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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 non-

enrolled 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

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

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:

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

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:

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

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 ($\delta_i=0$ otherwise), β and γ are parameters to be