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Nonmarket Valuation and Land Use: Two Essays

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NONMARKET VALUATION AND LAND USE: TWO ESSAYS

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An Abstract of the Thesis Presented
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The research presented here consists of two essays that describe applications of nonmarket valuation techniques to current land use issues. The individual studies were designed to address important methodological and policy issues, respectively.

In the first essay, Geographic Information System (GIS) data are used to develop variables representing the physical extent and visibility of surrounding land use/cover features in a hedonic model of a rural/suburban housing market. Three equations are estimated to determine if views affect property prices, and, further, if omission of visibility variables leads to omitted variable bias. Results indicate that the visibility measures are important determinants of prices and that their exclusion may lead to incorrect conclusions regarding the significance and signs of other environmental variables.

The second essay represents a synthesis of findings from focus groups conducted in five states. The focus groups were the first step in a study designed to identify the types of attributes of farmland and agricultural systems that are important to the public and should be preserved as open space. Modeling of responses to a variety of choice exercises provides several insights. Overall, the results suggest that open space protection through preservation of agricultural lands is an important issue to the public. Preferences for farmland preservation vary depending on the

region of the country and the attributes of the land. The physical location of the farm, the type of farm and the farming practices used are important to people, all of which are directly and indirectly influenced by state and federal agricultural policies.

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Chapter 1

INTRODUCTION

The research presented here consists of two essays that describe applications of nonmarket valuation techniques to current land use issues. The individual studies were designed to address important methodological and policy issues, respectively.

The first essay describes the use of spatial data to construct variables in a hedonic property value model of a rural/suburban residential market. This study combines property sales and Geographic Information System (GIS) data to estimate implicit prices for proximity, extent and visibility of several land use and land cover features. This is one of the first studies to develop a continuous measure of visibility and the first to incorporate proximity, physical area and visibility of environmental attributes in a hedonic model.

The second essay provides information on public preferences for attributes of farmland and agricultural systems in the context of a national policy to protect open lands. This research utilizes data from conjoint questions and other choice exercises completed in focus groups in five states. While other studies have estimated the value of farmland protection programs in specific regions or for specific types of farmland, this study is the first to provide evidence of how preferences might vary by region of the country and to identify specific attributes of farmland most desirable to the public.

Both of these essays provide information valuable to future nonmarket valuation research. The first demonstrates that exclusion of variables describing the visibility of environmental attributes from a hedonic equation may lead to omitted variable bias. As a result, incorrect conclusions regarding the sign and significance of other environmental attributes may be drawn. Hedonic property value analyses have, on occasion, constituted important elements of public policy decisions. They are discussed specifically in National Oceanic and Atmospheric

Administration and Department of the Interior rules regarding methods to assess damages to natural resources and EPA guidelines for conducting economic analyses.

The second essay is a synthesis of findings from the early stages of a larger study designed to provide information in support of a national open lands protection policy. In addition to exploring appropriate language and methods of communicating the notion of open space amenities and protection to the public, this research describes specific attributes that could be important in a farmland protection program. This information is critical to the design of a reliable survey instrument for the larger study and provides evidence relevant to other land use valuation applications.

Chapter 2

USING GIS TO INCORPORATE VISIBILITY IN HEDONIC PROPERTY VALUE MODELS

Introduction

There is a long history of using hedonic models to investigate the effects of amenities and disamenities on sale prices of residential properties. The most common approach has been to include distance from the property to the amenity or disamenity as an explanatory variable in the model(s) (Milon et al., 1984; Kohlhase, 1991; Mendelsohn et al., 1992; Nelson et al., 1992; Thayer et al., 1992; Kiel, 1995; Lansford and Jones, 1995, among others). In this manner, the estimated coefficients represent the implicit price of proximity to the amenity or disamenity (which may or may not be visible from the property). In recent years, GIS (Geographical Information Systems) data have facilitated improved resolution of such distance measures and added an additional dimension to model specifications. In many instances there may be multiple occurrences of amenities and/or disamenities proximate to properties, and GIS data provides means to efficiently generate variables that distinguish between them. For example, in examining the influence of wetland amenities on sale prices of residential properties in Portland, Oregon, Mahan et al. (2000) consider distance to, as well as size and shape of, the nearest wetland area. Similarly, Powe et al. (1997) approximate forest amenities associated with a given property with an index variable that measures the ratio of acreage to squared distance from the home, summed over all woodland areas in the Southampton and New Forest areas of Great Britain. GIS data have also been used by Geoghegan et al. (1997) to construct variables that reflect the extent, diversity and fragmentation of land uses in various buffer sizes around residential properties in the Patuxent Watershed, Maryland. In each of these three studies, GIS data have enhanced the ability of the hedonic model to explain variation in sale prices by considering both proximity and extent of environmental attributes.

GIS data can also provide information on topography, which may influence the effect of nearby environmental attributes in that it largely dictates what is visible from a property. For example, while close proximity to commercial areas may offer convenience that could be reflected positively in property prices, an opposite effect may exist if the commercial area is visible from a home. Alternatively, the value of a proximate recreational resource, such as a lake, may be enhanced if it is also visible and thus contributes to the aesthetic qualities of the property. Some hedonic studies have included categorical variables to account for a view of a particular attribute. In an early example, McLeod (1984) utilizes a binary variable to indicate the presence of a river view in suburbs around the Swan River in Perth, Australia. Kulshreshtha and Gillies (1993) attempt to estimate the value of a view of the South Saskatchewan River, Saskatchewan by including variables that interact structural and neighborhood characteristics with a binary variable that indicates whether the river is visible from the property. More recently, Benson et al. (1998) examine mountain, lake and ocean views in the Bellingham, Washington residential market. These authors subdivide ocean views into "full," "superior partial," "good partial," and "poor partial" categories and interact these variables with measures of distance to the ocean. This latter example represents a considerable improvement over a binary characterization. However, in Benson et al., and other studies, the existence of a view is determined by visual inspection. This process could be prohibitively time consuming depending on the number of properties considered. In addition, the categorization of views is necessarily imposed by the researcher(s). These shortcomings are obviated through the use of GIS data. For example, Lake et al. (1998, 2000a and 2000b) utilize GIS data to develop sophisticated, continuous measures of visibility of various land uses for residences in Glasgow, Scotland. The authors consider topography as well as obstruction of views by surrounding buildings and apply various weighting schemes to account for potential diminishing effects of views with increased distance. However, these researchers were not able to obtain data on structural characteristics of residences that are customarily included in hedonic models. If structural attributes are correlated with the extent of visibility, then their absence in the model will create an omitted variable bias in the estimated implicit price of visibility. This situation may arise if the views offered by a property systematically influence construction.

In the research reported here, GIS data are used to construct variables that measure the extent (surface area) and visibility of surrounding land use/cover features in a hedonic model of the single-family, residential housing market in a portion of the Farmington River Valley of Connecticut. The physical area variables measure the percentage of the land within one kilometer of a property that is dedicated to a particular land use/cover, which represents the extent of the land use/cover within close proximity to properties. The visibility variables measure the percentage of the land visible overall within one kilometer of a property, as well as the visible land in each specific land use/cover.

Four types of land use/cover variables are included in the hedonic equation: development, agriculture, forests and surface water. Three equations are estimated. The first includes the variables representing the physical area of each land use/cover. The second equation includes the same variables as the first equation and a variable that represents the percent of the total land area that is visible within one kilometer of a property. The third equation includes the same variables as the second equation and adds four variables that represent the percentage of land within the same radius that is assigned to each of the land use/covers and visible. Moving from the first to the second equation, and from the second to the third equation, we examine the effects of including the additional environmental variables on the significance, signs and magnitudes of the variables that occurred in the prior equation(s). This sequential analysis makes it possible to identify if views do affect property prices and if their omission may lead to omitted variable biases in the coefficients on the other variables in the hedonic equation. Several studies have demonstrated the sensitivity of hedonic equations to imperfect specification (e.g., Cropper at el., 1988 and Graves et al., 1988). In a recent hedonic study of Chesapeake Bay water quality, Leggett and Bockstael (2000) consider the consequences of omitting an additional relevant variable, distance to the nearest point source, from their equations. The authors observe changes in the magnitude and significance of the coefficient on the water quality measure (fecal coliform) when these emitter effects are excluded. Results such as these underscore the importance of proper specification of the environmental variables in hedonic analyses. This is particularly true in the context of policy applications, where omission of relevant variables could lead to costly misallocation of resources.

The Hedonic Model

Hedonic methods are based on a theory of consumer behavior that suggests commodities are valued for their individual "utility-bearing" attributes or characteristics (Rosen, 1974). In this manner, the price of a property may be thought of as a function of it various attributes:

$$P = f(S, N, Q)$$

where P is the vector of sale prices of properties, S represents a vector of structural characteristics (e.g., size, style and age) of buildings on the property, N represents a vector of neighborhood characteristics (e.g., tax and crime rates and school quality), and Q represents a vector of environmental attributes. An individual's utility may be expressed as:

$$U = U[X, P(S, N, Q)]$$

where X is a composite commodity with price equal to one. The homebuyer's problem then is to maximize $U[\bullet]$ subject to:

$$I = X + P$$

where I is income. For a specific environmental attribute, q, it is assumed that an individual will choose a property such that they equate marginal willingness to pay with price for that characteristic:

$$\left(\frac{\partial U}{\partial q}\right)\Big/\left(\frac{\partial U}{\partial X}\right)=\frac{\partial P}{\partial q}$$

Estimation of the price function constitutes what is commonly referred to as a "first-stage" hedonic analysis (Palmquist, 1984 and Freeman, 1993).

Property Data and Construction of Spatial Variables

The adjacent towns of Simsbury and Avon are located northwest of Hartford, Connecticut in the Farmington River Valley. The two towns encompass 57 square miles of land area and had a combined population of 35,600 in 1998. Services, finance, insurance and real estate dominate employment in both communities. The towns of Simsbury and Avon offer comparable neighborhood attributes (tax structure, crime rate, accessibility to central business district and school quality) and share a fairly rural character, with 65 percent open land in Avon and 62 percent open land in Simsbury, including several parks, recreational areas and preserved lands.[1]

The extent of the study area was chosen based on conversations with local realtors, who suggested that the two towns are generally considered jointly by potential homebuyers. Multiple Listing Service data containing sale prices and property characteristic information were obtained for all single-family residence transactions over an 18-month period from late 1997 to early 1999. These data include residence style, year built, lot size, numbers of bedrooms and bathrooms and fireplaces, garage size, and basement type, among other characteristics. The average selling price

[1]The two towns are approximately equidistant from Hartford, where the majority of employment opportunities exist. There are several options for routes into the city. Thus, proximity to Hartford, or

during the time period was $211,000. Variable definitions and summary statistics on property characteristics included in the hedonic equations are reported in Table 2.1. These variables are included in all three equations that are estimated.

Table 2.1 Property Characteristic Variables: Definitions and Descriptive Statistics

Name	Definition	Mean	Standard Deviation
price	Selling price of residence	211,005	84,630
raise	1 if home style is raised ranch, 0 otherwise	.06	.23
col	1 if home style is colonial, 0 otherwise	.47	.50
ranch	1 if home style is ranch, 0 otherwise	.15	.36
cape	1 if home style is cape, 0 otherwise	.17	.37
split	1 if home style is split level, 0 otherwise	.04	.20
cont	1 if home style is contemporary, 0 otherwise	.10	.30
yr_built	Year home was constructed	1961	33
fam_rm	1 if home has a family room, 0 otherwise	.83	.38
frplc	Number of fireplaces in home	1.35	.79
bdrms	Number of bedrooms in home	3.54	.73
vehicles	Number of vehicles accommodated by garage space	1.84	.63
full_bath	Number of full bathrooms in home	1.93	.67
half_bath	Number of half bathrooms in home	.71	.52
full_base	1 if home has a full basement, 0 otherwise	.86	.35
acreage	Acreage of lot	1.09	.82

GIS data were obtained from the Connecticut Department of Environmental Protection. These data include layers that characterize the land use/cover patterns and topography of the study area. The land use/cover data are derived from satellite imagery information and include 28 categories. The topographical data are in the form of a digital elevation model (DEM) constructed by the U.S. Geological Survey from 7.5-minute (1:24,000 scale) quadrangles with ten-foot contour intervals. Street and road layers were

specific roads, are not considered in the model. In addition, each town has a small, poorly defined "downtown" area, proximity to which is not believed to influence property values.

utilized to geocode each property address using a matching algorithm included in the software.[2] The spatial land use/cover variables developed were: (1) the percentage of the land area occupied by residential and commercial development, agriculture, forest and surface water within a one-kilometer radius around each property; and (2) the percentage of land area visible overall, and the percentage of land visible in each land use/cover in the same radius.[3] For the latter, the DEM was employed in what is commonly referred to as a viewshed operation, a routine included in the software that determines visibility subject to certain parameters specified by the researcher. Visibility was calculated in a 360-degree circle, from a point six feet off the ground.[4] This provided the percentage of visible area overall within the one-kilometer radius for each property, and the operation was repeated to determine the percentage of the land visible for each specific land use/cover. In their analyses, Lake et al. (1998, 2000) also consider the heights of surrounding buildings as impediments to visibility. The data utilized by Lake et al. (1998, 2000) included outlines of building foundations that allowed the authors to match building heights determined by visual inspection. Such data do not exist for this study area, thus precluding proper positioning of structures on their respective lots, even if surveying were undertaken.[5] All spatial/environmental variables are defined in Table 2.2.

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[2] *ArcView GIS v.3.1,* software by Environmental Systems Research Institute, Inc. 1996. The match rate was approximately 80 percent.
[3] The one-kilometer radius was also used by Geoghegan et al. (1997). Based on personal experience with the study area, this would seem to be an appropriate buffer size. In other suburban areas, or certainly in an urban setting, a smaller buffer would likely be more appropriate. Omitted categories of land use/cover include scrub and shrub, turf and grass, exposed ground and sand and clear cut areas.
[4] The point corresponds to the street address, as established in the geocoding procedure.
[5] Our visibility measure is based exclusively on the topography of the area. Thus, when development or dense forest occurs very near to a property in an area with little topography, the view may be obstructed. In this case, our measure would likely overstate the extent of attributes visible. As mentioned, Lake et al. (1998, 2000) address the issue of view obstruction in an urban setting.

Table 2.2 Spatial Variables: Definitions and Descriptive Statistics

Name	**Definition**[a]	**Mean**	**Standard Deviation**
visible	Percent of area visible	27.5	11.1
develop	Percent of area developed, including commercial, industrial and residential	12.8	7.0
vis_dev	Percent of area developed and visible	3.7	3.0
agric	Percent of area in agriculture, including pasture and hay, cropland and shade-grown tobacco	2.9	2.6
vis_ag	Percent of area in agriculture and visible	0.8	0.9
forest	Percent of area that is forested, includes deciduous, coniferous and mixed forests	61.4	13.3
vis_for	Percent of area that is forested and visible	16.4	7.7
water	Percent of area that is covered by water	1.1	1.6
vis_wat	Percent of area that is water and visible	0.3	0.8

Notes: [a]Defined within a one-km. radius of each property

Of the land use/cover variables, open space provided by agricultural and forested areas and water might be expected to contribute positively to property values. However, much of the agriculture in the communities is shade-grown tobacco, which may not provide the positive amenities that open fields and pastures do. Nearby development may offer convenience, however, extensive development may create congestion, noise or other nuisances. The extent of visible area overall is likely to enhance property values, however, it is expected that visible developed area will likely detract from sale prices. For example, Lake et al. (2000b) find negative effects associated with visible industry and roads. The effects of visible agricultural and water are indeterminate. In both cases, the quality of these types of views in the study area is uncertain. Forests may be aesthetically pleasing, however, they are widespread in both towns and as a result of this abundance may not be valued as a visual amenity.

Model Specification

The hedonic equations were specified with the natural log of sale price as the dependent variable and the variables in Tables 1 and 2 as explanatory variables.[6] The nonlinear form is consistent with Rosen's (1974) notion that individuals cannot costlessly repackage housing attributes to capture arbitrage opportunities (also discussed by Graves et al., 1988).[7]

Recently, considerable attention has been devoted to the likely spatial dependence of error terms in estimated hedonic equations. In a well-known example, Pace and Gilley (1997) utilize data from Harrison and Rubinfeld's (1978) seminal study to compare ordinary least squares and spatial autoregressions, and realize significant efficiency gains with the latter. In light of this, we utilized spatial econometric software, in conjunction with GIS to test explicitly for spatial autocorrelation.[8] The first step in this process is to create a spatial weights matrix that reflects the underlying form of the hypothesized spatial dependence. We use a simple contiguity matrix that identifies properties within .5 kilometers.[9] Tests using Moran's *I* statistic (1950) suggested that spatial autocorrelation was indeed a problem. For example, the value of *I* was 6.73 and significant at the one percent level for Equation (1) (Table 3). As a result, first-order spatial autoregressive models are estimated via maximum likelihood (Anselin, 1995) to correct for this spatial dependence. This estimation strategy changes the parameter estimates only slightly (as ordinary least squares is still unbiased under spatial autocorrelation), but they are now more efficient. For further information regarding spatial weights matrices and estimation of spatial error models refer to Anselin (1988).

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[6] To verify that there were no major structural differences in the real estate markets between the two towns, a binary variable differentiating observations in each town was included in preliminary equations and found to be insignificant. In addition, a linear monthly trend variable was tested to determine if any significant price appreciation occurred over the 18-month study period, and this variable was also found to be insignificant. These variables are excluded from estimated equations reported here.

[7] Other functional forms were estimated, including linear and double-log. Statistical results, significance and signs for the environmental variables are not affected by these alternative specifications.

[8] *SpaceStat v.1.90* and the corresponding *ArcView* extension by Luc Anselin, 1998.

[9] This simple structure is based on personal observation of the spatial extent of neighborhoods in the study area that may share unobserved features giving rise to spatial dependence.

Three equations are estimated with all three including the structural variables from Table 1 and the size of the property (acreage). Equation (1) includes the variables that represent the percentage of land area within one kilometer that is in each of the four land uses/covers. Equation (2) includes the same variables as Equation (1) and adds the variable that represents the total area within one kilometer that is visible from the property. Equation (3) includes the same variables as Equation (2) and the variables that represent the percentage of the total land area within one kilometer that is visible in each of the four land uses/covers. The following comparisons are made across equations:

- Does changing the environmental variables in the estimation affect the significance, signs and magnitudes of the coefficients on the structural variables and the acreage variable?
- Does changing the environmental variables in the estimation affect the significance, signs and magnitudes of the coefficients of pre-existing environmental variables in the equations?

Estimation Results

Nine of the 14 structural variables and acreage are significant in all three equations (Table 2.3). The signs and magnitudes of the coefficients on these significant variables are remarkably stable across specifications. For example, each additional bedroom increases home price by roughly four percent, and an additional acre of land increases sale prices by about eight percent. The value of lambda, the spatial autocorrelation parameter, is roughly .3 for each equation and significant at the five percent level.[10]

[10] A positive value less than one suggests positive spatial autocorrelation and a stationary process.

Table 2.3 Estimation Results[a]

	(1)	(2)	(3)
visible		-.0017**	.0044
		(.0007)	(.0031)
develop	-.0051**	-.0046**	-.0011
	(.0019)	(.0019)	(.0028)
vis_dev			-.0116*
			(.0068)
agric	.0005	.0003	.0023
	(.0040)	(.0039)	(.0053)
vis_ag			-.0040
			(.0147)
forest	.0002	.0001	.0023
	(.0010)	(.0010)	(.0015)
vis_for			-.0074**
			(.0036)
water	-.0147**	-.0137**	-.0111
	(.0059)	(.0058)	(.0073)
vis_wat			-.0135
			(.0150)
raise	-.1988**	-.2002**	-.2057**
	(.0609)	(.0606)	(.0606)
col	.0478	.0497	.0437
	(.0537)	(.0534)	(.0537)
ranch	-.0978*	-.0949*	-.0987*
	(.0546)	(.0544)	(.0544)
cape	-.0590	-.0551	-.0607
	(.0544)	(.0542)	(.0542)
split	-.0819	-.0798	-.0845
	(.0625)	(.0622)	(.0622)
cont	.0149	.0189	.0119
	(.0571)	(.0569)	(.0571)
yr_built	.0010**	.0009**	.0009**
	(.0002)	(.0002)	(.0002)
fam_rm	.0844**	.0879**	.0900**
	(.0220)	(.0219)	(.0220)
frplc	.0521**	.0521**	.0496**
	(.0102)	(.0101)	(.0102)
bdrms	.0417**	.0408**	.0412**
	(.0125)	(.0124)	(.0124)
vehicles	.0754**	.0760**	.0768**
	(.0131)	(.0131)	(.0131)
full_bath	.1705**	.1718**	.1743**
	(.0147)	(.0146)	(.0146)
half_bath	.1008**	.1016**	.1031**
	(.0163)	(.0162)	(.0162)
full_base	.0330*	.0323*	.0317
	(.0201)	(.0199)	(.0198)
acreage	.0758**	.0776**	.0770**
	(.0114)	(.0113)	(.0113)
constant	9.4111**	9.5360**	9.3464**
	(.4553)	(.4559)	(.4640)
λ	.3444**	.3384**	.3322**
	Pseudo R^2 = .76	Pseudo R^2 = .77	Pseudo R^2 = .77
	LogL = 240.1	LogL = 243.0	LogL = 245.4
	N = 504	N = 504	N = 504

Notes: [a] First-order spatial autoregressive models based on a .5 km contiguity matrix. Standard errors in parentheses.
** denotes significance at 5% level, * 10%

In Equation (1) the extent of developed area and area occupied by water are significant at the five percent level and have negative coefficients.[11] The negative coefficient on *develop* is consistent with expectations; residing in a heavily developed area is undesirable. Initially, the negative coefficient on *water* was thought to reflect flood danger associated with proximity to the Farmington River. To test this hypothesis, GIS layers were acquired for the study area that describe flood risk according to Federal Emergency Management Agency (FEMA) guidelines. Properties in the "flood hazard zone" were identified with a binary variable. In each specification the coefficient on this variable was negative, yet insignificant, and the pattern of coefficients on the water (and other environmental) variables did not change. It is likely that the water variable instead identifies less desirable swampy or stillwater areas associated with the many streams and brooks in the two towns.

The same pattern of results remain for the environmental variables when the overall visibility variable is added to the equation; *develop* and *water* still have significant, negative coefficients that do not change in magnitude (Equation 2). Thus, omitting overall visibility does not seem to create an omitted variable bias in the coefficients on the other environmental variables. As noted, the coefficients on the structural variables are very stable. The coefficient on overall visibility (*visible*) is negative and significant at the five percent level, which is counterintuitive.

The counterintuitive sign on overall visibility is resolved in Equation (3), where the coefficient on *visible* is positive, but insignificant (p=.15). The extent of developed area is no longer significant, but visibility of development significantly detracts from property prices. That is, the extent of development appears to be a neutral attribute as long as it cannot be seen from the property.

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[11] Irwin and Bockstael (2001) show that endogeneity can be a problem when estimating the influence of proximate open space, to the extent that it is developable and privately held. Due to data limitations, the distribution of land ownership is not considered here.

The coefficient on forested area is positive and is very close to significance at the ten percent level (p=.11), while the extent of visible forestland is significant at the five percent level with a negative coefficient. These results suggest that people enjoy amenities associated with nearby forestlands, but prefer views of other types of cover. As the percentage of visible forest increases, for example, the property may seem more confined or closed-in. Alternatively, preferences for forest views may depend upon the species present. For example, Garrod and Willis (1992) found positive and significant property value effects associated with the extent of proximate hardwood forest and negative and significant effects associated with mature conifers. This effect may also be related to the degree of density typical of these different species. The majority of larger contiguous forested areas in Simsbury and Avon are occupied by coniferous varieties.

The extent of visible agricultural land does not appear to affect property prices. This is consistent with our perception that shade-grown tobacco may not present the desirable amenities, or disamenities, associated with other types of farming operations. Thus, this finding may not be replicated in another case study. The lack of significance associated with the water view likely reflects the fact that very few properties have such a view, and for those that do, it is very limited, or of inconsequential size. The effect of proximate water, although still negative, is less significant (p=.13) when visibility of water is included.

The explanatory power of the equations, as indicated by the pseudo R^2 values, changes very little when visibility is included.[12] As evidenced by coefficients on the development and forest variables in Equation (3) relative to (2), these results suggest that omitting visibility measures creates an omitted variable bias that affects the significance and signs of other environmental variables. The manner in which visibility is included in the equation is important,

[12] Reported as the ratio of the variance of the predicted values over the variance of the observed values for sales price (Anselin, 1995).

with visibility of individual land use/cover types providing results that can be more easily explained.

Conclusions

The results indicate that visibility is an important environmental variable, and omitting visibility of specific environmental attributes may lead to incorrect conclusions regarding the significance and signs of other environmental variables in hedonic price equations. Like Mahan et al. (2000), Powe et al. (1997) and Geoghegan et al. (1997), we found that variables describing the extent of environmental conditions within close proximity of a property significantly affect sale prices. Failure to include variables that reflect visibility of specific environmental conditions in the estimated hedonic equation can lead to incorrect conclusions regarding the significance and signs of environmental variables that measure the extent of the condition in proximity to a property. This is evident in the case of development. Thus, previous studies that simply measure proximity and extent of environmental conditions may have produced different statistical results if visibility variables were included in the estimation. However, the fact that inclusion or exclusion of the various environmental variables did not affect the estimated coefficients on structural variables suggests, at least for this study, that visibility variables are orthogonal to structural characteristics. This result suggests that Lake et al.'s (1998, 2000a and 2000b) inability to obtain structural data may not have created an omitted variable bias in the estimated coefficients on visibility.

In terms of practical significance, the results do confirm the saying "out of sight, out of mind" for development. At least for this application, development only appears to detract from sale prices when it is directly observable from a property. This finding could have important implications in siting decisions regarding undesirable land uses where, in the absence of other undesirable qualities (e.g., noise or odor), proximity alone may not result in property value losses if visibility is minimized.

Chapter 3

PUBLIC PREFERENCES FOR FARMLAND ATTRIBUTES IN CONSERVATION EASEMENT PROGRAMS

Introduction

Preservation of open land has become a prominent issue across the country. There were over 250 state and local open space measures on the 2000 ballot, an increase of 15 percent over 1998 (Myers, 2001). Programs to acquire or donate scenic easements to open land are in place in all 50 states (American Farmland Trust, 1997; Daniels, 1999; Wiebe et al., 1996). Many of these programs are targeted at open land in general. However, farmland specifically is an important source of open land. Agriculture (range, crop and pasture land) accounts for half of the nearly two billion acres of private land in the U.S. (Vesterby et al., 1994).

Agricultural policies affect the quantity and quality of agricultural lands. For example, the Farmland Protection Policy Act of 1981 required federal agencies to conduct reviews for the purpose of "minimiz(ing) the extent to which federal programs contribute to unnecessary and irreversible conversion of farmland to nonagricultural uses." The Farms for the Future program in the 1990 farm bill authorized a pilot program of subsidized loans to state and local governments to purchase conservation easements on farmland. This was superseded by the Federal Agricultural Improvement Act of 1996 (FAIR) that authorized up to $35 million in matching funds for state and local farmland protection programs. Maintaining farmland has the direct impact of protecting open land from being converted to other uses that do not provide the same sets of amenities.

Agricultural policies also affect the quality of farmland as open land. For example, the Conservation Reserve Program takes land out of agricultural production for 10 years while maintaining the land as open space that is planted to grasses or trees. This program affects water quality by retiring highly erodible soils and creating more grassland habitat for wildlife. The

Wetlands Reserve Program operates in a similar fashion to establish easements or cost-sharing agreements to promote wetland restoration.

Open land amenities of farmland are a classic joint production example where the joint product is a public good (Bromley and Hodge, 1990). While farmers receive compensation for the products they produce, there is no market to compensate them for the quantity and quality of open-land amenities they provide. Public views of scenic vistas provided by farms are nonrival and nonexcludable in consumption. There is also the tragedy of the commons that arises as urban sprawl encompasses farmland; each new resident contributes to a diminishment of the open-land amenities. These market failures appear to be the motivating factors behind public efforts to protect open land.

Several studies have employed contingent valuation techniques to estimate the value of farmland preservation. For example, in early research, Halstead (1984) estimated the value of agricultural land preservation in western Massachusetts. Bergstrom et al. (1985) estimated values for amenity benefits of prime agricultural land in Greenville County, South Carolina. Similarly, Beasley et al. (1986) estimated willingness-to-pay (WTP) to prevent residential and commercial development of agricultural lands in the Matanuska-Susitna valleys of south central Alaska. More recently, Bowker and Didychuk (1994) estimated the value of farmland preservation in three counties in New Brunswick, Canada. Rosenberger and Walsh (1997) estimated WTP to protect ranchland in the Yampa River Valley of Colorado and Krieger (1999) estimated WTP for farmland protection in three counties around Chicago.

Each of these studies generally examined how WTP varied with the extent of preserved land and respondent characteristics. Other studies have examined individuals' motivations for farmland preservation. For example, Fursueth (1987) found that public support for farmland protection in a North Carolina county was motivated by desire to protect food supply, preserve open spaces and preserve heritage. Similarly, motivations described in Krieger (1999) included protecting food supply and family farms, slowing development and preserving rural quality. In a study of Rhode Island residents, Kline and Wichelns (1998) examined how motivations such as protecting environmental resources, scenic quality, food supply and farming lifestyles influenced preferences for preservation of different types of farmland and open space using a contingent ranking format.

While studies such as these have estimated the value of farmland protection programs and identified motivations in specific regions or for specific types of farmland, they do not provide insight into how preferences vary by region of the country, nor do they adequately identify the attributes of farmland most desirable to the public. This information is crucial to the design of agricultural and other policies so that they do not diminish the open space amenities of farmland.

We conducted a series of focus groups in five states to begin to develop an understanding of the publics' view of the role of agriculture in the provision of open land and preferences for characteristics of farmland in the context of a protection program. In the research reported here, we describe the results of several choice exercises that provide information about preferences for specific farmland attributes, their role in a desirable protection program and how they vary by region of the country.[1]

Focus Group Administration

Four focus groups were held in each state, two per evening on successive evenings. The groups were held at commercial facilities that recruited participants, provided the focus group room with an adjacent viewing room behind a one-way mirror, and audio and video taping of the groups. We hired a professional moderator, who is an economist, to lead the focus groups.

[1] Full focus group reports for each state appear in Paterson et al., "Improved Information in Support of a National Strategy for Open Land Policies: Summary of Focus Group Findings, Summer, 2000," REP Staff Paper No.495. This document describes all of the exercises performed and accompanying materials.

We asked the facilities to recruit enough participants to ensure that each group consisted of 10 to 12 people. We also asked the facilities to undertake random recruitment of participants and to not draw participants from an established panel of people they maintain to staff focus groups, i.e., we did not want "professional" focus group participants. The facilities attempted to recruit two urban groups, one suburban group and one rural. While protection of farmland as open space is physically a rural issue, any program to protect farmland as open land will require broad public support. Thus, it was important to develop an understanding of the perspectives of people who live in urban and suburban areas. Any general population survey, at the state or national level, would be primarily comprised of urban and suburban residents.

In general, the facilities were successful in recruiting 10 people to participate in each group (Table 3.1). These numbers of participants are clearly insufficient to test for differences in results between groups. However, the aggregate results from each group are useful to begin to develop a general picture of what characteristics of farmland people do and do not care about in the provision of open space.

Table 3.1 Numbers of Focus Group Participants (Group Type/Participants)

States	**Day 1**		**Day 2**	
(Cities)	**Group 1**	**Group 2**	**Group 3**	**Group 4**
Ohio (Columbus)	Suburban 10	Urban 10	Urban 10	Rural 10
Georgia (Augusta)	Urban/Suburban 11	Urban/Suburban 12	Rural 9	Rural 11
Colorado (Denver)	Rural 11	Urban 9	Urban 7	Suburban 10
Oregon (Portland)	Urban 10	Rural 8	Urban 9	Suburban 8
Maine (Portland)	Urban 10	Suburban 9	Urban 7	Suburban 10

<u>**Data Collected and Analysis Procedures**</u>

In the first two sets of groups, exercises focused on identifying terminology and language associated with open space amenities, as well as important farmland attributes. Subsequent groups concentrated on learning about how individuals compare and trade-off these attributes.

The first set of focus groups was held in Ohio and a very open format was used. Respondents were asked by the moderator to explain what the term "open space" meant to them and to identify attributes of farms that they found desirable and undesirable. The last set of focus groups was held in Maine with a structured format where respondents were given a survey instrument to complete and were debriefed by the moderator after they had completed the survey. We report selected results from the major exercises administered in each set of focus groups (Table 3.2).

Table 3.2 Primary Focus Group Exercises

	Exercises			
	Group 1	**Group 2**	**Group 3**	**Group 4**
Ohio	General discussion of open space and farm attributes			
Georgia	Rated 30 photographs of farmland scenes		Rated a subset of 10 photographs	
Colorado	Rated each scene in five sets of four photographs		NA[a]	
	Answered one conjoint question			
Oregon	NA[b]		Answered three conjoint questions	
Maine	Answered five conjoint questions			

Notes: [a] The scene rating exercises were not used on the second evening. [b]On the first night we experimented with a design of the conjoint question where respondents saw all levels of all attributes. This proved to be too complex of a task and we only use results from the second night in the estimation reported here.

In Georgia we presented participants with color photographs of farmland scenes from around the state. Our intent was to obtain a more precise idea of what attributes of farmland participants liked and disliked. The two groups on the first night evaluated 30 pictures and the groups on the second night evaluated only 10 of these photographs. The number of photographs was reduced the second night because respondents seemed to tire when evaluating 30 scenes and we wanted to allow more time for discussion. Participants were asked to rate the scenes on a 10-point likert scale that ranged from 1 (very undesirable) to 10 (very desirable).

In Colorado participants were asked to evaluate sets of scenes. That is, in Georgia the evaluations of attributes, such as the presence of livestock, were dependent on the context of the picture(s) where they occurred. In Colorado we presented participants with sets of four scenes. For example, one set portrayed beef cattle grazing in a harvested grain field with trees in the background, in a feedlot, on open range, and grazing a harvested alfalfa field in the mountains. This was done for different types of livestock confinement facilities, different types of farm building scenes, different types of field operations, and different types of crops being grown. As in Georgia, we had respondents rate each of the scenes in the pictures, but on a three-point scale of "like,' "dislike" and "neither like nor dislike."

Participants' evaluations of the scenes in Georgia and Colorado were analyzed using an ordered-probit model. This is appropriate given the discrete, ordinal nature of the responses, which represent an expression of intensity of preferences for a given scene. Explanatory variables were a set of binary variables developed to describe the farmland characteristics collectively portrayed in the photographs.[2] Two members of the study team independently

[2] We attempted to estimate the equations using random effects as the data contain multiple responses (10 or 30) from each respondent. Random effects were identified for the analysis for all participants based on the evaluations of 10 scenes, but this specification would not converge for the two models based on the 30 scenes for the Georgia data. In the latter models we have more responses per respondent than we do respondents and the opposite holds for the first model, which may explain this difference in convergence. We also tried including variables to represent each of the four groups and the coefficients on these variables were not significant and are not reported. We did not find significant random effects for the Colorado data.

reviewed the photographs and coded the explanatory variables. When disagreements arose in the coding, a third member of the team reviewed the specific photographs to break the deadlock.

Participants in Colorado, Oregon and Maine were asked to answer conjoint questions. The purpose of the conjoint question was to identify how participants evaluated protecting farmland as open land with different farm characteristics. The conjoint questions presented two farmland protection programs (A and B) that differed in terms of selected farm characteristics (Figure 3.1). Participants were first asked to choose between Program A and Program B, and then were asked to choose between Programs A and B and Do Nothing (maintain the status quo), as in a voting situation.

As shown in Figure 3.1, the first column in the questions listed the attributes and the second and third columns listed the levels of these attributes for Programs A and B. Attribute levels were randomly assigned with the condition that the levels had to vary for at least one attribute between Programs A and B. As will be shown later, the attribute and attribute levels varied from state to state to some extent. These changes occurred as we attempted to address concerns that participants discussed.

The choices in the conjoint questions dealt with purchasing conservation easements to protect farmland. Farmland with the specified levels of the attributes in the programs would receive priority in the purchases of the easements. All attributes, except the total number of acres of easements and the household cost, also had a level of no targeting (or not considered).

The total acres of conservation easements and household cost attributes are not specific to farmland characteristics, but are important program attributes. The acres protected were fixed in Colorado (1 million) and varied in Oregon and Maine. The same cost amounts were used in Colorado and Oregon, but were increased in Maine due to a lack of price sensitivity in the Colorado and Oregon responses.

Figure 3.1 Sample Conjoint Question (Maine)

1. Suppose you had to vote between two conservation easement programs, Program A and Program B. These programs differ in terms of the attributes of the farms that would receive priority in the bidding process, the number of acres in the program and the cost to you. We understand that you might not like either program and you will get a chance later to let us know if you would prefer doing nothing. However, please tell us which of the two programs you would support if you had to choose between Program A and Program B *(Please check one box in the last row)*

	Program A: *Gives priority to farms with*	**Program B:** *Gives priority to farms with*
Livestock	*Not considered*	*Poultry*
Crops	*Vegetables*	*Berries*
Water	*Streams and ponds*	*Not considered*
Size	*Not considered*	*Medium- 100 to 260 acres*
Area of Maine	*Southern Maine*	*Not considered*
Ownership	*Not considered*	*Corporate- not family*
Located in towns with	*4 or less operating farms*	*5 or more operating farms*
Soil quality	*High quality soil*	*Not considered*
Acres with easements	*80,000 acres*	*120,000 acres*
One-time cost to your household	*$75*	*$100*
Check the box for the program you would prefer	☐	☐

2. Suppose you could vote between Program A, Program B and doing nothing. How would you choose? *(Circle one number)*

1 I would vote for Program A
2 I would vote for Program B
3 I would vote to do nothing

As indicated in Table 3.2, the number of conjoint questions administered varied across states. In Colorado we have one response per respondent and in Maine we have five responses per respondent. The choice between Programs A and B and Do Nothing (responses to the second question in Figure 3.1, and also for questions in Colorado and Oregon) is analyzed using multinomial logit models. This approach arises from a utility maximization framework where respondents are assumed to choose the option that yields the greatest utility. Explanatory variables are the levels of the attributes. Each attribute level is coded as a binary variable, and the omitted categories are the conditions when the attribute levels are "not considered."[3]

Given the small sample sizes, we investigate the effects of the attributes by entering one set of attribute variables in the models at a time. All models, however, include the cost attribute and alternative-specific constants for Programs A and B. Thus for the Maine example in Figure 3.1, nine equations were estimated. The equation for livestock, for example, contains four binary variables for each of the attribute levels used in the design. Again due to the small sample sizes, we investigated the significance of attributes up to the 20% level. Specifics of these analyses will be explained in the respective result subsections below.

Focus Group Results

Ohio Results

On the first evening participants were asked what the term "open space" meant to them. While professionals who deal in land use issues on a daily basis have a general consensus of what this term means, the interpretations of focus group participants included more than undeveloped land, e.g., large foyers in buildings. Of those who thought of undeveloped land, they were more likely to think of public land than private land. Thus, in talking to a lay audience, open space is not a particularly useful term, particularly in the context of farmland. On the second night, we

[3] Due to small sample sizes we did not investigate random effects of group effects in the analyses of the conjoint data.

used the term "rural landscape" and this term appeared to be more likely to have people think of undeveloped rural land and farms. We also investigated the term "countryside," which many people associated with small towns. To get away from potentially loaded terminology, we simply discussed preserving farmland and queried participants about characteristics of protected farmland they find desirable and undesirable for the focus groups held in other states.

The desirable attributes of farmland noted by more than five participants, in descending order of the number of respondents citing the reasons, are food supply, livestock, work ethic, openness (not crowded), crops in fields and not contributing to pollution. The undesirable attributes cited by more than five respondents, again in descending order of the number of times cited, are odor, sensitive to weather (production), and poor access to modern conveniences; the last two attributes were cited primarily by the urban groups. The odor issue appeared to arise mainly from a large egg farm that is located in the area where focus group participants were recruited.

When asked if open space or rural landscapes should be preserved, participants indicated that preservation is an important, but not urgent issue. People had difficulty understanding the concept of "purchasing development rights" and tended to reject any payment vehicle that involved increasing taxes. In the remainder of the focus groups we worked on refining the definition of purchasing conservation easements and this terminology seemed to work quite well in the final set of focus groups that was held in Maine.

Georgia Results

The explanatory variables developed to identify the farmland characteristics portrayed in the photographs are presented in Table 3.3.

Table 3.3 Explanatory Variables Used in Analysis of Scene Ratings for Georgia

Variable	Definition
POPEN	= 1 if scene is primarily fields and 0 otherwise
PTREES	= 1 if scene is primarily trees and 0 otherwise
TOPOGY	= 1 if the land has topography and 0 otherwise
WATER	= 1 if farm has a pond present and 0 otherwise
HOME	= 1 if a residence present and 0 otherwise
BUILDINGS	= 1 farm buildings present and 0 otherwise
OLDBUILDINGS	= 1 if old farm buildings present and 0 otherwise
SILOS	= 1 if silos present and 0 otherwise
EQUIPMENT	= 1 if farm equipment present and 0 otherwise
IRRIGATION	= 1 if irrigation equipment present and 0 otherwise
FENCE	= 1 if fences present and 0 otherwise
LIVESTOCK	= 1 if livestock present and 0 otherwise
ROWS	= 1 if crops growing in rows and 0 otherwise
HORT	= 1 if horticultural crops present and 0 otherwise
HARVESTED	= 1 if fields with harvested crops present and 0 otherwise
TIMBER	= 1 if timber harvesting present and 0 otherwise
ROW CROPS	= 1 if row crops present and 0 otherwise
GRAIN	= 1 if grain field present and 0 otherwise
HAY	= 1 if a hay field present and 0 otherwise
PASTURE	= 1 if a pasture present and 0 otherwise

The first four variables describe the physical landscape portrayed in the scenes. The omitted category for POPEN and PTREES represents scenes that are neither predominantly fields nor predominantly woods. The second set of variables describes the farm structures and implements portrayed in the scenes. OLDBUILDINGS are typically barns that are not obviously in current use by farmers. The crop variables represent the types of crops being grown in the scenes. ROWS indicate scenes where crops are grown in rows, and HORTICULTURE designates rows that are horticulture and not field crops such as corn and tobacco. In both Ohio and Georgia respondents indicated that the orderly nature of rows was very desirable. The last four variables break field crops into four categories with the omitted category being scenes with abandoned fields or where we could not identify what type of crop was being grown. While the focus group discussions revealed that often respondents could not identify the types of crops being grown in the scenes, it was evident that they found some crop scenes more desirable than others. Thus, ROW CROPS, GRAIN and HAY represent what we refer to as informed coding, where we investigate crop effects even though we know participants can not identify the crops.

We report estimates from three equations (Table 3.4). The first equation utilizes responses from all participants for the 10 scenes evaluated by all respondents. This smaller number of photographs did not contain all of the variables portrayed in Table 3. In addition, some variables were perfectly correlated. Thus, we present estimates for a parsimonious set of variables. The second and third equations use the responses for the groups on the second night that evaluated 30 scenes. The second equation did not use our "informed" coding of crops, only ROW and HORTICULTURE. The third equation removes the ROW variable and uses the variables that designate specific crops.

Table 3.4 Ordered Probit Analysis of Scene Ratings for Georgia

	All Groups/ 10 Pictures	**First Two Groups/ 30 Pictures**	
	Naive Coding of Crops	**Naive Coding of Crops**	**Informed Coding**
POPEN	-1.235**	-.282*	-.288*
	(.423)	(.147)	(.152)
PTREES		.958**	.552**
		(.189)	(.197)
TOPOGY	.765	.603**	.912**
	(.500)	(.196)	(.301)
WATER	.672**	-.0724	.468
	(.300)	(.245)	(.308)
HOME	1.084**	1.042**	1.115**
	(.394)	(.205)	(.200)
BUILDINGS		1.096**	.636**
		(.192)	(.242)
OLDBUILDINGS		-.653**	-.183
		(.224)	(.308)
SILOS		-.864**	-.292
		(.375)	(.450)
EQUIPMENT		-.868**	-.781**
		(.149)	(.155)
IRRIGATION		.586**	.508**
		(.181)	(.180)
FENCE		.0893	.404
		(.207)	(.338)
LIVESTOCK	.371	.464**	.105
	(.515)	(.237)	(.476)
ROWS	.729**	.803**	
	(.329)	(.148)	
HORT	-.707*	-.581**	.329*
	(.374)	(.158)	(.175)
HARVESTED	-.422	-.466**	-1.766**
	(.296)	(.162)	(.405)
TIMBER	-3.775**	-4.252**	-4.008**
	(.518)	(.390)	(.400)
ROW CROPS			1.066**
			(.173)
GRAIN			2.030**
			(.499)
HAY			.645**
			(.178)
PASTURE			.127
			(.434)
Constant	3.519**	2.127**	1.980**
	(.576)	(.167)	(.178)
	N = 430	N = 687	N = 687

Notes: Standard errors in parentheses. * denotes significance at the 10 percent level, **5 percent

In the first model six of nine variables are significant at the 10 percent level. Participants like farm homes, water and crops grown in rows. It is interesting that land that was primarily fields or had horticultural crops had significantly lower ratings. It is not surprising that land where timber was recently harvested is undesirable. Another interesting feature is that the presence of livestock did not significantly affect ratings of the scenes.

In the second model, with 30 scenes and naive coding of crops, 14 of 16 variables are significant. Three variables that were insignificant in the 10-scene model become significant. Participants like farm landscapes that were primarily trees, had topography, farmsteads, livestock and crops grown in rows. OLDBUILDINGS, SILOS, EQUIPMENT, HORTICULTURE, and scenes with harvested crops or timber each have negative effects on ratings. The lack of significance for WATER may be the result of water being present in only two photographs, one was a wetland scene that some interpreted as flooding and the other was a small farm pond in a pasture for watering livestock. Respondents appeared to believe that there were ponds in other scenes, but were not visible from the perspective of the photographs.

In the third model, with 30 scenes and informed coding of crops, 13 of 19 variables are significant. Here WATER, OLDBUILDINGS, SILOS and LIVESTOCK are no longer significant. Three of the four crop variables are significant and have positive effects on ratings. In addition, the coefficient on HORTICULTURE changes sign.

Several general insights arise from these results. Land with trees is preferred to land that is largely fields, topography is desirable, farm buildings are important, dormant equipment is undesirable, harvested crops and timber are undesirable, various crops are desirable, and the presence of livestock does not appear to have a significant effect. This suggests attributes that would be important in a program to protect farmland as open land. Buildings are an important attribute of the farm and crops appear to be more desired than livestock operations. In addition, aspects of the land that are independent of the farming operation also matter.

Colorado Results

The variables and coding differed from that used in Georgia to represent unique aspects of agricultural lands in Colorado (Table 3.5).

Table 3.5 Explanatory Variables Used in Analysis of Scene Ratings for Colorado

Variables	Definitions
TREES	= 1 trees present and 0 otherwise
MOUNTAINS	= 1 if mountains present and 0 otherwise
TRADBUILDING	= 1 if traditional farm buildings and 0 otherwise
MODBUILDING	= 1 if modern farm buildings and 0 otherwise
ELEVATOR	= 1 if grain elevators and 0 otherwise
EQUIPMENT	= 1 if farm equipment present and 0 otherwise
PIVOTS	= 1 if central pivot irrigation present and 0 otherwise
LIVESTOCK	= 1 if livestock present and 0 otherwise
CONFINEMENT	= 1 if livestock in confinement and 0 otherwise
ROW CROPS	= 1 if row crops present and 0 otherwise
GRAIN	= 1 if grain field present and 0 otherwise
GROW	= 1 crops growing and 0 otherwise
HARVESTING	= 1 active harvesting present and 0 otherwise
PLOWED	= 1 if fields are plowed and 0 otherwise

For example, trees are very sparse in eastern Colorado, but increase in density as one moves into the foothills. Mountains are the primary types of topography. We also added photographs with farming activities ongoing, which were not present in the Georgia photographs and a variable for growing crops, which distinguished between green landscapes and plowed fields.

Eight of the 14 variables were significant in explaining respondents' ratings of the pictures (Table 3.6). TREES, TRADBUILDINGS, EQUIPMENT, ELEVATOR, PIVOTS and

HARVESTING all lead to higher ratings. GRAIN and PLOWED both led to lower ratings, which suggests that participants did not like large open fields without other features.

Table 3.6 Ordered Probit Analysis of Scene Ratings for Colorado

TREES	.890**
	(.377)
MOUNTAINS	-.0489
	(.306)
TRADBUILDING	1.078**
	(.328)
MODBUILDING	.0197
	(.507)
ELEVATOR	1.430**
	(.556)
EQUIPMENT	.806*
	(.452)
PIVOTS	1.163*
	(.674)
LIVESTOCK	-.391
	(.329)
CONFINEMENT	-.301
	(.540)
ROW CROPS	-.161
	(.530)
GRAIN	-1.109**
	(.479)
GROW	.198
	(.464)
HARVESTING	1.080*
	(.574)
PLOWED	-.877**
	(.328)
Constant	.632*
	(.332)
	N = 364

Notes: Standard errors in parentheses. * denotes significance at the 10 percent level, **5 percent

This dislike of large, open landscapes is similar to what we found in Georgia. We did not characterize farm buildings in active use in Georgia. However, the results here suggest the type of building matters; traditional buildings (typically wood) contribute positively to ratings, while modern buildings (typically steel) do not have an effect. Equipment had a negative effect in

Georgia, and the positive effect in Colorado may be due to it being portrayed in active use versus being stored. The change of sign for harvest between Georgia and Colorado appears to be due to the fact that the Georgia scenes were harvested fields, while the Colorado scenes were of ongoing grain and hay harvesting (active field activities).

We found that respondents were continually using the pictures to seek clues as to whether the scene represented a small, family farm. In addition, participants tried to evaluate the quality of the soil, the quality of the farming operation, and in some cases, the quality of the photographs themselves. We decided that while pictures were helpful in identifying important farmland attributes, they were providing unintended cues to respondents. In proceeding to the conjoint questions we decided to focus on verbal descriptions of attributes that would not be accompanied by pictures.

Based on the results from the scene rating exercise in Georgia the following attributes of farmland were considered for use in the conjoint question for Colorado: location of the land, type of farm structures, water on the land, farm/ranch size, ownership, livestock and types of crops (Table 3.7). We also added the geographic location of the farm, the size of the farm in acres and the ownership of the farm. Location in Colorado is highly correlated with the extent of trees and topography, so these attributes were excluded. Participants in both previous focus groups mentioned farm size and ownership as being important factors in the general discussions.

While participants indicated that location was important in the verbal discussions, none of the levels of this attribute were significant (Table 3.8). We did find that participants liked traditional, wooden buildings and disliked modern, steel buildings. In addition, farms from 250 to 1,000 acres, no livestock, and hay fields were significant and made respondents more likely to choose the alternatives in which they were contained. Corporate ownership was negative and significant. These results continue to support the general findings from the picture evaluations and the verbal comments of participants. COST was never significant, which suggests that the highest price point of $50 was not sufficient to choke respondents out of the market for protecting agricultural lands as open land.

Table 3.7 Explanatory Variables Used in Conjoint Analysis for Colorado

Attributes	Attribute Levels	Variable Names
Location	Not Specified	
	Eastern Plains	PLAINS
	Front Range	FRANGE
	Mountain Valleys	MVALLEYS
Water	Not Specified	
	None	NONE
	Irrigation ponds for wildlife	PONDS
	Stream buffers for wildlife	STREAMS
Buildings	Not Specified	
	None	NONE
	Traditional, Wooden	TRADBUILDINGS
	Modern, Steel	MODBUILDINGS
Farm/Ranch Size	Not Specified	
	<250 Acres	<250
	250-1,000 Acres	250-1000
	>2,000 Acres	2000+
Ownership	Not Specified	
	Family	FAMILY
	Corporation	CORPORATE
Livestock	Not Specified	
	None	NONE
	Grazing	GRAZING
	Feedlots	FEEDLOT
Crops	Not Specified	
	None	NONE
	Hay	HAY
	Row Crops	ROW
	Grains	GRAIN
	Mix of crops	MIX
Program Cost	One-time cost to household (1, 5, 10, 20, 30, 40 or 50)	COST

Table 3.8 Results of Multinomial Logit Analysis of Program Voting: Colorado

Dep. Var. = Choice (A, B, Do Nothing) N=35

	Location	Water	Buildings	Size	Ownership	Livestock	Crops
Program A Constant	-1.686***	-1.251**	-1.225**	-1.634***	-.620	-1.122*	-1.734**
	(.854)	(.736)	(.733)	(.793)	(.702)	(.729)	(1.024)
Program B Constant	-1.523**	-1.064*	-.940*	-1.745**	-.611	-1.298*	-.246
	(.861)	(.725)	(.708)	(1.002)	(.708)	(.839)	(1.057)
COST	-.001	-.002	.011	.007	.003	-.006	.006
	(.016)	(.017)	(.017)	(.017)	(.016)	(.018)	(.019)
PLAINS	.821						
	(.917)						
FRANGE	.471						
	(.998)						
MVALLEYS	1.010						
	(.854)						
NONE		----[a]					
PONDS		.116					
		(.731)					
STREAMS		.476					
		(.725)					
NONE			-.443				
			(.748)				
TRADBUILDINGS			1.287*				
			(.840)				
MODBUILDINGS			-1.673*				
			(1.155)				
<250				.232			
				(1.036)			
250-1,000				1.316*			
				(.907)			
2,000+				.555			
				(.857)			
FAMILY					.060		
					(.691)		
CORPORATE					-1.657**		
					(.888)		
NONE						1.218*	
						(.869)	
GRAZING						-.141	
						(.896)	
FEEDLOT						.042	
						(1.002)	
NONE							-1.394
							(1.340)
HAY							2.650***
							(1.111)
ROW							-.039
							(1.123)
GRAIN							-1.238
							(1.204)
MIX							-1.788
							(1.422)

Notes: Standard errors in parentheses. * significant at 20%; ** significant at 10%; *** significant at 5%. [a] This parameter could not be estimated due to lack of variation.

Oregon Results

Best management practices (BMPs) were added as an attribute because participants had indicated concern for pollution from farm chemicals and other residues and because there are government programs based on the adoption of BMPs (Table 3.9). In addition, while the program size was fixed in Colorado, it was varied in Oregon.

We found that farmland protection as open land was important in all three designated regions of the state (Table 3.10), but verbal discussions indicated there were different reasons behind each region. Respondents said the COAST because there is so little farmland, the VALLEY because it is threatened by sprawling development, and EASTERN because it is an important part of the local economy. Farms with small to medium acreage are significant and make participants more likely to support protection, while confinement livestock has the opposite effect. Targeting ownership was undesirable to participants. In discussions, participants indicated they want open land regardless of the location and ownership, and some felt that corporate ownership would lead to larger areas of contiguous open land. The total acreage with conservation easements was significant. In contrast to the Colorado results, COST is negative in all but one equation and is significant in one equation.

Table 3.9 Explanatory Variables Used in Conjoint Analysis for Oregon

Attributes	**Attribute Levels**	**Variable Names**
Location	Not Specified	
	Coastal	COAST
	Willamette Valley	VALLEY
	Central/Eastern	EASTERN
Water	Not Specified	
	With ponds or streams	WATER
Farm/Ranch Size	Not Specified	
	<50 Acres	<50
	50-1,000 Acres	50-1000
	>1,000 Acres	1000+
Ownership	Not Specified	
	Family	FAMILY
	Corporation	CORPORATE
Livestock and Crops	Not Specified	
	Feedlots	FEEDLOT
	Orchards and nurseries	HORTICULTURE
Management	Not Specified	
	Best management practices	BMPs
Program size	0.5 million acres protected	Omitted Category
	1.0 million acres protected	1.0 MILLION
	1.5 million acres protected	1.5 MILLION
Program Cost	One-time cost to household (1, 5, 10, 20, 30, 40 or 50)	COST

Table 3.10 Results of Multinomial Logit Analysis of Program Voting: Oregon

Dep. Var. = Choice (A, B, Do Nothing) N=48

	Location	Water	Size	Ownership	Livestock and Crops	Management	Program Size
Program A Constant	-2.148***	-.628	-.572	.542	.014	-.280	-.624
	(.962)	(.703)	(.682)	(.564)	(.521)	(.550)	(.574)
Program B Constant	-2.451***	-1.020*	-1.149*	.084	-.323	-.829*	-1.321***
	(.950)	(.692)	(.871)	(.572)	(.550)	(.638)	(.653)
COST	.002	-.015	-.018	-.011	-.015	-.017	-.022*
	(.015)	(.014)	(.014)	(.147)	(.014)	(.014)	(.014)
COAST	1.841***						
	(.903)						
VALLEY	2.260**						
	(.891)						
EASTERN	1.819**						
	(.967)						
WATER		.695					
		(.614)					
<50			1.349**				
			(.729)				
50-1,000			1.055*				
			(.827)				
1,000+			-.287				
			(.933)				
FAMILY				-.940*			
				(.620)			
CORPORATE				-1.010*			
				(.648)			
FEEDLOT					-.894*		
					(.641)		
HORTICULTURE					.233		
					(.511)		
BMPs						.434	
						(.528)	
1.0 MILLION							1.324***
							(.628)
1.5 MILLION							.966*
							(.621)

Notes: Standard errors in parentheses. * significant at 20%; ** significant at 10%; *** significant at 5%

Maine Results

Here we added an attribute for soil quality and the number of farms in a town (Table 3.11). Soil quality may be an important attribute because farmland preservation programs have historically used this as the single most important criteria. Participants in prior focus groups raised soil quality as an attribute and high quality soils for farming in Maine are quite limited. Participants in prior groups were also concerned about the number of farms located in an area. They felt that a small number would preclude a farmer from expanding if needed and they may not have anyone to sell the farm to when they retire. Given the general insignificance of COST in Colorado and Oregon, we increased the magnitudes.

Location within the state did not have a significant effect (Table 3.12). Streams and ponds had a positive and significant effect. Target farm size had a significant, positive effect for farms larger than 260 acres. Programs considering corporate ownership were less likely to be selected while family farms had a significant, positive effect. Programs considering farms with POULTRY or SHEEP were less likely to be selected. This result for POULTRY is not surprising given the controversy surrounding a single, large facility in the state that has been well publicized by the local media. Targeting of greenhouse crops increased the probability that a protection program would be selected. The number of farms present in a town did not appear to influence program choice. We found that COST was negative in all equations, though only significant in two of the six.

Table 3.11 Explanatory Variables Used in Conjoint Analysis for Maine

Attributes	Attribute Levels	Variable Names
Location	Not Specified	
	Southern	SOUTHERN
	Central	CENTRAL
	Northern	NORTHERN
Water	Not Specified	
	With ponds or streams	WATER
Farm Size	Not Specified	
	<100 Acres	<100
	100-260 Acres	100-260
	>260 Acres	>260
Ownership	Not Specified	
	Family part-time	P-T FAMILY
	Family full-time	F-T FAMILY
	Corporation	CORPORATE
Livestock	Not Specified	
	Beef	BEEF
	Dairy	DAIRY
	Poultry	POULTRY
	Sheep	SHEEP
Crops	Not Specified	
	Berries	BERRIES
	Greenhouse	GREENHOUSE
	Vegetables	VEGETABLES
	Orchards	ORCHARDS
Soil Quality	Not Specified	
	High soil quality	HIGH QUALITY
Number of Farms in Town	Not Specified	
	More than 5	5 OR MORE
	Less than or equal to 4	4 OR FEWER
Program size	80,000 acres protected	Omitted Category
	100,000 acres protected	100,000
	120,000 acres protected	120,000
Program Cost	One-time cost to household (10, 25, 50, 75, 100)	COST

Table 3.12 Results of Multinomial Logit Analysis of Program Voting: Maine

Dep. Var. = Choice (A, B, Do Nothing) N= 179

	Location	Water	Size	Ownership	Livestock	Crops	Soil Quality	Number of Farms	Program Size
Program A Constant	.569**	.398*	.403*	.494**	.722***	.223	.483**	.740***	.661***
	(.311)	(.263)	(.313)	(.292)	(.279)	(.380)	(.265)	(.280)	(.273)
Program B Constant	.411*	.215	.280	.450*	.567***	.119	.359*	.548***	.469**
	(.295)	(.267)	(.299)	(.308)	(.278)	(.366)	(.254)	(.255)	(.256)
COST	-.003	-.005*	-.003	-.006**	-.003	-.003	-.004	-.004	-.004
	(.003)	(.330)	(.003)	(.004)	(.003)	(.003)	(.003)	(.329)	(.334)
SOUTHERN	.395								
	(.326)								
CENTRAL	-.035								
	.298								
NORTHERN	-.342								
	(.311)								
WATER		.461***							
		(.229)							
<100			-.156						
			(.335)						
100-260			.186						
			(.276)						
>260			.430*						
			(.314)						
P-T FAMILY				.755***					
				(.341)					
F-T FAMILY				.610***					
				(.307)					
CORPORATE				-.740***					
				(.360)					
BEEF					-.238				
					(.347)				
DAIRY					-.016				
					(.271)				
POULTRY					-.479*				
					(.349)				
SHEEP					-.558*				
					(.402)				
BERRIES						.347			
						(.378)			
GREENHOUSE						.522*			
						(.367)			
VEGETABLES						.272			
						(.393)			
ORCHARDS						.340			
						(.407)			
HIGH QUALITY							.207		
							(.216)		
5 OR MORE								-.256	
								(.275)	
4 OR FEWER								-.289	
								(.265)	
100,000									.131
									(.262)
120,000									-.333
									(.286)

Notes: Standard errors in parentheses. * significant at 20%; ** significant at 10%; *** significant at 5%

Discussion

Given the small sample sizes in the focus groups it is not possible to generalize the results to any larger group of people. Similarly, the evolution of exercises from state to state obscures comparisons to some degree. However, some general insights and trends arise. From the initial focus group and discussions in subsequent focus groups, we found that terms such as "open space," which are quite familiar to us as professionals, have very different meanings to the public. In addition, we found that focus-group participants found the idea of purchasing conservation easements a very odd concept and had difficulty understanding how someone could simply sell the right to a specific use of their land. When conducting surveys of the public on land use, or doing any type of public education related to land use, it is important to carefully consider and explain the terminology you use. As a group we have done numerous surveys and have found that farmland, as open land and conservation easements to protect this land are some of the more difficult concepts we have had to convey.

The evaluations of photographs of agricultural scenes present several interesting insights (Table 3.13). The predominant portion of coded attributes proved to be significant determinants of ratings. While there are inherent differences in farmland and farming activities in Georgia and Colorado, the statistical analyses of the scene ratings indicate some commonality and differences in focus group participant preferences. For example, participants in both locations appear to dislike large, open landscapes and the seasonal effects of harvested or plowed fields. Similarly, the results suggest that livestock is not a factor in either location. While crops seem to be important in Georgia, they were insignificant or negative (grains) in Colorado.

Table 3.13 Summary of Statistical Analyses of Ratings of Farm Scenes

	Georgia – Model 3 (N=687)	**Colorado (N=364)**
Landscape	Primarily open (-) Primarily trees (+) Topography (+)	Trees present (+) Mountains (+)
Farmstead	Residences (+)	Traditional buildings (+)
Farm equipment	Stored equipment (-)	Farm equipment (+) Grain elevator (+)
Farm operation	Irrigation (+) Harvested fields (-) Harvested timber (-)	Center pivot irrigation (+) Field activities (+) Plowed fields (-)
Crops	Horticulture (+) Row crops (+) Grain (+) Hay (+)	Grain (-)
Livestock	NS[a]	NS

Notes: Variable signs in parentheses. [a]NS indicates that the coefficients on all attribute levels were not significant.

The results of the conjoint exercises similarly reflect the importance of specific attributes and regional variation (Table 3.14). These results suggest that farm ownership and size are important. Other attributes such as water, crops and livestock may be more or less important depending on the region.

Table 3.14 Summary of Conjoint Findings Regarding Significant Attribute Levels

	Colorado (N=35)	**Oregon (N=48)**	**Maine (N=179)**
Farm location	NS[a]	All (+)	NS
Water	NS	Ponds/Streams (+)	Ponds/Streams (+)
Number of farms	X[b]	X	NS
Buildings	Traditional, wood (+) Modern, metal (-)	X	X
Farm size	250-1,000 acres (+)	<50 acres (+)	>260 acres (+)
Farm ownership	Corporate (-)	Family (-) Corporate (-)	Family, part time (+) Family, full time (+) Corporate (-)
Best management practices	X	NS	X
Soil quality	X	X	NS
Crops	Hay (+)	NS	Green houses (+)
Livestock	None (+)	Confinement (-)	Poultry (-) Sheep (-)
Acres protected	X	NS	NS
Household cost	All NS 3 of 7 (-)	3 of 6 Significant All (-)	2 of 6 Significant All (-)

Notes: Variables signs in parentheses. [a]NS indicates that the coefficients on all attribute levels were not significant. [b]X indicates the attribute was not considered for the particular state.

The number of acres protected, while fixed in Colorado, was not significant in Oregon and Maine. This is a variable that is crucial to any program to purchase conservation easements and deserves further consideration in future analyses. This is particularly true give the concern over the ability of contingent-valuation studies to detect marginal values for the scope of a program (NOAA, 1993). The scope of any program to purchase conservation easements is the total number of acres where easements are purchased. Several studies have shown that acreage preserved is a positive determinant of WTP for protection programs (Bergstrom et al., 1985; Bowker and Didychuck, 1994; Rosenberger and Walsh, 1997). In our case, it is possible that the specified levels of acreage protected were inadequate to detect scope. The cost of the program to participants' households, while generally negative for all models, as expected, was only significant in selected models in Oregon and Maine.

The specific attributes of land to be preserved clearly have an effect on individuals' preferences for preservation. The number of attributes of farms people care about are diverse and a full study is required to identify those that are truly significant and contribute the most to making farmland desirable as open land to the public. Our findings suggest that the most important attributes include the physical location of the farm, the type of farm and the farming practices used, all of which are directly and indirectly influenced by state and federal agricultural polices.

Chapter 4

CONCLUSION

The research presented in the preceding chapters provides information useful to future nonmarket valuation studies of land use issues. It also raises some additional questions. For example, the first essay demonstrates that omitting variables that measure visibility of environmental attributes from a hedonic equation can result in biased parameter estimates. While the method suggested for constructing the visibility variables represents a considerable improvement over binary or categorical treatments employed in past research, it is somewhat unrefined nonetheless. For example, because the visibility measure is based exclusively on topography, when obstructions such as development or dense forest occurs very near to a property in an area with little topography, it likely overstates the extent of attributes visible. This issue has been examined by other authors in an urban setting via visual inspection of properties. Unfortunately, this procedure could be prohibitively time consuming for a large sample. An additional question fundamental to the analysis pertains to the basis of measurement for visibility. In the research reported here, visibility is measured within a specified radius around a geocoded point on the street. Further research might examine several different radii, or experiment with alternative points using parcel-level data.

The results of the focus group research conducted to identify important attributes of farmland and agricultural systems suggests that valuation of land preservation programs presents several challenges. In particular, language and elicitation techniques must be carefully designed in order to distinguish preferences for physical attributes from respondent motivations. While the current research provides some guidance in this manner, whether meaningful valuation information on farmland preservation can be collected remains to be answered by a full-scale study.

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