An Evaluation of Working Land and Open Space Preservation Programs in Maryland: Are They Paying Too Much?

by

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AN EVALUATION OF WORKING LAND AND OPEN SPACE PRESERVATION PROGRAMS IN MARYLAND: ARE THEY PAYING TOO MUCH?

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Abstract: Farmland preservation programs compensate landowners who enroll for the value lost due to the the restrictions on development applied to their land. These restrictions in principle decrease the value of the land. Yet few studies have found strong statistical evidence that preserved parcels sell for lower prices than unpreserved parcels. We use both a hedonic and a propensity score method to find that preserved parcels sell for 11.4 to 19.8% less than identical unpreserved parcels in Maryland. While significant, a decrease of less than 20% in land value is surprisingly small. If impacts to land value are small, could programs pay landowners less to enroll and thus enroll more land?

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Introduction

Beginning in the mid-1950s, many states, particularly in the Northeast, created farmland preservation programs due to concerns about the loss of farmland. Farmland preservation programs are justified on a variety of grounds: to preserve a productive land base for the agricultural economy, to preserve the amenity values of open space and rural character, to slow suburban sprawl, to provide wildlife habitat, and to provide groundwater recharge in areas where suburban development is occurring (Gardner 1977; Wolfram 1981; Fischel 1985; McConnell 1989; Bromley and Hodge 1990; Nelson 1992; Kline and Wichelns 1998; Hellerstein et al. 2003; Duke and Aull-Hyde 2002). Since the late 1970's, state and local programs have taken two basic forms, either purchase of development rights/purchase of agricultural conservation easements (PDR/PACE), or transfer of development rights (TDR). Most programs attach an easement to the preserved land that restricts the right to convert the land to residential, commercial and industrial uses. The landowner is provided with some type of payment and/or tax benefit for participation.

More than 124 governmental entities in the United States have implemented farmland preservation programs and over 1.67 million acres are now in preserved status at a cost of almost $4 billion (American Farmland Trust 2005a, 2005b). Citizens continue to pass ballot initiatives generating funds for these types of programs: in 2002, $5.7 billion in conservation funding was authorized; in 2001, $1.7 billion; and in 2000, $7.5 billion, and most recently in 2006, $5.73 billion (Land Trust Alliance 2006). In addition, the Land Trust Alliance reports that U.S. land trusts have doubled their conservation acres from 6 million to 11.9 million acres since 2000. The state of

Maryland, the focus of the research in this paper, has had a variety of state and county agricultural land preservation programs since the late 1970's, with almost 250,000 acres preserved by 2004 in the state Maryland Agricultural Land Preservation Foundation (MALPF) program.

There is a growing body of research evaluating farmland preservation programs. Research has asked a broad range of questions related to the programs such as: are enough acres enrolled; what types of farms are enrolled – hobby or productive; does contiguity matter and is it achieved; do certain programs work better than others (PDR versus TDR); do programs impact farmland loss or development patterns; do preserved lands provide the amenity benefits people desire; and do the programs have spill-over impacts (Conrad and LeBlanc, 1979; Brabec and Smith 2002; Lynch and Lovell 2003; Duke and Ilvento 2004; Liu and Lynch 2006; Sokolow 2006, Lynch and Carpenter 2003, Duncan 1984; Pfeffer and Lapping 1994; Bergstrom and Ready 2006, Feather and Barnard, McConnell and Walls 2005; McConnell, Kopits, and Walls 2006, Bastian et al. 2002; Lapping 1982; Zollinger and Krannich 2001; Rilla and Sokolow 2000; Nelson 1992; Feitshans 2003). Daniels and Lapping (2005) suggest that preservation programs should be included in smart growth programs as the two types of objectives complement one another. In Maryland's recent Smart Growth legislation, the Rural Legacy program set out to prioritize preserving contiguous farms to make orderly and fiscally responsible development more achievable and create large agricultural zones (Lynch and Liu 2007). These papers provide some sense of how agricultural land preservation programs may be altered and/or formulated to improve social welfare.

Yet these papers and others continue to suggest that too much farmland is being lost[1] in part because PDR programs can be very expensive (MALPF Task Force 2001; Gardner 1994; Blewett and Lane 1988; Heimlich and Anderson 2001; Levy and Melliar-Smith 2003). To further complicate matters, several papers have now found that preservation efforts can generate positive amenities for adjacent homeowners and may increase demand for housing near preserved parcels, which makes achieving the goals of preservation even more costly and thus more difficult (Geoghegan, Lynch, and Bucholtz 2003; Ready and Abdalla 2005; Irwin 2002; Roe, Irwin, and Morrow-Jones 2004).

One of the underlying motivations for farmland preservation programs is that the programs keep agricultural land affordable, as farms with conservation easements attached should sell at a discount. The lower-priced land should be more easily purchased by new and expanding farmers and thus help retain a viable agricultural sector (Gale, 1983). Therefore in order to evaluate whether farmland preservation programs are facilitating the purchase of land for agricultural producers, an analysis of how much the easement restriction decrease the selling prices for preserved farms, compared to similar properties without easements, is required.

Another related policy question is what the optimal budget for a farmland preservation program should be? A recent Maryland report suggests that to achieve current preservation goal (686,000 more acres), the state would need to allocate as much as $4.58 billion to obtain the least expensive eligible acres (Lynch, Palm, Lovell and Harvard 2007). Both of these questions, how much of a discount do farms sell at, and what should the program's budget be, requires a better understanding of the "right" price farmers should be paid for their enrollment in the program. Conceptually, this is quite

[1] No real analysis of what is the "optimal" amount of farmland to retain is provided. Some authors propose that too much farmland preservation may be occurring (McConnell 1989)

straightforward: the attachment of the easement reduces the value of the agricultural property because of the lost opportunity to develop. If the development rights have no value, then no compensation should be paid. If the development rights are the full market value of the land, then a fee simple purchase by the public sector might be most appropriate.

Another alternative view of this issue is to ask if these programs are over-paying for the properties they enroll. For example, if agricultural lands that are enrolled are not selling at a discount, does the preservation program provide any benefit to retaining the agricultural industry, as they are not making land "more affordable" to farmers? Or are these programs simply providing privately–owned inaccessible open space at a large cost to the taxpayers? In this paper, we try to answer these questions.

Capital Asset Price theory predicts that the restrictions imposed on further development with agricultural easements will reduce the sales price of a farm and thus farmland owners should be compensated. Therefore, it was surprising when Nickerson and Lynch, using sales data for 223 farms (20 with easements) in Maryland during 1994-1997, found little evidence that easement restrictions affect sales price. Lynch, Gray and Geoghegan (2007) reexamined the impact of agricultural easements on sales prices using a substantially expanded data set of 3,554 observations in 22 Maryland counties, including 249 preserved properties over 1997-2003, using both hedonic pricing models and propensity score models. Results from the hedonic analysis suggest statistically significant reductions in price due to preservation, ranging from 11.4% to 16.9%. However, the results of a propensity score approach were quite different, taking advantage of a very strong predictor of program participation: the distance to the closest preserved parcel. With this distance variable in the model, the estimated impact of preservation on price became small and statistically insignificant. This means that unrestricted land located near preserved parcels tends to sell for the same low price as the preserved land. Anderson and Weinhold (2005) also find a statistically insignificant impact on the land value from the easement restrictions. They find a significant result only when they eliminate several control variables from the analysis. They estimate an impact of 35% up to 50% for vacant land with a high variance. The 50% reduction is based on 8 of the 19 easement parcels' sales with the most strigent easement restrictions. A recent study in Baltimore county also finds that preserved parcels do not sell for a lower price than unpreserved parcels, all else equal (Michaels 2007).

We found these results to be quite puzzling. If these results are true, then the agricultural preservation programs are paying much more than the opportunity costs of the landowners. In this current paper, we re-investigate the question once again, using a new measure to capture the influence of near-by preserved parcels, i.e. trying to further incorporate the spatial aspects of preservation and land markets. Instead of the distance to the nearest preserved parcel, we use GIS techniques to calculate the percent of preserved agricultural land in a 1 kilometer and a 5 kilometer buffer surrounding each agricultural sales parcel. We then analyze the impact of agricultural easements on sales prices, using both hedonic regression and propensity score approaches, including this new variable. We also investigate a sample that contains only agricultural parcels without structures, as these parcels are strictly for agricultural use, to eliminate the potentially confounding effect of residential services associated with structures.

Maryland Background

Maryland has been a leader among states in land preservation efforts, with several programs to retain land in forest and agricultural use. These programs began in part because the state lost almost 50 percent of its agricultural land, 1.9 million acres, between 1949 and 1997 (USDA 1999), while its population increased by almost 120% (U.S. Census Bureau 1999). While the losses have been large, Maryland still contains a fair amount of natural and working lands on its 6.2 million acres. In December 2002, developed lands represented only 20 percent of Maryland's total land area, and protected lands[2] accounted for another 19 percent. Much of the remaining 3.8 million acres was privately-owned undeveloped land; one-half in agriculture and the other one-half in forest or other natural cover. Maryland recently set a goal of tripling the amount of land currently in preservation status to over 1 million acres by the year 2022.

In the 25 years that agricultural and other preservation programs have existed in Maryland, the state and county programs have preserved approximately 343,000 acres. If the programs have managed to purchase easements on the "easiest to enroll" parcels or those with the lowest cost, preserving twice this much land in just 20 years will require very efficient programs. Maryland's population is also projected to grow 11.5% to six million people by 2020, likely requiring on-going conversion of agricultural and forest land to housing and commercial development. In addition, preservation is becoming more costly as the value of land continues to increase: between 2002 and 2006, average land values doubled in Maryland to $8,900 per acre.

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[2] Protected lands include lands publicly owned at the federal, state, and local levels, as well as private preserves and privately owned lands with conservation easements.

Maryland began one of the first statewide purchase of development rights (PDR) programs in the late 1970's with the creation of the Maryland Agricultural Land Preservation Foundation (MALPF). As of 2004, MALPF has preserved almost 233,000 acres at a cost of $329 million (MALPF Task Force, 2005); approximately 4% of the state land area and 10% of the agricultural acres in the state. MALPF uses appraisals and an “auction” to set the easement value. It uses the lower of 1) a calculated easement value equal to an appraisal value minus the agricultural value, or 2) a bid made by the landowner. Farms are accepted in order of highest value per dollar bid until the budget is expended. MALPF has determined that the savings due to landowners being willing to take a lower value than the calculated easement value has been almost $102 million out of the total easement value of $398.9 million for the 217,460 acres it had preserved through 2002. This computes to about a 25% discount in the easement values. Minimum eligibility criteria were recently changed to include 50 contiguous acres or contiguity to another preserved farm, and having at least 50 percent of its soil classified as USDA Class I, II, or III, or Woodland group I or II.

In addition to the statewide efforts, individual counties have introduced their own agricultural preservation programs using both transfer of development rights (TDR) and PDR formats. Calvert County and Montgomery County are considered leaders in the use of TDR programs. Howard County’s use of installment purchase agreements is studied throughout the country. The Rural Legacy program, begun in 1997, as part of the state’s Smart Growth program, seeks to preserve large contiguous blocks of natural and working landscapes. State-wide, the Rural Legacy program has encumbered $156 million through 2006 and preserved almost 52,000 acres. In addition, federal and state tax benefits provide incentives to landowners to enroll their property in preservation programs and with the Maryland Environmental Trust (MET).

MALPF and some of the local preservation programs are funded at least in part by the continued conversion of farmland to other uses. An agricultural transfer tax is collected when farmland leaves an agricultural use for a residential, commercial, or industrial use. Through simple calculations, one can determine the cost of preserving one acre of land at the average 2002 MALPF easement price per county when the agricultural transfer tax is the sole funding mechanism. Carroll County would require the conversion of $60,051 worth of farmland, Baltimore County the conversion of $76,352, St. Mary's the conversion of $49,607, and Talbot County the conversion of $40,722. In terms of acres, the preservation of just one acre of land in Carroll County would require the loss of 11.65 acres elsewhere in the county, in Baltimore County the loss of 9.6 acres, in St. Mary's the loss of 12.75 acres and in Talbot County the loss of 9 acres (Lynch, Palm, Lovell and Harvard 2007).

Theoretical Framework

In a competitive land market, land is assumed to yield a stream of net returns. Ricardian theory states that the profitability of agricultural land is based on fertility or soil characteristics and this fertility determines the land rent an agricultural producer would pay. Von Thunen, Mills and others proposed that the stream of benefits of living/farming at a particular location relative to the town center determines the rent an individual would be willing to pay. Hardie et al. (2001) combine the Ricardian and Von Thunen models and find that the market values of parcels in suburban counties are the sum of the Ricardian rent and the location or accessibility rent. Capozza and Helsley

(1989) and later Plantinga and Miller (2001) and Plantinga, Lubowski, and Stavins (2002) add an expectation component (possible capital gains) when valuing land at the urban fringe. This expected stream of rents and potential gains determines the market price per acre P_i of the parcel *i*. The market value is thus the expected sum of agricultural rents, A_i, from time $t=0$ up to an optimal conversion date t^*, at which time the land is converted into a residential use with expected net returns of R_i as shown in equation (1).[3]

Agricultural and residential rents are a function of X_i, the characteristics and location of the land, and *s,* time.

(1)
$$P_i = E_t\left[\int_{t=0}^{t^*} A_i(X_i, s)e^{-r(s-t)}ds + \int_{t^*}^{\infty} R_i(X_i, s)e^{-r(s-t)}ds\right]v$$

Land ownership may be thought of as a bundle of rights, one of which is the right to develop the land up to the allowable zoning density, which a landowner can sell without relinquishing ownership of the land. An agricultural land owner can extract the value of these development rights by selling the rights to a preservation program, receive a net easement payment, EV_i, and the new market price would be the expect sum of agricultural rents forever as shown in equation (2).

(2) $$P_i = E_t\left[\int_{t=0}^{\infty} A_i(X_i, s)e^{-r(t)}ds\right]$$

Land owners will enroll their parcel in an agricultural preservation program if

(3) $$E\left[\int_{0}^{t^*} A_i(X_i, s)e^{-r(s)}ds + \int_{t^*}^{\infty} R_i(X_i, s)e^{-r(s)}ds\right] < E\left[\int_{0}^{\infty} A_i(X_i, s)e^{-r(s)}ds\right] + EV_i$$

or

[3] To simplify the model only two land uses are used. However, in some cases the landowner will maximize present value by shifting the land use to commercial, industrial or other alternative land uses.

(4) $$E\left[\int_{t^*}^{\infty} R_i\left(X_i, s\right)e^{-r(s)}ds\right] < E\left[\int_{t^*}^{\infty} A_i\left(X_i, s\right)e^{-r(s)}ds\right] + EV_i .$$[4]

However, whether or not the restrictions are fully capitalized into the land value is an empirical question. In a Washington state PDR program, Blakely (1991) found that while the permanent easement restrictions did lower the prices of preserved farms relative to unpreserved farms, the resulting prices were much higher than the use value assessments based on the stream of agricultural rents. Nickerson and Lynch (2001) found lower prices for restricted prices but found only weak statistical evidence that the easement restrictions were the explanation. Lynch, Gray and Geoghegan (2007) found limited evidence of price impacts using propensity score methods. Anderson and Weinhold (2005) and Michaels (2007) also find very limited evidence of significant effects on land price.

Methodology

The hedonic model is the traditional approach for estimating a capitalization effect, and we begin our analysis using this approach. Hedonic modeling has a long tradition in agricultural economics and has been used in innumerable applications. Unfortunately, simply including a dummy variable for the existence of an agricultural easement in the regression is problematic, since landowners may have (not) entered farmland preservation programs specifically because their parcel's market value was lower (higher) than other parcels. Nickerson and Lynch (2001) use a Heckman model to control for sample selection as do Anderson and Weinhold (2005), but neither find a significant selection effect.

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[4] Lynch and Lovell (2003) argue that participation is actually based on the utility of the farmland owner under the preserved and non-preserved states and thus may include non-market values beyond those mentioned here.

In addition to a hedonic model, we also use a non-parametric approach, the propensity score method. This method has multiple benefits. First, the matching protocol ensures that the preserved parcels will be matched to those non-preserved parcels that are most similar in terms of characteristics, so dissimilar parcels and outliers will have no or little influence in the analysis. Second, it does not assume that preservation status is exogenous, i.e. the decision to participate could depend on the parcel's expected sale price and the expected PDR payment. Finally, unlike the Heckman model, this approach does not assume a specific functional form for the price equation.

The propensity score matching method was developed by Rosenbaum and Rubin (1983). This method has been used in economic studies to evaluate the effect of job training programs (Heckman, Ichimura and Todd 1997; Dehejia and Wahba 1999; 2002; Smith and Todd 2004); labor market effects of college quality (Black and Smith 2004); the labor market effects of migration (Ham, Li, and Reagan 2003); the plant birth effects of environmental regulations (List, Millimet, Fedriksson, and McHone 2003); and the land market effects of zoning (McMillen and McDonald 2002); the impact of preservation program on farmland loss (Liu and Lynch 2006); in addition to our earlier work on agricultural easements (Lynch, Gray and Geoghegan 2007).

Assessing the impacts of the easement restrictions is difficult because of incomplete information. While one can identify whether a parcel is preserved (is treated) or not (not treated or control) and the outcome (market price) conditional on its treatment, one can not observe the counterfactual, i.e. what would have happened if the parcel had not been enrolled in a farmland preservation program. Thus, the fundamental problem in identifying the treatment effect is constructing the unobservable counterfactuals for the treated observations.

Let Y_1 denote the outcome in the group of observations if treatment has occurred ($D=1$), and Y_0 denote the outcome for the group of control observations ($D=0$). If one could observe the treated and the control states, the average treatment effect, τ, would equal $\overline{Y}_1 - \overline{Y}_0$ where $\overline{Y}_1$ equals the mean outcome of the treatment group and $\overline{Y}_0$ of the control group. Unfortunately, only $\overline{Y}_1$ or $\overline{Y}_0$ are observed for each observation. In a laboratory experiment, researchers solve this problem by randomly assigning subjects to be treated or not treated and then construct the counterfactual. Outside of the laboratory, however, $\tau \neq \overline{Y}_1 - \overline{Y}_0$ unless the treatment condition was random assigned. The propensity score matching (PSM) method proposed by Rosenbaum and Rubin (1983) demonstrates that if the data justify matching on some observable vector of covariates, *X,* then matching pairs on the estimated probability of selection into treatment or control groups based on *X* is also justified. We assume a CIA condition that:

(6) $$E[Y_0 \mid D=1, X] = E[Y_0 \mid D=0, X] = E[Y_0 \mid X], \quad P(D=1 \mid X) \in (0,1)$$

to estimate the average treatment effect.

The average treatment effect on the treated is thus the expected difference in outcome *Y* between the treated observations and their corresponding counterfactuals constructed from the matched controls.

(7) $$\Delta^{TT} = E(Y_1 \mid D=1) - E(Y_0 \mid D=1) = E(Y_1 \mid D=1) - E(Y_0 \mid D=0, P(X))$$

For the weaker condition to hold, the conditioning set of *X* needs to include all of the variables that affect both selection and outcome. Finding parcels that have identical values for all covariates in *X* is not possible since the set of *X* is usually multidimensional. However, Rosenbaum and Rubin (1983) demonstrate that if one calculates a propensity score such that $P(X) = P(D = 1 \mid X)$, this is equivalent to conditioning on *P(X)*. So, in our example, all factors that may affect the price outcome and the existence of an easement on a parcel except the treatment state are included to estimate *P(X)*. By assuming the *X*'s are equivalent for the matched treatment and control observations, we are controlling for the effects of these factors that may impact the market price.

Data

Our main data source is the GIS-based MDPropertyView 2002 Database (from the Maryland Department of Planning), consisting of all arm's-length agricultural land parcels greater than 10 acres that were sold between 1997 and 2003.[5] In order to calculate the per-acre land value, we subtracted the assessed value of any improvements to the parcel (such as structures) from the market price, then divided by parcel size to get PRICE per acre. We included both parcels with and without homes. We did however drop parcels deemed either unrepresentative of those a preservation policy would target or those which appeared to have data errors. Thus we dropped all parcels that had improvement values of more than $1 million and those with residential structures that had no improvement value listed. Parcels with per-acre land value less than $300 were also dropped as this was the minimum assessed agricultural use value. Due to Critical Area regulations, which might interact with preservation development restrictions, we dropped all observation having waterfront area. This resulted in 3,359 observations, of which 245

[5] Prices were adjusted using the Index of Prices Received by Farmers (USDA) to a base year of 2003 to account for any inflation or deflation that may have occurred during this time period.

had easement restrictions. We also dropped observations from Montgomery County as we could not determine the exact number of TDR rights individual parcels within Montgomery County had sold or retains and thus the level of restrictions on these properties.

The data set creation relies on the ArcView 3.2 and ArcGIS 8.2 Geographic Information Systems (GIS) software programs to extract and combine data for geographically referenced parcels. The compiled data set contains one record for each parcel in the State of Maryland at least 10 acres in area, with geocoded parcel-level attribute data for each parcel.

The MDPropertyView 2002 Database (MDPVD) includes data updated through October 2002 from the state's Department of Assessments and Taxation. For each parcel, data were collected from MDPVD on the most current transfer date, price paid for the entire parcel at last transfer date, how the parcel was conveyed (arms length or non-arms length), whether it was part of a multi- parcel sale, number of the parcel in acres, waterfront area for those counties near the Atlantic Ocean, Chesapeake Bay or major tributaries, the assessed value of the land, the assessed value of all improvements, and the total assessed value. The parcels are spatially referenced by the x and y coordinates in NAD83 meters Maryland State Plane Coordinate System. Each parcel is also identified by a unique account number that allows parcel-level links between the various MdPropertyView 2002 data files and parcel-level data sets created by other state agencies.

A wealth of data characterizing Maryland lands is linked to the MDPVD land parcels spatially through GIS techniques. For example, the Maryland Department of

Planning has detailed land use data from satellite and aerial photography taken as recently as 2002. Land uses are categorized into Urban Areas, Agriculture, and Forest. Urban Areas includes the sub-categories low-density residential, medium-density residential, high-density residential. Agriculture includes cropland, orchards, vineyards, and agricultural buildings and storage (CROP). PASTURE was treated as a separate land-use. Forest (FOREST) includes deciduous, evergreen, and mixed forests as well as brush. ArcView is used to extract the land use data for each buffer parcel as the percent of the parcel in each land use category.

Soil data come from the U.S. Department of Agriculture Soil Conservation Service and Maryland Department of State Planning's 1973 work to classify and map all Maryland soils. Soils are grouped by productivity, erosion potential, permeability, stoniness and rockiness, depth to bedrock, depth to water table, slope, stability, and susceptibility to flooding. The authors define these factors as most significant for land use planning purposes. The Natural Soil Groups Technical Report (Maryland Department of State Planning, 1973) provides estimated chemical and physical properties for each soil group. Each soil group is classified according to categories for each of several soil properties. We followed the Maryland classification system in defining prime soils (PRIME) as agriculturally productive, permeable, having limited erosion potential, and having minimal slope (Maryland Department of State Planning 1973).

GIS techniques were also used to add distance to nearest metropolitan area (Washington, D.C., Baltimore) base on Euclidean distance. These distances were logged to allow for nonlinear impacts (LDDC, LDBALT).

Maryland Department of Planning has also developed a generalized zoning map based on the individualized zoning within each county. ArcView was used to extract a generalized zoning code for each parcel within the database to create comparability between counties. ZONE1 (most protective), ZONE2 (moderately protective) and ZONE3 (less protective) describe the generalized zoning codes for the rural areas of each county, while ZONE4 includes all other less-restrictive zoning categories combined (residential, commercial, industrial). ZONE1 is the most restrictive with a density of 1 dwelling unit for each 20 acres. ZONE2 is less restrictive with a density of 1 dwelling unit for each 10 to 20 acres. ZONE3 is the least restrictive rural and residential zoning, with a density of 1 dwelling unit for each 1 and 10 acres.

Data was obtained on existing agricultural easements from the Maryland Agricultural Land Preservation Foundation (MALPF) published in 2004.[6] Additional easements and preservation acquisitions made by state, local, and private organizations were compiled from several data sets.[7] Maryland Environmental Trust easements also are perpetual restrictions on development. Private conservation groups' parcels, such as land trusts, were only included when easement restrictions could be ensured; otherwise these parcels were deleted from the database. Subsequently, using the full range of preserved properties, the amount of easement area surrounding each agricultural sales

[6] For Howard, Calvert, Carroll and Montgomery Counties, we also had information on easement acquired through the county programs that might not have been included in the state level data. We thank Virginia McConnell, Elizabeth Kopits and Margaret Walls for assistance with updating the Calvert's TDR database. For other counties, we were unable to locate a source of this information. Therefore if the county had not transmitted information on county-level easements to the State, the analysis would not include them.

[7] Parcels with certain types of easements were excluded from the analysis. For example, parcels with easements labeled as "exclusion, inholding, and road" or with easements which did not have identifiable boundaries, tax identification numbers, or geocoded centroids were not included.

parcel at a 1km (EASE1K) and 5km (EASE5K) radius was calculated, using *all* easement lands, not only those that sold during the study period.

In some cases, multiple parcels were purchased by the same person on the same date and the recorded sales price was not separated between parcels. Instead, the total price for the entire transaction was recorded making it necessary to aggregate these parcels into one transaction. These parcels were aggregated to the "farm-level" where properties were adjacent, defined as being within ¼ mile of each other, using the edges of the circular parcel buffer as the measurement points. The parcel-level data were aggregated to the farm level by weighting each parcel's characteristics by the number of acres in that parcel. This applied to the size of the parcel in acres, the number of acres in easements, the percentage of prime soil, and the percentage of the parcel in various land uses. The farm-level transaction price and the assessed values for land, improvements, and total value were obtained by summing over prices and assessed values per parcel in that farm. If more than one parcel was purchased on the same date by the same person, but were further than ¼ mile from each other, they were considered separate observations. In this case, we divided the total sale price weighted by the number of acres in each parcel bought.

Table 1 presents descriptive statistics for the full sample as well as the subsamples of preserved and unpreserved parcels and parcels without structures. Preserved parcels have a lower per-acre land price on average: $3,293 compared to $5,677. Preserved parcels have a greater amount of preserved land in its vicinity: approximately two and a half times as much for the smaller 1 kilometer area, and a little less than half again as much for the larger 5 kilometer area. Preserved parcels are (not surprisingly) more likely to qualify for the MALPF program; they are larger, with a higher percent of prime soils and cropland, and have a larger portion in crop use. Only a small fraction of these agricultural parcels are located in residential, commercial or industrial zones, although this is more common for the non-preserved parcels. The land price per acre is lower for parcels without structures, even after subtracting off the assessed value of the structure for those with structures, while most of the other variables are more similar between the full sample and the no structure sub-sample.

Results

In order to test our hypothesis concerning the capitalization of easements into agricultural sales prices, we develop a suite of econometric specifications. We perform a side-by-side comparison of a traditional hedonic model and a propensity score matching approach, using the same set of covariates in each modeling approach. In our initial analysis, the results suggested that agricultural properties without structures were potentially a separate market from parcels with structures, so the models are also estimated for the sub-sample of parcels without structures.

Table 2 presents the results of an OLS hedonic model of parcel prices for the entire sample for three different specifications. Model 2a is a base case that includes no variables relating to nearby easements, models 2b and 2c include the fraction of preserved lands in 1 km and 5km buffers, respectively, plus an interaction term between these variables and the existence of a structure.[8] That is, EASE1K is the effect of protected land within 1 kilometer for parcels without structures, and EASE1K +

[8] Including this interaction term was necessary in order for the PSM model to pass balancing tests. The hedonic model had qualitatively similar results without the interaction term, but the results presented here include the interaction terms to facilitate direct comparisons between the two modeling approaches.

EASE1K_S is the effect for parcels with structures (EASE1K_S is the marginal impact of EASE1K for parcels with structures).

Estimated per-acre land prices for preserved parcels in the hedonic models are about 11% lower, and this effect is statistically significant across model specification. There may be something of a neighborhood effect of preservation although the evidence here is weak. For parcels without structures, increasing the fraction of the buffer land enrolled in preservation programs by 10 percentage points would decrease the selling price of the parcel by 0.9% for the 1 km buffer and by 2.8% for the 5 km buffer. For parcels with structures, the estimated effect is opposite: for the 1 km buffer, prices would increase by 1.5%, while for increases in the 5 km buffer, prices would increase by 0.7%.

The control variables generally have the expected effects: higher prices per acre for properties with prime agricultural soils, higher levels of crop rather than pasture or forest and with structures present; lower prices per acre for parcels farther from cities or with larger total area. The zoning variables do not behave completely as expected. With the excluded category of ZONE3 (the least restrictive rural zoning), the estimated coefficient on ZONE4 (all other residential and commercial zoning) is positive and statistically significant, as expected, and the estimated coefficient on ZONE2 is negative and statistically significant (as fewer houses are permitted per acre, i.e. zoning density decreases, the market value of the land decreases). However, the estimated coefficient on ZONE1 is counter-intuitively positive and statistically significant.

The population growth rates in the 1970s and 1980s do not have a statistically significant impact on the selling price of agricultural property, but the population growth rate between 1990 and 2000 does have a positive and statistically significant impact on the market value, suggesting that only recent population growth affects sales prices.

Moving from the hedonic approach to the propensity score approach, the first stage of the propensity score analysis involves estimating a probit model of the propensity for a property to be preserved. Table 3 present these results. Similar to the hedonic approach, we estimate three different specifications: a base, with EASE1K, with EASE5K. We find a greater probability of easements on properties that are larger, with more crop land and prime agricultural soils, and (not surprisingly) properties indicated to be eligible for the program. Structures, distance to cities, and population growth rates have no statistically significant impact on the probability of enrollment. The individual easement buffer variables (EASE1K and EASE5K) significantly increase the probability of enrollment – the more neighboring land is enrolled, the greater the probability of a parcel being enrolled, all else equal. In addition, the inclusion of the EASE1K or EASE5K increases the value of the pseudo-R-squared. The same (odd) pattern of results on the zoning variables from the hedonic models hold for these models as well: relative to ZONE3, ZONE4 decreases and ZONE2 increases the probability of enrollment, as expected, but ZONE1 unexpectedly decreases the probability of enrollment.

In Table 4, we find the final results of the propensity score analysis for the full sample and the two sub-samples: those parcels with and those without structures. The "average effect of treatment on the treated" (ATT) values are calculated as the difference between the sales price of each easement property (the treatment group) and the average sales price for a comparison (control) group of non-easement properties with similar estimated probabilities of participating in a preservation program. We consider two approaches for forming the control groups: nearest-neighbor (based on the single closest control observation to the treatment observation); and kernel (based on a distance-weighted average of all observations "reasonably close" to the treatment observation).

For the full sample, using propensity scores calculated for the base model, the nearest-neighbor matching method estimates the market price of preserved parcels to be 6.2 to 9.1% lower than comparable non-preserved parcels, although the bootstrapped t-statistics are somewhat weak. The kernel method substantially increases the estimated effect of preservation, with 13.6 to 14.7% lower prices for preserved parcels, while allowing nearly all of the non-preserved parcels to serve in one or more of the comparison groups. Including the EASE1K and EASE5K variables, respectively, change the coefficients and t-statistics only slightly. Thus the impact of the easement restrictions is robust to the measures of the degree of preservation of lands near the parcel (unlike the results of the Lynch, Gray and Geoghegan (2007) paper where the "distance to nearest preserved parcel" variable was used.

The results for the no structure dataset demonstrate a greater estimated effect of easements on sales price. The kernel model approach, with statistically significant results, has a range of decreased market land values per acre of 18.2% to 22.6%. Parcels with no structures and with limited ability to build structures in the future are the one we would most expect to demonstrate a price decrease due to easement restrictions.

The results for the structure sub-sample are similar although smaller overall. The kernel model approach, does have statistically significant results unlike the nearest neighbor, has a range of decreased market land values per acre of 10.4% to 13.3%.

Parcels with no structures and with limited ability to build structures in the future are the one we would most expect to demonstrate a price decrease due to easement restrictions.

Conclusions

Hedonic models of land price per acre suggest statistically significant reductions in price due to preservation, ranging from 11.4% to 16.8% and the propensity score matching approach (using the kernel method) shows a similar, and statistically significant, range of 13.6% to 19.8%. We found results differ for the sub-sample that only contained parcels without structures – these latter parcels sell at a greater discount, suggesting a much different market between parcels with structures (which might be purchased as “hobby farms” or due to the amenity value of the open space) and parcels without structures (where the land value is more clearly related to agricultural production). Therefore, we do see a price decrease in the parcels that have sold with an easement.

In addition, we find that preserved parcels have a greater amount of preserved land in its vicinity: approximately two and a half times as much for the smaller 1 kilometer area, and a little less than half again as much for the larger 5 kilometer area. This suggests that some degree of contiguity is being achieved although the mean values are quite small (18% for the preserved area within 1 kilometer and 12% for that within 5 kilometers). Preserved parcels are also larger than non-preserved parcels (on average 86 acres compared to 39 acres). They also have a higher average quality of soil: 58% prime soils rather than 41% for the unpreserved parcels) and higher average cropland per parcels: 68% as compared to 49%. Less than 1 percent of them are located in residential, commercial or industrial zones with over 55% is the two most restrictive zoning areas compared to 44% of the unpreserved parcels.

Surprisingly however, the population growth in the block groups surrounding the preserved parcels is very similar to those of the unpreserved parcels, although recent population growth was statistically significant in the models explaining sale prices. While these variables were included to control for growth pressures, perhaps other measures are required to capture this effect, such as population density. Also somewhat surprisingly, preserved parcels are slightly closer to Baltimore MD and/or Washington, D.C. than unpreserved parcels. These attributes of preserved parcels, albeit only the ones that have sold since their preservation suggests that the programs are retaining the types of farms desired, that they are achieving some degree of continuity, and that they may be preserving threatened agricultural parcels.

However, even though this set of preserved parcels appear to have desirable characteristics given the goals of the programs relative to non preserved parcels, the impact on land values for the degree of easement restriction is surprisingly small – less than 20%. This suggests that MALPF and other preservation program may be paying too much or offering tax benefits that are too large. Landowners receive payments from MALPF for their development value but the market does not appear to decrease their land value by a commensurate degree. For this sample, the predicted decrease in value averaged only \$660 per acre whereas the average easement payment in 2002 was \$2,717 per acre. Hypothetically then, a landowner could sell their land after enrolling it in a preservation program and make an “extra” \$2000 per acre. Of course, an issue with any voluntary program is the need to pay sufficiently to induce participation. Waiting lists and/or low discounting on some bids suggest that some landowners have realized they may be better off enrolling prior to any sale. Clearly, landowners do not gain this extra benefit until they actually sell the land.

One interpretation of our results is that landowners do not enroll in preservation programs in those areas where land values are high (or likely to become high in the near future). We tried to control for this using distance to Baltimore and Washington measures as well as population growth rates over the past 30 years, but including these variables did not affect our main results. Because high land values are likely to be linked to local development pressures, we may be missing this effect by including the entire state of Maryland in a single analysis. Similarly, the zoning categories may be acting as proxies for some county-level attributes other than development density for those counties that have very protective zoning. Therefore, we plan to treat different sub-regions of Maryland as separate markets and re-estimate these models to test the extent of regional differences, as well as to incorporate different measures of growth pressures, such as changes in population density, in the model.

Many people suggest PDR programs are not effective because they cost too much money and thus can not enroll enough acres. Our results suggest they may not be efficient in the sense they pay more for the development rights than opportunity costs to the landowners of foregoing them. It is possible that programs may be able to pay less and still induce individuals to participate in the programs. In this manner, the budget will stretch further and more acres may be enrolled.

Table 1: Descriptive Statistics

			Preserved		
	3152 - full sample		Yes	No	
	N=3152		N = 255	N=2897	
	Mean	standard dev.	Mean	Mean	
price	5,484	8,732	3,293	5,677	Price($/ acre, adjusted)
logpr	8.076	0.987	7.820	8.099	Log(Price)
agprot	0.081	0.273	1.000	0.000	Preserved parcel (0/1)
ease1k	0.082	0.141	0.181	0.073	Fraction preserved within 1 kilometer
ease5k	0.074	0.074	0.116	0.070	Fraction preserved within 5 kilometers
elig	0.397	0.489	0.773	0.364	Meets eligibility criteria for MALPF(0/1)
prime	0.427	0.423	0.583	0.413	Fraction of prime quality soil in parcel
crop	0.504	0.349	0.678	0.489	Fraction of cropland in parcel
struct	0.548	0.498	0.620	0.542	Structure present (0/1)
lacres	3.742	0.911	4.455	3.679	Log(Acres)
ldbalt	11.136	0.697	11.006	11.148	Log (distance to Baltimore MD)
lddc	11.368	0.475	11.284	11.376	Log (distance to Washington DC)
popg78	0.236	0.179	0.245	0.236	Census Tract population growth 70-80
popg89	0.155	0.129	0.160	0.155	Census Tract population growth 80-90
popg90	0.109	0.116	0.115	0.108	Census Tract population growth 90-00
zone1	0.184	0.388	0.106	0.191	Most restrictive rural zoning
zone2	0.260	0.439	0.447	0.244	Less restrictive zoning
zone3	0.488	0.500	0.435	0.493	Least restrictive zoning
zone4	0.067	0.251	0.012	0.072	All other zoning (residential, commercial, industrial)

Table 2: Hedonic Results: Full Sample (N=3,152)

Model :	2a	2b	2c
Depvar:	logprice	logprice	logprice
intcpt	16.377	16.387	16.411
	(25.64)	(25.66)	(25.59)
agprot	-0.114	-0.119	-0.113
	(-2.33)	(-2.40)	(-2.30)
struct	0.159	0.140	0.133
	(6.06)	(4.64)	(3.64)
lacres	-0.401	-0.401	-0.401
	(-27.20)	(-27.18)	(-27.15)
prime	0.168	0.169	0.170
	(4.57)	(4.58)	(4.60)
ldbalt	-0.40	-0.40	-0.401
	(-10.65)	(-10.64)	(-10.63)
lddc	-0.220	-0.220	-0.220
	(-3.59)	(-3.58)	(-3.59)
crop	0.272	0.274	0.274
	(6.92)	(6.94)	(6.95)
zone1	0.135	0.132	0.137
	(3.55)	(3.43)	(3.56)
zone2	-0.245	-0.250	-0.244
	(-6.76)	(-6.79)	(-6.52)
zone4	0.172	0.172	0.172
	(3.25)	(3.24)	(3.23)
popg78	0.084	0.087	0.087
	(0.96)	(0.99)	(0.99)
popg89	-0.166	-0.169	-0.164
	(-1.37)	(-1.40)	(-1.36)
popg90	0.635	0.628	0.628
	(5.21)	(5.15)	(5.15)
ease1k		-0.092	
		(-0.66)	
ease1k_s		0.238	
		(1.31)	
ease5k			-0.283
			(-0.93)
ease5k_s			0.348
			(0.99)
R-sq	0.484	0.485	0.484

Table 3: Probit Model of Easement Participation: Full Sample (N=3,152)

Model :	3a	3b	3c
	Probability of Being Preserved		
intcpt	-3.864	-4.252	-5.421
	(-2.06)	(-2.16)	(-2.75)
malpf	0.471	0.519	0.522
	(3.52)	(3.72)	(3.81)
struct	0.109	0.089	0.015
	(1.42)	(0.91)	(0.12)
lacres	0.290	0.271	0.265
	(4.00)	(3.62)	(3.58)
prime	0.327	0.337	0.369
	(3.08)	(3.04)	(3.36)
ldbalt	0.026	0.058	0.089
	(0.23)	(0.49)	(0.74)
lddc	-0.011	-0.010	0.052
	(-0.06)	(-0.05)	(0.27)
crop	0.771	0.746	0.746
	(6.04)	(5.66)	(5.72)
zone1	-0.342	-0.471	-0.443
	(-2.83)	(-3.66)	(-3.50)
zone2	0.262	0.133	0.108
	(2.65)	(1.29)	(1.04)
zone4	-0.706	-0.690	-0.685
	(-2.58)	(-2.41)	(-2.45)
popg78	0.327	0.510	0.537
	(1.25)	(1.84)	(1.93)
popg89	-0.223	-0.617	-0.457
	(-0.58)	(-1.45)	(-1.08)
popg90	0.385	0.254	0.284
	(1.02)	(0.63)	(0.71)
ease1k		1.737	
		(5.26)	
ease1k_s		0.403	
		(0.95)	
ease5k			2.926
			(3.43)
ease5k_s			1.098
			(1.13)
R-sq	0.181	0.224	0.206

Table 4: Average Effect of Treatment on the Treated (ATT) Models

Full-Sample (3,152 obs)

	ATT – nearest neighbor			ATT – kernel		
BASE	255 / 218	-0.088	-1.0	255 / 2768	-0.147	-2.7
EASE1K	255 / 206	-0.062	-0.7	255 / 2582	-0.136	-2.7
EASE5K	255 / 207	-0.091	-1.2	255 / 2681	-0.146	-2.5

No-Structure Sub-sample (1,424 obs)

	ATT – nearest neighbor			ATT – kernel		
BASE	97 / 86	-0.149	-1.0	97 / 1243	-0.226	-2.9
EASE1K	97 / 78	-0.149	-1.2	97 / 1139	-0.191	-2.4
EASE5K	97 / 82	-0.152	-1.3	97 / 1205	-0.182	-2.4

Structure Sub-sample (1,728 obs)

	ATT – nearest neighbor			ATT – kernel		
BASE	158 / 141	+0.016	+0.1	158 / 1416	-0.104	-1.9
EASE1K	158 / 125	+0.001	+0.0	158 / 1319	-0.109	-1.7
EASE5K	158 / 126	+0.067	+0.7	158 / 1338	-0.133	-2.3

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