LAND VALUES AS A MEASURE OF RETURNS TO WATER RESOURCE INVESTMENTS

Dale Colyer
Professor of Agricultural Economics
Division of Resource Management
West Virginia University

Leslie J. Selzer
Economist
Federal Railroad Administration
U.S. Department of Transportation

Introduction

The role that natural resources play in economic development and the effects of investments in natural resources on economic development have been matters of disagreement among economists. An excellent review of the arguments was given by Jansma in his analysis of studies on the investment in small watershed projects for S-71, a Southern Regional Research project (3). The general conclusion was that there were few measurable effects on employment and income from such projects and that these generally were noticeable only after a lag of several years. Colyer, however, in a study of the effects of natural resources on the levels and changes in income and employment in West Virginia concluded that there were links, although not necessary ones, between resource endowments and measures of economic development (1).

The focus of the projects carried out under the Southern Regional effort was relatively narrow in that many other types of investments in natural resources, including water resources, are possible. The criteria for determining the effects also could be expanded from, primarily, employment to other measures of development effects. That is, not all beneficial effects will be measured directly by employment or income although the level of employment and per capita income levels and changes might be more appropriate measures. Investments in resources seldom occur in isolation of other forces which are causing changes. Thus it becomes difficult to separate out the effects of the investments from other and sometimes more quantitatively important influences. Because of these complicating factors it may be necessary to look for alternative measures and/or indirect effects of such investments.

One such alternative may be the examination of land values to determine if the benefits are capitalized into the land. A major effect of farm price supports, for example, seems to have been to affect land prices as shown by Seagraves for tobacco (5). Downing and Jansma used land values to evaluate the effects of public investment in park facilities and Knetch also used land values to determine the effects of TVA reservoir (6,4). Where land owners are the primary beneficiaries of a program or investment they may tend to ascribe the benefits to the land and to place a higher value on it and if land buyers also recognize such benefits they will pay more for the land. Analysis of changes in land values or of the factors affecting land values may, then, be an appropriate method for indirectly determining benefits from projects where land is an important factor.

Land values, as employment and income, are affected by many factors and therefore many of the same measurement problems will affect such studies. Land, unlike people, is fixed geographically. Due to legal requirements for reporting and recording land sales and values, data on land prices can be determined from public records for any period of time and through time. The main requirement is that the land market be active enough so that a sufficient number of observations can be obtained. While each parcel of land is unique, at least as to exact location, generally it is possible to obtain enough information of its characteristics to allow statistical analysis. However, to estimate the parameters an econometric model of land values must include a sufficient number of observations on sales of land parcels which vary with respect to the characteristics being studied.

This article reports on a study of values for land surrounding major flood control projects in West Virginia (6). The purpose is to test the hypothesis that many of the recreational and related benefits from such multipurpose projects become capitalized into the values of the surrounding land. Statistically significant relationships between reservoir related variables and land values would tend to support the hypothesis and to indicate that natural resource investments do produce benefits.

Procedures and Data

The basic data used for the study were obtained from the public land records kept by the counties where the flood control reservoirs are located. Data relating to values, size, assessments, etc. of land sales within five miles of the projects for the periods of time during and subsequent to the construction of the dams were obtained from the land (tax) books, transfer records, and deed books. Additional information on physical characteristics of the parcels of real estate were obtained from the county offices of the Soil Conservation Service. Information on each of the reservoirs was obtained from Corps of Engineers publications while other sources of data were USDA publications, census reports, State government publications, and county government reports. Location and distances were measured on tax maps in the County Assessors' offices. Some 14 independent variables were defined for use in analyzing the factors which affected land values around each of the reservoirs (Table 1).

A stepwise, multiple regression model was used to determine which of the variables were associated with land price variations with a ten percent probability level used for retention of variables in an estimated equation. Both reservoir and nonreservoir related variables were used in the model to avoid specification errors from omitted variables. A preliminary correlation analysis indicated that inter-correlation between some of the independent variables could be a problem, implying the need to delete some of the variables. In general of an inter-related pair, the variable with the largest correlation with the dependent variable was kept in the model. The interrelated variables differed from one site to another.

The dependent variable in the model was the per acre price paid for a parcel of land deflated by the consumer price index for the year of the sale, including the value of improvements which are included in reported sale prices. Until recent years the consumer price index was a fairly reliable indicator of changes in the general level of land prices which were affected by the same forces as other goods, but the purpose of deflation in this analysis was to remove the effects of the general inflationary trend in all prices. Another technique sometimes used to remove trends in time series data is to include a time variable as one of the independent variables. The data for this study includes both time series and cross sectional data; that is data on a large number of sales for each year were collected for a period of several years during and after the construction of the reservoirs.

A time variable, year of purchase, was used in this analysis as an independent variable. Since development takes time and is a continuous process, it would be expected that the increase in land prices resulting from the investment would exceed the general rise in prices. The time variable would allow for measuring this developmental process, i.e., would tend to capture any increases in real values that may result from capitalization into land values of the benefits associated with the reservoirs.

Equations were estimated for each of the three reservoir sites separately and for all the data combined. Combining the data allowed inclusion of reservoir specific variables such as cost and size of the reservoir. Since only three observations were available for these types of variables they act more as classification variables than as continuous variables. Care is required in their interpretation, however, since they may reflect site differences as much or more than the effects intended to be determined.

Reservoir Characteristics

The three reservoirs selected are all Corps of Engineers projects where flood control was a primary justification for their construction although recreation and wildlife benefits were included as part of justification in the cost-benefit analyses. All are located in the south-central area of West Virginia on tributaries of the Kanawha River. The sites vary considerably with respect to soil types, topography, accessability, and dates of construction. All had been constructed for a sufficiently long time that a major share of the benefits could have been realized.

The Bluestone Dam and Reservoir was started before WW II, but construction was halted during the conflict, resumed in 1948, and completed in 1949. The total cost was $29,180,631 of which $1,771,149 was for land acquistions. The reservoir occupies an area of 25,635 acres. It is located in Summers County, near Hinton the county seat, and is in an area that is relatively inaccessable. The land in the area and particularly that surrounding the reservoir is hilly to mountainous with a large portion characterized by very steep slopes. Relatively little development has occurred around the lake and thus the effects on land values should not be as great as in areas where more development has taken place.

The Sutton Dam and Reservoir is on the Elk River in Braxton County. Construction was started in 1949 and completed in 1961. The project cost $36,792,500 with $2,369,303 for land purchases. Some 13,375 acres are involved in the project, which is more accessable than the Bluestone area although still somewhat isolated. The terrain in the area is also rough but less steeply sloped than around Hinton and the Bluestone Reservoir. More development also has occurred and thus somewhat greater effects on land prices could be expected to have taken place.

The Summersville Dam and Reservoir, on the Gauley River in Nicholas County, was started in 1960 and completed in 1966. The project covers 9,346 acres and cost $47,900,000 of which $1,777,980 was for land purchases. The terrain is the least steeply sloped of the three sites, the area is closer to larger population centers, and is more accessable. A considerable amount of development of both a residential type, including vacation and second homes, and of a commercial type has occurred. Thus considerably more pronounced effects on land prices could be expected to have occurred.

Results of Analysis

The regression coefficients and related statistics from the estimated equations are shown in Table 2. All four equations explained a statistically significant portion of the variation in deflated per acre land prices, with F ratios that varied from 7.2 to 22.1. The R^2 values ranged from only 0.20 to 0.49, meaning that only from one fifth to one half of the variance was explained by the variables used. Relatively low R^2 values are a less serious problem in regression analyses that seek to isolate significantly related variables than in those that seek to obtain a predictive model. The major purpose here was to test the hypothesis that the reservoirs tend to increase the value of surrounding land.

Reservoir related variables were found to be associated with land prices in all four equations. These included location of the parcel of land relative to the dam (above or below), distance from the reservoir (linear and squared terms), year of purchase, and for the combined data equation the construction cost per acre of reservoir. The latter variable could only be used for the combined data since it has the same value for every observation at each of the three sites. Its significance in the combined data equation is probably more due to site differences than to cost per acre of the projects; the sign was negative, the opposite expected since it could be assumed that the more expensive projects would have greater impacts.

All of the other reservoir related variables were in at least two of the equations but none of them were in all four or even all the three individual reservoir models. These results indicate that although the reservoirs did tend to affect land values there are differences due to the conditions surrounding a reservoir. The variable for year of purchase was statistically significant in all but the Sutton equation, but was negative for the Bluestone and combined data equations and positive for Summersville. The sign of this variable indicates that land values in the Bluestone area tended to increase at a rate less than the rate of inflation while at Summersville land values increased at a rate above the inflationary trend. The coefficient for this variable for the Sutton Reservoir area was not 'statistically different than zero' which can be interpreted to mean that land prices increased at about the inflation rate when the effects of the other factors are considered.

Distance from the reservoir was found to be related to land values at both Sutton and Summersville. At Sutton distance was related in a quadratic form, with a positive linear term and a negative squared term indicating that land values increased with distance but then reached a peak and subsequently declined with greater distances. Solution of the first derivative of the estimated equation with respect to distance showed that land values were at a peak about two miles from the reservoir. For Summersville only the linear term was significant and with a negative coefficient which means that land values tended to decline with distance from the project's shoreline, the expected result.

Location relative to the dam, above or below, was related to land values at Bluestone with land downstream from the dam valued higher, i.e., the coefficient for the dummy variable (where a one represented the downstream location) was positive. At this site the land surrounding the reservoir is very hilly to mountainous with a high proportion having steep slopes while the land below the dam is in the river valley and thus commanded a premium as it also would in the absence of a reservoir.

The nonreservoir related variables that were found to be statistically associated with deflated per acre land values were terrain, building assessments, tax class, and public expenditures per acre of land in the county during the year of the sale. The building assessment variable was the only one that was statistically significant in all four equations. It was positively associated with values and represented the relatively higher value of land that had inprovements in relation to unimproved properties. This would be expected since houses and other buildings are a component of the value of the property.

Terrain or topography was related at both Bluestone and at Sutton. For this variable the land was classified as mountainous, hilly, relatively level upland, and bottomland with values, respectively, of one to four. The flatter land was considerably more valuable at the two sites and especially so at Bluestone where relatively little level land exists. The variable did not enter the equation for the Summersville location where the amount of level land is comparatively abundant. Tax class was in both the Sutton and Summersville equations with negative signs on the coefficients. In West Virginia owner occupied residential property and farms are in Class II while commercial properties are in Classes III and IV which are taxed at rates at least twice that of Class II property. The higher tax rates could contribute to the lower values although generally commercial properties are substantially more valuable than those in other uses and development should be expected to lead to a greater commercial use and value. However, the opposite effect found may be explained by higher per acre values of improved residential properties, including second and vacation homes, where the lots are small in size and therefore have high per acre values. A considerable amount of subdivision has taken place, especially at Summersville. The only other variable which entered an equation was public expenditures per acre of land in the county at the Summersville site. This may reflect the greater level of public services being offered in the area around the reservoir and which are both a cause and result of the development.

Conclusions

The primary conclusion of this study of the effects on land values of public investments in major flood control dams is that while they appear to have a generally positive effect this is neither necessary nor similar from one project to another. Thus, cost-benefit studies should take the site features into account if they are to be accurate. Other than flood control which benefits the areas further downstream, the primary uses of such projects are recreational in orientation. These uses tend to be concentrated near the reservoir and many of them tend to be capitalized into the value of the surrounding land. For the potential benefits to be realized, however, the terrain needs to be amenable to development and the site needs to be accessable to relatively large numbers of users.

The three reservoirs studied represent different levels in relation to the potential for achieving the recreational benefits. Summersville is closer to larger population concentrations than the other sites and has relatively level land. Consequently there has been considerably more development and land prices have increased more rapidly than inflation. At the Bluestone site, on the other hand, the terrain is hilly to mountainous with the immediately surrounding land very steeply sloped, the area is somewhat isolated and inaccessable, relatively little development has occurred, and land values have tended to increase less rapidly than the rate of inflation. The conditions at the Sutton Reservoir are intermediate, between those of the other two sites and development and land price changes also have been in between those of the Summersville and Bluestone Reservoir areas.

Table 1

INDEPENDENT VARIABLES USED IN REGRESSION ANALYSIS

Variable Name	Variable Description
TOWN	Distance from nearest town in miles
YEAR	Year of Purchase (1950, 1951,...)
TAX CLASS	Tax Class (2=0, 3 or 4=1)
SIZE	Size of parcel in acres
LOCATION	Location relative to dam (below - 1, Above - 0)
DISTANCE	Distance from reservoir in miles
SOIL	Soil type, ordinel increasing with quality
POPULATION	Population per square mile of county in year of purchase
TERRAIN	Topography: 1. Mountainous, 2. Hilly, 3. Level Upland, 4. River Bottomland(Entered as Dummy Variable)
TAXES	Deflated taxes per acre, deflated by CPI
EXPEND	Deflated public expenditures per acre in county, year of purchase
ASSESBLG	Deflated building assessment per acre, prior to sale[a/]
COST	Cost of construction per acre of reservoir
OWNERSHIP	Fee ownership (1) vs. Surface rights only (0)

[a/] Buildings are a portion of real estate values and are included in the per acre values, used as the dependent variable. The assessment for buildings is included as an independent variable to account for value differences due to the necessity for including these in the dependent variable.

Table 2

Results of Stepwise Regression on Land Values
Around Flood Control Reservoirs in West Virginia

Statistic or Variable	Regression Coefficients, Standard Error, or Other Data[a]			
	BLUESTONE	SUTTON	SUMMERSVILLE	COMBINED
YEAR OF PURCHASE	-325.08 (98.77)	N.S.	469.10 (182.21)	-202.00 (68.96)
DISTANCE	N.S.[b]	2,317.28 (1,173.25)	-820.37 (342.47)	N.S.
DISTANCE SQUARED	N.S.	-592.98 (258.32)	N.S.	N.S.
LOCATION FROM DAM	3,543.44 (1,084.78)	N.S.	N.S.	1,853.70 (535.40)
COST OF DAM	N.A.[c]	N.A.	N.A.	-0.35 (0.19)
BUILDING ASSESSMENT	177.72 (59.12)	51.71 (24.40)	95.32 (34.11)	79.58 (25.22)
TERRAIN	4,496.21 (579.92)	1,251 69 (366.64)	N.S.	2,730.88 (327.12)
TAX CLASS	N.S.	-1,720.28 (1,191.27)	-1,454.10 (741.50)	N.S.
PUBLIC EXPENDITURES	N.S.	N.S.	5.61 (2.08)	N.S.
INTERCEPT[d]	629,090	-2,455	49,543	
R SQUARE	0.49	0.20	0.44	0.31
F RATIO	22.1	7.7	7.2	22.0
STANDARD ERROR OF ESTIMATE	4,912.	2,860.	2,393.	4,133.

[a] Standard error of regression coefficients are in parentheses.
[b] N.S., not statistically significant 0.10 or better.
[c] N.A., not applicable in individual site model.
[d] Intercept may be very large because of use of actual date for year of purchase.

References

1. Colyer, Dale, "Natural Resources in Community Development: A Preliminary Study", J. Northeastern Agr. Econ. Council,: October 1975.

2. Downing, Roger H. and J. Dean Jansma, The Economic Impact of Public Investment on Property Values in York County, 1950-1965 Research Publication No. 61, The Institute for Research on Land and Water Resources, Penn. State Univ., April 1970.

3. Jansma, J. Dean, Measuring the Impact of Rural Development Activities on Natural Resource Investment, Staff Paper #10, Food and Resource Economics Department, University of Florida, July 1975.

4. Knetch, Jack L., "The Influence of Reservoir Projects on Land Values," J. Farm Economics, 41:234-243, May 1964.

5. Seagraves, James A., "Capitalized Values of Tobacco Allotments and the Rate of Return to Allotment Owners", American J. of Agricultural Economics, 51:320-334, May 1969.

6. Selzer, Leslie J., The Effects of Flood Control Reservoir Projects on Regional Land Values in West Virginia, Unpublished Ph.D. Disertation, West Virginia University, Morgantown, 1975.