Publications

TR-99

The Economic Value of Irrigation Water in the Western United States: An Application to Ridge Regression

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- Full Text

Reliable estimates of the demand characteristics of irrigation water are crucial to successful water policy formulation in the West. Although various studies concerning irrigation water demand exist in the literature, most are somewhat limited in scope and present their results in varied forms. Thus, comparison of results presents a problem. This study follows a more comprehensive approach by determining the demand characteristics, viz., water value, demand elasticities, etc., for major western irrigated regions. These results should prove useful in water policy formulation and evaluation.

Eleven homogeneous regions were identified as major irrigated areas of the West. Agricultural output (in value terms) in each region was hypothesized to take the form of a multiplicative function with nine domain variables, i.e., irrigation water applied, value of land and buildings, hired labor expenditures, fuel and lubricant expenditures, fertilizer and lime expenditures, feed expenditures, value of machinery inventory, value of livestock inventory and miscellaneous expenditures.

Using *1969 Census of Agriculture* data, each regional function was statistically fit using both ordinary least squares (OLS) and ridge regression. As expected, parameter estimates under OLS were highly unstable due to high correlations among the explanatory variables (multicollinearity). One-third of the estimated coefficients took on nonsensical signs and the standard errors were generally high.

To circumvent the multicollinearity problem ridge regression was employed. While admittedly a biased estimation technique, the credibility of the estimates appeared to increase. All parameter estimates, except for one out of 99, took on the expected positive sign and the standard errors were decreased in every case. Returns to scale were

estimated to vary from a high of 1.200 in the Northwestern Ogallala to a low of .887 in the Lower Rio Grande Basin. Overall, the functions estimated with ridge regression were more compatible with theoretical expectations than those based on OLS estimates.

From the fitted production functions, the demand for irrigation water was derived for the long run, two intermediate runs and the short run. Generally, water demand was found to be slightly elastic for all lengths of run considered with the more elastic demand in the Desert Southwest and Upper Colorado Basin, and slightly less elastic demand in the Snake-Columbia, Lower Rio Grande Basin and Northwestern Ogallala. The quantity of water applied was found to be most sensitive to product price in the Central California, Desert Southwest, Upper Colorado Basin and Northwestern Ogallala Regions. In terms of cross-factor effects, water application rates were found to be most responsive to changes in the prices of land and labor for all regions.

Marginal irrigation water values for each length of run considered were estimated for 1969 at the respective regional mean values of water usage, fixed input levels and variable input prices. These estimated values varied from a high of $27.79 for the long run in Central California to a low of $1.71 in the short run for the Snake-Columbia Basin. It appears that the value estimates may be distorted in some instances due to the influence of livestock variables in the model. Subsequent research should attempt to correct this deficiency.

Projections of values for 1974 (a census year) and 1978 were made with the assumption of no change in technology and level of "fixed" input and water - usage since 1969. Though a somewhat gross projection, water values were found to increase until 1974 and then decrease in 1978. These projections should serve as a basis for possible later validation by other researchers.

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