The Effect of Farmland Preservation Programs on Farmland Prices

Cynthia J. Nickerson and Lori Lynch

Government agencies in urbanizing areas are increasingly utilizing purchase and transfer of development rights programs to preserve farmland and protect local farm economies. This article tests the effect of development restrictions imposed by permanent easement sales on farmland sales prices, using Maryland data. We correct for selectivity bias due to the voluntary nature of these programs in estimating hedonic sales equations. Although preserved parcels' actual land values are lower, the effect of the restrictions is not statistically significant. These findings may encourage additional participation in preservation programs or justify reductions in the easement prices paid by agencies.

Key words: farmland preservation, farmland prices, hedonic models, land values, sample selection.

More than fifteen state and thirty-four local governments permanently preserve farmland by purchasing development rights or by allowing the transfer of development rights among landowners (American Farmland Trust). Particularly in metropolitan areas, agencies use these purchase of development rights (PDR) and transfer of development rights (TDR) programs to supplement other farmland preservation measures (property tax relief, right-to-farm laws, low-density or agricultural zoning) that have proven ineffective at slowing farmland conversion. PDR and TDR programs are the most direct means to protect farmland, because an easement is placed on the land restricting the current and all future owners from converting the parcel to a non-agricultural use. When a landowner enrolls a parcel in a PDR/TDR program, he or she sells the rights to develop the land but retains ownership of the parcel.

Capital asset pricing theory predicts that the market value of a farm parcel that retains development potential will reflect its value in an agricultural use (the discounted present value of the future stream of farming returns) and the value of the option to convert to a non-farm use. Because farmland preservation programs use easements to restrict non-farm uses, capital asset pricing theory predicts a restricted parcel's market value will only reflect its agricultural use value. Agencies view this expected reduction in the parcel's value as a positive effect of PDR/TDR programs because it more easily enables farmers to purchase lower priced land when other farmers retire (Gale). Current landowners benefit from the reduction in land value and from the large cash payment from selling an easement, because both increase estate planning options and can decrease the heirs' need to sell the farm to pay estate taxes.

However, the development restrictions imposed by preservation programs may not significantly decrease farmland values. Some landowners may anticipate that as the demand for developable land rises, political pressure will force legislators to relax the "permanent" land use restrictions imposed by the preservation programs. If landowners and/or land buyers believe these land use restrictions are not permanently binding, land values will not be significantly reduced by the use restrictions. Also, land buyers may buy preserved farm parcels as hobby farms and could bid up the price of a restricted parcel because they receive non-market values (unconnected to agriculture) from owning land in an agricultural area that is more

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The authors are economist, Resources Division at the Economic Research Service, and assistant professor, Department of Agricultural and Resource Economics, University of Maryland.

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likely to retain its rural character and open space.

As more states utilize PDR/TDR programs to contain sprawl and preserve local farm economies, understanding the effect of these programs on farmland prices becomes increasingly important. If land prices of restricted parcels are not significantly reduced, then preservation agencies may be less likely to preserve productive farmland and the local farm economy, even though they may be maintaining environmental resources and open space.[1] A landowner's decision to participate in a PDR/TDR program may also be affected by the impact of use restrictions on land prices. The public supports PDR programs and the use of tax dollars because easements preserve environmental resources (e.g., groundwater resources, wildlife habitat, natural places, rural character) and contribute to growth control efforts and to farmland protection (Kline and Wichelns 1994, 1996). State residents may be less supportive of allocating tax dollars to such programs if open space is preserved as hobby farms rather than as productive farmland, or if participating landowners disproportionately benefit from selling development rights.

We test empirically whether the development restrictions imposed by permanent PDR/TDR preservation programs significantly reduce the restricted parcels' value using parcel-level data on farmland sales in three Maryland counties. We correct for selectivity bias that may arise due to the voluntary nature of the landowner's decision to preserve. We find little statistical evidence that the development restrictions imposed by PDR/TDR preservation programs significantly reduce farmland prices.

Review of Literature

Previous research has examined the capitalization of various types of farmland preservation measures into farmland prices. Blakely investigated the effect of a PDR program on land values in Washington. While the sale prices of preserved farmland were lower on average than the prices of unpreserved farmland, the former were significantly higher than use value assessments (based on agricultural rental values). This suggests that the preservation restrictions were not fully capitalized into land values. Possible explanations given for these results include a perception that legislators may remove development restrictions, the existence of a premium for non-market rural amenities, and the fact that assessed use values may not accurately reflect net expected agricultural returns. Sample selection issues were not addressed.

Vitaliano and Hill used a hedonic model to test whether New York's voluntary agricultural district program negatively affects farmland prices. That program protects farmers from regulations that restrict normal farm activities and provides lower property tax assessments for those who continue agricultural production for three to eight years. The authors found an insignificant coefficient on the binary variable that was included to capture agricultural district participation and concluded that the program had little effect on farmland prices. However, the voluntary participation decision may have given rise to a sample selection problem which could have resulted in biased parameter estimates (Maddala).

Using county-level data, Anderson, and Anderson and Bunch, found that Michigan's circuit-breaker (income-based) tax credits for farm families were only partially capitalized into land prices. This voluntary program refunded part of the property taxes paid by farm families whose income fell below a certain level.

Other studies have examined the impacts on land prices of non-voluntary farmland protection and nonpermanent land use control measures (zoning, property taxes). These studies find that non-voluntary programs negatively affect land values for restricted parcels (Pasour, Beaton). Henneberry and Barrows found that the impact on land price of Wisconsin's exclusive agricultural zoning, a growth management measure often adopted by farmer-dominated local governments, depended on a parcel's location. Increased per acre prices were found for larger agriculturally zoned parcels located far from cities while lower per acre prices occurred for smaller agriculturally zoned parcels closer to cities.

[1] While an easement restricts a parcel's development potential, it does not legally require the landowner to actively farm the land; i.e., the land can simply be maintained as open space (Daniels and Bowers).

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Permanent Farmland Preservation Programs in Maryland

Three counties in Maryland serve as the study area: Carroll, Calvert, and Howard. All are within the Baltimore–Washington metropolitan region, where returns from developing land have been increasing since the 1970s. In 1997, 56%, 24%, and 25% of land was farmed in Carroll, Calvert, and Howard Counties, respectively. As of June 1997, Carroll, Calvert, and Howard had preserved 25,591 acres (9%), 14,540 acres (11%), and 17,426 acres (11%) of total county land, respectively.

The State of Maryland has operated a PDR program since 1978, which is available to landowners in all counties. The State calculates the easement value as the difference between a parcel's appraised market value and its agricultural use value, where the latter is based mainly on soil types and county cash rents. The State will pay a landowner the lower of the easement value or the landowner's submitted bid. When the State faces a binding budget constraint it ranks applications for purchase by the ratio of the easement value to the landowner's bid. A parcel can be withdrawn from the program after twenty-five years only if the owner can prove that agriculture is no longer profitable, the easement value is repaid at current year prices, and the State and county agencies approve the buyback. Carroll County relies primarily upon the State program to preserve farmland.

In Howard County, virtually all parcels preserved after 1988 were enrolled in its county PDR program. The County calculates the easement value based on a published formula and pays higher prices for parcels with better soils, location within a rural conservation district, road frontages, and greater development pressure. Also, 75% of property taxes due on agriculturally assessed preserved parcels are forgiven.

In Calvert County, most farmland is preserved through its county PDR and TDR programs. Landowners can sell rights on a piecemeal basis, but the sale of a single development right preserves the entire parcel. In the TDR program, landowners and developers negotiate a price for the development rights. In its PDR program, landowners are paid a set price for the development rights based on the average selling price of the previous year's TDRs. The county forgives all property taxes due on agriculturally assessed preserved land. Preservation programs in all counties require landowners to implement water quality and soil conservation plans.

Model

This paper tests the effect of the development restrictions imposed by the sale of development rights on farmland sales prices. The sales price of an unrestricted parcel should reflect the value in the use that generates the highest returns. In metropolitan areas, urban growth pressures increase the demand for land in developed uses over time and the profitability of converting farmland. In the absence of farmland preservation programs, the sales price of an unrestricted farm parcel is a function of the discounted present value of the stream of farming returns up to the optimal development time and the discounted present value of returns from converting a farm to a non-farm use at the optimal development time. In areas with farmland preservation programs, the sales price of a parcel will reflect the greater of the land value *if* the parcel is developed in the future *or* the discounted present value of the benefits of preserving: the continued stream of farming returns and the easement proceeds received at the optimal preservation time.

The following model recognizes these alternative uses and returns for a farm parcel. The per acre sales price of the ith unrestricted farm parcel, V_i^*, is modeled as

$$V_i^* = \max_{\delta} \left\{ \begin{aligned} &(1-\delta)\left[\int_{t=0}^{u} A_i\left(\mathbf{x}_i, t\right) e^{-rt}\, dt + R_i\left(\mathbf{x}_i, u\right) e^{-ru}\right] \\ &+ \delta\left[\int_{t=0}^{\infty} A_i\left(\mathbf{x}_i, t\right) e^{-rt}\, dt + E_i\left(\mathbf{x}_i, p\right) e^{-rp}\right] \end{aligned} \right\} \tag{1}$$

where $\delta = 1$ if a landowner participates in a preservation program ($\delta = 0$ otherwise), A_i is the per acre annual net returns from farming, R_i is the one-time per acre returns from developing net of conversion costs, E_i is the one-time per acre easement price net of participation costs, $\boldsymbol{x}_i$ is a vector of exogenous parcel characteristics, and t is time. u is the optimal development date, p is the optimal preservation date, and r is the discount rate. A_i, R_i, and E_i are all functions of $\boldsymbol{x}_i$ as parcel characteristics (such as soil quality) affect net returns from farming and from developing.

If the restrictions imposed on parcel i by the sale of development rights are fully capitalized into the farmland values, capital asset pricing theory implies the sales price of a preserved farm will be a function of only the present value of net returns in an agricultural use:

$$(2) \quad V_i^{P*} = \int_t^{\infty} A_i(\boldsymbol{x}_i, t)e^{-rt}\,dt \qquad \text{for } t \geq p$$

where V_i^{P*} is the per acre sales price for the ith preserved parcel.

To determine whether the easement restrictions affect farmland prices for preserved parcels, we estimate the sales price of farmland using a hedonic approach. We assume that land buyers and sellers approximate the present value of returns in each use after considering the role the parcel's characteristics have played in recent farmland sales transactions. Using sales information on farm parcels in our sample, we estimate the contribution of various parcel characteristics to the sales price.[2] The empirical form of the sales price model is

$$(3) \quad V_i = \boldsymbol{x_i\beta} + \delta_i\gamma + \varepsilon_i$$

where V_i is the log of the sales price per acre, $\boldsymbol{x}_i$ is the vector of exogenous parcel characteristics affecting net returns in agricultural and developed uses, δ_i is a structural shift term equal to 1 if the parcel is preserved ($\delta_i = 0$ otherwise), $\boldsymbol{\beta}$ and γ are parameters to be estimated, and ε_i represents unobserved characteristics which we assume are normally distributed.[3]

Unobserved characteristics included in ε_i may be correlated with the landowner's voluntary decision to participate in a preservation program, which could introduce a sample selection problem.[4] Our a priori expectation is that farm parcels with a higher value in a developed use are less likely to be enrolled (Bockstael and Bell, Vitaliano and Hill, Anderson). To account for selectivity bias, the first order condition of equation (1) is taken with respect to δ. A landowner will enroll a parcel in a preservation program if the returns from participation exceed the returns from non-participation. We assume that a latent variable z_i^* exists, which is the net returns to preservation, such that

$$(4) \quad z_i^* = \int_{t=0}^{\infty} A_i(\boldsymbol{x}_i, t)e^{-rt}\,dt + E_i(\boldsymbol{x}_i, p)e^{-rp} - \int_{t=0}^{u} A_i(\boldsymbol{x}_i, t)e^{-rt}\,dt - R_i(\boldsymbol{x}_i, u)e^{-ru}.$$

The empirical form of this model of the participation decision is

$$(5) \quad z_i^* = \boldsymbol{w_i\alpha} + \mu_i$$

where $\boldsymbol{w}_i$ is a vector of observed characteristics and μ_i is unobserved characteristics.

Because the participation decision is inherently related to land values, sample selection is assumed to exist and the error terms μ_i and ε_i are distributed as bivariate normal with a correlation coefficient ρ, $N(0, 0, \sigma_\varepsilon^2, \sigma_\mu^2, \rho)$. Although z_i is not observed and the disturbance cannot be estimated, its sign, z_i, is observed.[5] The participation decision is reformulated, where $z_i = 1$ if $z_i^* > 0$, and $z_i = 0$ if $z_i^* \leq 0$. We estimate the parameters of the probit equation (5) and use them to formulate the vector of inverse Mills ratios to include in our estimation of farmland sales prices (Greene).[6]

Whether participation in a PDR or TDR program significantly reduces the sales price of restricted farm parcels is tested in three ways. First, we assume that the same underlying process generates the sales prices for restricted and unrestricted parcels or that all parcels have the same marginal value for

[2] A hedonic approach is useful when one can observe parcel characteristics but not use values. This approach has been employed to measure impact on prices of various farmland preservation measures (e.g., Vitaliano and Hill, Beaton, Chicoine), effects on price of erosion control or parcel characteristics (e.g., Shi, Phipps, and Colyer; Elad, Clifton, and Epperson; Palmquist and Danielson), and in Maryland land value studies (e.g., Bockstael and Irwin, Bockstael).

[3] The semi-log specification was selected because our data have a skewed distribution with the median per acre price less than the mean per acre price. Previous hedonic studies have found that a semi-log functional form fits this shape well (Berndt, Palmquist and Danielson, Vitaliano and Hill).

[4] A second form of sample selection exists as data on unpreserved farms are not randomly drawn from the population of all individual farm parcels, but from only those individual parcels that have sold. We do not attempt to correct for this possible bias.

[5] Because μ cannot be estimated, the variance of μ is normalized to one.

[6] It is possible that our data also exhibit spatial autocorrelation. However, the restrictive conditions of standard tests for spatial autocorrelation (e.g., Moran I and Lagrange multiplier tests) rule out their use in sample selection models (Kelejian and Prucha). Mapping and visual examination of the residuals from the estimated sales equations reported below revealed no consistent patterns.

each parcel characteristic. Using sales data on all farm parcels in our sample, we estimate equation (3) as

(6a) $V_i = \boldsymbol{x_i\beta} + \delta_i\gamma + \rho\sigma_\varepsilon\lambda_i + \varepsilon_i$

where λ_i is the inverse Mills ratio that corrects for selectivity bias, and other variables are as described above. A negative and statistically significant coefficient on δ_i would indicate that the easement restrictions were negatively capitalized. However, if the marginal values of characteristics in $\boldsymbol{x_i}$ differ between restricted and unrestricted parcels, the coefficient estimates in equation (6a) will be biased.

Second, we allow for the underlying processes generating sales prices of restricted and unrestricted parcels to differ. In this case, we estimate equation (3) as

(6b) $V_i = \boldsymbol{x_i\beta} + \delta_i\gamma + \rho\sigma_\varepsilon\lambda_i + (\boldsymbol{x_i}^*\delta_i)\boldsymbol{\beta^P} + \varepsilon_i$

where $(\boldsymbol{x_i}^*\delta_i)$ is a vector of variables created from interacting parcel characteristics with preservation status to allow the preserved parcels to have different marginal values for characteristics, and $\boldsymbol{\beta^P}$ is a parameter vector to be estimated. We use a Wald test to determine whether γ and $(\boldsymbol{\beta^P})$ are jointly equal to zero. Again, a negative and statistically significant coefficient on δ_i would provide evidence that restricted parcels receive significantly lower prices than unrestricted parcels.

In the third test, we hypothesize that even though on average we may not observe a significantly lower sales price for restricted parcels than for unrestricted parcels, a lower sales price will be observed for at least some restricted parcels. We test whether a restricted parcel receives a significantly different sales price from what it would have received if unrestricted, parcel by parcel. The following equation is estimated for the sample of unrestricted parcels only:

(6c) $V_i = \boldsymbol{x_i\beta} + \rho\sigma_\varepsilon\lambda_i + \varepsilon_i.$

The parameter estimates from estimating (6c) are used to predict the price each restricted parcel would have received *if* it had no development restrictions, conditional on the values of its explanatory variables. We calculate a prediction interval around the mean predicted unrestricted price for each preserved parcel and compare this interval on a parcel by parcel basis with the preserved parcel's *actual* sales price. The prediction interval reported defines the 95% confidence interval for the mean predicted unrestricted price. If a preserved parcel's actual sales price falls within the prediction interval, we conclude there is no statistically significant difference between the sales prices of restricted and unrestricted parcels. If a preserved parcel's actual sales price falls below the lower bound of the prediction interval, we conclude that there is a statistically significant difference between the sales prices of restricted and unrestricted parcels and that participation in a PDR or TDR preservation program significantly lowers the sales price. Since we estimate a logarithmic model for the sales equation, we correct for both the predicted mean and the predicted variance of the equation when we form the prediction interval (Dadkhah).

Data

The data include 224 individual parcels of farmland that were sold between January 1994 and August 1997 in the three Maryland counties. Our data set contains only private, arms-length sales, and includes sales transactions for 200 unpreserved and 24 preserved farm parcels.[7]

From the State of Maryland's Tax and Assessment database we obtained sales prices, transaction dates, geographic coordinates, the number of acres sold, appraised value of structures, and minimum lot size. Because this database contains limited information on structures other than houses (e.g., barns, silos, etc.), we subtract the appraised value of the structures from the parcel's sale price and estimate the parcels' sales price for the land value only in equations (6a)–(6c). We obtained other parcel characteristics (soil quality, land use, and distances to various landscape features) from Maryland Office of Planning digitized maps and matched them with each farm parcel based on its geographic coordinates using ARC/INFO (a geographic information system). Table 1 defines the variables and basic descriptive statistics.

Farmland owners decide whether to participate in a farmland preservation program

[7] Two of the twenty-four preserved parcels were actually preserved together, as a 53-acre block and then sold separately as two parcels with 26 and 27 acres. We treated these two observations as one observation for the participation equation, but as two observations for the sales equation.

Table 1. Description of Data and Summary Statistics

Variable	Description	All Parcels (N=224) Mean	All Parcels (N=224) Std. Dev.	Unpreserved Parcels (N=200) Mean	Unpreserved Parcels (N=200) Std. Dev.	Preserved Parcels (N=24) Mean	Preserved Parcels (N=24) Std. Dev.
TOTAL PRICE[a]	Total sales price	$198,712	$168,104	$190,002	$164,906	$271,295	$180,406
PRICE PER ACRE[a]	Price per acre	$8,437	$7,203	$8,998	$7,376	$3,761	$2,592
ACRES	Parcel size in acres	39.81	42.90	33.29	35.82	94.15	57.42
%PRIME	% of parcel with prime soil (MDSP 1973)	31.82%	37.35%	32.37%	37.82%	27.20%	33.52%
DISTCITY	Distance to closer of Baltimore or Wash. DC, in miles	28.33	9.00	27.82	8.85	32.54	9.34
LUFOREST	= 1 if parcel is forested at centroid	0.20	0.40	0.20	0.40	0.17	0.38
CALVERT	= 1 if parcel located in Calvert Cty	0.14	0.35	0.13	0.33	0.25	0.44
HOWARD	= 1 if parcel located in Howard Cty	0.18	0.39	0.18	0.38	0.25	0.44
CARROLL	= 1 if parcel located in Carroll Cty	0.68	0.47	0.70	0.46	0.50	0.51
DISTSTRM	Distance to nearest stream, in yards	668.12	540.95	680.09	560.81	568.45	323.04
%EROSIVE	% of parcel with highly erosive soils (MDSP 1973)	16.83%	27.73%	17.48%	28.20%	11.39%	23.31%
DISTPRAG	Distance to nearest preserved farm parcel, in miles	0.63	0.89	0.69	0.92	0.14	0.10
MILLS RATIO	Sample selection variable	0.0030	0.3639	-0.0814	0.2221	0.7060	0.5287

[a] Prices are deflated using the index of Prices Received and Paid by Farmers (Council of Economic Advisers, 1998).

based on returns to farming, costs of participation, returns to developing the parcel, and the value of the development rights. As a proxy for agricultural returns in equation (5), we include the percent of land comprised of prime soil (%PRIME).[8] Farmers earning higher agricultural returns are more likely to participate in a preservation program so we expect the sign of the coefficient on this variable to be positive. The variable LNACRES is the log of the number of acres in the parcel. The preservation programs favor larger parcels, so we expect this variable to positively affect participation. Landowners who participate in preservation programs are required to implement water quality and soil conservation plans; proxies for these participation costs include distance to the nearest stream (DISTSTRM) and the percent of highly erosive soil (%EROSIVE). Higher costs associated with implementing these plans could discourage participation, so greater distances from streams should positively affect participation and greater percentages of erosive soil should negatively affect participation.

We include several proxies to capture returns in a developed use. DISTCITY measures the distance to the nearest major urban center (Washington, D.C. or Baltimore). As the distance to employment opportunities increases, returns per acre from converting a parcel are likely to decline and the probability of participation is likely to increase, so the sign of the coefficient on this variable is expected to be positive. We include a binary variable equal to one if the parcel is heavily forested (LUFOREST). Forested parcels are expected to have a lower value in development, since clearing trees for building entails higher conversion costs. Because these parcels are likely to earn lower net returns in a developed use, landowners may be more likely to enroll forested parcels in the preservation program.[9]

We include binary county variables (CALVERT, HOWARD) to account for differences in the average price landowners expect to receive for selling development rights, services, property tax rates, zoning regulations, and preservation programs. We expect participation to be greater in Howard and Calvert Counties since these counties offer additional preservation benefits. Distance to the nearest preserved farm (DISTPRAG) captures agency preferences for parcels in close proximity to already preserved parcels.

The same proxies for returns to farming and returns to development in the participation equation serve as explanatory variables in the sales price equations: %PRIME, DISTCITY, and LUFOREST. Previous research has consistently found a nonlinear relationship between sales price and parcel size with smaller parcels receiving higher per acre prices, suggesting the sign of the coefficient on LNACRES will be negative. The county variables (HOWARD, CALVERT) account for differences in county level infrastructure services, zoning regulations, and property tax rates. The binary variable (PRES) indicates preservation status (=1 if preserved), and we expect its coefficient's sign to be negative.

Results and Discussion

Table 2 reports the coefficient estimates for the reduced form probit equation. The signs on the variables' coefficients were generally consistent with our expectations. Landowners with larger parcels and parcels closer to preserved parcels were significantly more likely to enroll in a preservation program. Landowners whose parcels were further from Baltimore and Washington, D.C. were more likely to enroll, at the 10% significance level. Howard County and Calvert County farmers (at the 5 and 10% significance level, respectively) were more likely to enroll than Carroll County farmers, suggesting that the county level programs in Howard and Calvert were more attractive to landowners than the State program.

We did not find that the percent of prime soil mattered in the decision to preserve. Although prime soils are likely to increase agricultural returns, these soils may be equally desirable for development since the lack of slope and good permeability decreases conversion costs. The coefficients on the proxies for participation costs also were not significant, suggesting that the costs of implementing soil conservation and water

[8] We do not have geocoded information on parcel boundaries, only on the parcel centroid. To calculate proxies involving percentages we approximated the parcel boundaries by assuming the parcel acreage was evenly distributed around the centroid.

[9] A reviewer pointed out that forested land could have a lower value because it is often of lower quality land in general. This could make these parcels equally unattractive for agricultural purposes and decrease the probability they will be enrolled, because preservation agencies favor parcels with better soils.

Table 2. Probit Equation Estimates (N = 223)

Variable	Coefficient	ASE
CONSTANT	−7.8068**	2.2055
LNACRES	1.2751**	0.2823
%PRIME	0.3152	0.8417
DISTSTRM	−0.0004	0.0005
%EROSIVE	−1.4333	1.2604
DISTCITY	0.0846*	0.0464
LUFOREST	0.2790	0.5643
CALVERT	1.6788*	0.9707
HOWARD	2.4681**	0.9535
DISTPRAG	−6.8745**	2.1215

Predicted versus Actual in Probit Equation

	Predicted		
Actual	Unpreserved	Preserved	Total
Unpreserved	195	5	200
Preserved	8	15	23
Total	203	20	223

** Significant at the 0.05 level.
* Significant at the 0.10 level.

quality plans were not important or that participating farmers had already implemented these measures.

The lack of significance of some coefficients may have been due to the sample we used to predict participation (which is limited to parcels that sold during our study period), and that preserved parcels comprised a small proportion of the sample. While we needed to account for the landowner's participation decision to correct for sample selection in our estimation of sales prices, we did not explain the participation decision well (Maddala).

Coefficient estimates for the sales price equation (6a) are presented in table 3. Larger parcels, parcels further from employment centers, and those that are forested received a significantly lower price per acre. We did not find that the percent of prime soil significantly impacted price. This result is plausible if the parcel was sold for non-agricultural use, and agricultural returns are low relative to returns in a developed use. It could also stem from the possibility that most of the variation in sales prices is accounted for by returns in a developed use. A farmland parcel located in either Howard or Calvert County received a significantly higher price than a parcel in Carroll County. Higher density zoning and a greater array of public services in the former counties contribute to this result. Although the sign of the coefficient on the preservation status variable was negative, preservation did not appear to significantly reduce sales prices from unpreserved parcels. Estimation of this model, though, did not allow the marginal values of parcel characteristics to differ between restricted and unrestricted parcels.

McMillen and McDonald find evidence of sample selection in land value models of unimproved land zoned for residential uses, but we could not reject the null hypothesis of no selectivity bias in farmland prices (the coefficient on λ was not significant). While it is possible that selectivity bias was not present, this result could also have reflected a problem of identification. Many variables used to predict participation are also used to explain variation in sales prices, and these variables appear in the inverse Mills ratio in a nonlinear form (Maddala).

In estimating equation (6b), we allowed the marginal values of characteristics to vary by the parcel's preservation status (table 3). The coefficients for unrestricted parcels did not change either qualitatively or in magnitude. At the 10% significance level, a greater distance from employment centers increased the per acre sales price for a preserved parcel, and Howard County's preserved parcels received a higher sales price per acre relative to Carroll County preserved parcels. The influence of parcel size was not significantly different between preserved and unpreserved parcels. Even though the coefficient on the preservation status variable was statistically significant at the 10% level, using a Wald test we failed to reject the null hypothesis that the coefficients on this variable and the interacted variables were jointly equal to zero ($\chi^2 = 8.4378$). Thus, while restricted farm parcels were expected to have different marginal values for some characteristics, evidence of this was not strong.

Finally, we estimated equation (6c) using only the unrestricted parcels. The results from estimating the sales price equation for the unrestricted parcels are consistent with those reported for the entire sample. We used these coefficient estimates to predict the unrestricted sales price and to calculate the prediction interval for each restricted parcel.

Table 4 reports the actual sales price per acre for restricted parcels, the point prediction for the unrestricted sales price, and the

Table 3. Sales Equations

	All Parcels[b] (N=224)		With Interactive Terms[c] (N=224)		Unrestricted Parcels only[d] (N=200)	
Variable	Coefficient	ASE	Coefficient	ASE	Coefficient	ASE
CONSTANT	10.8130**	0.2014	10.8919**	0.1993	10.8748**	0.2086
LNACRES	−0.5306**	0.0368	−0.5398**	0.0361	−0.5369**	0.0377
%PRIME	0.0709	0.0791	0.05532	0.0789	0.05601	0.0808
DISTCITY	−0.0169**	0.0049	−0.0184**	0.0049	−0.0181**	0.0051
LUFOREST	−0.1780**	0.0780	−0.1918**	0.0783	−0.1912**	0.0802
CALVERT	0.4126**	0.1028	0.5073**	0.1067	0.5077**	0.1093
HOWARD	0.5294**	0.1041	0.4938**	0.1036	0.4997**	0.1071
PRES[a]	−0.1640	0.1595	−2.7484*	1.4667		
LNACRES*PRES[a]			0.20656	0.1779		
%PRIME*PRES[a]			0.20314	0.3248		
DISTCITY*PRES[a]			0.0465*	0.0239		
LUFOREST*PRES[a]			0.04328	0.2849		
CALVERT*PRES[a]			−0.52639	0.3316		
HOWARD*PRES[a]			0.8513*	0.5159		
LAMBDA	−0.0421	0.1201	0.02075	0.1339	0.05054	0.1562

Note: Dependent variable = ln(price/acre).
** Significant at the 0.05 level.
* Significant at the 0.10 level.
[a] Wald statistic for testing restriction that all are jointly equal to zero at the 0.05 level: 8.4378.
[b] Adjusted R-sq = 0.6965.
[c] Adjusted R-sq = 0.6994.
[d] Adjusted R-sq = 0.6657.

Table 4. Prediction Intervals

Obs. Number	Trade Date (yymmdd)	Acres	Actual Restricted Price/Acre	Estimated Unrestricted Price/Acre	Prediction Interval Lower Bound	Prediction Interval Upper Bound	Easement Payment per Acre
1	960328	11.87	$6,305	$10,159	$1,309	$19,010	$3,290
2	950112	62.00	6,153	4,951	654	9,249	3,740
3	960802	11.87	5,926	10,219	1,315	19,122	3,196
4	950922	26.18	3,202	8,653	1,184	16,121	1,964
5	950616	27.04	2,946	8,493	1,162	15,825	2,007
6	960926	142.48	1,036	3,068	425	5,712	4,699
7	950329	143.90	2,014	2,011	273	3,749	1,268
8	940103	202.73	1,670	1,799	249	3,349	1,275
9	960212	123.10	2,349	2,165	294	4,037	1,282
10	970807	116.15	2,084	2,208	298	4,118	1,102
11	970502	42.59	1,418	4,038	550	7,525	1,113
12	941206	70.46	3,490	3,431	477	6,384	1,616
13	940829	135.73	1,913	2,362	328	4,396	1,328
14	940322	139.15	1,236	2,387	333	4,442	1,676
15	940809	98.69	2,136	2,860	396	5,325	1,628
16	960501	90.39	2,348	3,515	491	6,539	1,087
17	950626	156.00	2,091	2,180	302	4,058	1,216
18	951211	211.73	1,376	1,808	251	3,364	1,889
19	970619	83.58	4,473	7,605	1,024	14,187	6,955
20	951128	131.60	3,097	4,957	684	9,231	1,726
21	970630	61.70	7,618	6,101	843	11,358	6,352
22	961031	31.67	9,724	11,089	1,532	20,646	2,616
23	970110	39.01	6,409	9,687	1,340	18,034	5,433
24	951017	100.00	9,257	5,847	803	10,891	2,441

lower and upper bounds of the prediction intervals. Also reported is the easement payment received by the landowner. In no case is a restricted parcel's actual sales price outside the 95% prediction interval. This result may be due to the large widths of the calculated prediction intervals, which arise from the unexplained variation in sales prices of unrestricted parcels (adjusted $R^2 = 0.6657$). In four cases the actual sales price of the restricted parcel exceeded its predicted unrestricted sales price by a wide margin. In three of these cases, the sum of a restricted parcel's sales price plus the easement payment substantially exceeded the upper bound of the prediction interval.

Conclusions

Given the restrictions imposed, economic theory predicts that sales prices for preserved parcels should be significantly lower than the sales prices of unpreserved parcels, unless the restrictions are not binding or offsetting incentives exist. These easement restrictions have been upheld in court and thus are legally binding (Danskin). Nor do substantial offsetting incentives exist. Two of the three counties in our study area forgive property taxes for preserved parcels, but the annual savings are rather minor (less than $10 per acre) and are not likely to contribute much to explaining a lack of negative capitalization. Contrary to our expectations, we find little statistical evidence that voluntary permanent preservation programs significantly decrease the price of farmland in Maryland.

Several possible explanations exist for our results. Our best explanation is that landowners and land buyers do not expect that land use restrictions imposed by the easement to be binding in the future. Because the State's PDR program has been in place less than twenty-five years, the proviso allowing withdrawal from the program after this period has not yet been challenged; some landowners or land buyers may underestimate the difficulty in doing so. If land buyers expect that the development restrictions will not always be permanently binding, they may be willing to pay prices in excess of the land's agricultural use value. Second, preservation programs in Maryland allow neighboring parcels to be grouped together to meet minimum size requirements. After preservation, these parcels may be sold individually. If these parcels each have a house, they increase the opportunities for hobby farmers (or land buyers who value urban amenities but wish to live on a farm) to buy preserved land. These buyers may be willing to pay more than the agricultural income stream for the opportunity to own a farm near an urban area.

The results suggest that permanent preservation programs may not lower farmland prices significantly, so agencies may need different mechanisms to provide new farm entrants the opportunity to purchase farmland at or near agricultural use value. The results also cast doubt about the ability of PDR/TDR programs to support a local farm industry. If land buyers are hobby farmers and they rent the land to commercial operators, then the local farm industry may continue to survive. However, if the land is not rented or farmed intensively, the farm economy may continue to suffer although other program goals (such as preserving environmental resources and open space) may be easily attained. The results also imply that agencies may have a basis for reducing the easement payments, since land values do not appear to be reduced by the full value of the development rights. This may be particularly important for agencies which have limited funds for purchasing easements.

Our results suggest that preservation agencies tend to favor preserving larger parcels and those near already preserved parcels. We also find weak evidence that the sales price of farmland varies with certain parcel characteristics by preserved status (county, distance to nearest city). The percent of prime soils, our proxy for farming returns, did not appear to explain variation in the sales price in any of the estimated equations. Finding adequate proxies for agricultural returns continues to be a challenge for researchers studying land values in urbanizing areas. Finally, we did not find evidence of selectivity bias.

The results warrant interpretation with some caution. It is possible that the limited number of arms-length sales of preserved parcels in our sample prevented us from detecting significantly lower prices for restricted parcels. Yet, the difficulties posed by small samples in this article are no different than those faced by most studies on disaggregated farmland prices.

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