Agricultural & Applied Economics Association

A Hedonic Study of the Effects of Erosion Control and Drainage on Farmland Values
Author(s): Raymond B. Palmquist and Leon E. Danielson
Source: *American Journal of Agricultural Economics*, Vol. 71, No. 1 (Feb., 1989), pp. 55-62
Published by: Blackwell Publishing on behalf of the Agricultural & Applied Economics Association
Stable URL: http://www.jstor.org/stable/1241774
Accessed: 13/09/2010 16:19

Your use of the JSTOR archive indicates your acceptance of JSTOR's Terms and Conditions of Use, available at http://www.jstor.org/page/info/about/policies/terms.jsp. JSTOR's Terms and Conditions of Use provides, in part, that unless you have obtained prior permission, you may not download an entire issue of a journal or multiple copies of articles, and you may use content in the JSTOR archive only for your personal, non-commercial use.

Please contact the publisher regarding any further use of this work. Publisher contact information may be obtained at http://www.jstor.org/action/showPublisher?publisherCode=black.

Each copy of any part of a JSTOR transmission must contain the same copyright notice that appears on the screen or printed page of such transmission.

JSTOR is a not-for-profit service that helps scholars, researchers, and students discover, use, and build upon a wide range of content in a trusted digital archive. We use information technology and tools to increase productivity and facilitate new forms of scholarship. For more information about JSTOR, please contact support@jstor.org.

Blackwell Publishing and *Agricultural & Applied Economics Association* are collaborating with JSTOR to digitize, preserve and extend access to *American Journal of Agricultural Economics.*

http://www.jstor.org

A Hedonic Study of the Effects of Erosion Control and Drainage on Farmland Values

Raymond B. Palmquist and Leon E. Danielson

Valuing farmland improvements is important for individual farmers and policy makers. This paper demonstrates the use of a hedonic land value study to determine the value of erosion control and drainage using data from North Carolina. Land values are significantly affected by both potential erosivity and drainage requirements. This study's estimates are compared with estimates derived from a variety of other types of studies.

Key words: drainage, erosion, hedonic study, land quality, land values.

Various improvements can be made to farmland, including clearing or draining the land and controlling erosion. Individual landowners must decide whether to undertake such improvements. These decisions require knowledge of both the value and costs of the improvements. In addition, various government programs are designed to encourage (or in some cases to discourage) changes in the characteristics of farmland. Evaluating such programs also requires estimating the benefits of the resulting changes. This article demonstrates the application of a hedonic model of factors of production to farmland sales and discusses using the model to value land improvements.[1]

The literature contains several studies of the relationship between farmland values and the land characteristics. Miranowski and Hammes, Ervin and Mill, and Gardner and Barrows used hedonic techniques to study the effects of soil quality and erosion on land values. Miranowski and Hammes found that three measures of topsoil quality (topsoil depth, potential erosivity, and pH) had the expected signs and were statistically significant. The other two studies had mixed results and generally concluded that land values were not predictably related to actual or potential erosion. This article emphasizes the use of hedonic techniques to value drainage and reductions in the erosion potential of land.

Using Hedonic Results to Value Farmland Improvements

The market for farmland should be modeled as a market for a differentiated factor of production because of the differences in the characteristics of the various parcels of land. Such a model has been developed by Palmquist (1987, 1989) for the farmland rental market. A modification of that model is applied here. The modification is necessary because data were available only on farmland sales rather than rents.[2]

Hedonic results can be used to value changes in the characteristics of farmland, although different techniques will be necessary in different situations. Improvements made by an individual landowner or as a result of public policies that influence only a few parcels of land within the market will not influence the

---

Raymond B. Palmquist is an associate professor, and Leon E. Danielson is a professor, Department of Economics and Business, North Carolina State University.

Paper No. 11633 of the Journal Series of the North Carolina Agricultural Research Service.

Useful comments on an earlier draft of this paper were made by Dana Hoag, Paul Johnson, E. C. Pasour, Daniel Sumner, and Walter Thurman.

[1] A hedonic regression relates the price of a differentiated product to the various characteristics that it provides.

[2] When people rent land, their only interest will be in the current productive capabilities of the land, although the lease may require them to protect the interests of the landowner. The value of land as an asset depends on the present value of future rents. The land may be used for different purposes in the future, so different characteristics may be relevant. These characteristics would then influence asset value but not rental value. For example, proximity of farmland to a major population center might increase land values even though it did not increase agricultural productivity. In the same vein, a characteristic that is of value in agricultural use, such as soil productivity, may be discounted in the asset price if that characteristic is not as highly valued in some alternative use (e.g., commercial use) that is anticipated in the near future.

equilibrium price schedule. This is because the market is made up of a large number of parcels of land, so the improvement of one or a few parcels will not appreciably change the price of parcels other than those directly affected. Thus, the benefits of the improvement are measured by the increased price of the improved land, which can be forecast easily because the constant hedonic price schedule is known.

If the policy change being evaluated affects a large number of land parcels, then the price schedule is changed. In this case the hedonic equation may provide an upper-bound on the value of land improvements. Freeman and Lind use an assignment model to show that, before the policy change, the difference in price between the parcels that will be improved and parcels that are already improved provides an upper-bound for the value of the benefits of the improvements. Bartik shows that if the other characteristics of the land are not changed in response to the improvement and if the landowner's costs of changing other characteristics are uninfluenced by the change, then this upper-bound also applies within the more general hedonic model. For example, agricultural policies with respect to erosion might not cause the landowner to change the other characteristics of the land, so the hedonic would provide an upper-bound measure. Bartik suggests that even if other changes take place one would expect the hedonic to provide an upper-bound.

Historically, programs that assisted with drainage control were "small" because of the limited number of parcels involved. Similarly, the cost-sharing of soil conservation efforts, such as terracing and field leveling under the Agricultural Conservation Program, has usually been on a scale which would not affect the land price schedule. On the other hand, the conservation programs in the Food Security Act of 1985 are significant enough that land price schedules will change. In this case, only an upper-bound measure may be available from the hedonic analysis.

Data Collection

To demonstrate the use of land value studies in evaluating land improvements such as erosion control or drainage, hedonic techniques were applied to data from North Carolina. Cross-sectional data came from a survey of brokers, realtors, appraisers, bankers, tax supervisors, loan representatives, and others knowledgeable about farm sales. The survey covered land sales from 1 October 1979 to 31 March 1980 (Danielson) and yielded 252 usable observations. There were data on the characteristics of each tract as well as on the buyer and the seller of the tract. The characteristics of the land parcels included soil quality, the percentage of the parcel in cropland and forest land, the presence and quality of buildings, the quantity of tobacco quota, tract size, and various other information on the land.

The survey data were supplemented with county-level information from the 1980 census of population. These variables represented the population growth in the area and the urban pressures on farmland. Information on these nonagricultural influences was necessary because the prices used in the study were real estate market prices, not rental prices. Because North Carolina has 100 counties of roughly the same size, county data provide good information on the changes in the surrounding area. The population density of the county in which the parcel was located was used to measure current population pressures, while the rate of population increase was a proxy for expectations of population growth. Housing development near the tract measured more localized urban pressure, while a community water system near the tract indicated the availability of urban services. Finally, an interaction term between soil quality and urban influence was included. This was done because the present value of future agricultural productivity would be greater if the land were expected to remain in agriculture than if it were expected to be converted to urban use in the near future.

Measures of erosivity and the need for drainage were determined through an elaborate procedure on a tract-by-tract basis with the help of an experienced soil scientist.[3] First, each tract was located on a large and detailed county highway map using information obtained in the survey. This information included county, township, distance to the closest city, and distance to the next closest city, all reported for each tract. Next, the loca-

---

[3] A special thanks is given to J. A. Phillips, formerly Assistant Director and State Leader, ANR/CRD, North Carolina Agricultural Extension Service, for his able assistance in developing this information.

tion of the tract was transferred to soil maps that included ninety-eight different soil classes found in North Carolina. Each class was an aggregate of only two to three detailed soil series. Plotting the tract on this map determined its soil class. The final step was to aggregate the ninety-eight classes into thirty-two soil productivity groups (SPG) defined in a USDA/North Carolina State University study. That study rated the thirty-two SPGs for erosivity and need for drainage. Erosion potential was given in tons per acre per year. The drainage index given for each of the SPGs was converted to six dummy variables for the analysis.

Table 1 describes the variables used in this study. The two variables of primary interest are susceptibility to erosion and desirability of drainage. For erosion, two measures should affect land values. The first, the susceptibility of the soil to erosion, influences land prices even if control efforts have prevented erosion damage. Erosion control efforts represent an expense for the farmer. That is captured by *EROSION* which measures the inherent erosion potential of the soil type. Second, land values also are influenced by the erosion that has already occurred on the land. The presence of erosion was considered by the survey respondents in estimating the soil quality (*SOILQUAL*) for the specific tract because land with subsoils partially exposed is less productive. Thus, the regression analysis reported below at least partially controls for the erosion phase of the tracts.

Drainage also has two considerations:

Table 1. Variable Definitions, Sources, and Statistics

Variable	Mean Value	Standard Deviation	Definition	Source
PRICE	1481.	1080.	Price of land per acre ($)	N.C. 1980 Rural Real Estate Survey (RRES)
EROSION	72.34	41.36	Estimated soil loss on tract; USLE, bare ground (tons per acre per year)	See discussion in text
SOILWET	.0833	.2769	Dummy: Soil wetness (1 if poorly or very poorly drained; 0 otherwise)	See discussion in text
SOILQUAL	2.151	41.36	Quality of soil rating (poor = 1, average = 2, good = 3)	N.C. RRES
SIZE	100.3	135.2	Tract size (acres)	N.C. RRES
PCROP	42.46	31.92	Percent cropland	N.C. RRES
TALLBAC	49.05	80.02	Tobacco quota (lbs./acre)	N.C. RRES
POPCHGE	14.80	8.467	County population increase (1970–80) (%)	1980 Census of Pop.
*POPDEN*80	158.6	149.7	County population density (1980) (persons per square mile)	1980 census of population
DHOUSING	.1230	.3291	Dummy: Community housing (1 if located nearby; 0 otherwise)	N.C. RRES
DWATER	.1071	.3099	Dummy: Community water (1 if located nearby; 0 otherwise)	N.C. RRES
POPSOIL	339.5	342.7	Interaction term, *POPDEN*80**SOILQUAL*	
GBLDG	.0794	.2708	Dummy: Good quality buildings (1 if present; 0 otherwise)	N.C. RRES
ABLDG	.1825	.3871	Dummy: Average quality buildings (1 if present; 0 otherwise)	N.C. RRES
SOILGD	.3056	.4615	Dummy: Good soil quality (1 if present; 0 otherwise)	N.C. RRES
SOILBD	.1548	.3624	Dummy: Poor soil quality (1 if present; 0 otherwise)	N.C. RRES
*DRAIN*4	.0238	.1526	Dummies for soil wetness classes (*DRAIN*6 the wettest class)	See discussion in text
*DRAIN*5	.0040	.0632		
*DRAIN*6	.0794	.2709		
DRAINCRP	4.409	18 74	Interaction term, *SOILWET***PCROP*	

whether the land requires drainage for crop production and whether the land already has been drained. The former measure is captured by *SOILWET* in the regression. *SOILWET* is a dummy variable representing soils that require drainage for crop production. Information on whether the land has been drained is implicitly available since drainage must have occurred on poorly drained land used for crop production. On the other hand, forest lands usually are only drained enough for harvesting and reforestation, and the drainage is not maintained between harvests. Even if the original drainage effort has been made, maintenance costs must be incurred to keep land in crop production. An interaction term between *SOILWET* and the percentage of the land in crops can be used to determine if the effect of poorly drained soil depends on land usage.

One would expect that soil quality and the percentage of cropland in the parcel also would have other effects on price. The price per acre should vary inversely with the size of the tract because of the legal and political costs of subdividing a tract of land. The final agricultural variable concerned tobacco quota sold with the land. The poundage quota of the parcel was divided by the number of acres in the parcel to obtain a variable for testing the effect of the quota on the price per acre.

Empirical Results

The functional form of the hedonic equation was selected empirically by applying Box-Cox techniques to the most common functional forms (linear, semilog, log-linear, and inverse semilog).[4] The semilogarithmic form was preferable. The regression results are given in table 2.

The results in column 1 are typical. All of the variables have the expected signs, and except for *POPCHGE* and *ABLDG*, they are all significant at the 5% level or better. A soil that is wet enough to require drainage is estimated to cause about a 25% reduction in land prices.[5] At the mean land price this represents a \$374 per acre reduction.[6] The susceptibility of the soil to erosion also results in a price reduction that is equal to a \$3.06 per unit increase in the erosion potential of the land on an average tract. Soil quality also has an important effect on land prices, causing land values to differ by as much as 60%. A pound of tobacco quota was worth \$2.78 on an average parcel of land. Cropland was worth \$488 more per acre than forested land. Including the percentage of the land that was not used for either crops or forests in the regression yielded a negative but statistically insignificant coefficient. This result probably occurred because only 3% of the land was in this category.

The second column of table 2 reports the results when *SOILQUAL* was replaced with dummy variables representing land that was rated good or poor as opposed to average. The R^2 measures were not significantly affected, and the magnitudes and significance of the other variables also were essentially unchanged. The third column provides the results when dummy variables representing the two categories of poor drainage included in *SOILWET* were included separately along with a dummy variable for the next category of land with better drainage. The coefficients of

---

[4] The choice among the four functional forms can be made by minimizing the residual sum of squares once the dependent variable has been transformed appropriately. Box and Cox show that a continuous range of functional forms can be indexed by a parameter λ and the log-likelihood function is

$$L(\lambda) = -\tfrac{1}{2}n \ln \hat{\sigma}^2(\lambda) + (\lambda - 1) \sum_{k=1}^{n} \ln P_k.$$

For the four forms considered here λ takes values of either 0 or 1. For example, for the linear case $\lambda = 1$ so

$$L(\lambda) = -\tfrac{1}{2}n \ln \cup\sigma^2(1),$$

while for the semilog case $\lambda = 0$, so

$$L(\lambda) = -\tfrac{1}{2}n \ln \hat{\sigma}^2(0) - \sum_{k=1}^{n} \ln P_k.$$

If one transforms the dependent variable (P_k for observation k) by the inverse of the geometric mean of P,

$$P_k^* = \exp((-\Sigma \ln P_i)/n)P_k, \text{ then}$$
$$\ln P_k^* = \ln P_k - (\Sigma \ln P_i)/n \text{ and}$$
$$\Sigma \ln P_k^* = \Sigma \ln P_k - n(\Sigma \ln P_i)/n = 0,$$

since the sum of the logs of the prices is the same regardless of the index used. This means that the second term in the log-likelihood function for the semilog case is zero. Thus minimizing the residual sum of squares for the functional forms with the transformed variable is equivalent to maximizing the log-likelihood function over the two functional forms. The same process applies to the log-linear and inverse semilog since the only difference is in the form of the independent variables.

[5] For the semilog equation used here, a consistent estimate of the relative effect on rental price of the presence of a dichotomous characteristic is given by $\exp(\hat{\beta}) - 1$, where $\hat{\beta}$ is the estimated coefficient (Halvorsen and Palmquist). For small samples the potential bias of this estimator can be reduced by using $\exp[\hat{\beta} - \tfrac{1}{2}\hat{V}(\hat{\beta})] - 1$, where $\hat{V}(\hat{\beta})$ is the variance of $\hat{\beta}$ (Kennedy). For discrete changes in a continuous variable, a consistent estimate of the relative effect is given by $\exp(\hat{\beta}\Delta N) - 1$, where ΔN is the change in the variable. For small samples a better estimator is $\exp[(\hat{\beta}\Delta N) - \tfrac{1}{2}(\Delta N)^2\hat{V}(\hat{\beta})] - 1$ (Palmquist 1982). The interpretation of the results makes use of the two small-sample estimators.

[6] All prices based on the estimates are in 1980 dollars.

Table 2. Hedonic Regression Results

	Parameter Estimates (t-values)			
Variable	(1)	(2)	(3)	(4)
EROSION	−0.002065	−0.002057	−0.001878	−0.002063
	(−2.524)	(−2.514)	(−2.214)	(−2.516)
SOILWET	−0.283379	−0.280580		−0.267096
	(−2.283)	(−2.259)		(−1.416)
SOILQUAL	0.239284		0.245991	0.239637
	(3.365)		(3.429)	(3.360)
SIZE	−0.001134	−0.001137	−0.001147	−0.001139
	(−5.035)	(−5.046)	(−5.063)	(−4.944)
PCROP	0.002904	0.003026	0.002756	0.002954
	(2.772)	(2.867)	(2.593)	(2.600)
TALLBAC	0.001875	0.001875	0.001889	0.001867
	(4.618)	(4.617)	(4.624)	(4.511)
POPCHGE	0.005196	0.005222	0.005424	0.005220
	(1.426)	(1.433)	(1.479)	(1.427)
*POPDEN*80	0.002364	0.002337	0.002430	0.002368
	(3.197)	(3.156)	(3.256)	(3.192)
DHOUSING	0.284361	0.288706	0.293142	0.284515
	(2.962)	(3.004)	(3.031)	(2.958)
DWATER	0.279203	0.278918	0.275591	0.280321
	(2.859)	(2.856)	(2.808)	(2.851)
POPSOIL	−0.000695	−0.000687	−0.000740	−0.000697
	(−2.108)	(−2.085)	(−2.210)	(−2.107)
GBLDG	0.250812	0.255711	0.255782	0.252172
	(2.242)	(2.283)	(2.277)	(2.237)
ABLDG	0.117010	0.102569	0.116277	0.116954
	(1.473)	(1.269)	(1.459)	(1.469)
SOILGD		0.187373		
		(2.099)		
SOILBD		−0.304161		
		(−3.103)		
*DRAIN*4			0.177504	
			(0.873)	
*DRAIN*5			−0.391367	
			(−0.848)	
*DRAIN*6			−0.255766	
			(−1.973)	
DRAINCRP				−0.000319
				(−0.115)
Intercept	6.354158	6.856168	6.327840	6.351835
	(37.225)	(64.709)	(36.357)	(36.877)
R-Square	0.4460	0.4481	0.4479	0.4460
Adjusted R-Square	0.4157	0.4155	0.4128	0.4133

*SOILW*5 and *SOILW*6 are negative as expected, but the coefficient of *SOILW*5 is no longer significant. The latter result may have occurred because this category contained only one observation as opposed to twenty in the sixth category. Rather than discard this observation, it was aggregated with category 6 to form *SOILWET*. The dummy variable for the next drier category of land was positive but not significantly different from zero, a result which was to be expected. The results in column 4 reflect the addition of an interaction term between *SOILWET* and land usage. This addition also had little statistical significance. The results for the other variables were scarcely affected by the inclusion of this interaction term, although not surprisingly the t-ratio was reduced for *SOILWET* when that variable entered the regression in two forms.

How reasonable are these estimates, and how well do they correspond to estimates derived by other methods?

Drainage

The soil wetness coefficient suggests that draining wet soils would increase land values by 34% on average. To our knowledge, market data are not available for land values before and after drainage. However, when the sales data for this study were collected, wet soils requiring drainage for crop production were available for around $400 to $500 per acre in eastern North Carolina (Barnes). Although cost levels can vary greatly, Skaggs and Nassehzadeh-Tabrizi estimated that 1982 drainage costs for two common Coastal Plain soils (Rains and Portsmouth) could range from $80 to $400 per acre, depending on the drainage system implemented and whether main ditches were in place. In North Carolina some, but not all, wetlands eligible for drainage are drained. Thus, the market is near equilibrium, with drainage costs approximately equal to the increase in land values. Assuming a cost of $450 for undrained land and a land market in equilibrium, these data imply that land value would rise by between 18% and 89% if drainage were undertaken by a profit-maximizing landowner. The estimate of 33.9% from the hedonic equation is well within this range.

Erosion

The variable representing erosion potential on land is the *RKLS* factor in the universal soil loss equation. This variable takes into account rainfall, soil type, and the length and steepness of slope. These factors are generally beyond the farmer's control on a particular tract, although conservation practices such as terracing can influence the last two factors. The *RKLS* factor is the appropriate variable since it measures the inherent erosivity of the soil class and cannot be influenced by temporary cultivation or conservation practices. *RKLS* can be converted to tons of erosion per acre per year by multiplying by factors for cultivation and conservation practices. If no specific conservation practices such as contouring are used, the supporting practice factor can be assumed to equal one. However, the cultivation of any crop will reduce the erosion rate below that on continuously cleaned and tilled fallow soil. Thus, the *RKLS* factor must be multiplied by a factor (C) less than one to yield the erosion in tons per acre per year. For example, in the Piedmont of North Carolina continuous corn cultivation on land with average productivity using turn plowing, cut silage, and residue removal yields a C factor of .494. Other common crop rotations and practices also yield C values in the same general range. In this case, erosion in tons per acre per year would be .494 times *RKLS*. The coefficient in the regression indicates that a one-unit reduction in *RKLS* would be worth, on average, $3.06. However, a one-unit reduction in *RKLS* represents a reduction in potential soil loss of only (.494 × *RKLS*) tons per acre per year. Thus, a one ton per acre per year reduction in potential soil loss would be worth (1/.494)3.06 or $6.19 in terms of land prices.

The farmers buying the land may choose to allow the potential erosion to occur, in which case the regression coefficient measures the present value of future productivity losses due to erosion. On the other hand, they may take steps to reduce the erosion, but these steps are costly. Then the coefficient is measuring the present value of future control costs and productivity losses from the remaining erosion. Erosion control presumably is undertaken because its cost is less than the productivity losses from erosion. In this case the coefficient will be lower than the damages from uncontrolled erosion.

The results of this study can be compared to those derived in three types of studies. First, one can relate erosion to reduced yields and then determine the value of the lost crops. The Soil Conservation Task Force of the American Agricultural Economics Association has estimated that a 10% yield reduction after 100 years of erosion on the 142 million acres of land growing the nation's corn and soybeans would result in a net loss in present value terms of $4.3 billion at a 10% rate of discount assuming that corn and soybeans are priced at $3.00 and $7.00 per bushel, respectively. This loss is an average cost of $30.28 per acre. In a Corn Belt study, Pierce et al. estimate that average yields would decline by 4% over 100 years with an erosion rate of 7.8 tons per acre per year. This implies that the Task Force's 10% reduction would result from an erosion rate of 19.5 tons per acre per year if a linear relationship is assumed. Dividing the per-acre cost estimate of the Task Force by this erosion estimate yields $1.55 as the present value of the yield loss due to an erosion rate of one ton per acre per year. Our estimate is $6.19. Two factors suggest that the Task Force/Pierce et al. estimate is low relative to our study area. First, the topsoil depths in North Carolina are less than those in the Corn Belt, so a given soil loss results in a greater productivity reduction in North Carolina. Second, the task force estimate, which assumes a high level of management to optimally replace nutrients and maintain certain soil properties, does not incorporate the costs of these practices, whereas a land value study does.

The second method of comparison is examining studies using land values. Miranowski and Hammes used only soil characteristics in their chosen hedonic equations. They estimate that a one-unit reduction in potential erosivity (*RKLS* in the universal soil loss equation) results in an increase in farmland value of approximately \$5.70 based on 1978 data. For comparison with this study, their estimate was adjusted to 1980 dollars using an index of Iowa farmland prices (USDA May 1984). This adjustment yielded a value of \$7.58. In their conclusions they equate the one-unit change in *RKLS* to a change of one ton of erosion per acre per year. This suggests that they have assumed the management and practice factors of the universal soil loss equation are equal to one. Their estimate is higher than the \$3.06 estimate derived in this study. Both Ervin and Mill and Gardner and Barrows obtain more mixed results and are led to question whether, in general, farmland values capture differences in erosion.

A third type of comparison employs the user costs of soil estimates developed by Hertzler, Ibañez-Meier, and Jolly. Using reasonable estimates for crop mix, crop prices, costs, etc., they estimate that .12 inches of soil eroded per acre per year would have a user cost of \$8.33 per acre per year. For comparison with our results, this figure was converted to \$0.46 per ton per acre per year using their estimate that 18.2 tons equals .12 inches of soil. With a discount rate of .05 this annualized cost would have a capitalized value of \$9.16 per ton per acre; if the discount rate were .10 the capitalized value would be \$4.58. These values bracket our estimate of \$6.19 as revealed by land values.

Other Variables

Our estimates suggest that cropland is worth about \$488 per acre more than forest land. Since timbered land can be cleared, is this possible if the land markets are near equilibrium? Clearing land in the study area at that time cost, on average, about \$400 per acre.[7] This clearing cost is reasonably close to the estimate of price differences, especially since quality differences between land used for crops and land used for timber might not be fully captured in the equation.

The value of tobacco quota in 1980 was estimated to be \$2.78 per pound in this study. This value probably differed significantly between counties, but comparison with other average estimates is still useful. Using 1980 Federal Land Bank data for North Carolina, Seagraves and Williamson estimated tobacco quota values at \$3.24 per pound in 1980 dollars. Pugh and Hoover estimated that the North Carolina lease-and-transfer rate for quota in 1980 was 37.79¢ per pound per year. In 1983 the value of quota was approximately five times the rental rate based on a survey of North Carolina County Tobacco Extension Agents. Using this capitalization rate, the Pugh and Hoover estimate represents a value of \$1.89 per pound, so our estimate is well within the bounds of existing estimates.

Finally, the hypothesis that the capitalized value of future soil productivity would be less for land subject to alternative uses than for land expected to remain in agriculture was confirmed. The significant negative coefficient of the interaction term *POPSOIL* indicates that while soil quality is of significant value, this value is significantly reduced for land subject to urban conversion.

Concluding Comments

Overall, the hedonic equation performed quite well, and the results are indicative of the usefulness of hedonic estimation. Individual farmland owners could gain additional information from such studies to assist in making investment decisions. For example, the results can provide an estimate of the average increase in land value due to drainage. This information can be combined with drainage cost estimates in deciding whether or not to drain land, an especially relevant question in the late 1980s because of the loss of benefits that may occur because of the Swampbuster provisions of the Food Security Act of 1985. Similar informa-

---

[7] Personal communication, Rick Hamilton, Extension Forestry, North Carolina State University.

tion can be provided for the landowner concerning the value of erosion control.

Hedonic results also can be useful in policy decisions. For example, the Agricultural Conservation Program provides cost sharing for erosion control practices. The benefits of such practices include maintaining on-farm productivity and reducing off-farm damages from sedimentation. Hedonic studies can help determine the value of the on-farm benefits so that the level of subsidies needed to obtain a particular level of erosion control can be determined.

[*Received September 1986; final revision received June 1988.*]

References

Barnes, Steve. "Agricultural Adaptability of Wet Soils of the North Carolina Coastal Plain." *Pocosin Wetlands: An Integrated Analysis of Coastal Plain Freshwater Bogs in North Carolina,* ed. Curtis J. Richardson. Stroudsburg PA: Hutchison Ross Publishing Co., 1981.

Bartik, Timothy J. "Measuring the Benefits of Amenity Improvements in Hedonic Price Models." *Land Econ.* 64(1988):172–83.

Danielson, Leon E. *The Rural Real Estate Market in North Carolina.* Dep. Econ. and Bus. Econ. Info. Rep. No. 66, North Carolina State University, 1981.

Ervin, David E., and John W. Mill. "Agricultural Land Markets and Soil Erosion: Policy Relevance and Conceptual Issues." *Amer. J. Agr. Econ.* 67 (1985):938–42.

Freeman, A. Myrick. "Spatial Equilibrium, the Theory of Rents, and the Measurement of Benefits from Public Programs: A Comment." *Quart. J. Econ.* 88(1975):470–73.

Gardner, Kent, and Richard Barrows. "The Impact of Soil Conservation Investments on Land Prices." *Amer. J. Agr. Econ.* 67(1985):943–47.

Halvorsen, Robert, and Raymond Palmquist. "The Interpretation of Dummy Variables in Semilogarithmic Equations." *Amer. Econ. Rev.* 70(1980):474–75.

Hertzler, Greg, Carlos A. Ibañez-Meier, and Robert W. Jolly. "User Costs of Soil Erosion and Their Effect on Agricultural Land Prices: Costate Variables and Capitalized Hamiltonians." *Amer. J. Agr. Econ.* 67(1985):948–53.

Kennedy, Peter E. "Estimation with Correctly Interpreted Dummy Variables in Semilogarithmic Equations." *Amer. Econ. Rev.* 71(1981):801.

Lind, Robert C. "Spatial Equilibrium, the Theory of Rents and the Measurement of the Benefits from Public Programs: A Reply." *Quart. J. Econ.* 88 (1975):474–76.

Miranowski, John A., and Brian D. Hammes. "Implicit Prices of Soil Characteristics for Farmland in Iowa." *Amer. J. Agr. Econ.* 66(1984):745–49.

Palmquist, Raymond B. "Land as a Differentiated Factor of Production: A Hedonic Model and its Implications for Welfare Measurement." *Land Econ.* 65(1989): 23–28.

———. "Measuring Environmenntal Effects on Property Values without Hedonic Regressions." *J. Urban Econ.* 11(1982):333–47.

Pierce, F. J., R. H. Dowdy, W. E. Larson, and W. A. P. Graham. "Soil Productivity in the Corn Belt: An Assessment of Erosion's Long-Term Effects." *J. Soil and Water Conserv.* 39(1984):131–36.

Pugh, Charles R., and Dale M. Hoover. "Lease Rates in North Carolina Counties Under the Program for Flue-Cured Tobacco." Paper presented at the 29th Tobacco Workers Conference, Lexington KY, 19–22 Jan. 1981.

Seagraves, J. A., and Fred E. Williamson. *Returns to Investors in Flue-Cured Tobacco Allotments 1975–1980.* Dep. Econ. and Bus. Econ. Res. Rep. No. 42, North Carolina State University, 1981.

Skaggs, R. W., and A. Nassehzadeh-Tabrizi. "Optimum Drainage for Corn Production." North Carolina Agr. Res. Serv. Tech. Bull. No. 274, North Carolina State University, June 1983.

"Soil Erosion and Soil Conservation Policy in the United States." Ames IA: AAEA Soil Conservation Policy Task Force, Jan. 1986.

United States Department of Agriculture, Econ. Res. Serv. *Outlook and Situation Summary: Farm Real Estate.* Washington DC, May 1984.

———. *Soil Productivity Groups in North Carolina: Supplemental Economics Base Information.* Soil Conservation Service and Forest Service, Raleigh, North Carolina, Apr. 1975.