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THE IMPACT OF SOIL CONSERVATION

INVESTMENTS ON LAND PRICES

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Will farmers invest in the optimal amount of soil erosion control? Virtually all economists agree that, at least in theory, farmer's erosion control practices are based on his estimate of the net present value of the investments, or, more precisely, the costs of losing soil to erosion (Ervin and Ervin; Seitz and Swanson).

Whether this investment calculus leads to the socially-optimal amount of investment in soil conservation is debatable. Sub-optimal investment could result from imperfect information, or from divergence between social and private discount rates or planning horizons (Crosson and Stout). Some argue that farmers have imperfect information on the effects of erosion although others argue that the farmer has better information than anyone else.

Some economists argue that the only reason for divergence between social and private discount rates is a difference in the degree to which society (versus individuals) wishes to hedge against the uncertainties of future increases in the demand for food and fiber (Crosson and Stout). Others question whether the market system can or should value one generation's income more highly than another's, except to account for the opportunity cost of capital.

The third major point of disagreement is whether individuals use proper planning horizons. Some argue that the individual will have a shorter planning horizon than the society, especially if the farmer has no heirs to take over the farm. Other economists note that a short planning horizon is not a problem because land prices reflect differences in productivity among parcels, productivity is effected by erosion, and therefore the farmer, taking into account the capital value of his asset at the end of his planning horizon, will invest appropriately soil conservation.

Aside from the normative issues of the discount rate the main argument for public programs to maintain on-site soil productivity hinges on the empirical question of whether the value of conservation investment is capitalized into land prices. If capitalization occurs the farmer has a strong incentive to invest in soil conservation until the present value of the future stream of net income increments due to erosion control is equal to the cost of the investment. Under these conditions there is little rationale for public policies to control erosion on-site (although there may be good reasons to adopt policies to reduce the off-site effects of sedimentation of water pollution).

Amazingly, in spite of the vigorous discussion of these issues there is no empirical evidence to support, or refute, the hypothesis that the value of soil conservation investments is capitalized into land prices--the subject of this research.

METHODOLOGY

Several empirical studies have concluded that soil productivity (as measured by soil type) is an important determinant of farmland prices. Since erosion control affects productivity it might be tempting to conclude that the studies demonstrate that investment in conservation practices is capitalized into land prices. However, previous studies have not measured conservation investment and have been based on gross classifications of soil productivity, using the Soil Conservation Service's (SCS) Land Capability Classes (LCC) or productivity data for entire soil associations. Erosion effects relative land productivity within these categories and is therefore not necessarily incorporated when LCC data or similar measures are used.

In addition, even if very detailed soil quality data were used, the results would not be a test for capitalization unless data on erosion control investment or field measurements of soil quality were included in the model. The difficulty stems from the relationship among soil conservation practices, topsoil depth and soil productivity. Crosson and Stout argue that: over some considerable range of topsoil depth, erosion does not greatly affect soil productivity because the depth is adequate for the plant's rooting zone. At some point further topsoil losses greatly effect yields as the subsoil begins to be plowed into the topsoil and rooting depth exceeds topsoil depth. As topsoil depth continues to decrease, the effect on the already-low yield becomes less dramatic (see Figure 1). Methodologically, the usual soil productivity measures do not reflect the important movement from point A to point B, or even A to C, in Figure 1. Yet a parcel with topsoil depth at point A is more valuable than a parcel represented at B and a well-informed buyer would not be fooled into thinking that the two parcels were identical. Present yields from parcels at points A and B may not differ greatly, but the parcels would be valued quite differently by an informed buyer, assuming that movement from B to C can occur in a relatively short time. Investment in soil conservation can be observed or discovered by the buyer and prices should therefore reflect previous investments. It is critical, methodologically, to include the history of erosion control practices on the parcel.

SAMPLE AND MODEL

Southwestern Wisconsin's Crawford and Vernon counties ideal region in which to test the hypothesis that the value of soil conservation practices is capitalized into land prices. Land is highly susceptible to erosion, erosion has a strong effect on soil productivity, conservation practices dramatically reduce erosion, conservation practices have been used on some parcels for a long time, and adequate land market data are available.

About 70% of the land has a slope of 12% or greater, the soils are well-suited for crops, are very susceptible to erosion on sloping land, and differences in erosion rates among parcels cause considerable differences in potential crop yield. Some parcels have a long history of erosion control and contour plowing/strip cropping has long been both the recommended and the predominant conservation practice. Thus, farm parcels can move quickly from point A to point B and are likely to be at points such as B and C, where small changes in topsoil depth mean large differences in soil productivity.

Accurate data for 158 farmland transfers (1977-79) were available from the Wisconsin Department of Revenue (DOR). Transactions that were not "arms-length" by DOR criteria (e.g. family sales, forced sales, etc.) were excluded, as were parcels near the region's small city and parcels with less than 40 cropland acres (to minimize the impact of recreational demand).

Prices are posited as a function of parcel and transaction characteristics. Parcel characteristics include the proportion of the parcel in cropland, pasture and forest; the proportion of the parcel in the SCS LCC's; the proportion of the parcel in each of six slope classes, with class endpoints at 2, 6, 12, 20, 30 and 100 percent; the proportion of the parcel in each SCS erosion phase--Phase 1 is uneroded, compared to its natural state, Phase 2 is moderate erosion, and Phase 3 is severe erosion in which the topsoil has been largely lost; the average proportion of land on the parcel contour plowed in 1947, 1961, 1967, and 1974, calculated from aerial photographs; distances to the nearest commercial center for farm inputs and consumer goods and to the nearest incorporated municipality; the aggregated value of improvements was available from DOR; and whether the parcel had a very small tobacco allotments. The transaction characteristics include percent downpayment, term (years) of the financing, a dummy variable for land contract finance, the transaction's interest rate, and a price index for all Wisconsin farmland.

A linear hedonic price function was used. The coefficient estimates from the linear, log-log and semi-log forms are highly consistent suggesting that a Box-Cox procedure was unnecessary (Edwards and Anderson).

RESULTS

The full Model 1 explains over 91% of the variation in price per acre.[1] Many of the land quality variables have significant coefficients, such as the large, positive and significant coefficient on the proportion of the parcel in cropland.[2] Both the forest and the pasture variables are excluded because forest acreage and acres in LCC VIIs are very highly correlated. As forest acreage is implicitly included by LCC VIIs, pasture is the excluded class. Of the twenty-five LCC's in the sample parcels, nine appear in only a few parcels with very little variation. Class IVel erosion Phase 1 and slope 6-12% were dropped to avoid singularity.

The LCC class variables are significant taken as a group, and the unexpected positive and significant, coefficients on LCC VIe and VIIs (sloping forested land) may be due to recreational demand for land. The transaction characteristic variables are significant, taken as a group. The coefficients on land contract, term and interest rate are not significant when all are included but each is significant if included alone, an expected result since the variables are highly correlated.

The primary interest is whether past erosion control investments influence farmland prices. The proportions of the parcel contour plowed in the photograph years are highly correlated so the model uses the average proportion contour plowed in the observation years.[3] The coefficient is not significantly different from zero, implying no capitalization. However, it might be argued that contour plowing is simply a reaction to particular (poor) soil characteristics. This is not plausible because in a separate regression, only 52% of the variation among parcels in the proportion contour plowed is explained by the other soil characteristics in the model.

It is of considerable interest to ask whether erosion control investment is capitalized into land prices on those parcels most in need of such investment. An interaction term measuring the proportion of the parcel contour plowed[4] in the presence of severe erosion (proportion in Phase 3) has a positive and statistically significant coefficient (see Model 2). Land in Phase 3 has lost most of its topsoil, so the results imply that if erosion is visible and severe, buyers are willing to pay more if contour plowing is in place. Conservation investment appears to be clearly capitalized into price only when the need is visible and obvious.

This result has two possible explanations. First, the presence of severe erosion may act as a proxy for erosion control need that is not already reflected by other variables in the model. Although this is possible it is not likely given the other variables in the model. The second explanation is that since severe erosion is easily visible to prospective buyers, it may change their perception of the value of existing conservation investments. This is the simple and most likely explanation and is also supported by soil scientists and farmers in the area.

The hypothesis that conservation investments are capitalized into farmland prices should be rejected, at least tentatively. In general it appears that investment is not capitalized, except in the presence of severe, readily visible erosion problems. However, the results are not entirely unambiguous and other conclusions are possible.

First, it is possible that soil erosion does not effect land productivity, unlikely because the soils are highly erosive and both soil scientists and farmers agree that erosion effects productivity strongly. Second, it is possible that conservation investment does not effect erosion, although both studies and the long history of farmers' conservation investments suggest otherwise. Third, it is possible that conservation investment pays only when severe erosion has already occurred. This is both possible and plausible. However, since the movement from point A to point C can occur relatively quickly and since considerable topsoil depth can be lost by lack of conservation investment, this explanation implies that farmers should place little value on the topsoil lost in movement from point A to point B, which would require a <u>very</u> short planning horizon in order to be consistent with rational behavior. More important, to explain away the empirical results it is necessary to argue that land <u>buyers</u> place little value on the movement from point A to point B, a very unlikely proposition.

The most reasonable conclusion is the most obvious--conservation investment is not generally capitalized into farmland values. The most likely explanation for the result is that buyers have imperfect information and cannot easily determine how much erosion has occurred on the parcel, <u>unless</u> the erosion is obvious and visible as is likely for parcels with soils in erosion Phase 3. Any differences in productivity among parcels due to erosion would be easily masked by differences in technology and management, especially in the use of non-land inputs such as fertilizers. In the absence of a visible need for conservation investment, buyers are not willing to pay more for land on which sellers have invested.

If the value of soil conservation investments is not generally capitalized into land prices the rational, well-informed, profit-maximizing farmer will under invest in soil conservation because the value of his land asset at the end of his planning horizon (sale date) will not reflect the value of his investment. The lack of capitalization occurs largely because of imperfect information.

This implies that government investment in soil conservation to maintain on-farm soil productivity may be warranted, depending on the economics of the intervention options and opportunity costs. (Intervention may be warranted because of discount rate divergence or off-site effects as well). A second policy implications is that of the land market could be improved with better information on soil productivity and erosion, one through publicizing the existing soil survey or computerized digitizaton of soil survey and property maps.

The results strongly suggest that more research is needed on the capitalization of soil conservation investment into land prices. The lack of capitalization is contrary to the predictions of theory, although it is likely that imperfect information explains the difference between theory and empirical observation.

However, the empirical results are not totally unambiguous. The data are specific to a time and region, were gathered at the parcel level rather than at the more preferable level of the soil quality unit, and only a single measure of erosion control investment was used. Further research is needed to establish the generality of the conclusions.

FOOTNOTES

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1 All the major results are unchanged when the value of improvements is subtracted from the price. However, this is not an appropriate specification because improvement value is an appraisal rather than a market price and a consistent bias in appraisal could potentially bias other results.

2 "Significant" is taken at the 5% level of probability. Although statistical tests are used, the data represent a census of all farmland sales. The relevant population may be the universe of regions similar to the study counties.

3 Two other possible measures of conservation practice were not included--the proportions of the parcel cultivated and planted to row crops, proxies for the extent and intensity of cultivation, respectively. The proportion cultivated is highly correlated with the DOR cropland variable, and 79% of the variation in row crop acreage is explained by other land characteristics.

4 The model uses the contouring variable in the most recent year because, given that the land is severely eroded at the time of the soil survey (1970), the erosion control practices at the time of sale are probably the most important to the buyer.

REFERENCES

Crosson, Pierre and Anthony Stout. Productivity Effects of Cropland Erosion in the United States. Washington, D.C. Resources for the Future, 1983.

Edwards, Steven and Glen Anderson. "Land Use Conflicts in the Coastal Zone: An Approach for the Analysis of the Opportunity Costs of Protecting Coastal Resources." J. Northeast. Agr. Econ. Council 13(1984):73-81.

Ervin, Christine and David Ervin. "Factors Affecting the Use of Soil Conservation Practices: Hypotheses, Evidence and Policy Implications." Land Econ. 59(1982):277-292.

Seitz, W. and E. Swanson. "Economics of Soil Conservation from the Farmer's Perspective." Am. J. Agr. Econ. 62(1980):1083-1088.

TABLE 1

Land Price Per Acre as a Function of Conservation

Investment and Other Variables

	Model 1		Model 2	
Variable	Coefficient	T-Ratio	Coefficient	T-Ratio
Constant	-404.5	-2.04	-444.9	-2.26
Acreage	-0.2603	-2.43	-0.2608	-2.47
Improvements	1.2767	16.63	1.2773	16.85
Land Contract	10.25	0.26	10.68	0.28
Percent Down	-186.07	-1.90	-193.95	-2.00
Interest Rate	24.00	0.01	342.0	0.19
Years to Pay	-0.179	-0.11	-0.391	-0.25
Price Index	0.3901	5.69	0.3850	5.69
County (Vernon=1)	27.45	1.06	24.34	0.95
Dist-Comm-Cntr	-19.056	-3.08	-17.923	-2.93
Dist-Incorp-Mun.	4.08	0.40	2.14	0.21
Tobacco Acres	-217.3	-0.77	-206.6	-0.74
Prop. Contoured	-91.93	-1.19	-126.33	-1.63
Prop. Cropland	658.9	6.20	663.2	6.32
LCC I	1429.4	1.46	1331.6	1.37
LCC IIe1	460.03	5.02	444.74	4.89
LCC IIe2	181.6	0.50	214.8	0.60
LCC IIe5	12.4	0.04	36.4	0.13
LCC IIw	38.6	0.21	23.4	0.13

TABLE I (continued)

	Model 1		Model 2	
Variable	Coefficient	T-Ratio	Coefficient	T-Ratio
LCC IIIe1	236.5	2.55	264.9	2.58
LCC IIIe2	-56.4	-0.24	-87.1	-0.37
LCC IIIw	291.0	0.84	281.0	0.83
LCC IVe2	189.0	1.55	198.6	1.65
LCC IVe5	-721.0	-0.63	-608.0	-0.54
LCC Vw	-236.0	-0.50	-104.8	-0.22
LCC VIe	321.8	2.23	346.5	2.42
LCC VIs	-299.3	-0.96	-263.4	-0.86
LCC VIIe	-161.8	-0.46	-80.2	-0.23
LCC VIIs	412.7	2.81	452.7	3.10
Erosion Ph. 2	12.38	0.13	48.85	0.50
Erosion Ph. 3	-357.8	-1.62	-832.4	-2.61
Slope 0-2%	-30.64	-0.51	-19.20	-0.32
Slope 2-6%	-64.34	-1.02	-54.90	-0.88
Slope 12-20%	95.09	1.59	94.43	1.59
Slope 20-30%	95.31	1.46	84.99	1.31
Slope 30+%	69.85	1.01	60.03	0.87
ErosionPh3/Contour	--	--	2441.0	2.04
	R^2=.919		R^2=.922	

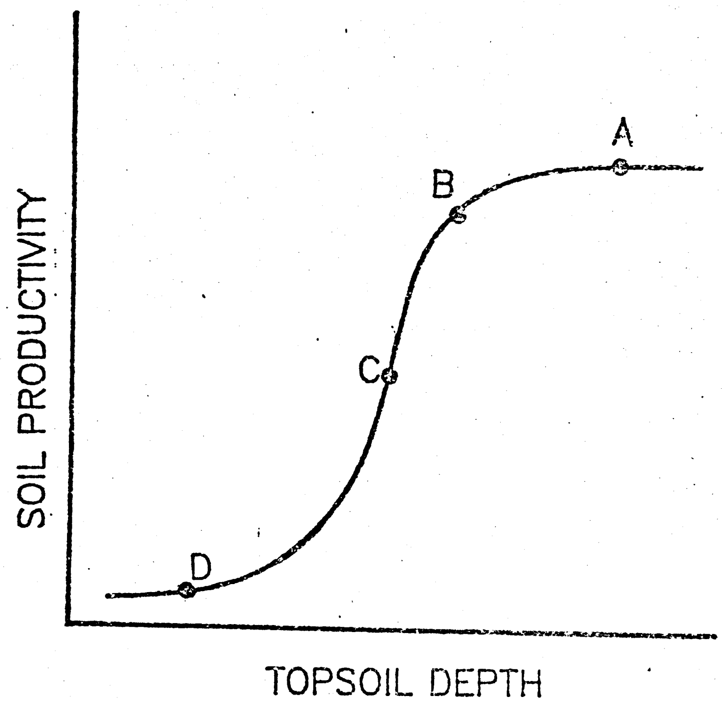

FIGURE 1: TOPSOIL DEPTH AND SOIL PRODUCTIVITY