Capitalization of Farmland Preservation Programs into Farmland Prices

Cynthia J. Nickerson and Lori Lynch*

AAEA Annual Meetings
August, 1998

*Authors are Graduate Student and Asst. Professor, respectively, in the Agricultural and Resource Economics Department, University of Maryland. We are very grateful to Nancy Bockstael for her help and insights. This research was funded by the EPA, a Maryland Sea Grant, and a grant from the Center for Agriculture and Natural Resource Policy at the University of Maryland.

Introduction

Over 35 state and local governments actively engage in the permanent preservation of farmland by purchasing development rights, or by allowing for the transfer of development rights among landowners. In the Northeast U.S., these "purchase of development rights" (PDR) and "transfer of development rights" (TDR) programs are used where financial returns to conversion are growing rapidly. Government agencies believe these programs can help to maintain the viability of a local farming industry as well as to concentrate urban sprawl.

A preservation program can help maintain the viability of a local farming industry by enticing new farmers to enter the industry as older farmers retire. PDR and TDR programs can provide such an incentive, because the sale of development rights results in permanent restrictions on the ability to convert a farm into a developed (or any non-farm) use.[1] The capitalization of development restrictions into farmland prices reduces the market value of enrolled farmland parcels, and makes the purchase of farmland more affordable for new farmers. This reduction in land value can encourage greater entry into the farming industry by young farmers (Gale 1993). Also, the reduction in value benefits the heirs of current farmers by reducing estate taxes and decreasing the likelihood that heirs will need to sell the farm to pay the taxes. However, if capitalization is not occurring, new and next-generation farmers do not benefit from these development restrictions.

When a landowner enrolls an agricultural parcel in a preservation program which imposes permanent development restrictions, capital asset pricing theory suggests the parcel's sale price should only reflect the present value of the future stream of farming returns and that any development or "speculative" value should be zero. However, no empirical studies exist to date that examine whether the development restrictions imposed by permanent farmland preservation programs are negatively capitalized into farmland prices.

This paper examines whether the development restrictions imposed by permanent, but voluntary, farmland preservation programs are negatively capitalized into farmland sales prices. We use data on actual farmland sales in three Maryland counties to empirically test for

[1]Development rights are sold to the government in PDR programs, and to developers in TDR programs.

capitalization of PDR and TDR programs. Preliminary results suggest that capitalization is occurring.

Review of Literature

Others have examined the capitalization of different types of farmland preservation programs into farmland prices, both theoretically and empirically. These programs, including preferential tax assessment and agricultural district programs, are similar to the PDR and TDR programs we evaluate in that participation is voluntary. However, previously studied preservation programs differ from the ones we study because the former do not result in permanent restrictions on development.

The studies on capitalization of voluntary but non-permanent preservation programs yield conflicting results. Vitaliano and Hill (1994) used a hedonic price equation to test whether New York's Agricultural District program is capitalized into farmland prices. Their results suggest that only farmers facing limited returns from conversion join this tax abatement program and thus they found no evidence of negative capitalization. Anderson (1993) found partial negative capitalization of circuit-breaker tax credits. Anderson and Bunch (1989) also found this capitalization effect in Michigan's income-based property tax relief program, where participants were relieved of 80 to 90 percent of their annual property taxes.

Other studies have examined the capitalization 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 cannot be considered permanent preservation programs. In general, these studies find that non-voluntary programs negatively affect land values subject to the development restriction (see Beaton 1991 for one review of these studies). Henneberry and Barrows (1990) found evidence in Wisconsin of a net positive price capitalization of strict agricultural zoning, but find the effects of zoning depended on parcel characteristics. Pasour (1975) empirically tests for the capitalization of real property taxes into farmland prices, and finds that property taxes are negatively capitalized into land values.

Our paper contributes to the literature in two ways. First, we investigate the capitalization

effects of voluntary farmland preservation programs that result in permanent restrictions on development. Second, since these programs are voluntary we consider the landowner's decision to participate, and we correct for possible sample selection bias that participation may have our estimation of sales prices. If we do not correct for this sample selection problem, it could result in inconsistent parameter estimates. Some other studies using individual farmland sales transactions acknowledge that estimates may be affected by the landowner's decision to participate in a preservation program, but the significance of the participation decision and its effect on the parcel's sales price cannot readily be determined (see Anderson (1993), and Vitaliano and Hill (1994)).

Permanent Farmland Preservation Programs in Maryland

Three counties in Maryland serve as the study area: Carroll, Calvert, and Howard. These counties all operate their own county programs in addition to participating in the State PDR program. In PDR programs, the administering agency determines the prices paid for development rights and purchases the rights (rights are retired after purchase). In TDR programs, landowners and developers privately negotiate a price for the rights. The developer uses the rights to increase development densities in another area. Participation in a PDR or TDR program is voluntary, and a legal restriction is placed on the deed of the preserved parcel to permanently restrict the land from non-agricultural uses. The programs operated by the State and counties are briefly described below.

Since 1978, the State has purchased development rights or easements from landowners in all Maryland counties.[2] The State calculates the value of the easement as the difference between its "highest and best" use value and agricultural use value, where the former is based on appraisals and the latter is calculated as the county rental rate adjusted by productivity measures. The State uses a competitive bidding process to prioritize the applications to sell easements. The State

[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. According to State program administrators, this provision is unlikely to result in any withdrawals of land from the preservation program. However, the administrators believe that many landowners underestimate the probable difficulty in withdrawing from the program after 25 years of enrollment.

compares the estimated easement value to the landowner's specified "bid" or asking price, and will offer to purchase the easement at the lesser of the easement value or asking price. Given its limited funds, the State is often unable to make offers on all the applications submitted. Also, not all landowners accept the State's offer to purchase the easement; historically, only 65 percent of landowners who are made offers have accepted them.

Carroll County down-zoned its agricultural areas simultaneously with the beginning of the State preservation program in 1978. This county relies primarily upon the State program to compensate farmers for losses in equity caused by the zoning change. Since 1995, the County has financed the purchase of four additional easements beyond what the State offers to purchase each year.

Calvert County established its TDR program in 1979. Landowners are not required to sell all development rights at once; however, once a single development right has been sold the entire parcel is preserved. In 1992, after passing an inadequate public facilities ordinance that resulted in decreased demand for TDR's, the County established its PDR program. The County PDR program offers a set price based on the average TDR selling price in the previous year. Landowners can sell up to 10 development rights in this program annually.

Howard County established its PDR program in 1980. The County calculates the price for development rights based on a published formula, giving higher prices for parcels with better soils, road frontage, location within a rural conservation district, and greater development pressure. Since 1988, landowners have been paid the purchase price in installments over 30 years, plus tax-free interest on the unpaid balance. Tax advantages to landowners include tax-free income from interest on the unpaid balance, deferral of the capital gains tax until the principal is paid, and the ability to liquidate the installment purchase agreement at any time. Since 1980, agricultural land in the County has also been preserved via mechanisms similar to a TDR program which is called the "density/cluster exchange option" (DEO or CEO). Similar to Calvert's TDR program, the sale of one development right encumbers the entire preservation parcel.

Model and Estimation

The sales price for any given parcel will reflect the value in the use that generates the highest returns, since buyers planning to devote the parcel to that particular use will be able to outbid buyers intending to use the parcel for other purposes. In addition to the discounted stream of agricultural returns, the sales price of a parcel currently in a farming use could reflect "speculative" value; i.e., value that arises if converting the farm to a non-farming use in the future is positive.[3] However, if the development restrictions imposed by participation in a PDR or TDR program are fully capitalized (i.e., negatively capitalized) into the sales price of a farm parcel, the sales price should reflect the present value of returns in an agricultural use and no speculative value, since conversion to developed uses is restricted.[4] We model the sale prices of the i^{th} unrestricted farm parcel to be equal to the present value of the returns in an agricultural use for the time the parcel remains in farming (discounted to today) plus the present value of returns the parcel could earn in a developed use once converted (discounted to the date of conversion):

$$(1)\quad V_i^{NR} = \int_0^u A_i(X^A, t)e^{-rt}dt + \int_u^\infty R_i(X^B, t)e^{-rt}dt$$

where V_i^{NR} is the sales price of an unrestricted parcel, A_i represents the annual net returns from farming, R_i is the annual net returns in a developed use net of conversion costs, X^A and X^B are the vector of exogenous parcel characteristics for the i^{th} parcel, u is the optimal conversion date, r is the discount rate and t is time.[5] Restricted or preserved farms should have no value for

[3] The owners of agricultural land in metropolitan areas can achieve different financial returns from conversion at different dates depending on their location and parcel characteristics. If a landowner expects the growth in the value of returns in a developed use to exceed the cost of keeping the land in farming for another year, the landowner delays conversion. Studies on farmland prices in metropolitan areas suggest influences of increasing urbanization on farm prices (i.e., influences with local effects) could overshadow influences that are not as locally defined (see for examples Chicoine (1981), Vitaliano and Hill (1994)). A host of other studies in the literature offer explanations for changes in farmland prices that are related to influences on farmland prices. Many of these suggest farmland prices are influenced as much by macroeconomic variables as by farming returns (see, for example, Just and Miranowski 1993). In general, though, these studies do not focus on farmland in metropolitan areas which characterizes the farmland in our study area.

[4] Under most cases, the programs require a minimum acreage of 100 acres. Therefore, we assume parcels are not bought solely for use as a residence.

[5] $A_i(X^A,t)$ and $R_i(X^B,t)$ can be expected to grow but not necessarily at the same rates. They are also subject to uncertainty. However, we do not attempt to model uncertainty in this preliminary paper.

developing in the future. If the restrictions are fully capitalized (negatively) into the sales price of a farm parcel, the sales price should only reflect the present value of returns in an agricultural use:

$$(2)\ V_i^R = \int_0^\infty A_i(X^A, t)e^{-rt}dt\,,$$

where V_i^R is the sales price of a restricted parcel and other variables are as described above.

To determine whether farmland preservation programs are negatively capitalized into farmland prices, we first divide the sales of farm parcels into two categories: those that are enrolled in a preservation program (have development restrictions), and those that are not. Given the parcel characteristics, we then estimate equation (1) for the unrestricted parcels. We do this using a hedonic approach, which assumes a landowner approximates the present value of returns in each use after considering the role the parcel's characteristics played in recent farmland sales transactions.[6] Using sales information on unrestricted farm parcels in our study area, we estimate the contribution of various parcel characteristics to the value of the land.

Using the coefficient estimates from estimating equation (1), we next calculate the expected sales price of the restricted parcels as if they were not restricted (i.e., we calculate V_i^{NR} for these parcels, which we will refer to as EV_i^{NR}). We then construct a prediction interval around the price estimate for each parcel and compare the interval (rather than a point estimate) to the actual sales prices of preserved parcels. The prediction interval was constructed by subtracting (and adding) one standard deviation from the point estimates (EV_i^{NR} +/- σ). We hypothesize that if the preservation programs are negatively capitalized into the land price, a preserved parcel's sale price should be below the lower bound of its prediction interval (EV_i^{NR} - σ > V_i^R).

When we estimate equation (1) using the sales transactions of unpreserved farms, we need to take into account that sample selection bias may be present. This bias could exist because we have two groups of farms, preserved and unpreserved, and we want to use the results from

[6]The hedonic approach assumes the study area is represented by a single market for farmland (Freeman 1993). The close proximity of the counties in the study area suggests that they are likely to be contained within the same market, but it is possible that they do not represent the full extent of the market. If this is true, coefficient estimates in the sales price equation may be inefficient since we have not captured all information on sales in the market.

estimating the sales price for unpreserved farms (equation 1) to derive estimates of sales prices for a different group of parcels (the preserved parcels). We know that a difference between preserved and unpreserved parcels exist, because only certain landowners were motivated to enroll their parcels in a preservation program. For example, if only farms with low expected sales prices per acre participate in preservation programs, then the sample of unrestricted parcels would be biased toward higher valued land. If we do not account for a possible difference between preserved parcels and unpreserved parcels, the parameter estimates we derive in equation (1) for unpreserved parcels may be biased.[7]

To account for this possible bias, our first step is to determine the probability a landowner participates in a preservation program. We estimate a "reduced-form" probit equation to predict participation. We predict this decision based on variables that would explain land value in alternative uses. In what follows, we describe this procedure.

To estimate participation in a preservation program, we hypothesize that a landowner decides to enroll the parcel i (=1, . . .N) in a preservation program j (=0,1) based on the returns he can earn from participation (i.e., returns to farming plus the payment for the development rights), and returns he can earn if he does not participate (i.e., returns from having the land in its "highest and best" use, which in our study area is usually a developed use). We assume that a latent (unobserved variable) z^* exists, which is the net value of the parcel in preservation, and is a function of characteristics of the parcel represented by s_i in the relationship

$$(3) \qquad z_i^* = g's_i + m_i .$$

z_i^* is not observed, but z_i is, where

$$z_i = 1 \; if \; z_i^* > 0, \; z_i = 0 \; if \; z_i^* \le 0 .$$

Using the probit model, the equation that determines the probability that parcel i will be enrolled in a preservation program is $p_{i1} = \Pr(z_i = 1) = \Phi\left(g's_i\right)$ where Φ is the cumulative distribution of

[7] 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 in this paper.

the standard normal.

Once we have this estimate of the probability that a landowner enrolls his parcel in a preservation program, we use it to correct for any bias in the sales price model (equation (1)) while estimating this model for unpreserved parcels using a hedonic approach. Following Colwell and Sirman (1978) and Chicoine (1981), we specify a model for the sales prices of unpreserved farm parcels (*j=0*) as:

$$(4)\ V_{ij} = d_j AC_{ij}^{\ j} (\exp(b_j' X_{ij}^A + J_j' X_{ij}^B)$$

which we empirically estimate in the form:

$$(5)\ \ln V_{ij} = d_j + a_j \ln AC_{ij} + b_j' X_{ij}^A + J_j' X_{ij}^B + e_{ij},$$

where V_i is the sales price per hectare, AC_i is the number of hectares in the parcel, and X_i^A and X_i^B are vectors of exogenous parcel characteristics. This functional form reflects the exponential relationship between land value and distance variables suggested by theory and previous studies (Chicoine 1981, Mills 1972, Muth 1961).

We assume that the terms, ε and μ, are distributed as a bivariate normal ~ $N(0,0,\sigma^2_\epsilon,1,\rho)$, where the variance of μ is normalized to one. The correlation coefficient between the error terms in the participation and sales price equations will be non-zero if sample selection exists. We estimate this model using Full Information Maximum Likelihood to get the consistent and asymptotically efficient estimators.

Once we have the corrected estimates of sales prices for the unpreserved parcels, we can proceed with using them to determine whether preservation programs are negatively capitalized into the price for the preserved parcels (using the procedure described at the top of page 8). In the following two sections, we describe the data that we used to predict participation (equation 3) and the sales price of unpreserved parcels (equation 5), followed by the estimation results.

Data

The data we use in the estimation includes individual parcels of farmland (N=455) that were sold between January 1990 and August 1997 in Calvert, Carroll and Howard Counties, Maryland. Our data set includes 407 sales transactions of unpreserved farms and 48 sales

transactions of preserved farms. We were able to identify parcels as preserved by address-matching data on preserved farms (obtained from the state and county offices which administer the preservation programs) with address data in the State of Maryland's Tax and Assessment database. Only private, arms-length sales of single parcels are included. From the tax assessment database we obtained sales prices, transaction dates, geographic coordinates, the number of acres sold, assessed value of land and structures, and whether the parcel is waterfront property. Because this database contains only limited information on structural characteristics of buildings, and even less data on structures other than houses (e.g., barns, sheds, silos, etc.), we estimate the sales price equation (5) that predicts the value of the land only. To get the price of the land excluding structures, we subtract the assessed value of the structures from the parcel's sale price. Other parcel characteristics (soil type, 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).

In the vector of parcel characteristics (s_i) in the participation equation (3), we include the 1997 rental rate that the USDA Farm Service Agency uses to determine payments under the Conservation Reserve Program (RENTRATE) as a proxy for agricultural returns.[8] The log of the parcel size (LNHECTARES) is included, because most programs pay more for development rights the larger the parcel. Since we hypothesize that owners of parcels earning higher agricultural returns and higher payments for development rights are more likely to participate in a farmland preservation program, we expect signs on these variables to be positive. We also include a variable representing the percent of the open space within one-quarter mile around the parcel that remains in farmland and forest (AGFORAREA). We anticipate that a landowner is more likely to participate if other farming operations (including tree farms) surround his parcel, since conflicts with non-farm neighbors would be minimized. We include two proxies to capture the returns in a developed use: distance to the nearest major urban center (DISTCITY) and the

[8]These rates are based on the soil quality and are adjusted by county. However, since we do not have information on parcel boundaries, we assumed soil quality at the parcel centroid was representative of the entire parcel. A soil quality dummy indicating whether the parcel had prime soil for row crops performed similarly, in estimation, to the rental rate variable as a proxy for agricultural returns.

distance to the planned public sewer service boundary (DISTSEWER).[1] Returns from converting a parcel are likely to be smaller when the distance to employment opportunities and to planned sewer service extensions increases, so we expect these variables to positively affect participation. We include county variables to account for differences in the average price landowners receive for selling development rights, services, property tax rates, and county level programs.[10]

We also expect estimated returns in developed uses and returns to farming to affect the sales prices in equation (5). In the vector of explanatory variables X_i^A we use RENTRATE as a proxy for returns to farming, and in X_i^B we include DISTCITY and DISTSEWER as proxies for returns in a developed use. We include several other variables in X_i^B that we expect to influence the returns in a developed use. We expect land along the Chesapeake Bay to command a premium and include a binary variable equal to one for waterfront property (WATERFRONT). Forested property results in higher conversion costs which lowers returns to non-agricultural uses, so we also include a binary variable equal to one if the parcel is forested (LUFOREST). Recent studies on residential land values in Maryland suggest that the pattern of land use surrounding residential parcels affects sales prices (e.g., Bockstael and Bell 1997, Bockstael and Irwin 1997), so we include the variable AGFORAREA (described above) to test whether local surroundings affect farmland sales prices. The variable IMPROVEVAL measures the assessed value of existing improvements on the parcel; we have no *a priori* expectations about the sign of this variable. Developers are likely to consider the existence of farm buildings (other than the farmhouse) an increase in conversion costs, and would pay less for the land, but other farmers would consider buildings an amenity and would pay more for the land. We include a county variable to account for differences in county level services and property tax rates.

[1]The variable DISTCITY is the distance as the crow flies to Washington, D.C. or Baltimore, whichever is closer.

[10]We assume a landowner considers prices the government agency paid to other landowners in his county to estimate the price he might receive if he were to enroll in a preservation program and sell development rights.

Results

Estimation of Sales Price for Unpreserved Parcels

The coefficient estimates for the unrestricted parcels are presented in Table 1.[1] We do not find evidence that selectivity bias was present. The asymptotic t-statistic on r (the measure of the correlation between the error terms in the probit and sales equation in the maximum-likelihood estimation) was not significant. This may be due to the fact that no bias is present, or to the fact that we inadequately captured what causes a landowner to preserve his parcel or to not preserve it. The latter reason may be a result of our including in estimation only those parcels which had sold in our seven year study period.

In the estimation of the sales price of unpreserved parcels in equation 5, larger parcels received a significantly lower price per hectare as expected. We did not find that the proxy for agricultural returns (RENTRATE) significantly impacted price. If the parcel was being sold for non-agricultural use and agricultural returns are low relative to non-agricultural returns, then this makes sense. However, conversion costs are often less expensive for soil types that earn higher farming rents, since these soils are flat and well drained, so a positive impact of this proxy on the sales price would have been plausible. Most of the proxies for returns in a non-agricultural use performed as expected, except for DISTSEWER. The latter poor result could be due to the fact that distance to public infrastructure has little effect on farmland prices, or to the fact that little variation exists for this variable. The value of existing structures did not have a significant effect on sales prices; this could be a result of offsetting influences of buyers who are developers and buyers who are farmers. Parcels surrounded more by farms and forest sold for less than other parcels (significant at the 10 percent level), suggesting that neighborhood effects may matter for agricultural parcels. Howard County parcels received a higher price than either Carroll or Calvert County, which is not surprising given its proximity to both Baltimore and Washington, D.C.

Capitalization of Development Restrictions

Using the estimates of sales prices for unpreserved parcels, we calculated the estimated

[1]Coefficient estimates for the probit equation are included in Table 3. We do not discuss them here due to space limitations.

sales prices for the 48 preserved parcels as if they were not preserved. We constructed prediction intervals around these point estimates, and compared the actual sales prices of the preserved parcels to the lower bound of the prediction interval. We found that in all 48 cases, the actual sales price fell below the expected unrestricted sales price interval. Therefore, we conclude that development restrictions imposed by participation in a farmland preservation program appear to be capitalized into the land value in these counties.

Conclusions

Unlike some non-permanent preservation programs, voluntary but permanent preservation programs do appear to decrease the price of farmland. This lower price should enable young or new farmers to enter into the industry.

We make several qualifications to our results. First, our conclusion that PDR and TDR programs are capitalized (negatively) into farmland prices assumes that we have adequately corrected for sample selection bias. Second, we do not check for multicollinearity, a common problem in hedonic studies. Third, we do not attempt to correct for spatial autocorrelation, a problem that others have found result in overstatement of the significance of land use pattern variables (e.g., Bockstael and Bell 1997). While methods for treating both sample selection and spatial autocorrelation in the same estimation have not yet been developed, results obtained here suggest that confining attention to the latter may be more important. Fourth, as urban pressures become greater and the value of the land rises, farmers may switch their cropping patterns. If the types of crops produced changes, then the expected returns to farming should also change. This response to urbanization may not be adequately reflected by the rental rate proxy for agricultural returns. That proxy also assumes that farmers in the same county with the same soil type at the centroid of their parcels expect the same returns to farming. Fifth, we do not consider the effects of a landowner's decision to choose one farmland preservation program over another (e.g., the state PDR vs. county PDR vs. county TDR program); we implicitly assume that the participation decision is independent of program choice. Finally, some counties in Maryland have introduced inadequate public facilities regulations during the sample period to ensure that sufficient roads, schools, sewage systems were in place before major subdivisions were constructed; Calvert

County did this in 1992. These regulations affect the sales price of land by pushing development opportunities to a future date; but we did not incorporate this into the model.

Table 1. Description of Data and Summary Statistics

Variable	Description	Mean	Std.Dev
PRICE*	Sales price per hectare	205,670	226,492
HECTARES	Parcel size in hectares	14.89	15.91
RENTRATE	Rate paid by USDA under CRP, by soil type	54.10	12.05
DISTCITY	distance to closer of Balt or DC, in meters	44,484	14,506
DISTSEWER	Distance to nearest sewer service boundary (existing or planned), in meters	1,780	1,475
WATERFRONT	= 1 if parcel is located on the Chesapeake Bay	.04	.20
LUFOREST	= 1 if parcel land use = forest at its centroid	.22	.42
IMPROVEVAL	Assessed value of buildings and other improvements	78,403	84,463
AGFORAREA	% of land use in farming and forest within 400 meters of parcel, as of 1990	.84	.16
HOWARD	= 1 if parcel located in Howard County	.21	.41
CALVERT	= 1 if parcel located in Calvert County	.14	.35
CARROLL	= 1 if parcel located in Carroll County	.65	.35

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

Table 2. Parameter Estimates in Sales Price Equation

Variable	Coefficient*	Asymp. Std. Error
Constant	11.402*	.454
Lnhectares	-.533*	.058
Rentrate	.003	.003
Distcity	-.00001*	.000004
Distsewer	.00001	.00003
Waterfront	.565*	.226
Luforest	-.223*	.086
Improveval	.0000005	.0000004
Agforarea	-.569	.298
Howard	.591*	.117
Calvert	.241	.191
Rho	-.023	.330
lnL	-504.12	

*Significant at the .05 level.

Table 3. Parameter Estimates in Participation Equation

Variable	Coefficient*	Asymp.Std. Error
Constant	-9.132*	1.502
Lnhectares	.806*	.153
Rentrate	.017	.018
Distcity	.00004*	.00001
Distsewer	.0001	.0001
Agforarea	2.146*	1.020
Howard	1.372*	.493
Calvert	.1.439*	.366

*Significant at the .05 level.

References

Alston, Julian M. "An Analysis of Growth of U.S. Farmland Prices, 1963-82." *American Journal of Agricultural Economics* 68(1986):1-9.

Anderson, J.E. "State Tax Credits and Land Use: Policy Analysis of Circuit-Breaker Effects." *Resource and Energy Economics* 15(1993):295-312.

Anderson, John E., and Howard D. Bunch. "Agricultural Property tax Relief: Tax Credits, Tax Rates, and land Values." *Land Economics* 65(1989):13-22.

Beaton, W.P. "The Impact of Regional Land-Use Controls on Property Values: The Case of the New Jersey Pinelands." *Land Economics* 67(1991):172-94.

Bell, K. and N. Bockstael. "Applying the Generalized Methods of Moments Approach to Spatial Problems Involving Micro-Level Data." Under review with *Review of Economics and Statistics* (1997).

Bockstael, N. and K. Bell. "Land-Use Patterns and Water Quality: the Effect of Differential Land Management Controls." In *International Water and Resource Economics Consortium: Conflict and Cooperation on Transboundary Water Resources*, R. Just and S. Netanyahu, eds. (1997).

Bockstael, N. and E. Irwin. "Modeling Change in the Pattern of Land Use: A Discussion of Spatial Models and Models of Spatial Processes." Working Paper 97-08, Department of Agricultural and Resource Economics, University of Maryland, College Park, MD.

Burt, Oscar, R. "Econometric Modeling of the Capitalization Formula for Farmland Prices." *American Journal of Agricultural Economics* 68(1986): 10-26.

Chicoine, David L. "Farmland Values at the Urban Fringe: An Analysis of Sale Prices," *Land Economics*, 57(1981): 353-362.

Colwell, P.F. and C.F. Sirmans. "Area, Time, Centrality and the Value of Urban Land." *Land Economics* 54(1978):514-519.

Council of Economic Advisors. *Economic Indicators*. U.S. Government Printing Office (1998).

Freeman, A.M. III. *The Measurement of Environmental and Resource Values: Theory and Methods.* Washington, D.C.:Resources for the Future (1993).

Gale, H.F. "Why Did the Number of Young Farm Entrants Decline?" *American Journal of Agricultural Economics,* 75(1993):138-146.

Greene, W.H. *Econometric Analysis, 2nd edition*. Englewood Cliffs, NJ:Prentice-Hall, Inc. (1993).

Henneberry, David M., Barrows, Richard L. "Capitalization of Exclusive Agricultural Zoning into Farmland." Prices, *Land Economics* 66(1990):249-58.

Just, Richard E., and John A. Miranowski. "Understanding Farmland Price Changes," *American Journal of Agricultural Economics,* 75(1993):156-168.

Mills, Edwin W., *Urban Economics*. Glenview, Ill.: Scott, Foreman and Co., 1972.

Muth, Richard F. "Economic Change and Rural-Urban Conversion." *Econometrics* 29(1961): 1-12.

Rigoberto A. Lopez, Adesoji O. Adelaga, and Margaret S. Andrews "The Effects of Suburbanization on Agriculture." *American Journal of Agricultural Economics* 70(1988): 346-358.

Pasour, E.C., Jr. "The Capitalization of Real Property Taxes Levied on Farm Real Estate." *American Journal of Agricultural Economics* Nov (1975):539-548.

Stam, Jerome M. "Credit as a Factor Influencing Farmland Values." Rural Economy Division, Economic Research Service, U.S. Department of Agriculture. Staff Paper No. AGES 9504.

Vitaliano, D.F. and C. Hill. "Agricultural Districts and Farmland Prices." *Journal of Real Estate Finance and Economics* 8(1994):213-223.