The Effect of Farmland Preservation Programs on Farmland Prices

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Introduction

More than 15 state and 34 local governments actively engage in the permanent preservation of farmland by purchasing development rights or by allowing the transfer of development rights among landowners (American Farmland Trust). In the Northeast United States, governments use these "purchase of development rights" (PDR) and "transfer of development rights" (TDR) programs to protect farmland in metropolitan areas, where financial returns through conversion to developed uses are growing rapidly. When a landowner enrolls a parcel in a PDR or TDR program, he sells his rights to develop the land, but retains ownership of the parcel. Agencies administering the PDR or TDR program place an easement on the land, which restricts the current and all future owners from converting the parcel to a non-agricultural use. Agencies have resorted to PDR and TDR programs when other farmland preservation measures, including property tax relief, right-to-farm laws and low-density or agricultural zoning efforts have proven unable to prevent farmland conversion. Policy makers defend the use of tax dollars to administer these programs and to purchase easements, citing several types of long-run benefits: reducing infrastructure expansion requirements (e.g., public water and sewer services and extensive road networks), maintaining a land base to support a local agricultural economy, protecting amenity values associated with open space, preserving the rural character of local farm communities, and protecting groundwater recharge areas as farmland will not be subdivided and converted.

Capital asset pricing theory states that the price 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 speculative value (the value of the option to convert the parcel to non-farm uses). Because farmland preservation programs use easements to restrict non-farm uses such as residential, commercial or industrial uses, capital asset pricing theory suggests that a restricted parcel's market value will only reflect the discounted present value of the future stream of farming returns. Government agencies view this expected reduction in the restricted parcel's value as a positive effect of PDR and TDR programs, because young farmers are better able to purchase the lower priced land when older farmers retire (Gale). Also, agencies promote the estate tax benefits of lower land prices. The anticipated reduction in land value and the large cash payment from selling an easement increases estate planning options and can decrease the likelihood that heirs will need to sell the farm to pay these taxes.

However, it is possible that development restrictions do not decrease farmland values. Program administrators report that some landowners anticipate the demand for developable land will continue to rise, and that eventually political pressure will force legislators to relax the "permanent" development restrictions imposed by the preservation programs. If landowners and/or land buyers believe PDR and TDR program restrictions on land use are not permanent, then land values will not be reduced or will be only partially reduced by the development restrictions. In addition, some land buyers may buy smaller farm parcels with restrictions on use as "ranchettes" (in some states preserved parcels can have as few as ten acres), bidding up the price of a restricted parcel because they receive non-monetary returns from owning land in an area that is more likely to retain its rural character.

As more states utilize PDR and TDR programs as a means of containing sprawl and preserving their farming economies, understanding the effect these programs have on farmland prices becomes increasingly important for government agencies, farmland owners and also state residents. Under PDR programs, agencies use tax dollars to purchase easements on farmland parcels, an effort the public supports because easements preserve environmental resources (e.g., groundwater resources, wildlife habitat) and contribute to growth control efforts as well as for the protection they afford to farmland (Kline and Wichelns). If land prices of restricted parcels are not significantly reduced as a result of the development restrictions, then preservation agencies may be less likely to preserve productive farmland even though they may be maintaining environmental resources. For example, open space rather than productive farmland may be preserved if "ranchette" buyers outbid "traditional" farmers for farmland, and subsequently do not lease the land for a "traditional" farming use. The effect of preservation programs on farmland prices also matters to current landowners, since the impacts of use restrictions on land prices will affect the decision to participate in existing or new PDR/TDR programs. Also, understanding the effects on prices matters to state residents, as they may be less supportive of the allocation of taxpayer money to such programs if open space is preserved in the form of ranchettes rather than as farmland with the rural character that accompanies it.

The question of whether the development restrictions imposed by PDR and TDR preservation programs reduce farmland prices is an empirical one. This paper tests whether the development restrictions imposed by permanent, but voluntary, farmland preservation programs results in lower farmland prices for restricted relative to non-restricted parcels. In our estimation we correct for possible selectivity bias, due to the voluntary nature of the landowner's decision to participate in a farmland preservation program. Others have found evidence of sample selection in undeveloped residential land value models, but we are not aware of studies on farmland values that correct for it (McMillen and McDonald). We use parcel-level data on farmland sales that occurred between 1994 and 1997, in three Maryland counties where farmers participate in PDR and TDR programs. We find little evidence that the restrictions on development imposed by permanent farmland preservation programs reduce farmland prices.

Review of Literature

In general, farmland preservation programs encompass several types of land use control measures. These programs include voluntary programs with permanent restrictions (PDR and TDR programs), voluntary programs that impose nonpermanent restrictions on development (such as preferential tax assessment, right to farm, and agricultural district programs), and land use control measures that are both nonvoluntary and nonpermanent (including strict agricultural zoning).[1] Previous research has examined the capitalization of many of these programs.

Blakely investigated the effect of a PDR program in King County, Washington on land values. While the sales prices of preserved farms were lower on average than prices of unpreserved farms, the former were found to be significantly higher than the stream of expected net agricultural returns. This suggests that preservation only partially reduced land values. Also, sample selection was left untreated. Other possible explanations given for these results include the perception that the development restrictions may be removed in the future (e.g., future demands for developable land will encourage legislators to remove the development restrictions), that buyers' desires for a hobby farm are unrelated to the income stream, and that the current assessed use values (based on agricultural rents) may not accurately reflect that net expected returns from agriculture.

Vitaliano and Hill used a hedonic price equation to test whether New York's voluntary agricultural district program negatively affects farmland prices. This program protects farmers from government restrictions against normal farm activities and provides farmers with lower property tax assessment if they agree to continue agricultural production for three to eight years. The authors test for capitalization by including a dummy variable for participation in the agricultural district participation, and find that the coefficient is insignificant. The authors conclude that the program has little effect on farmland prices, hypothesizing that only farmers who will benefit from the program will join. Due to the voluntary nature of the participation decision, the sample used by Vitaliano and Hill may be subject to sample selection. If sample selection exists, the dummy variable cannot be treated as exogenous and the parameter estimates will be biased (Maddala). Also, the methodology presumes both enrolled and nonenrolled parcels participate in the same land market.

Using county-level data. Anderson. and Anderson and Bunch found partial positive effects on land prices of Michigan's circuit-breaker (income-based) tax credits for farm families. Under this voluntary program. if a farm family was below a certain income level. they would be refunded part of their taxes.

Other studies have examined the impacts of non-voluntary farmland protection and land use control measures into land prices. Because measures such as zoning and property taxes can be altered if the composition of the county or state level government changes. they do not constitute permanent preservation programs. In general. these studies find that non-voluntary programs negatively affect land values for parcels subject to the development restriction (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 relative to urban centers. Increased land prices per acre were found for larger agriculturally zoned parcels located far from cities while lower prices per acre occurred for smaller agriculturally zoned parcels closer to cities. Although these zoning decisions could have been endogenous. the authors did not examine why some communities had adopted this type of zoning and others did not.

Permanent Farmland Preservation Programs in Maryland

Three counties in Maryland serve as the study area: Carroll, Calvert. and Howard. All three counties are within the Baltimore-Washington metropolitan region. where returns from developing parcels have been growing rapidly since the 1970's. As of June 30. 1997, 25,591 acres. 14,540 acres. and 17,426 acres have been preserved in Carroll, Calvert and Howard Counties, respectively.

Carroll County relies primarily upon Maryland's State program to preserve farmland. Since 1978, the State has purchased easements through its PDR program from landowners in all Maryland counties.[2] 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 offers to purchase easements at the lower of the calculated easement value or the landowner's asking price.

In Howard County, virtually all parcels preserved after 1988 have been enrolled in its county PDR program. Howard County calculates the price for development rights based on a published formula, and pays higher prices for parcels with better soils, road frontages, location within a rural conservation district, and greater development pressure.

In Calvert County, most farmland is preserved through its county PDR and TDR programs. While this county's programs allow for the piecemeal sale of development rights, once a single development right has been sold the entire parcel is preserved. Thus, in essence Calvert's programs preserve farmland in a manner similar to the State and Howard. In Calvert County's TDR program, landowners and developers privately negotiate a price for the development rights. In this county's PDR program, landowners are paid a set price per development right based on the average selling price of TDRs in the previous year.

The costs of participating in any of the preservation programs include implementing water quality and soil conservation plans that meet regulatory standards. These costs are at least somewhat offset by property tax credits available to Calvert and Howard County participants.

Whether the administering agencies rely upon appraisals, formulas, or private negotiations to establish an estimate of the value of a parcel's development rights, in each case the landowner forms his own estimate of the value of the development rights as the difference between a parcel's non-farm use value and agricultural use value. Landowners tend to participate in these programs when the payment they would receive exceeds their estimate of the value of the development rights.

Model

This paper tests the effect of the development restrictions imposed from the sale of an easement on farmland sales prices. To do this, we consider that the sales price of an unrestricted parcel will reflect the value in the use that generates the highest returns, since those buyers planning to devote the parcel to that particular use will be able to outbid other buyers. In metropolitan areas, urban growth pressures increase the demand for land in developed uses over time. Without farmland preservation programs, the sales price of an unrestricted parcel currently in a farming use 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 (the latter is often referred to as "speculative value"). 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: a stream of farming returns and the easement payment received from the sale of an easement at the optimal preservation time.

The following model recognizes these alternative uses and returns from a farm parcel. The per acre sales price of the i^{th} unrestricted farm parcel, V_i^*, is modeled as

$$(1) \qquad V_i^* = \max_{\delta} \left\{ \begin{array}{l} (1-\delta)\left[\int_{t=0}^{u} A_i(X_i, t)e^{-rt}dt + R_i(X_i, u)e^{-ru} \right] + \\ \delta\left[\int_{t=0}^{\infty} A_i(X_i, t)e^{-rt}dt + E_i(X_i, p)e^{-rp} \right] \end{array} \right\}$$

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 per-acre one-time net returns from developing net of conversion costs, E_i is the one-time easement value paid per acre net of participation costs, X_i is a vector of exogenous parcel characteristics, and t is time. u is the optimal date to sell the parcel for a developed use, p is the optimal date to sell an easement, and r is the discount rate. A_i, R_i and E_i are all functions of X_i as many parcel characteristics are likely to affect both returns from farming and net returns from developing (e.g., how far the parcel is located from the nearest city determines transportation costs for farmers to reach a large farm market, and for residential users to reach the nearest employment center).

Once the landowner has been paid E_i for enrolling parcel i in a preservation program and selling an easement, and if the easement restrictions imposed by the sale of development rights are fully capitalized into the farmland values, the sales price of a preserved farm will be a function of only the present value of returns in an agricultural use:

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

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

To determine whether farmland preservation programs result in lower 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 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 value of the land.[3] The empirical form of the sales price model is:

$$(3) \qquad V_i = X_i\beta + \delta_i\gamma + \varepsilon_i$$

where V_i is the log of the sales price per acre for a farm parcel, X_i is the vector of exogenous parcel characteristics affecting returns in agricultural and developed uses, δ_i is a structural shift term equal to 1 if the parcel is preserved (δ_i=0 otherwise), β and γ are parameters to be estimated, and ε_i represents unobserved characteristics which we assume are normally distributed.

Unobserved characteristics included in ε_i may be correlated with the landowner's decision to participate in a preservation program. Therefore, in estimating the sales price of farm parcels we account for the sample selection problem that is likely to be present due to the voluntary nature of farmland preservation programs. Our *a priori* expectation is that farm parcels with a higher value in a developed use are less likely to be enrolled in a preservation program (Bockstael and Bell, Vitaliano and Hill, Anderson). If left untreated, the difference between preserved parcels and unpreserved parcels gives rise to an omitted variable specification error, which biases the parameter estimates.[4]

To account for this selectivity bias, we assume a rational landowner will maximize his land value and we take the first order condition of equation (1) with respect to δ. The landowner will enroll a parcel in a preservation program if the returns he can earn from participation (the returns to farming plus the net easement payment) exceed the returns he can earn if he does not participate (the returns from selling the land for its "highest and best" use) or:

$$\int_{t=0}^{\infty} A_i(X_i,t)e^{-rt}dt + E_i(X_i,p)e^{-rp} > \int_{t=0}^{u} A_i(X_i,t)e^{-rt}dt + R_i(X_i,u)e^{-ru} \quad (4)$$

We assume that a latent (unobserved) variable z_i^* exists, which is the net returns to preservation, such that

(5)

$$z_i^* = \int_{t=0}^{\infty} A_i(X_i,t)e^{-rt}dt + E_i(X_i,p)e^{-rp} - \int_{t=0}^{u} A_i(X_i,t)e^{-rt}dt - R_i(X_i,u)e^{-ru}$$

The empirical form of this model of the participation decision is

(6) $$z_i^* = W_i\alpha + \mu_i$$

where W_i is the vector of observed characteristics and μ_i is a vector of unobserved characteristics.Because the participation decision is inherently related to land values, we assume the error terms between the participation equation (equation (6)) and the sales equation (equation (3)) are correlated, or that sample selection does exist. Assuming μ_i and ε_i are distributed as bivariate normal with a correlation coefficient ρ, $N(0,0,\sigma^2_\varepsilon,\sigma^2_\mu,\rho)$, the expected value of the per acre sales price of a restricted farm parcel is:

(7) $$E[V_i|z_i^* > 0] = E[V_i|\mu_i > -W_i\alpha]$$

$$= X_i\beta + \delta_i\gamma + E[\varepsilon_i|\mu_i > -W_i\alpha]$$

$$= X_i\beta + \delta_i\gamma + \rho\sigma_\varepsilon\lambda_i\left(\frac{-W_i\alpha}{\sigma_\mu}\right)$$

where λ_i is the inverse Mills ratio for the i^{th} parcel.

$$\lambda_i\left(-\frac{W_i\alpha}{\sigma_\mu}\right) = \frac{\phi\left(\frac{W_i\alpha}{\sigma_\mu}\right)}{\Phi\left(\frac{W_i\alpha}{\sigma_\mu}\right)}$$

and ϕ and Φ are the density and cumulative distribution functions of the standard normal. For an unrestricted farm parcel ($\delta_i = 0$),

$$\text{(8)} \qquad E\left[V_i \mid z_i^* \leq 0\right] = X_i\beta + \rho\sigma_\varepsilon\lambda_i\left(\frac{W_i\alpha}{\sigma_\mu}\right)$$

where the inverse Mills ratio is defined as

$$\lambda_i\left(\frac{W_i\alpha}{\sigma_\mu}\right) = \frac{-\phi\left(\frac{W_i\alpha}{\sigma_\mu}\right)}{1-\Phi\left(\frac{W_i\alpha}{\sigma_\mu}\right)}$$

(Greene). Our first step, then, is to estimate equation (6) to obtain the inverse Mills ratios for restricted and unrestricted parcels. To do this, note that we do not observe z_i*, so we cannot estimate the disturbance.[5] However, we do observe its sign, z_i. We reformulate the participation decision, where $z_i = 1\ if\ z_i^* > 0,\ z_i = 0\ if\ z_i^* \leq 0$.

The probability a landowner chooses to participate in a farmland preservation program is:

$$\Pr(z_i = 1) = \Pr[W_i\alpha + \mu_i > 0]$$

$$= \Pr[\mu_i > -(W_i\alpha)]$$

$$= 1 - \Phi(-(W_i\alpha))$$

$$= \Phi(W_i\alpha)$$

The probability he chooses not to participate is:

$$\Pr(z_i = 0) = 1 - \Phi(W_i\alpha).$$

Using a simplified approach, we estimate the parameters of the probit equation and use them to formulate the inverse Mills ratio, which we include in our estimation of the sales price of farmland.

We test to determine whether participation in a PDR or TDR program affects the sales price of restricted farm parcels in three ways. First, we proceed under the hypothesis that the same underlying process generates the sales prices for restricted and unrestricted parcels, or that all parcels have the same marginal value for each parcel characteristic. Using sales data on all farm parcels in our sample, we estimate equation (3) as:

$$V_i = X_i\beta + \delta_i\gamma + \rho\sigma_\varepsilon\lambda_i + \varepsilon_i \quad (9a)$$

where V_i is the log of the sales price per acre, λ_i is the inverse Mills ratio that corrects for selectivity bias, and other variables are as described previously. If these parcels are characterized by the same underlying process and have the same marginal values for the parcel characteristics in X_i, a negative and statistically significant coefficient on δ_i would provide evidence that the easement restrictions were negatively capitalized into the land price. However, if the marginal values of characteristics differ between restricted and unrestricted parcels, the parameter estimates in equation (9a) will be biased.

Secondly, then, we allow for the underlying processes generating sales prices of restricted and unrestricted parcels to differ. In this case, we estimate equation (9a) as

$$V_i = X_i\beta + \delta_i\gamma + \rho\sigma_\varepsilon\lambda_i + \left(X_i * \delta_i\right)\beta^P + \varepsilon_i \quad (9b)$$

where $(X_i*\delta_i)$ is a vector of variables from interacting preservation status with the parcel characteristics to allow for different marginal values of characteristics for the preserved parcels, and β^P is a parameter to be estimated. We investigate whether whether δ_i and $(X_i*\delta_i)$ are jointly equal to zero, using a Wald test. 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 for the effect of participation on farmland prices, we hypothesize that even though on average we may not observe a significantly lower sales price for restricted parcels than for unrestricted parcels, we will observe lower sales prices for at least some restricted parcels. Here, we test whether restricted parcels receive significantly different sales prices from what they would have received if unrestricted, on a parcel by parcel basis. We proceed by estimating the following equation for the sample of unrestricted parcels only:

(9c) $$V_i = X_i\beta + \rho\sigma_\varepsilon\lambda_i + \varepsilon_i$$

We use the parameter estimates from estimating (9c) to predict the price each restricted (preserved) parcel would have received *if* the development restrictions did not exist on the property, 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 percent 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 (preserved) and unrestricted (unpreserved) 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 includes individual parcels of farmland (N=224) that were sold between January 1994 and August 1997 in Calvert, Carroll and Howard Counties, Maryland. Our data set contains only private, arms-length sales, and includes 200 and 24 sales transactions of unpreserved and preserved farm parcels, respectively.[6]

From the State of Maryland's Tax and Assessment database we obtained sales prices, transaction dates, geographic coordinates of the parcel centroid, the number of acres sold, appraised value of structures, and minimum lot size. Because this database contains only limited information on the structural characteristics buildings, and even less data on structures other than houses (e.g., barns, sheds, silos, etc.), we estimate the parcels' sales price for the value of the land only in equations (9a-9c). To get the sales price of the land excluding structures, we subtract the appraised value of the structures from the parcel's sale price. Other parcel characteristics (soil quality, land use, and distances to various features in the landscape) were obtained from Maryland Office of Planning digitized maps, and matched with each farm parcel based on its geographic coordinates using ARC/INFO (a geographic information system). Table 1 describes the variables we use in estimation.

Farmland owners decided whether to participate in a farmland preservation program 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 the participation equation (6) we include the percent of land comprised of prime soil (%PRIME).[7] Since we hypothesize that owners of parcels earning higher agricultural returns are more likely to participate in a farmland preservation program, we expect the sign on this variable to be positive. The variable LNACRES is the log of the number of acres in the parcel. Most preservation programs pay more per acre for 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; a proxy for these costs of participation include distance to the nearest stream (DISTSTRM) and the percent of highly erosive soil on the parcel (%EROSIVE). Higher costs associated with implementing these plans could discourage participation, so we expect greater distances from streams to positively affect participation and greater percentages of erosive soil to negatively affect participation.

We include several proxies to capture the returns in a developed use. DISTCITY measures the distance to the nearest major urban center (Washington, D.C. or Baltimore). Returns per acre from converting a parcel are likely to be smaller when the distance to employment opportunities increases so we expect the probability that a landowner will enroll the parcel will increase with distance; and 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 forested (LUFOREST) as a proxy for conversion costs. Because higher conversion costs decrease net returns to development, landowners may be more likely to enroll forested parcels in the preservation program.

We include 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 county level programs. All else equal, we expect participation to be greater in Howard and Calvert Counties since these counties offer preservation benefits not available to Carroll County landowners. Also, since the preservation agencies favor parcels in close proximity to already preserved parcels, we include a measure of the distance to the nearest preserved farm (DISTPRAG).

Six of the nine variables that appear in the participation equation also appear in the sales equations. The same proxies for returns in farming and returns to development in the participation equation appear as explanatory variables in the sales price equations for restricted and unrestricted farm parcels: %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 on LNACRES will be negative. The county dummy variables (HOWARD, CALVERT) account for differences in county level infrastructure services and property tax rates. The binary variable (PRES) indicates preserved status (=1 if preserved), which we expect to be negative in the estimations including both restricted and unrestricted parcels.

Results and Discussion

Table 2 reports the parameter estimates for the reduced form probit equation (6). The signs on the variables' coefficients are generally consistent with our expectations. The size of the parcel had a significant effect on the likelihood a landowner enrolled the parcel in a preservation program, as did the proximity to the nearest preserved parcel. Howard County farmers (at the 5 percent significance level) and Calvert County farmers (at the 10 percent significance level) were more likely to enroll than Carroll County farmers, suggesting that the county level programs in Howard and Calvert are more attractive to landowners than the State program (the only preservation option in Carroll). Parcels further away from Baltimore and Washington, D.C. were also more likely to have an easement sold, at the 10 percent significance level.

We do not find that the percent of prime soil matters in the decision to preserve. Prime soil should increase returns to agricultural use; however, because prime soil is also relatively flat and permeable, it is also the least costly to convert to other uses. The attractiveness of these parcels for developed uses may offset the effect of prime soil due to its agricultural value. The proxies for participation costs also were not significant, suggesting that the costs of implementing soil conservation and water quality plans are either not important or that farmers who participate have already implemented these measures. Alternatively, the lack of statistical significance could be due to these proxies also capturing the effect of erosive soils and distance to streams on the costs of converting to a non-farm use. Conversion costs of parcels with more erosive soils or parcels close to streams are likely to be higher, suggesting the parcel is less likely to be developed and more likely to be preserved: this positive effect on participation may be offsetting the negative effect from participation costs, resulting in insignificant parameter estimates.

Another reason for the lack of significance of some of these variables may be that the sample size is limited to those parcels that have sold during our study period to predict participation, and that only a relatively small proportion of parcels in our sample were preserved. Thus, while we need to account for the landowner's participation decision to correct for sample selection in our estimation of sales prices, we do not shed much light on the participation decision itself (Maddala).

Parameter estimates for the sales price equation (9a) estimated with all parcels 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 proxy for agricultural returns (%PRIME) significantly impacted price. This result is plausible if the parcel was being 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. The county dummy variables, our proxies for public services, suggest farmland values vary across counties. *Ceteris paribus*, a farmland parcel located in either Howard or Calvert County receives a significantly higher price than a parcel in Carroll County.

Participation in a preservation program does not appear to result in significantly different sales prices for preserved parcels. In this estimation, though, we did not allow the returns from parcel characteristics to differ between restricted and unrestricted parcels.

Unexpectedly, we find that the coefficient on λ is not significant, so we cannot reject the null hypothesis of no selectivity bias. While it is possible that selectivity bias is not present, this result could also reflect a problem of identification. An identification problem could exist because many of the variables used to predict participation are the same ones that explain variation in sales prices (the proxies for returns to farming and returns to development), and these variables appear in the Mills Ratio in a nonlinear form (Maddala).

In the next regression (equation (9b)), we allow the returns to parcel characteristics to vary by the land's preservation status (Table 3). When we allow the returns to parcel characteristics to vary, we find that the coefficients for non-restricted parcels do not change either qualitatively or in magnitude. At the 10 percent significance level, being further away from employment centers increases the per acre sales price for a preserved parcel, and Howard County's preserved parcels receive a higher sales price per acre relative to Carroll County preserved parcels. We found that the influence of parcel size on the per acre price is not significantly different between preserved and unpreserved parcels. More importantly, the preservation coefficient is now statistically significant at the 10 percent level. While this is not a strong result, this provides some evidence that capitalization might be occurring due to the program's restrictions. Using a Wald test, we failed to reject the test that the coefficients on the preservation status variable and the interactive terms were jointly equal to zero. Thus, while we expected restricted farm parcels to have different marginal values than unrestricted farm parcels for at least some characteristics, we do not find strong evidence that this is the case.

In our final test for capitalization, we estimated equation (9c) using only the unrestricted parcels. The results from estimating the sales price equation for the unrestricted parcels are consistent with those reported for the sample as a whole (Table 3). We used these parameter estimates to predict the "unrestricted" sales price and to calculate the prediction interval for each restricted parcel. We then compared on a case-by-case basis whether the actual sales price falls below this interval, which would imply that negative capitalization of the easement restrictions has occurred, and that restricted parcels receive significantly lower sales prices per acre than unrestricted parcels.

Table 4 reports the actual sales price per acre for restricted parcels, as well as the point prediction for the "unrestricted" sales price and the lower and upper bounds of the prediction intervals. Also reported is the easement payment received by the landowner. For no restricted parcel can we demonstrate that the actual sales price was outside the 95 percent prediction interval.

Admittedly, this result may be due in part to the large width of the calculated prediction intervals, which stems from the amount of unexplained variation in sales prices of unrestricted parcels (adjusted $R^2 = .6657$). Yet, it is interesting to note that in four cases the sum of a restricted parcel's sales price plus the easement payment exceeds the upper bound of the prediction interval (observations 2, 6, 21, and 24). Also, in three cases the actual sales price of the restricted parcel was larger than its predicted "unrestricted" sales price (observations 7, 9, and 12).

Previously we noted that an identification problem may hamper our ability to correct for sample selection. If, in this last test for capitalization, sample selection is in fact present but was not adequately corrected for in our estimation, then we would be using unrestricted parcels that are inherently more valuable in development to predict the "unrestricted" prices for the preserved parcels. This would lead to an exaggeration of the difference between the parcels' "unrestricted" prices and their actual sales prices. In such a case, we would be more likely to incorrectly reject the null hypothesis of no capitalization. That is, we would be more likely to conclude that the development restrictions have been capitalized into the sales prices of preserved farm parcels when it has not been capitalized. If selectivity bias does in fact exist, then, we can be even more confident in our results.

Conclusions

Contrary to our expectations, we find very little evidence that voluntary but permanent preservation (PDR and TDR) programs significantly decrease the price of farmland. The results suggest that agencies should not unequivocally assume that farmland preservation programs will lower farmland prices. To ensure that farmland can be purchased at or near agricultural use value for new farming entrants, agencies may have to employ additional mechanisms. Our finding may be due to some land buyers' perceptions that the development restrictions on preserved parcels in our study area are not permanent, and also to a preservation program feature that allows relatively small farmland parcels to be grouped together and preserved as a whole. We also found that a sample selection problem was not apparent in the data we used.

Our results confirm that preservation agencies tend to favor preserving larger parcels and those near already preserved parcels. The results also provide some evidence that the sales price of farmland varies with certain parcel characteristics by preserved status (distance to nearest city, county). For the unrestricted parcels, size, distance, county characteristics, and conversion costs impacted the per acre sales price. The proxy for farming returns did not appear to explain the sales price for either preserved or unpreserved parcels in any of the equations we estimated.

The results warrant interpretation with some caution. Because so few restricted farm parcels sold during the period for which we had data, our sample of restricted parcels is rather small. Yet, the difficulties associated with small samples here is no different than those faced by most studies on disaggregated farmland prices. In addition, as urban pressures become greater and the value of the land rises, farmers may change the nature of their farming enterprises. If the types of crops produced changes, then the expected returns to farming is likely to change. This response to urbanization may not be adequately reflected by the proxy we use for agricultural returns. That proxy also assumes that all farmers with the same soil type at the centroid of their parcels expect the same returns to farming. Obtaining adequate proxies for returns to farming continues to be a challenge for researchers studying farmland values in urbanizing areas due to farmers changing farming practices and that many characteristics that make a parcel attractive for farming also make it attractive for development.

Table 1. Description of Data and Summary Statistics (N=224)

Variable	Description	All parcels Mean	All parcels Std.Dev
TOTAL PRICE*	Total Sales price	$198,712	$168,104
PRICE PER ACRE	Price per acre	$8436.97	$7202.90
ACRES	Parcel size in acres	39.81	42.90
%PRIME	Estimated % of prime soil based on Maryland Office of Planning soil classifications (MDSP 1973).	31.82%	37.35%
DISTCITY	Distance to closer of Baltimore or Wash.DC in miles	28.33	9.00
LUFOREST	= 1 if parcel land use is forest at its centroid	0.20	0.40
CALVERT	= 1 if parcel located in Calvert County	0.14	0.35
HOWARD	= 1 if parcel located in Howard County	0.18	0.39
CARROLL	= 1 if parcel located in Carroll County	0.68	0.47
DISTSTRM	Distance to nearest stream, in yards	668.12	540.95
%EROSIVE	%of parcel with highly erosive soils (MDSP 1973)	16.83%	27.73%
DISTPRAG	Distance to nearest preserved farm parcel, in miles	.63	.89
MILLS RATIO	Sample selection variable	0.0030	0.3639

* Prices are deflated using the index of Prices Received and Paid by Farmers (Council 1998).

Table 1a. Summary Statistics by Preservation Status

Variable	Unpreserved parcels (N=200)		Preserved parcels (N=24)	
	Mean	Std Dev	Mean	Std Dev
TOTAL PRICE*	$190,002.0	$164,906.0	$271,295.3	$180,405.9
PRICE PER ACRE	$8,998.0	$7,376.3	$3,761.3	$2,592.4
LUFOREST	0.2000	0.4010	0.1667	0.3807
CALVERT	0.1250	0.3315	0.2500	0.4423
HOWARD	0.1750	0.3809	0.2500	0.4423
CARROLL	0.7000	0.4594	0.5000	0.5108
%PRIME	32.37%	37.82%	27.20%	33.52%
%EROSIVE	17.48%	28.20%	11.39%	23.31%
ACRES	33.2857	35.8167	94.1505	57.4171
DISTPRAG	0.6918	0.9189	0.1365	0.0950
DISTCITY	27.8193	8.8500	32.5429	9.3436
DISTSTRM	680.09	560.81	568.45	323.04
MILLS RATIO	-0.0814	0.2221	0.7060	0.5287

* Prices are deflated using the index of Prices Received and Paid by Farmers (Council 1998).

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

**Significant at the .05 level

* Significant at the .10 level

Predicted vs. Actual in Probit Equation

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

Table 3 . Sales Equations

dependent variable = ln(price/acre)

Variable	All Parcels[1]		Using Interactive Terms[2]		Unrestricted Parcels only[3]	
	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

**Significant at the .05 level

* Significant at the .10 level

[a] Wald statistic for testing restriction that ([a]) are jointly equal to zero: 8.4378

[1]Adjusted R-sq = 0.6965

[2]Adjusted R-sq = 0.6994

[3]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

1. Agricultural districts often restrict development for a specified number of years in exchange for reduced property tax assessments and protection from nuisance complaints.

2. The state program has a proviso which permits a parcel to be converted to another use after 25 years if the owner can prove that agriculture is not feasible on the land and if he repays the easement value at current year prices. Several State program administrators report that many landowners appear to underestimate the probable difficulty in withdrawing from the program after 25 years of enrollment.

3. A hedonic approach is useful when parcel characteristics are observable, but use values are not. This approach has been employed in farmland value studies to measure capitalization of nonvoluntary o nonpermanent preservation programs (e.g., Vitaliano and Hill, Beaton, Chicoine), to measure the effects of erosion control or parcel characteristics on farmland values (e.g., Shi et al., Elad et al., Palmquist and Danielson), and in land value studies in our study area (e.g., Bockstael and Irwin, Bockstael).

4. A second form of sample selection also exists, due to the fact that the data on unpreserved farms is 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. Two of the 24 observations of the preserved parcels were actually preserved together, as a block. The parcels were preserved at one time as an approximately 53 acre parcel, and then later sold as two parcels with 26 and 27acres. We treated these two observations as one observation for the

participation equation and then split them into two parcels for the sales equation. Thus, we have 23 observations for the preserved parcels in the participation equations and 24 observations for the sales equation.

7. We do not have geocoded information on parcel boundaries, only on the parcel centroid. To calculate proxies involving percentages (percent prime soil, percent erosive soil, etc.) we approximated the parcel boundaries by assuming the parcel acreage was evenly distributed around the centroid.

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