography*, *33*(6), 743-765.

Christie, M., Hanley, N., Warren, J., Murphy, K., Wright, R., & Hyde, T. (2006). Valuing the diversity of biodiversity. *Ecological economics*, *58*(2), 304-317.

Deacon, R., & Shapiro, P. (1975). Private preference for collective goods revealed through voting on referenda. *The American Economic Review*, 943-955.

Doss, C. R., & Taff, S. J. (1996). The influence of wetland type and wetland proximity on residential property values. *Journal of agricultural and resource economics*, 120-129.

Fischel, W. A. (1979). Determinants of voting on environmental quality: a study of a New Hampshire pulp mill referendum. *Journal of Environmental Economics and Management*, *6*(2), 107-118.

Floyd, M. F., Outley, C. W., Bixler, R. D., & Hammitt, W. E. (1995). Effect of race, environmental preference and negative affect on recreation preferences. In *national recreation and park association symposium on leisure research* (p. 88).

Garrod, G. D., & Willis, K. G. (1992). Valuing goods' characteristics: an application of the hedonic price method to environmental attributes. *Journal of Environmental management*, *34*(1), 59-76.

Gobster, P. H. (2002). Managing urban parks for a racially and ethnically diverse clientele. *Leisure sciences*, *24*(2), 143-159.

Heintzelman, Martin D. 2010. "Measuring the Property-Value Effects of Local Land Use and Preservation Referenda." *Land Economics* 86, no. 1: 22-47.

Kahn, M. E., & Matsusaka, J. G. (1997). Demand for environmental goods: Evidence from voting patterns on California initiatives. *JL & Econ.*, *40*, 137.

Kotchen, M. J., & Powers, S. M. (2006). Explaining the appearance and success of voter referenda for open-space conservation. *Journal of Environmental Economics and Management*, *52*(1), 373-390.

Kotchen, M. J., & Reiling, S. D. (2000). Environmental attitudes, motivations, and contingent valuation of nonuse values: a case study involving endangered species. *Ecological Economics*, *32*(1), 93-107.

Lang, C. (2016). Using Voting and Valuation to Assess the Efficiency of Local Public Good Provision.

Le Goffe, P. (2000). Hedonic pricing of agriculture and forestry externalities. *Environmental and Resource Economics*, *15*(4), 397-401.

Lincoln Land Institute (LLI). 2016. *Land Prices by State*. https://datatoolkits.lincolninst.edu/subcenters/land-values/land-prices-by-state.asp

Loomis, J. B., & White, D. S. (1996). Economic benefits of rare and endangered species: summary and meta-analysis. *Ecological Economics*, *18*(3), 197-206.

Lupi, F., Kaplowitz, M. D., & Hoehn, J. P. (2002). The economic equivalency of drained and restored wetlands in Michigan. *American Journal of Agricultural Economics*, *84*(5), 1355-1361.

Lutzenhiser, M., & Netusil, N. R. (2001). The effect of open spaces on a home's sale price. *Contemporary Economic Policy*, *19*(3), 291-298.

Mahan, B. L., Polasky, S., & Adams, R. M. (2000). Valuing urban wetlands: a property price approach. *Land economics*, 100-113.

McConnell, V., & Walls, M. A. (2005). *The value of open space: Evidence from studies of nonmarket benefits* (pp. 1-78). Washington, DC: Resources for the Future.

McFadden, D. (1973). Conditional logit analysis of qualitative choice behavior.

Nelson, E., Uwasu, M., & Polasky, S. (2007). Voting on open space: What explains the appearance and support of municipal-level open space conservation referenda in the United States? *Ecological Economics*, *62*(3), 580-593.

Peterson, L. G. (2003). A primer on nonmarket valuation (Vol. 3). P. A. Champ, K. J. Boyle, & T. C. Brown (Eds.). Dordrecht: Kluwer Academic Publishers.

Reynolds, J. E., & Regalado, A. (2002). The effects of wetlands and other factors on rural land values. *Appraisal Journal*, *70*(2), 182-182.

Shoyama, K., Managi, S., & Yamagata, Y. (2013). Public preferences for biodiversity conservation and climate-change mitigation: A choice experiment using ecosystem services indicators. *Land use policy*, *34*, 282-293.

Stevens, T. H., Benin, S., & Larson, J. S. (1995). Public attitudes and economic values for wetland preservation in New England. *Wetlands*, *15*(3), 226-231.

Trust for Public Land (TPL). (2016). *LandVote*® www.landvote.org

U. S. Census Bureau (USCB), Census 2000.

https://www.census.gov/prod/2002pubs/c2kprof00-us.pdf.

U. S. Census Bureau (USCB). (2016). *USA Counties Data File Downloads.*

https://www.census.gov/support/USACdataDownloads.html.

U. S. Department of Agriculture (USDA). (2016). *Census of Agriculture*. https://www.agcensus.usda.gov/Publications/2007/Full_Report/Volume_1,_Chapter_2_County_Level/).

U. S. Fish and Wildlife Service (USFWS). (2016). *Endangered Species*. https://www.fws.gov/endangered/.

Vincent, Jeffrey R. 2015. Impact Evaluation of Forest Conservation Programs: Benefit-Cost Analysis, without the Economics. *Environmental and Resource Economics*: 1-14.

Virden, R. J., & Walker, G. J. (1999). Ethnic/racial and gender variations among meanings given to, and preferences for, the natural environment. *Leisure Sciences*, *21*(3), 219-239.

Weigher, J. C., & Zerbst, R. H. (1973). The externalities of neighborhood parks: an empirical investigation. *Land economics*, *49*(1), 99-105.