Chapter #

Local Land Markets and Agricultural Preservation Programs

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INTRODUCTION

Local and state governmental entities have implemented transfer of development rights (TDR) and purchase of development rights or purchase of agricultural conservation easements (PDR/PACE) programs to permanently preserve farmland throughout the United States (AFT (American Farmland Trust) 2001a; AFT, 2001b; AFT, 2001c). In each of these programs, the sale of development rights results in an easement attached to the title of the land which restricts the current and all future owners from converting the parcel to residential, commercial, or industrial uses. The value of the land in alternative uses affects an owner's willingness to participate in these programs as well as the program costs. Thus, information on the value that the private market places on parcel characteristics is important in determining participation behavior and payment levels. In addition, knowledge of the marginal contributions of different parcel characteristics to both private market prices and easement values can help program administrators decide which easement purchases can maximize society's benefit at the lowest cost.

Lynch and Lovell (2002) found that the agricultural land preservation programs in three Maryland counties (Calvert, Howard and Carroll counties) paid higher per acre easement values for farmland close to the nearest employment center, smaller farms, and farms with a high percent of prime soils, and paid lower values for farms with a high percent of cropland. The importance of certain land characteristics on the easement values was affected by the type of agricultural preservation program (TDR or PDR/PACE) that had enrolled the farm. In an analysis of whether or not the easement restrictions affected the preserved parcels' market price, Nickerson and Lynch (2001) examined private

market sales prices for 200 farmland parcels in the same Maryland counties (Howard, Carroll, and Calvert). They found that the private market paid higher prices per acre for farmland close to the nearest employment center, smaller farms, non-forested parcels, and those parcels in Calvert and Howard counties. They found that prime soils were not important in determining the parcel price in the private market. Comparing the results of these two studies, we find both similarities and differences in the effect of different characteristics on easement values and private market prices for agricultural land.

This chapter explores these similarities and differences by investigating whether the private land market pays similar values for parcel characteristics or whether the preservation programs design payment schemes that are not market-driven. Analyzing a spatially explicit dataset of 2,592 arm's-length transactions, we also correct for possible spatial correlation that might occur due to the proximity of the observations to one another. We also include parcels that are no longer in an agricultural use. By examining the local market for land, we can determine if the easement value indicated by the supply curve of eligible land to be preserved based on the easement programs' payments is comparable to the prices received by recently sold local land.

Preservation programs can use this information to adjust their payment schemes to ensure the purchase of future acres, assuming that the underlying conditions remain the same. In addition, program administrators have been proposing the use of a point system, which assigns monetary values to different parcel characteristics rather than expend limited program dollars and time using the more expensive appraisal process to determine the market value. To guarantee enrollment under such systems, the programs need to have point systems which result in easement values that satisfy a landowner's participation constraint. In addition, these point systems need to be justified to county commissioners and state authorities, especially if programs want to value characteristics that the market does not typically reward (but that may maximize society's welfare), such as wetlands or other resource features. An hedonic model analyzing recent market transactions, for both agricultural and non-agricultural parcels of at least one acre, will illustrate what monetary values have been attached to land characteristics.

Preservation programs preserve agricultural lands and woodlands to provide sources of agricultural products, control urban expansion, and protect open-space land (Maryland Agricultural Land Preservation Foundation, 2001). Lynch and Musser (2001) translated these goals to preserving those farms most likely to be converted in the near future (close to the city or town); preserving productive farms (prime soils; growing crops); maximizing the number of acres (many farms; large farms); and preserving farms close to one another (large blocks of land). While researchers suggest that preserving farmland is not necessary for food security purposes, agricultural preservation programs can maintain environmental amenities such as wildlife habitat, groundwater recharge, and rural and scenic views, contribute to curbing urban and suburban sprawl, and sustain a viable local agricultural economy (Bromley and Hodge 1990; Fischel 1985; Gardner 1977; McConnell 1989; Wolfram 1981). Society values these public goods, according to contingent valuation analyses that have been conducted (Pruckner 1995; Drake 1992; Beasly, Workman, and Williams

1986; Bergstrom, Dillman, and Stoll 1985; Halstead 1984). Furthermore, according to the Land Trust Alliance (2000), U.S. citizens appear willing to finance these types of programs. Numerous ballot initiatives have been designed to preserve parks, open space, farmland, and other amenities. For example, in 2000, U.S. $7.4 billion in conservation funding was authorized; in 1999, U.S. $1.8 billion; and in 1998, U.S. $8.3 billion.

While these studies demonstrate that the general public supports agricultural and open space preservation, they may desire to preserve land with different characteristics than those that are highly valued in private market transactions. The preservation of an individual farm with a given set of characteristics may achieve all the goals mentioned above. However, in many cases, program administrators will have to make trade-offs between different characteristics, as most farms will have some but not all of those characteristics that are desired. Thus, information on the existing land market returns for various characteristics may assist in ensuring that the incentive structure for potential participants is well designed. For example, if the private market does not reward prime soils, and yet this is a characteristic preferred by the program's goals, an appraisal process based on market transactions to determine the easement value may not reflect the value society would place on preserving a particular parcel with a high percentage of prime soils. With information on the influence of the various parcel characteristics to the private market value of the land, even that which is already developed, program administrators of agricultural land preservation programs may be better able to select among the farms offered to be preserved or to set up a scheme to compensate and attract landowners with farms having the desired characteristics.

METHODS

An hedonic approach, corrected for possible spatial correlation, is used to model the sales price per acre of land. When deciding whether to place his or her land on the market, a landowner examines the relative returns to the parcel's characteristics in recent sales in the local land market. Similarly, the buyer will evaluate the relative cost of the parcel's characteristics before deciding to purchase the property. The price per acre of the land in real estate transaction i is modeled as the net present value of the stream of agricultural rents, A_i, as a function of the parcel's characteristics, X_i, and time, t, until an optimal date to develop the land, t^*, and of the residential rents, R_i, as a function of the parcel's characteristics, X_i, and time, s, the time when t is greater than t^* such that

$$P_i = \left[\int_{t=0}^{t^*} A_i\left(X_i, t\right) e^{-rt} dt + \int_{t^*}^{\infty} R_i\left(X_i, s\right) e^{-rs} dt \right]. \quad (1)$$

Parcel characteristics include soil quality, land use, and geographic location, as well as other attributes. Parcels already in residential use ($t>t^*$) and those that continue in agricultural use ($t<t^*$) are included in the analysis.

A hedonic model is estimated to explain how these characteristics are rewarded for a locus of equilibrium land prices in recent private market transactions. The empirical form of the land value model can be specified as

$$P = X\beta + \varepsilon, \tag{2}$$

where P is a vector of the natural log of the private market sales price per acre, X is a matrix of exogenous parcel characteristics influencing the value of land in agricultural and residential use, β are parameters to be estimated, and γ is a vector of random error terms representing unobserved characteristics and is assumed to be normally distributed. However, parcel characteristics that affect the market price may be spatially correlated. If some of these characteristics are not observable, then there may be spatial dependence across error terms. Many of the market transactions are in the same general region and thus would have similar unobservable characteristics. Given this possibility, the empirical problem becomes:

$$\begin{aligned} P &= X\beta + \varepsilon \\ \varepsilon &= \rho W\varepsilon + \mu \end{aligned}, \tag{2a}$$

which can be estimated as

$$P = X\beta + (I - \rho W)^{-1}\mu \tag{2b}$$

(Whittle, 1954; Cliff and Ord, 1973), where W is a spatial weight matrix, ρ is a scalar parameter to be estimated, μ is a vector of random error terms assumed to have a mean of 0 and variance-covariance matrix $\sigma^2 I$, and γ is a vector of random error terms with mean 0 and with variance-covariance matrix $\sigma^2(I-\rho W)^{-1}(I-\rho WN)^{-1}$ (Bell and Bockstael, 2000; Kelijian and Robinson, 1993). The correlation between the errors of the observations is assumed to decrease as the distance between the observations increases. Thus, the spatial weight matrix is of a distance-decay format defined to be the inverse function of the distance between observations. A distance-decay matrix is different from the type of matrix often used when estimating regressions thought to have spatial correlation. Usually, spatial dependence is assumed to be 1 for adjacent observations such as those with common borders, and zero for other observations (see Anselin and Florax, 1995 for a review).

However, given the micro-level data used in this analysis, a distance-decay format was assumed to be more appropriate. A distance-decay format of the spatial weight matrix assumes that those observations closest to a parcel are more highly correlated than those observations farther away. Defining d_{ij} as the distance between parcel i and parcel j, and c as the distance after which no spatial correlation is expected, the elements of W for the inverse distance matrix equal $w_{ij} = 1/d_{ij}$ if $d_{ij}<c$ and $w_{ij} = 0$ if $i=j$ or if $d_{ij}>c$ (Bell and Bockstael, 2000). Bell and Bockstael (2000), using similar Maryland land values, found that after 600 meters little to no spatial dependence is apparent. Given this result and that

as *c* becomes larger, the matrix becomes less sparse, we set *c*=1609.27 feet (490 meters) or about a third of a mile.

DATA

Data from the Maryland Division of Tax and Assessment has been geographically identified by the Maryland Department of Planning. This data contains transaction and parcel information, including the X and Y coordinates of the parcel, which enables us to use a geographic information system (GIS) to extract additional parcel level and geographic information. The spatially explicit dataset includes 709 (Calvert), 1028 (Carroll), and 855 (Howard) arm's-length transactions that occurred between July 1993 and June 1996. We include one-acre-or-larger parcels that have the parcel coordinates attached. Because the primary interest is the value of the land, we subtract the assessed value of the residential structure from the market price if the parcel contained a house. The dependent variable is the natural log of the real estate transaction price per acre in 1996 dollars discounted using the Urban Annual CPI index. The average price per acre for the land was $59,612 in Calvert, $61,208 in Howard, and $47,368 in Carroll (Table 1).

Table 1. Descriptive Statistics by County (Calvert, Howard, and Carroll)

	Calvert N = 709		Howard N = 855		Carroll N = 1028	
Variables	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.
Price per acre	$59,612	$35,950	$61,208	$37,807	$47,368	$27,800
Miles to city	40.617	8.697	21.532	4.414	29.273	5.825
Miles to town	3.823	1.566	1.59	1.639	4.358	2.019
Miles to major road	0.572	0.475	0.473	0.436	0.723	0.656
Number of acres	2.231	5.355	2.966	5.323	4.059	11.772
Percent prime soils	51.10	0.373	76.01	0.285	56.50	0.401
Percent agricultural land use	8.50	0.193	13.92	0.231	21.50	0.288
Percent preserved for agriculture	1.20	0.083	2.91	0.13	6.30	0.213
Percent of water or beach	0.80	0.045				
Hooked to sewer	1.00	0.099	7.95	0.271	3.40	0.181
Future sewer planned	4.40	0.205	8.77	0.283	5.30	0.223
Size less than minimum rural zoning	93.50	0.246	45.61	0.498	89.20	0.311

These averages are much higher than the value using sales transactions for land in an agricultural use, which was found to have an average sales price of

$8,998 (Nickerson and Lynch, 2001). They are also much greater than the average easement payment received in these counties, which was $2,403 in Calvert, $4,685 in Howard and $1,165 in Carroll (Lynch and Lovell, 2002). For parcels with 20 or more acres, however, the prices per acre were lower and were similar to the easement prices: $5,203 in Calvert, $9,764 in Howard, and $5,620 in Carroll. Some of the properties investigated have been improved; some are attached to municipal sewer service. However, if landowners are observing the sales price for developed parcels that are selling for substantially higher prices, they may be incorporating this information into their calculations of the relative value of their land.

In explaining the variation in the transaction price per acre, we include characteristics that will affect both the agricultural and the development value of the land. Because the Maryland Department of Planning has geo-coded the centroid of these land parcels, we are able to access other geographic data. Using Geographic Information System software (ARCINFO), parcel characteristics from digitized maps were added. These include the percent of prime soil; the distance in miles to nearest metropolitan area (Washington, D.C., or Baltimore), to the nearest town, and to the nearest road; the percent of area within a 100 square meter radius (approximately 1 acre) around the centroid that is water, wetlands or beach (Chesapeake Bay or Patuxent River) in Calvert County; the percent of area within a 100 square meter radius around the centroid that is permanently preserved agricultural and forest land having an easement attached; the percent of area of the current land-use (pasture, row crops, vegetable crops, and forest); and whether the parcel was connected to the county or municipal sewer or plans exist to connect the parcel to the sewer system in the future. Summary statistics for the data are presented in Table 1. The spatial variables are consistent with those used in previous analyses of parcel-level farmland values on the urban-rural fringe that included proxies for agricultural and development values (Bell and Bockstael, 2000; Lynch and Lovell, 2002; Nickerson and Lynch, 2001; Shi, Phipps, and Colyer, 1997).

Proxies for the development value and timing include the distance to the nearest employment center (either Washington, DC, or Baltimore) and the distance to the nearest town (measured as a straight line). Land close to the city and employment opportunity or land near a local town is hypothesized to receive a higher sales price per acre. However, the relationship between distance to these areas and the market value may not be linear (i.e., the effect of the city or town on the value could dissipate as the distance increases). Therefore we include both distances as a logged variable to allow for possible non-linearity. We also expect that parcels close to a road will receive a higher price per acre. Surprisingly, we find that on average preserved parcels in Calvert are closer to the city than the non-preserved ones in this analysis (36 versus 41 miles). Calvert County parcels next to a high percentage of waterfront property may have a higher market value. Therefore, the percent of water, wetland, or beach (the Chesapeake Bay or major tributary) for Calvert parcels is included as an explanatory variable in the analysis.

Larger parcels usually receive a lower price per acre when sold in the land market. Thus, we hypothesize that parcels with fewer acres will have a higher price per acre. We also include a variable to indicate when the parcel size is less

than the minimum rural zoning acreage, which is 5 acres in Calvert, 3 acres in Howard, and 6 acres in Carroll. This permits the rural area to have a different intercept. In addition, it introduces non-linearity into the acreage variable. We do not have a strong prior on this variable. The rural areas have had lower prices per acre, but many individuals have been attracted to this type of location recently; therefore, we might find either a positive or negative effect from this variable.

Easement programs typically express interest in preserving productive farms. Therefore, net agricultural returns were proxied by the size of the farm, the proportion of the parcel in agricultural uses (row crops, vegetables, and pasture), and the percentage of prime soils (Lynch and Lovell, 2002). For comparison purposes, we include similar characteristics in this analysis. Data on seven soil characteristics (agricultural productivity, erosion susceptibility, permeability, depth to bedrock, depth to watertable, stability, and slope) were extracted. Following the Maryland classification system, we define prime soils as agriculturally productive, permeable, with limited erosion potential, and with minimal slope (Maryland Department of State Planning, 1973). The desirable soil characteristics are aggregated into one variable: percentage of prime soils. A higher percentage of prime soil indicates higher productivity, and thus higher net agricultural returns, delaying conversion. Prime soils may increase the development value of the farm since it is often less costly to build on these soils. Therefore, parcels may receive higher returns in development due to this attribute and may have converted already.

Calvert's parcels included in this analysis had 51 percent prime soils, Howard's had 76 percent, and Carroll's had 57 percent. These compare to Calvert's preserved parcels with 43 percent prime soils, Howard's with 82 percent and Carroll's with 39 percent. In Calvert and Carroll, it appears that the land with the best soils was converted to housing earliest. Row crops, vegetables, and pasture-land uses would have lower conversion costs than a forested parcel and therefore may be considered more desirable. If a house has already been constructed, then the presence of land in a crop use could increase the value if people desire to be near open farmland, or could decrease the value of the land if people perceive agricultural land to be smelly, noisy, dirty, and prone to attract insects. Similarly, land with a high percentage of agricultural use may not have been subdivided or improved for a developed use yet, and therefore its value is hypothesized to be lower.

In addition, land that has been enrolled in a preservation program and that has sold or donated its development rights may have a lower price per acre. While Nickerson and Lynch (2001) found little statistical evidence that easement restrictions lower the market price, we include the percent of land that has been permanently preserved as a proxy for the absence of these rights. Permanently preserved open space is defined as farms and other land having easements prohibiting residential, commercial and industrial development, either purchased by one of the county or state agricultural land preservation program or donated to a land trust or the Maryland Environmental Trust.

Separate equations are run for each county because of the differences in the average returns landowners expect to receive from selling their land, in county-

level services, in permitted zoning densities, and because of alternative opportunities such as preservation programs.

ESTIMATION AND RESULTS

A separate regression model was estimated for each of the counties using SpaceStat Version 1.9 (Anselin, 1998). Tests for spatial dependence using a spatial weight matrix were conducted. The spatial weight matrix contains the inverse distance between parcel *i* to parcel *j* if they were less than 1609.27 feet apart. The matrix is row standardized. The Robust Lagrange Multiplier test (LM) was used to determine spatial correlation (for reviews, see Anselin 1988a, Anselin and Bera 1997). If the LM test was significant, we used an iterated Generalized Moments (GM) estimator to estimate the spatial error model. Due to the large sample size, the GM estimator provides statistically valid results (Bell and Bockstael, 2000).

In all three models (i.e., for Calvert, Howard, and Carroll counties) we found evidence of spatial dependence (*Robust* $LM_{(1)}$ = 20.67*; Robust* $LM_{(1)}$ = 17.78*, Robust* $LM_{(1)}$ = 7.19). Therefore, iterated GM models were estimated for all three. While spatial correlation was identified as a problem in these models, qualitatively and quantitatively the estimated coefficients did not change dramatically between the corrected and uncorrected models (Tables 2,3, and 4).

Table 2. Estimated Coefficients Explaining Private Market Real Estate Transactions in Calvert County with OLS and Spatial Model

	OLS			Corrected Model		
Variables	Coeff.		S.D.	Coeff.		S.D.
Constant	10.993		0.452	10.831		0.506
Log of miles to city	-0.334	**	0.11	-0.285	**	0.124
Log of miles to town	0.127	**	0.052	0.121	**	0.056
Miles to major road	-0.056		0.044	-0.059		0.049
Number of acres	-0.028	***	0.004	-0.028	***	0.004
Percent prime soils	-0.039		0.056	-0.034		0.06
Percent agricultural land use	0.085		0.108	0.06		0.112
Percent preserved for agriculture	0.16		0.208	0.068		0.201
Percent of water or beach	3.511	***	0.476	3.333	***	0.467
Hooked to sewer	0.343		0.219	0.333		0.214
Future sewer planned	-0.104		0.11	-0.113		0.114
Size less than minimum rural zoning	1.03	***	0.092	1.015	***	0.092
P				0.187		0
R2	0.357					
R2 (Buse)				0.684		
(spatial statistics for OLS)	M/I (d.f.)		Value	Prob.		
Moran's I (error)	0.172		5.014	0.000		
Robust LM (error)	1		20.668	0.000		

Table 3. Estimated Coefficients Explaining Private Market Real Estate Transactions in Howard County with OLS and Spatial Model

	OLS			Corrected Model		
Variables	Coeff.		S.D.	Coeff.		S.D.
Constant	11.37		0.342	11.32		0.379
Log of miles to city	-0.251	***	0.107	-0.24	**	0.12
Log of miles to town	0.034		0.024	0.032	***	0.027
Miles to major road	-0.017		0.037	-0.012		0.038
Number of acres	-0.029	***	0.003	-0.028	***	0.003
Percent prime soils	0.086		0.058	0.075		0.06
Percent agricultural land use	-0.169	**	0.073	-0.133	*	0.074
Percent preserved for agriculture	-0.100		0.13	-0.068		0.135
Hooked to sewer	-0.317	***	0.082	-0.297	***	0.087
Future sewer planned	-0.239	***	0.071	-0.251	***	0.077
Size less than minimum rural zoning	0.727	***	0.036	0.751	***	0.037
P				0.175		0
R2	0.464					
R2 (Buse)				0.739		
(spatial statistics for OLS)	M/I (d.f.)		Value	Prob		
Moran's I (error)	0.158		4.78	0.000		
Robust LM (error)	1		17.78	0.000		

The significance of certain variables and the overall fit varied by county. For Calvert, the R^2 (Buse) was 0.684, for Howard it was 0.74, and for Carroll it was 0.5499. The Buse R^2 has been adapted to the error structure of the spatial error model (Anselin, 1988a). The correction for spatial correlation resulted in higher R^2 values for Howard, Carroll and Calvert than the OLS models. Lynch and Lovell (2002) found a different pattern of overall fits using similar characteristics to explain easement values. For Carroll, spatial correlation was found and the R^2 (Buse) was 0.62, for Howard, no spatial correlation was found and the R^2 was 0.87, and for Calvert, no spatial correlation was found and the R^2 was 0.32.

In all three counties' regression models, the estimated coefficients on the distance-to-the-city variable suggests that the closer the parcel is to the city, the higher the easement value. A change in the distance has the biggest impact in Carroll county, where being 1 percent closer to the city raised the price 0.46 percent (Table 5). The easement value in Carroll will be almost 1 percent higher, as the parcel is 1 percent closer to Baltimore. The per acre price increases 0.29 percent in Calvert if the parcel is 1 percent closer to the city, compared to 7 percent for the easement value for a similar change in distance. Of course the easement values are much lower. A 7 percent change in the easement value of $2,403 is $168, while a 0.29 percent change in the market price of $59,612 is $173. In Howard, there is a 0.24 percent increase in the price per acre ($147) if

the parcel is 1 percent closer to a metro area compared to a 1.8 percent increase in the easement value ($84). Figure 1 illustrates the relationship between distance to the nearest city and the prices received in the 3 counties.

Table 4. Estimated Coefficients Explaining Private Market Real Estate Transactions in Carroll County with OLS and Spatial Model

	OLS			Corrected Model		
Variables	Coeff.		S.D.	Coeff.		S.D.
Constant	11.026		0.358	11.016		0.392
Log of miles to city	-0.461	***	0.099	-0.459	***	0.11
Log of miles to town	-0.022		0.032	-0.026		0.035
Miles to major road	-0.103	***	0.027	-0.106	***	0.03
Number of acres	-0.017	***	0.002	-0.017	***	0.002
Percent prime soils	0.109	**	0.043	0.11	**	0.045
Percent agricultural land use	-0.097		0.062	-0.09		0.063
Percent preserved for agriculture	-0.12		0.084	-0.123		0.087
Hooked to Sewer	0.026		0.099	0.013		0.105
Future sewer planned	0.129		0.084	0.122		0.089
Size less than minimum zoning	1.321	***	0.066	1.327	***	0.066
ρ				0.12		0
R2	0.486					
R2 (Buse)				0.55		
(spatial statistics for OLS)	M/I (d.f.)		Value	Prob		
Moran's I (error)	0.049		2.753	0.006		
Robust LM (error)	1		7.187	0.007		

Interestingly, Calvert has higher prices than Carroll even for those parcels farther away from the city. Calvert's nearest city is Washington, DC, which may have more employment opportunities than Baltimore, which is the closest city to Carroll. Alternatively, Calvert's location near the Chesapeake Bay may increase the desirability of its land. In addition, the road networks to Washington may result in a similar commute time.

Table 5. Elasticities from Estimated Models by County

Continuous variables	Calvert	Howard	Carroll
Miles to city	-0.285	-0.240	-0.459
Miles to town	0.121	0.032	-0.026
Miles to major road	-0.034	-0.006	-0.077
Size in acres	-0.062	-0.083	-0.068
Percent prime soils	-0.034	0.075	0.110
Percent Agricultural Land Use	0.06	-0.133	-0.09
Percent of water or beach	3.333		
Change in value for Binary = 0 to Binary = 1			

Hooked to sewer	$42,403	$-37,344	$1,846
Future sewer hook-up planned	$-11,547	$-32,193	$18,265
Size less than minimum zoning	$73,176	$112,389	$120,225

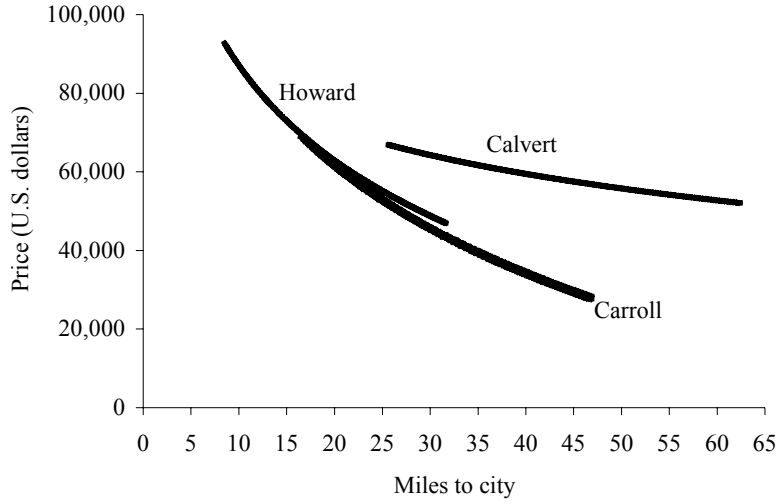

Figure 1 Market Price and Miles to Nearest City (by County)

The effect of distance to town varied by county. In Calvert, the coefficient was positive and significant, suggesting that the farther the parcel was from a town, the higher the price. Distance to the city and distance to town in Calvert were inversely related. In Carroll and Howard Counties, the estimated coefficient for the distance-to-town variable is not significant. In the estimated county-level regressions of the easement value, the distance to town was not significant in explaining the value paid. In the pooled model with all three counties, closeness to a town decreased the easement value.

In the Calvert model, we find that having a high percentage of beach or water attached to the parcel increased the value. One percent more beach or water increased the price per acre 3.3 percent. While measured differently in the easement analysis, proximity to the Chesapeake Bay or Patuxent River was also found to increase the easement payment. It appears that even preserved properties receive value for this attribute, which is also rewarded in the private market.

In all three models, parcels below the minimum zoning acreage received higher prices. In addition, the price is affected negatively by the number of acres in the parcel. Larger parcels receive lower prices per acre, consistent with other land market studies. There is either a ‘rural’ land market (wherein minimum zoning is in force and where the land is valued lower), or there is a nonlinear effect of parcel size on the price, or both.

Having a lot less than 5 acres increased the land value by $73,176 in Calvert. Having a lot less than 6 acres increased the land value by $120,225 in Carroll. And having a lot less than 3 acres increased the land value by $112,389 in Howard. In addition, as acreage increased by 1 percent, the land price fell 0.062 percent ($37) in Calvert County, whereas the easement value decreased 0.12 percent ($3). In Carroll County, the effect of acreage is similar, with a price drop of 0.068 percent ($32) in the real estate market and a 0.16 percent drop for the easement value ($1.9). The private market in Howard also paid less per acre for larger parcels. Acreage did not affect the easement value of Howard County parcels, however. Howard uses a point system to determine the easement value. By doing so, Howard may be 'overpaying' this parcel attribute to attract larger farms to join the preservation program.

In Figure 2, the relationship between number of acres in the parcel and the price received in the real estate market for parcels of at least the minimum rural zoning compared to the easement value in Howard and Calvert Counties is depicted. In Howard, parcels greater than 30 acres may receive higher per acre payments in the agricultural preservation programs than in the private market unless the owner incurs the expense of subdividing and selling the parcel in smaller sections. Similarly, in Calvert County, parcels larger than 90 acres may find a developer willing to purchase the development rights in the TDR program for a higher price than selling the land in the rural land market.

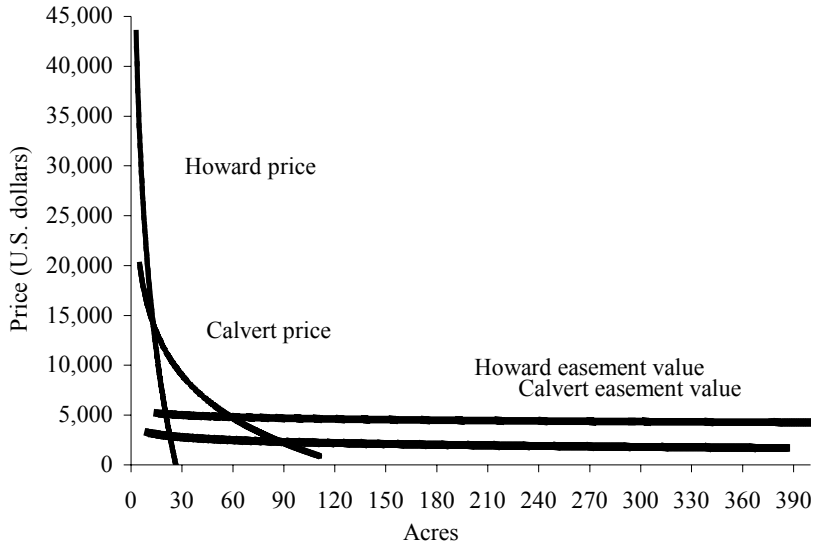

Figure 2 Number of Acres and Price in Real Estate Compared to Easement Payment (Howard and Calvert Counties)

While parcels with a higher percentage of prime soil command a significantly higher easement value estimated in the pooled model, in the

county-level models, none of the estimated coefficients on prime soil were significant. Lynch and Lovell (2002) hypothesize that the soils within each county are not sufficiently different, and that this fact is reflected in the insignificant coefficients in the county-level regressions. In the Howard and Calvert real estate market transactions, the soil quality had no impact. However, in Carroll county the price per acre increases as the percent of prime soil increases. One percent more prime soil resulted in a market price that was 0.11 percent higher.

None of the counties' markets reward current agricultural land use, in fact, it receives a lower price in Howard County's private market. This finding in Howard County is consistent with the finding that the percentage of agricultural land in a parcel decreases the easement value. Either landowners who are planting crops have a lower reservation price, or the preservation programs are not prioritizing enrollment of land being actively farmed. However, there was much less agricultural land use on the parcels included in this analysis. Calvert had on average only 9 percent of the parcels in agricultural use, Howard 14 percent, and Carroll 22 percent, compared to Calvert's average of 38 percent, Howard's 75 percent, and Carroll's 85 percent for the preserved parcels.

We included a variable to proxy whether the parcel was enrolled in the agricultural land preservation program, which we expected to decrease the parcel's value. This variable was not significant in any of the regressions. One interpretation, similar to the findings of Nickerson and Lynch (2001), is that the restrictions imposed by the easement provisions are not decreasing the price of preserved parcels. Alternatively, the variable might not be a good measure of these restrictions.

We also included several variables that we expected to affect the price per acre in an urbanizing area: distance to major roads and having a sewer connection (or having a sewer connection planned). The distance between the parcel and the nearest major road did not affect the price in Calvert or Howard. In Carroll County, however, the closer the parcel was to a major road, the higher the price received. If the parcel was 1 percent closer to the road, the market price was 0.077 percent higher. Surprisingly, being hooked up to a municipal or county sewer did not increase the land value in Calvert or Carroll. Nor did the anticipation of a sewer hook-up that was planned for the future increase the price per acre. Even more surprising was that in Howard County, being hooked up to a sewer system or having a sewer planned for the land in the future actually decreased the value of the land. Being hooked up to a sewer system decreased the land value by $37,344, and having a sewer hookup planned for the future decreased the value by $32,193. Rural areas on a septic system must be considered more desirable, all else being equal.

CONCLUSIONS

In this analysis, the marginal contribution of different parcel characteristics to the market-based land price per acre was modeled. The results were compared to the marginal contribution of the same or similar characteristics to easement

values paid by agricultural land preservation programs investigated in an earlier paper (Lynch and Lovell 2002). Information on the similarities and differences between the factors affecting easement prices versus market prices could help formulate policy decisions that will improve preservation programs, as well as ensuring that the correct parcels are selected to achieve the stated goals.

Using spatially explicit data, hedonic models corrected for spatial correlation were estimated for three Maryland counties: Calvert, Carroll and Howard. The models explained 55 percent to 74 percent of the variation in the market price of parcels that were at least one acre in size. Spatial correlation was identified as a problem in each of the estimated models. However, the estimated coefficients did not dramatically change, either qualitatively or quantitatively, between the corrected and uncorrected models.

Strong similarities between the characteristics' effects on easement values and market prices do exist. These included the effects of distance to the city, size of the parcel, and proximity to water in Calvert county. For other characteristics, only one or two counties showed similarities between how prices in the market and values in preservation programs were affected. For each of the three counties, both easement values and market land prices were affected by the distance to employment centers, as measured to the nearest city (Washington, DC, or Baltimore). This distance was also one of the most important determinants of value and price, as measured by the elasticities. The magnitude of the distance effect in terms of percentage changes on easement values (i.e., the percentage decrease in easement value for a 1 percent increase in distance) was larger than for market prices in all three counties. The magnitude in terms of actual dollars was remarkably similar. Distance to a metropolitan area is a significant determinant of easement value (Lynch and Lovell 2002; Wichelns and Kline 1993; Plantinga and Miller 2001). Program administrators appear to incorporate this market phenomena into the values they are willing to pay for easements in PDR programs, which use either point systems or appraisal methods to determine easement values.

Another consistently strong result was that market price per acre declined as parcel size increased. The decline was higher in percentage terms and lower in dollar terms for easements than for market prices. Even examining the averages of the transactions is illuminating. The average price per acre for the land alone was $59,612 in Calvert, $61,208 in Howard, and $27,368 in Carroll. Yet for parcels of 20 or more acres, the prices per acre were much lower: $5,203 in Calvert, $9,764 in Howard, and $5,620 in Carroll. Except in Howard county, easement payments per acre also decline with larger size parcels.

As with distance to the city, administrators are following the market signal by paying less per acre for larger parcels. In Howard, however, this appears not to be the case. A point system that assigns a higher weight to larger farms needs to be evaluated as to whether it is maximizing society's welfare. If larger farms do contribute substantially more to goal achievement, such as maximizing total acres preserved or preserving productive farms, then the market solution of discounting the value per acre due to large size may not be an optimal strategy. However, a program with limited resources could preserve more acres if it followed the private market behavior of paying a lower price per acre for larger parcels.

Both easement values and market prices were positively affected by proximity to the water in Calvert. However, because most of the land preserved in Calvert is through the TDR program, land with beach or water access is often not preserved due to its higher cost per acre. Some people argue that the increase in impervious surfaces caused by increased development near a water body can damage the water quality significantly. Therefore, if one of society's goals is to protect water quality in addition to open space, then a stronger mechanism may be needed to entice owners of farms near water to participate in the preservation program.

A higher level of prime soils does not receive a higher price in the real estate market except in Carroll county. This characteristic makes the land more desirable for both agricultural use and for residential or commercial uses as it is easier to build on and to farm. On inspection of the correlation coefficients, the insignificant coefficients in Howard and Calvert do not appear to be a result of multicollinearity, as was suggested in the easement analysis. Other parcel characteristics may contribute more heavily than soil quality to determining the equilibrium market price, although soil quality plays a role in the easement payment paid by preservation programs. If enrolling parcels with prime soils does maximize society's goals, the preservation programs may be following the optimal strategy to reward this feature, even though only in Carroll county's private market does prime soil contribute to raising the market price.

Carroll county was also unique among the counties in that distance to a road had an effect on land price in the private market. Although some program administrators suggest that the distance to a road or the road frontage should be included in the point system to determine the easement value, we find support for this suggestion only in Carroll county. Thus, only in Carroll county should the programs consider marginally increasing the easement payment for proximity to a road.

What lessons can be learned from the above analysis? These results demonstrate that some parcel characteristics have a similar effect on both market prices and easement values across all counties, but that the magnitudes of the effects are not necessarily the same. As a consequence, program administrators who want to increase enrollment in preservation programs may need to adjust the payments to encourage participation. Given the price that can be received for subdividing and improving land, especially in areas near employment centers, landowners will need to be adequately rewarded if they are to consider enrollment.

The most pressing situation concerns those farms that are facing the greatest threat of development. If society determines that it wishes to preserve those acres because they are close to the cities and urban populations and will thus provide more viewing and enjoyment possibilities, then some urgency is warranted. Program administrators are currently attempting to devise new methods and new payment schemes to attract these farmland owners to enroll. Easement programs may want to adjust their valuation of larger parcels in order to make them more comparable to the market valuation process.

As in this analysis, the use of hedonic models to determine the marginal value of certain land characteristics could provide some interesting information for easement program administrators. While developed parcels may not be as

comparable as unpreserved farms to preserved farms, the analysis sheds some light on how the real estate market values certain characteristics. Future research using sales of undeveloped land might provide a more comparable analysis than one using both developed and undeveloped land as in this study. On the other hand, landowners in these areas would consider the prices received by developed parcels as well as undeveloped parcels when evaluating the value of their land. In addition, while the data was unique and collected to do a micro-analysis, refinement of certain variables such as preserved status would be beneficial. Similarly, although spatial correlation was present in all three models, the analysis would have provided similar information and policy recommendations even if it had been estimated using OLS. Both qualitatively and quantitatively, the two sets of estimated coefficients were similar in each county.

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