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Title: Hedonic Price Analysis to Reveal the Value of Water in Irrigation: An Application to Northern Malheur County, Oregon

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Increasing water demand for growing municipalities, for water-based recreation and for fishery and wildlife habitat has intensified pressure on the existing resource. Reallocation of water from existing uses to other, higher-valued uses is receiving greater attention due to constraints on development of new water supplies. A key to reallocation is identification of the economic value associated with existing and alternative water uses. A hedonic price analysis of farm sales in eastern Oregon is performed to reveal the value of water used in irrigation. Estimation includes a joint test of heteroskedasticity and functional form. The value of water is shown to be strongly influenced by the crop-growing-capability of the soil on which it is applied. The value of an irrigated acre is not significantly influenced by the source of irrigation supply. The implicit market price of irrigation water in this area ranges from $44 per acre-foot (one-time delivery) on the best soils to $9 per acre-foot on the poorest soils irrigated.

HEDONIC PRICE ANALYSIS TO REVEAL VALUE OF WATER IN IRRIGATION: AN APPLICATION TO NORTHERN MALHEUR COUNTY, OREGON

by

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I understand that my thesis will become part of the permanent collection of the Oregon State University libraries. My signature below authorizes release of my thesis to any reader upon request.

John Faux, Author

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TABLE OF CONTENTS

CHAPTER PAGE

TABLE OF CONTENTS, (CONTINUED)

TABLE OF CONTENTS, (CONTINUED)

CHAPTER PAGE

LIST OF FIGURES

LIST OF TABLES

HEDONIC PRICE ANALYSIS TO REVEAL VALUE OF WATER IN IRRIGATION: AN APPLICATION TO NORTHERN MALHEUR COUNTY, OREGON

1. INTRODUCTION

1.1 Problem Statement

Growing populations in the western United States exert continually greater demands for water. These demands are growing not only in magnitude but also in variety. Growing cities require greater volumes to satisfy additional customers, per capita demand for water-based recreation is increasing and pressures are mounting to restore and preserve environmental systems dependent on streamflows.

Water supplies in the western United States were and are allocated according to the prior appropriation doctrine. This results in the more reliable water supplies being controlled by the earlier water users, which in most cases are irrigators. Most of the easily diverted waters were appropriated by the end of the 19th century. Then followed the age of dam building which developed "new" water supplies by moving water from times of excess to those times when needed. The past twenty years have marked the end of most dam building in the western U.S. as available federal funds have diminished and environmental concerns have increased.

Development of new water supplies has ceased to be a ready solution to the increasing demands for water. This has lead to an increasing need for and consequent trend toward reallocation of existing water supplies (Howe et al., 1986; Gould, 1988; Reisner and Bates, 1990; Colby, 1991). The majority of existing developed water is devoted to irrigated agriculture. Water supply for municipalities and instream flow for habitat and recreation are the two uses experiencing the greatest growth in demand. In many cases the economic value of water in municipal use or for environmental enhancement is several times the value in its existing use for irrigation (Young, 1984;

Duffield et al.1992). Reallocation can achieve substantial gains in economic efficiency. However, the nature of the resource makes reallocation difficult and expensive.

Water is a fugitive resource with low economic value per mass or per volume. Due to its low unit value and liquid state, water is constantly being lost along the way. Irrigators typically consume one-half of the water they divert from streamflow. The other half of the water diverted, called return flow, almost always becomes available for rediversion by another water user downstream. Because this return flow represents an important supply relied upon by others, western states water law has recognized the need to maintain return flows to protect that reliance. Ultimately, what happens in a highly appropriated stream basin is that any change in water use affects other water users. To insure no injury to other water users, western states require careful analysis of any proposed change in use of water rights and typically impose constraints on the new use of the transferred water rights (Rice and White, 1987).

Protective provisions are also typically imposed to safeguard the interests of irrigators who continue to irrigate from the same ditch from which water was transferred. Often a requirement is made that annual assessments shall continue to be paid because the entire ditch continues to require maintenance. Another common requirement is that the portion of subject water that historically seeped from the ditch is left in the ditch since essentially the entire historic ditch seepage will continue in the future.

Sale of water rights is made on a willing seller-willing buyer basis. As long as provisions are made to protect third-parties from injury caused by a change of water rights, overall economic welfare can be increased without making any individual worse off.

Because reallocation of water rights is a technically and politically difficult task, there is in most regions of the west very little buying and selling of water as a separate commodity. Usually, water is sold along with the land on which it is applied. This relative lack of a market in water is particularly acute in Oregon, where irrigation rights are by law appurtenant to specific parcels of land. In other states, irrigation rights typically are decreed for the geographic area served by those rights. The water provider which holds those water rights issues shares which represent a fractional right to the total supply of that provider. The shares can be bought and sold and the water delivery moved within the service area of that provider without oversight by the state regulatory agency. This allows easy reallocation of water supplies within that area and a limited market for water. In Oregon, even this limited trading of water is restricted by state regulatory requirements.

The absence of a well functioning market in water creates two problems: efficiency gains are lost due to the difficulty of reallocation, and price signals to aid in reallocation are absent. Price signals are critical to reallocation as prices indicate the relative value among possible uses and provide the incentive needed to move the resource toward higher valued uses. Price signals come from water sales but physical and legal impediments to water transfers limit the number of sales. Without sales, explicit price signals are missing, eliminating an economic basis to guide and spur reallocation.

Water rights were and are granted pursuant to the prior appropriation doctrine without regard for relative economic value. Much of the allocation of funds to develop water supplies through federal water projects was guided by political action rather than economic efficiency. Today, the growing need for reallocation is generating a growing need for valuation of water rights.

Examples of situations where valuation of water resources are needed include programs to purchase water for instream flow use, litigation and negotiations involving Indian claims to reserved water rights, benefit cost analysis of proposed construction of dams and transbasin diversions, and acquisition of agricultural water supplies to meet growing municipal demands (Young, 1978; Colby, 1989). In the Pacific Northwest, a major concern is reallocating water to aid in recovery of endangered species.

1.2 Salmon Recovery

Salmon populations in the Snake and Columbia River basins depend on streamflow for survival. The decline of salmon populations in recent years has impacted economies dependent on the salmon and has threatened extinction of species. This crisis has spurred research and calls for action to aid salmon recovery.

In the 1800's there were an estimated 1.5 million spring/summer chinook in the Snake River. By 1994 there were approximately 1800 adults. Fifty years ago there were about 72,000 fall chinook in the Snake River. Four hundred adults were counted at Lower Granite Dam in 1994. Forty years ago, adult sockeye returning to Red Fish Lake numbered over 4000. In 1993, only eight adult sockeye returned to Red Fish Lake. There are many activities that have contributed to the decline of salmon populations including hydropower dam operation, water storage and diversion for irrigation, over-fishing, habitat destruction, land use and hatchery practices (National Marine Fisheries Service, 1995).

Many agencies, both federal, state, regional and international are working to restore salmon populations in the Snake and mainstem Columbia rivers. In 1991 and 1992 the Snake River sockeye salmon and chinook salmon were listed pursuant to the Endangered Species Act. Various studies have been conducted to evaluate means for recovery of salmon populations. These means can be categorized as involving habitat, harvest, hatcheries or hydropower.

One action that has been studied and was recommended by the Snake River Salmon Recovery Team to the National Marine Fisheries Service is flow augmentation in the lower Snake and Columbia rivers. This has the benefit of improving migration of juvenile salmon, called smolts, downstream during the spring and to a lesser extent assisting passage of adult salmon back upstream during the fall. Specific recommendations for flow augmentation include creation of a water market in Idaho, legal recognition of instream flow as a beneficial use, negotiation for additional upper Snake River water, allocation of more water in the Snake and Columbia rivers for control and management by fishery agencies, and adjusting the timing of water release to provide best improvement of salmon survival (Snake River Salmon Recovery Team, 1993).

Flow augmentation can improve downstream migration of smolts by increasing velocity of water flow. Flow augmentation can improve upstream migration by insuring sufficient water is available for proper operation of fish ladders. Given the Snake River is essentially fully appropriated, implementation of this component of the salmon recovery plan will involve purchase of water rights from irrigators (Huppert and Fluharty, 1995).

As a pilot project, the Bonneville Power Administration (BPA) operated a temporary lease agreement in 1994, 1995 and 1996 to fallow land in Malheur County near the confluence of the Malheur and Snake Rivers. Cessation of irrigation on over 5000 acres of mostly sugar beets resulted in 16,000 acre-feet of water not being pumped from these rivers (Daley, 1996).

The Bureau of Reclamation is pursuing other sources of irrigation water in the Snake River basin for use in augmenting river flows to aid salmon migration. Estimation of the appropriate bid price for this water is needed to ensure that the maximum amount of water for salmon is purchased for a given amount of taxpayer funds while at the same time ensuring that irrigators are justly compensated for the value of their water.

1.3 Project Overview

This project examines the value of irrigation water in northern Malheur County, Oregon. Hedonic price analysis of irrigated land sales enables estimation of the implicit market price of irrigation water.

The study area is the irrigated region surrounding the towns of Ontario, Vale and Nyssa. The primary water sources are the Malheur, Owyhee and Snake Rivers. Principal cash crops are onions, potatoes and sugar beets. Annual precipitation averages eight inches. The Bonneville Power Administration temporary lease in 1994-96 of 16,000 acre-feet per year of water came from a large farm in this area.

Hedonic price analysis is a technique that uses multiple regression to disaggregate and identify the values associated with parts of a composite good. Irrigated farmland property is a composite, or bundled, good, being composed of soil, water supply, buildings and other attributes such as proximity to town. This bundled good sells for a single price. Multiple regression analysis allows this single price to be explained by the components of the bundle. In this way, the value of water, as implicitly determined in the marketplace, can be revealed.

The objective of this project is to estimate the implicit market value of irrigation water in the Ontario-Vale-Nyssa area. Included in this objective are the goals of identifying and evaluating the influence of soil quality on irrigation water value and the goal of identifying and evaluating differences in the value of an irrigated acre attributable to different water districts.

In Chapter 2 the use of hedonic price analysis in general and as applied to land sales is discussed. Chapter 3 describes the attributes of the irrigated property included in the study. Chapter 4 presents the model specification and testing. Chapter 5 provides interpretation of the results and Chapter 6 is a summary.

2. HEDONIC PRICE ANALYSIS

2.1 Use of Hedonics

Hedonic price analysis permits disaggregation of the values bound up in a bundled good. Through use of multiple regression, the values contributed by the components, or attributes, of a bundled good are separated. Because irrigation water is commonly sold as a component in a bundled good, hedonic price analysis is well suited for estimating its market value.

Irrigation water is usually sold as part of an irrigated property including land, buildings and water. Where water is sold detached from land, the value of water can be observed directly in the marketplace. Even where water is sold alone, the water includes a number of attributes which affect its value. Location can affect its value. For instance, water located high in the watershed represents greater potential energy for hydropower generation and provides the ability to divert by gravity to locations at higher elevation in the watershed. Location in a particular watershed will affect the value of water through the interaction of local supply and demand because of its bulk and weight. It is far easier to arbitrage the price of potatoes across several states than is to do the same for water.

Other important attributes of water include quality and reliability. High quality water presents less treatment cost for use in municipalities and industry. Water of low salinity used in irrigation avoids costs of salinization of soils and associated leaching and drainage requirements and reduced crop yields. Reliability refers to the assurance that water will be provided in amounts expected when expected. Because precipitation and runoff is a stochastic process, this is not always assured. The prior appropriation doctrine deals with this by allocating the available supply according to seniority of appropriation. In this way, more senior appropriators can expect and do receive a more reliable supply of water.

Because water is a multidimensional commodity, its value will vary depending on location and type of use. Where water is sold as a separate commodity, it is necessary to evaluate the attributes of water sold before extrapolating observed prices to other water supplies. Where water is sold as a separate commodity, comparable sales can be used to place a value on water. Similar to the way residential real estate is appraised, recent sales of comparable water supplies can be evaluated and the observed prices adjusted to reflect the character of the subject water supply. Regression analysis can be applied to observed market sales of water supplies to systematize the comparison and price adjustment process. Colby et al. (1993) used regression analysis to evaluate the factors influencing the price of water sold apart from land in southwestern New Mexico. Price per acre-foot paid was found to be influenced by water right priority and size of transaction. That is, price per acre-foot was greater for more senior water rights and for transactions involving smaller quantities of water.

Where water is sold in a bundle with land and buildings, hedonic price analysis can be used to separate out the value of water. Hartman and Anderson (1962) analyzed 44 farm sales in northeastern Colorado to estimate the value of water provided by a federal water project. Crouter (1987) evaluated 53 farms in the same area.

Hedonic price analysis has been applied to farm sales data to investigate other issues, including perception of and activity affecting erosion, the influence of urban growth on land values, and the use of hedonic analysis in rural real estate appraisal. Jennings and Kletke (1977), Chicoine (1981), Miranowski and Hammes (1984), Ervin and Mill (1985), Gardner and Barrows (1985), Palmquist and Danielson (1989), and Xu et al. (1993) have all demonstrated statistically significant results from the application of hedonic price analysis to farm sales data.

2.1.1 Market vs Production Value

Hedonic price analysis is applied to market transactions. As such the estimated implicit values for attributes reflect market valuation. This has the advantage of being based on actual market transactions, rather than on surveys of hypothetical choices or mathematical simplifications and simulations of production.

In an area where buyers and sellers value irrigation water for its contribution to agricultural productivity, the revealed market value will represent the value in agricultural production. In an area where buyers and sellers recognize a possibility for the water to be used in higher-valued municipal and industrial uses or amenity uses such as second-home property, the revealed market value will be greater than the value in agricultural production. In a situation such as this, if the objective is to determine the value in agricultural production, a technique other than hedonics would be necessary.

2.1.2 Other Methods of Water Valuation

There are many alternative ways to value water. Much of the pioneering work is shown in Eckstein (1958) and Young and Gray (1972). One method relies on a farm enterprise budget. Water value is estimated as total revenue minus non-water factor costs. This is sometimes referred to as the residual value method. Another commonly employed method uses the farm enterprise budget to build a linear programming model of profit maximizing crop production. In this method, the marginal value of water is obtained directly from the shadow price on water.

Sometimes it is possible to value water based on the difference between farm income with and without an additional increment of water. This is the procedure recommended by Young and Howe (1988) for economic evaluation of applications for new water appropriations in the Snake River basin in Idaho. In a similar way, it may be possible to value water as the difference in land price between irrigated and non-irrigated land. In other circumstances, it may be appropriate to estimate a maximum willingness to pay based on the least-cost alternative water supply available. This estimation procedure is usually applied to water demands associated with municipal and industrial projects where the alternative water source typically involves purchase from a water wholesaler or construction of facilities to develop new supplies.

2.2 Theoretical Foundation of Hedonic Price Analysis

Rosen (1974) is frequently cited for establishing the theoretical model which serves as the basis for hedonic price analysis. That model considers consumers and producers of a bundled consumer good. Palmquist (1989) extended the Rosen model to derived demand for a factor of production such as land.

Hedonic price analysis is based on the fact that under perfect market conditions, the price of an attribute will equal the marginal utility of that attribute, or in the case of a factor of production, the price of an attribute will equal the value of marginal productivity (VMP) of that attribute. Take, for example, the rental price of a piece of farm land. If the rental price is less than the value of the marginal productivity of that land, then economic profit is being obtained and another farmer would be willing to bid up the rental price to acquire use of the land and obtain a portion of the profit. This bidding up of the price would continue until the price matched the VMP and profit was eliminated. If the rental price exceeded the VMP, the farmer would be better off not renting the land. The land owner, in that case, would be better off lowering the rental price enough so that a farmer would be willing to rent the land.

Hedonic price analysis can be applied to land rental prices, though more typically it is applied to land sales. Sale price reflects the present value of expected future rents. Since land sales reflect the future stream of land rents and land rental prices reflect the marginal value of land productivity, farm sale prices can be used to reveal land productivity values. Since water is a major factor in influencing land productivity in arid regions, farm sales can be used to evaluate the value of irrigation water.

Note that sale price equals the present value of *expected* future rents. If expectation of future return to the land exceeds current return, then sale price will not reflect current productivity value. Instead, sale price will include a component of speculation.

2.3 Necessary Conditions for Hedonic Price Analysis

Hedonic pricing theory assumes the existence of several conditions (Freeman, 1993). To the extent these conditions do not hold in practice, the hedonic price analysis will be less than ideal. First, it is assumed that the market is in equilibrium. That is, the supply of all attributes will equal the demand for those respective attributes. To achieve this equilibrium, the price of each respective attribute will adjust to clear the market of that attribute. Second, all combinations of desired attributes will be available. Freeman likens the hedonic market to a vast warehouse of shopping baskets (the bundled good) each filled with various combinations of goods (attributes). The buyer must choose from the available baskets. Utility is maximized by the purchaser by selecting the specific quantity and quality of each attribute such that the marginal utility from each attribute equals the respective market price for that attribute. In order to achieve this, a basket must be available that includes those specific attributes.

Third, both buyers and sellers have full information of both attributes and prices. Fourth, search, transaction and moving costs will be zero. To the extent these costs are nonzero, marginal utility (or productivity in the case of land) will not be fully reflected in market prices.

Fifth and finally, all observations come from a single market. Separate markets (or a segmented market) will result where there exists distinctly different supply and/or demand functions and a barrier exists between the market segments. In the field of water resources, market segmentation can be expected to occur where watersheds enjoy different natural endowment and geography or institutions restrict movement of water between the basins. Drawing a sample from structurally different markets may confound the ability to discern attribute prices (Palmquist, 1991).

2.4 Second Stage of Hedonic Price Analysis

Hedonic price analysis enables the implicit market price of an attribute in a bundled good to be revealed where no explicit market price exists. This is the power of hedonic analysis and estimation of marginal value is the primary use of the hedonic method (Mendelsohn and Markstrom, 1988). Attempts have been made to extend this analysis in a "second stage" in order to determine the underlying demand function. Successful identification of the demand function facilitates welfare analysis associated with nonmarginal changes in market structure. Using hedonics to identify the demand function has proven to be fraught with econometric difficulty (Diamond and Smith, 1985; Mendelsohn, 1985; Palmquist, 1991; Freeman, 1993).

Rosen (1974) suggested that the observations of individuals' selections of quantities and implicit prices in a nonlinear price function could be used to identify the demand, or bid, function. However, he ignored the fact that each bid depended on the level of utility. In other words, each bid was made by an individual with different socio-economic background and preferences. For example, a bid by a second individual for a greater quantity at a lower price does not necessarily help build a demand curve; the second individual may have greater preference or greater income.

The most promising solution appears to be identification across separate markets. This allows the researcher to control for individual characteristics, such as income, so that "identical" buyers face different price functions in the different markets. This approach requires sufficient variation of price structure across markets and the ability to control for differences between buyers. A few studies have followed this procedure (Palmquist, 1984). Since this study is interested in marginal price and not in the demand function, no attempt was made to perform a second stage analysis.

2.5 Evaluation of Functional Form

Specification of functional form is an issue of particular interest in hedonic price analysis. Functional form refers to the mathematical formulation of the equation that combines the quantities and qualities of the various attributes to determine the price of the bundled good. The bundled good may be a simple addition of independent attributes or the combining of attributes may cause interaction among components resulting in a whole that is greater than the sum of the parts. A simple addition of attributes would be represented by a separably-additive linear function. A bundle that includes interactions among components would be represented by a nonlinear function containing interaction terms.

Economic theory guides selection of explanatory attributes but generally does not provide guidance for specifying the functional form of the hedonic equation composed of those attributes (Palmquist, 1989). An exception is in situations where a linear, separably-additive function may be expected. This would be the situation where an attribute could be costlessly repackaged. For example, a house containing 4000 square feet of floor space cannot be costlessly repacked into two houses of 2000 square feet. However, 40 acres of farm land could be repackaged into two parcels of 20 acres at a very low cost.

Where theory does not stipulate a linear functional form, it is important to test for best fit of functional form. Estimation of the implicit prices on attributes depends on and may be sensitive to the functional form selected. Allowing the data to specify functional form is recommended (Palmquist, 1991; Freeman, 1993). A widely used and recommended procedure uses a flexible functional form provided by the Box-Cox variable transformation (Box and Cox, 1964). Basically, this involves estimation of an exponent(s) on the variable(s) of interest.

2.5.1 Box-Cox Formulation

The Box-Cox transformation by coefficient λ on variable y is:

$$y^{(\lambda)} = \begin{cases} \frac{y^{\lambda}-1}{\lambda}, & \lambda \neq 0 \\ \ln y, & \lambda = 0 . \end{cases} \tag{1}$$

In the classic or simple Box-Cox equation, only the dependent variable is transformed:

$$y^{(\lambda)} = \beta_1 + \beta_2 x_2 + \beta_3 x_3 + \ldots + \beta_k x_k + e . \tag{2}$$

Simultaneous estimation of lambda and the beta coefficients is accomplished by maximizing the log of likelihood (L) function for the data set. Numerical techniques to speed solution of the maximum likelihood estimates are built into most statistical computer software.

A more general Box-Cox formulation includes transformation of all independent variables by a second lambda coefficient:

$$y^{(\lambda_1)} = \beta_1 + \sum_{j=2}^{k} \beta_j x_j^{(\lambda_2)} + e . \tag{3}$$

Several commonly used functional forms are shown in Table 1 to be special cases of equation (3):

Table 1 Special Cases of Two Variable Box-Cox Form

λ_1	λ_2	functional form
1	1	linear
0	1	semi-log
0	0	log-linear

A likelihood ratio (LR) test can be conducted to test whether the estimated value of λ_1 and/or λ_2 is significantly different than a hypothesized value. That is,

$$LR=2[L(H_A)-L(H_O)] \sim \chi^2_{(J)} \qquad (4)$$

where J = number of restrictions under H_0. For example, a test of linearity could be conducted as H_0: $\lambda_1=\lambda_2=1$, H_A: $\lambda_1 \neq 1$ or $\lambda_2 \neq 1$, J=2.

A yet more general formulation (Halvorsen and Pollakowski, 1981), termed the quadratic Box-Cox form, includes interaction terms:

$$y^{(\lambda_1)}=\beta_1+\sum_{j=2}^{k}\beta_j x_j^{(\lambda_2)}+\frac{1}{2}\sum_{j=2}^{k}\sum_{p=2}^{k}\alpha_{jp}x_j^{(\lambda_2)}x_p^{(\lambda_2)}+e \; . \qquad (5)$$

Instead of explicit modeling of interaction terms, other researchers (Spitzer, 1982) have emphasized the need to assign distinct transformation coefficients to each independent variable:

$$y^{(\lambda_1)}=\beta_1+\beta_2 x_2^{(\lambda_2)}+\beta_3 x_3^{(\lambda_3)}+\ldots+\beta_k x_k^{(\lambda_k)}+e \; . \qquad (6)$$

However, equations (5) and (6) become computationally expensive or prohibitive, limiting their usefulness. In addition, the increased number of coefficients in the model causes greater variance of estimation resulting in less precise estimates.

2.5.2 Criticisms of Box-Cox Approach

In addition to these two problems, there are other drawbacks associated with use of flexible functional form in hedonics (Cassel and Mendelsohn, 1985). A nonlinear, as opposed to linear, result makes interpretation of slopes and elasticities difficult or arbitrary, perhaps negating their usefulness in policy analysis. This problem derives from the fact that the marginal value of an attribute is no longer a constant, but rather depends on the selected quantity of that attribute and all other attributes. For example, if estimation of equation (2) reveals $\lambda=1$, that is, reveals a linear function, then the marginal value of X_2 equals a constant, β_2. However, if $\lambda\neq1$, then the marginal value of X_2 equals . $\beta_2(\beta_1+\beta_2x_2+\beta_3x_3+...+\beta_kx_k)^{\frac{1}{\lambda}-1}$.

Another criticism of Box-Cox estimation concerns the use of a single transformation coefficient for all explanatory variables (as in equation 3) since this forces a single functional form on all attributes. As an example, many studies have investigated the influence of air quality on housing price. If the variable of interest, air quality, is, in truth, related to the dependent variable linearly but is fitted with a power other than one as a result of other explanatory variables being more influential on price and being nonlinearly related, then the estimated value for air quality is not necessarily more accurate with Box-Cox estimation. As a compromise between the computationally prohibitive formulation where each variable receives a distinct transformation coefficient and the potentially misleading formulation where all explanatory variables receive the identical transformation, Palmquist (1991) suggested environmental variables be grouped and transformed by an exponent different from the exponent on structural variables for explaining housing price.

2.5.3 Heteroskedastic Errors in Box-Cox Analysis

Another problem with specification of functional form using a Box-Cox transformation concerns the imbedded assumption of spherical disturbances, i.e., the assumption of uniform variance and non-autocorrelated errors. Zarembka (1974) showed that the Box-Cox test is not robust in the presence of heteroskedastic errors or autocorrelated errors. Further, he demonstrated that in the presence of heteroskedasticity, there is a downward bias in estimation of the transformation coefficient (λ) on the dependent variable toward transformation (i.e., toward $\lambda=0$), since that leads to less heteroskedasticity in the error variance.

Lahiri and Egy (1981) presented a procedure that enables joint testing of heteroskedasticity and functional form. This is referred to as the Box-Cox heteroskedastic (BCH) model. It is applied to the simple Box-Cox model (only the dependent variable transformed) and assumes multiplicative heteroskedasticity, that is:

$$y^{(\lambda)}=X\beta+u \qquad u_i=z_i^{\delta/2}*e_i \qquad where \quad e_i\sim N(0,\sigma^2 I)\ . \qquad (7)$$

This procedure requires *a priori* selection of z, the variable most correlated with the heteroskedastic error variance. Joint testing proceeds by grid search over λ and δ to maximize the log-likelihood function (L). With this formulation, the concentrated log-likelihood function is:

$$L(\lambda,\delta;y,X)=C-\frac{\delta}{2}\sum_{i=1}^{n}\ln z_i+(\lambda-1)\sum_{i=1}^{n}\ln y_i-\frac{n}{2}\ln\hat{\sigma}^2(\lambda,\delta) \qquad (8)$$

where C is a constant. Once again, LR tests can be used to evaluate restrictions on λ and δ.

3. SAMPLE CHARACTERISTICS

The sample consisted of sales of EFU-zoned property in the tax districts identified by the Malheur County Assessor's Office as "diversified cropping area." The so-called diversified cropping area corresponds to the irrigated region around Vale, Nyssa and Ontario, Oregon. The sample was confined to this area due to the importance of analyzing a single market.

The sample included all but two of the *bona fide* sales of EFU-zoned properties during the calendar years 1991 through 1995. The County Assessor's Office had previously culled out those sales made between related parties where the transaction price did not provide a *bona fide* reflection of the property value. The two additional sales were excluded as outliers (explained later in this chapter) leaving a sample of 225 property sales. All but ten of these sales had some irrigated acreage.

3.1 Property Attributes

Information on most of the property attributes was available and obtained from the assessor's office. Distance to town was determined from highway department maps and verification of water source was obtained from the local water districts and Water Master.

3.1.1 Sale Price

Each property had a market price for which it sold. The sale price included the land and all its appurtenances, including irrigation water rights, water distribution and drainage ditches, drainage tile, fencing, roads, and buildings. The value of movable chattel such as farm equipment and sprinkler pipe was excluded from the sale price in the few cases where this was included in the sale. Prices ranged from $8000 to $1,500,000 with a median of $111,600. The median sale price was $1394 per acre.

3.1.2 Land Class

Soil quality is an important determinant of agricultural productivity. The quality of soil determines the types of crops that can be grown and the yield per acre that is reasonably attainable. The Soil Conservation Service has mapped and categorized soils into Soil Capability Classes corresponding to their ability to grow crops. The classes range from Class 1, which is the most capable, being deep and fertile, to Class 7-, the least productive.

In Oregon agricultural property is taxed based on potential returns to agricultural production. In order to do this, the county assessor's office estimated for each EFU-zoned property the number of acres in each soil class. All irrigated land falls in one of the classes 1 through 5. All nonirrigated land is in class 6 or 7. Table 2 lists the land classes and provides a description of agricultural capability for each class pertinent to the Ontario-Vale-Nyssa area.

Each sale is a collection of acreages of one or more land classes. Table 2 shows that most of the acreage in the sample of farms sold from 1991 through 1995 is land class 7, native rangeland. This does not correspond to the number of transactions involving each land class because rangeland tends to be sold in much larger blocks of acreage.

Table 2 Description of Soil Capability Classes

LAND CLASS	DESCRIPTION OF CAPABILITY	% OF SAMPLE ACREAGE
1	Best row crop land	0.3%
2	Good row crop land - suitable for all row crops	2.8%
3	Row crop land - may not be suitable for all row crops	9.6%
4	Alfalfa hay, alfalfa seed, grain, field corn or good pasture	14.1%
5	Irrigated pasture, meadow hay	7.3%
6+	Dry land farming	0.1%
6	Cleared and improved range with native or planted grasses	7.2%
7+	Best, well managed range with good cover of native grasses	2.9%
7	Typical uncleared range with average cover of native grasses	53.9%
7-	Rangeland with sparse ground cover or steep rocky slopes or wasteland within farming area	1.7%

3.1.3 Irrigation Water

Water is, of course, an important attribute of agricultural properties in northern Malheur County where the average annual precipitation is only eight inches. All but ten of the properties in the sample have some irrigated land. The ten completely nonirrigated parcels were not excluded from the sample because they were expected to share traits in common with the other parcels. This is because they are located in the same geographic area as the other parcels and because most of the other parcels also contain a small or large amount of nonirrigated land. Of the 215 parcels with irrigation water, 189 receive their supply from one of the four local irrigation districts. The remaining 26 farms obtain irrigation water from a source other than an irrigation district pursuant to their individual water right. These other sources include direct pumping from the Snake River, from the

Malheur River and from several local drainage ditches. Information was insufficient to further categorize or characterize these other water rights as to source, priority, amount or reliability of water supply.

The four water districts that supply irrigation water in this area are Old Owyhee Irrigation District, Owyhee Hiline Water District, Vale Oregon Water District and Warmsprings Irrigation District. Each water district holds different water rights, controls different water storage and conveyance facilities and delivers different amounts of water on average and in a dry year. It was expected that buyers and sellers of farms in this area would recognize differences between the water districts and land prices would reflect this recognition. The service area of each water district is shown in Figure 1. Table 3 shows the number of sample observations associated with each source of water.

Table 3 Sales Categorized by Source of Water

Water Source	# of sales in sample
Old Owyhee	9
Owyhee Hiline	101
Vale Oregon	61
Warmsprings	18
Other	26
None	10
Total	225

3.1.4 Location of Property

Location is always an important determinant of real estate value. Because this study involves rural property, location was evaluated in terms of distance to town. It was expected that a shorter distance to town would be valuable in terms of reduced time and transportation cost for obtaining goods and services from town and for delivering harvest to town. Ontario is the largest commercial area in Malheur County and has ten times the

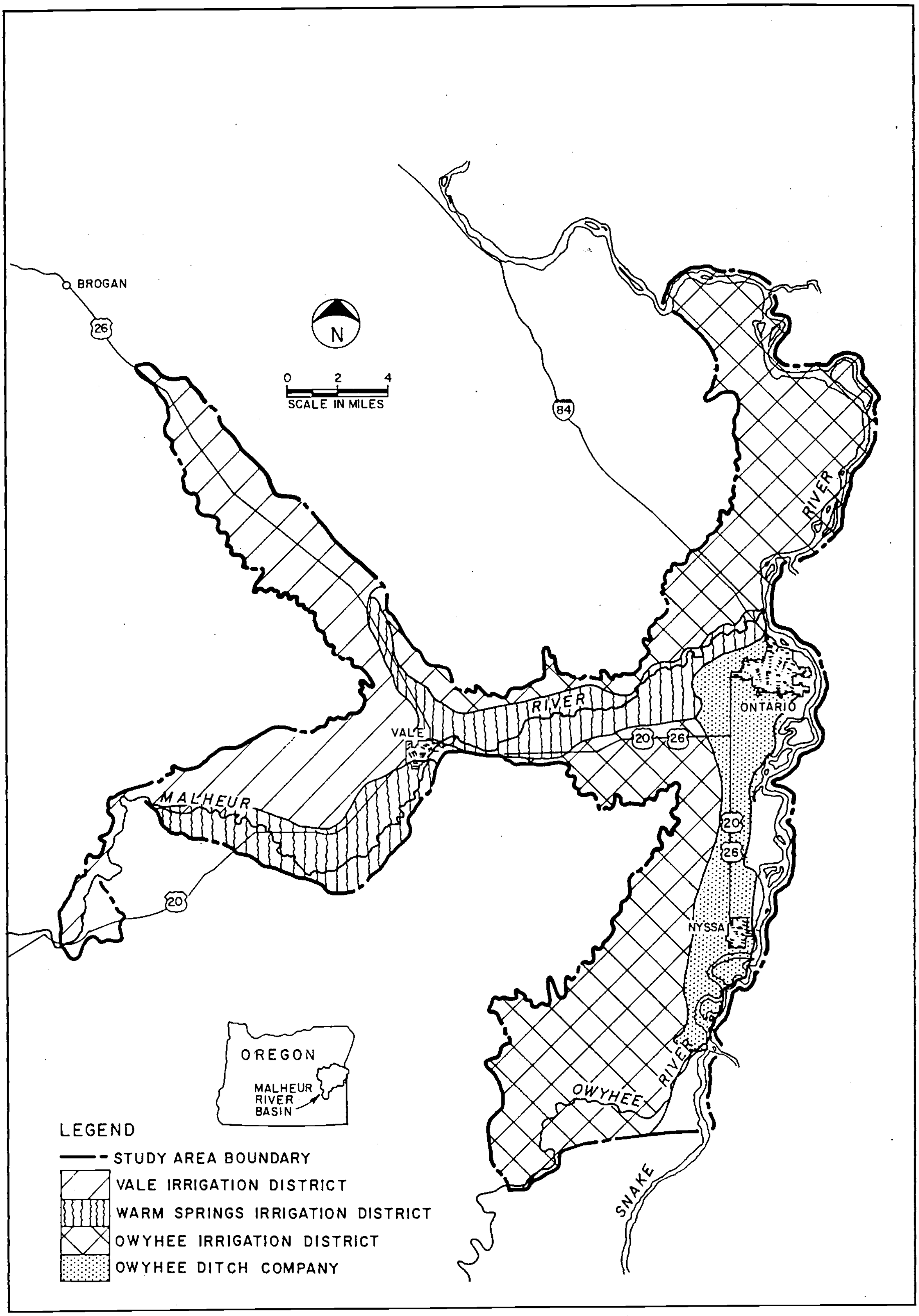

Figure 1 Map Showing Water Districts

population of the other local communities, Vale and Nyssa. Depending on the crop, there are several locations where agricultural harvest may be delivered in this area, including Ontario, Vale and Nyssa. Vale is the county seat and therefore includes various essential governmental offices. Vale and Nyssa both offer groceries, gasoline and restaurants. The distances in miles along roadways to these three towns were included as possible influences on rural property value.

3.1.5 Size of Property

The properties bought and sold in this sample range in size from 12 to 5534 acres. The median acreage is 78. Most hedonic studies of land sales include size of property as an explanatory variable because larger properties are expected to sell for less on a per acre basis. One reason for this expectation is that any costs of sale that are fixed per transaction will be spread over more acres. A second reason is that there may be a smaller pool of buyers with access to the capital necessary to purchase large properties resulting in a thin market for large parcels and a relative lack of competition among buyers to drive up prices as compared to the market for smaller properties. A third factor tending to differentiate unit prices between large and small properties is governmental restrictions on subdividing or constructing buildings on agricultural land. These restrictions act to prevent arbitrage and equalization of unit prices between large and small parcels.

3.1.6 Time of Transaction

This sampling of agricultural properties in the Ontario-Vale-Nyssa area covers a five year period during which the U.S. consumer price index (CPI) increased 3.5% per annum. The month in which the property title change was recorded was noted and included as a characteristic of the property that might explain the sale price. A nonstationary price may be attributable to devaluation of the dollar or to shifts of either the demand function or supply function. Table 4 shows the number of sales in each calendar year of the five year sampling.

Table 4 Sales Categorized by Year of Transaction

Year	# sales in sample
1991	30
1992	30
1993	56
1994	56
1995	53
Total	225

3.1.7 Improvement Value

Improvements appurtenant to the property are part of the total sale and as such are included in the observed market price. There is no observable price corresponding to the market value of improvements on the property. However, because property taxes are levied on all real estate, the Malheur County Assessor's Office makes an assessment of improvement value, if any, on each property. Improvements, as tracked by the assessor's office, only includes buildings. Improvements such as wells, head ditches, drain tile or drainage ditches are not included in the assessed value of improvements. Of the 225 properties, 188 included improvements, with a high value of $349,000, and a median assessed improvement value of $31,700 among those properties with improvements.

3.1.8 Residential Lots

In Oregon, property zoned for exclusive farm use is taxed at a lower rate than property zoned residential. EFU properties enjoy a lower tax rate but are subject to restrictions. One major restriction pertains to construction of a residence on EFU property. In 1984, Malheur County complied with Oregon Senate Bill 100 that required filing of a comprehensive plan and zoning ordinance. At that time, residences existing on land zoned for exclusive farm use were granted a non-conforming use permit. Since then, construction of a new residence is allowed only if replacing an existing residence, if the property is larger than 80 acres, or if an application to the county meets state requirements and receives approval from the County Planning Commission.

Each EFU property has an associated number of existing residential lots. For some properties this number is zero. Permission to create a new residential lot is difficult, yet there are both tax and amenity advantages to residing on farm land. Amenity value derives from the bucolic setting. Tax advantage results when the land is assessed for taxes based on agricultural productivity while the market prices the land higher because of its residential value. State and county land use laws restrict the supply of rural residential lots. Because of this, it is expected that residential lots are a valuable attribute of an EFU property. Table 5 shows the number of residential lots associated with the sample parcels.

Table 5 Sales Categorized by Number of Residential Lots

# of residential lots	# of properties
0	42
1	151
2	26
3	4
4	2

3.2 Outliers

Cross-checking and examination of the data was conducted to spot and correct any data collection errors. In the course of preliminary review of the data, two observations of sales were found that were judged to be outliers and removed from further study. One sale involved a feedlot with an assessed value of improvements exceeding the market price of the property. This unusual circumstance and the fact that this was the only parcel involving intensive agricultural production led to elimination of this observation from the sample.

The other sale excluded from further study was 3.5 times as expensive, on a per acre basis, than any other property in the sample. The sale also had the smallest total acreage sold, only 7 acres. For these reasons, this observation was considered an outlier and excluded from further analysis.

3.3 Summary of Data

After excluding the outliers, the full sample contained 225 observations. Table 6 provides a partial summary of the sample statistics. Tables 7 and 8 summarize sample information as categorized by water source.

3.4 Distribution of Sample Characteristics

The sample of agricultural property sales are from one part of one county. Commercial activity and water use in this area is dominated by agricultural production. This suggests the sample represents a single market. However, the Exclusive Farm Use designation may be broad enough to include property bought and sold in distinctly different markets.

Table 6 Sample Statistics (n=225)

Attribute	Units	Median	Mean	Coeff. of Var.	Min.	Max.
Price	$	111,600	147,255	1.11	8000	1,500,000
Acres	acres	78.4	210	2.92	12	5534
Price/acre	$/acre	1394	1598	0.66	44	5729
Distance to Ontario	miles	14	12.9	0.61	0	30
Residential lots	# lots	1	0.98	0.68	0	4
Improvement value	$	26,170	35,659	1.18	0	349,170

Table 7 Number of Acres in Data Set, Summarized by Water Source

	Soil Capability Class							Total
	1	2	3	4	5	6	7	
Old Owyhee	0	700	89	114	5	43	20	971
Owyhee Hiline	160	105	1731	3183	1365	1082	2978	10,657
Vale Oregon	0	0	782	2711	1580	830	2186	8089
Warmsprings	0	188	837	388	184	772	4857	7226
Other sources	0	352	1112	262	295	370	8590	10,981
No water	0	0	0	0	0	338	9011	9349
Full sample	160	1430	4552	6701	3447	3445	27,890	47,273

Table 8 Sample Means Summarized by Water Source

	Number of sales	Price per acre	Distance to Ontario
Old Owyhee	9	2700	7.4
Owyhee Hiline	101	1784	8.8
Vale Oregon	61	1205	20.5
Warmsprings	18	1389	13.6
Other sources	26	2001	11.5
No water	10	464	16.5
Full sample	225	1598	13.0

Attributes of the properties were examined to identify extreme-valued observations that may not belong in the characteristic market. Figures 2 through 5 illustrate the distribution of observed values for several of the important attributes. Figure 2 shows the total sale price. It may be that transactions involving large amounts of capital are traded in a separate market due to limited access to capital. Figure 3 shows the percentage of total sale price attributable to improvements. Figure 4 shows the magnitude of improvement value. These characteristics may reflect land purchases made primarily for residential purposes rather than agricultural production. That would comprise a different demand function. Figure 5 shows the amount of nonirrigated land in each purchase. This may indicate land purchases for the primary purpose of grazing as opposed to crop production. These differences may reflect separate markets containing different supply or demand functions and associated different equilibrium prices. The figures show skewed distributions, indicating there may be some extreme-valued observations belonging to a distinctly different market segment. This possibility will be addressed in the following chapter.

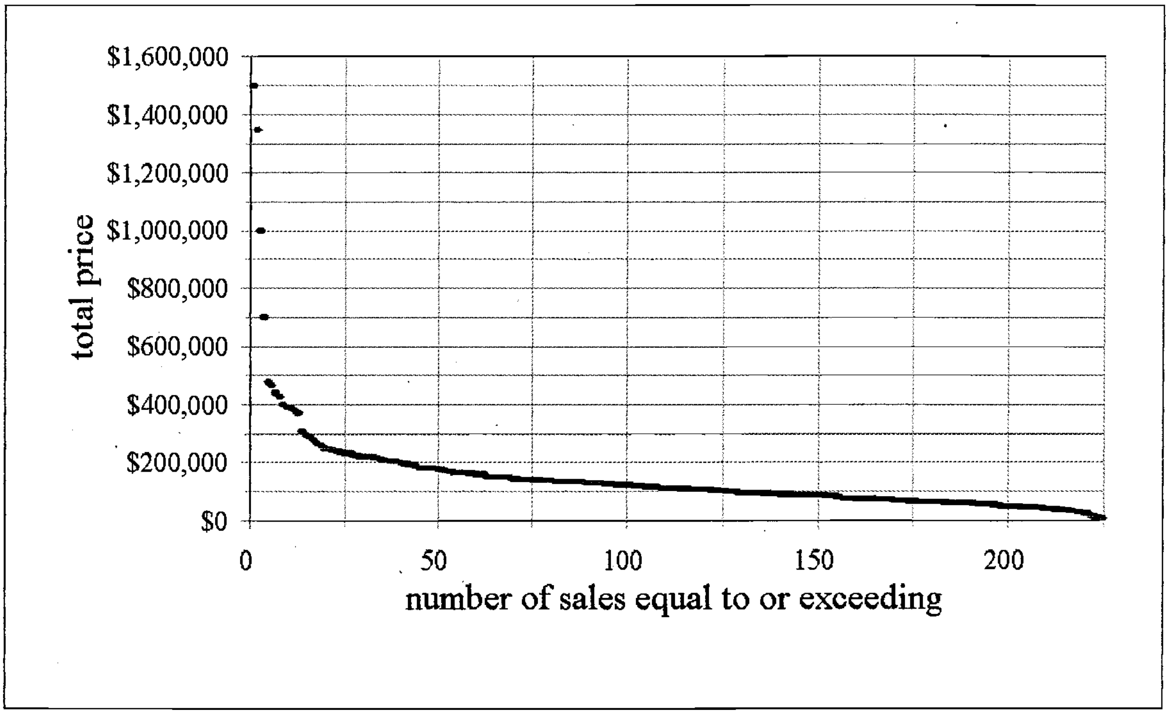

Figure 2 Distribution of Observations on Total Price

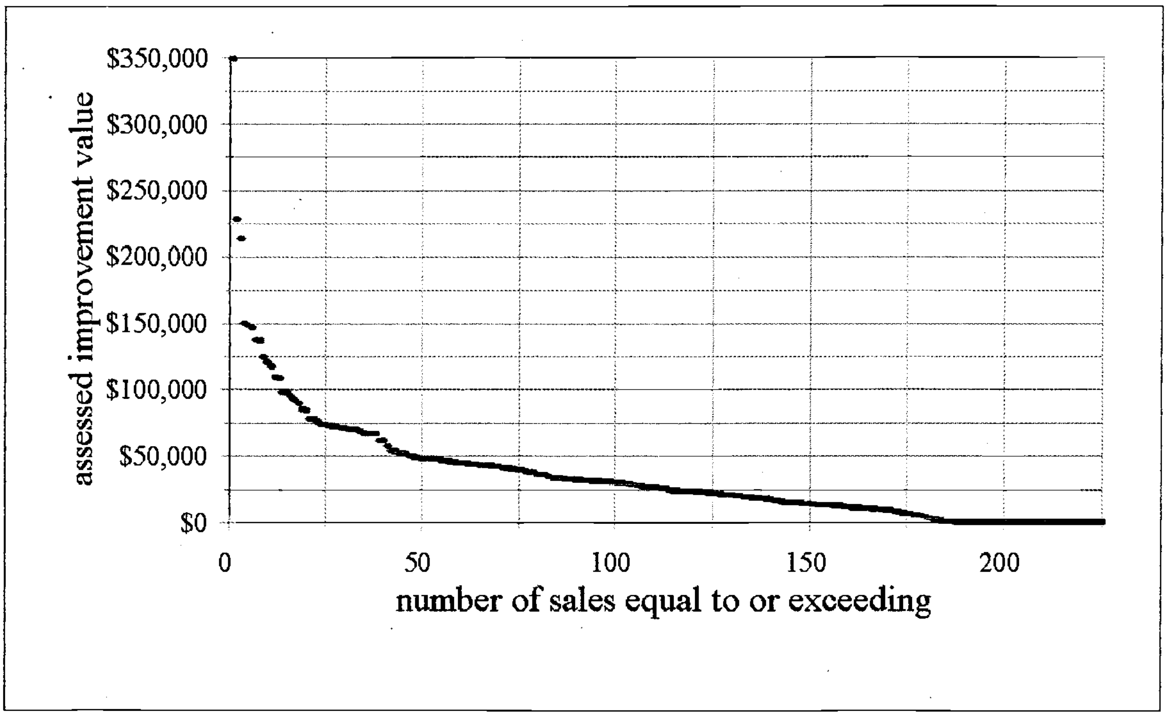

Figure 3 Distribution of Observations on Improvement Value

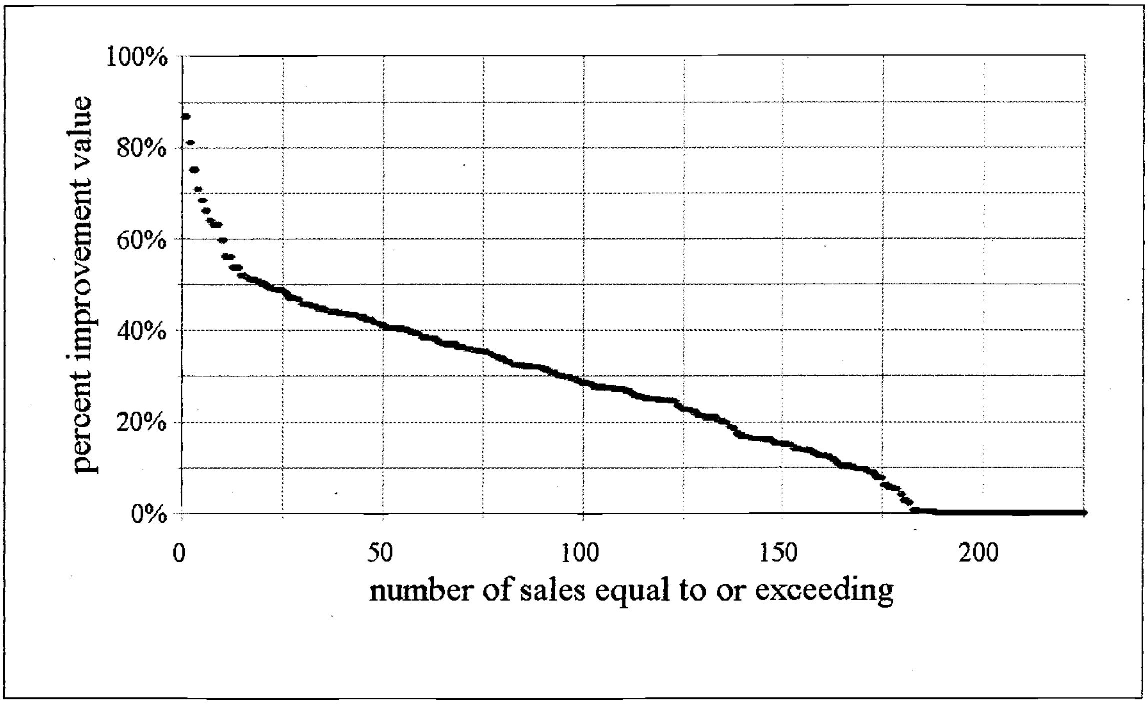

Figure 4 Distribution of Observations on Percent of Price in Improvements

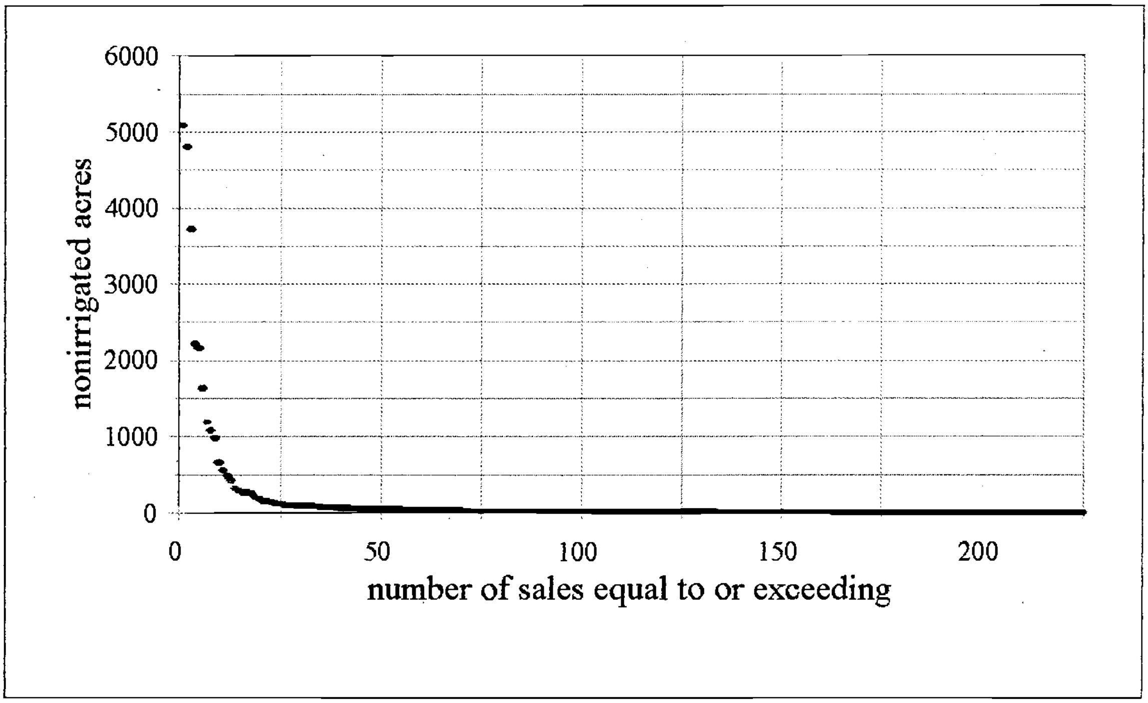

Figure 5 Distribution of Observations on Non-Irrigated Acreage

4. MODEL SPECIFICATION AND TESTING

Model specification in hedonic analysis is the process of translating the attributes of a bundled good into a mathematical representation of those attributes that adequately explains the market price of the bundled good. Model specification includes identification of variables and specification of functional form.

4.1 Variable Identification

The first step is to identify the variables to be included in the model. This identification includes specifying a numerical measure of each attribute and defining units for each variable.

4.1.1 Price

The sale price of agricultural land is the dependent variable in this study. Hedonic price analysis is being used to explain the dependent variable, sale price. This is equivalent to disaggregating the sale price into its component parts. The dependent variable was defined as sale price divided by total acres sold, or in short, price per acre. This variable was chosen rather than price for a number of reasons. First, most hedonic studies of land sales express the dependent variable as price per acre rather than price. Second, comparisons between sales can be made directly when described on a per acre basis. And third, analysis on a per acre basis reduces the statistical influence of sales with large acreage. When price is used as the dependent variable, transactions with larger acreage have correspondingly greater influence. When price per acre is the dependent variable, each observation has equal weight, that is, each transaction has equal weight regardless of its size.

4.1.2 Soil Quality

Soil quality is an important determinant of agricultural productivity. The capability of land to grow crops has been identified by the SCS and tabulated for each property by the County Assessor. The SCS land capability classes are identified numerically as 1 through 7. These are categories of soil quality. The numerical identifier does not represent a continuous variable. There is no reason to expect the productivity of land to be linearly related to the numerical identification of the land class. Some studies (Crouter, 1987; Xu et al., 1993) have specified soil quality as a continuous variable based on the SCS land class identification number. However, except for the expectation that productivity increases monotonically with decreasing numeric land class, there is no reason to expect a systematic relationship between land class number and land productivity.

In this study, soil quality is specified by creating seven land classes, land class 1 (LC1) through land class 7 (LC7), corresponding to the county assessor's compilation of soil capability. Each property sold includes a collection of different quality lands. For example, a given sale may comprise 15 acres of class 3 land, 30 acres of class 5 land and 5 acres of class 7 land. To be compatible with the dependent variable in units of price per total acres sold, the land class variables are also specified on a per-total-acres basis. In the foregoing example, the measure for variables LC3, LC5 and LC7 would be 0.30, 0.60, and 0.10, respectively. The measure for land classes LC1, LC2, LC4 and LC6 would all be zero.

Notice that the seven land class variables add to unity. Because of this, the model does not include a constant, or intercept, term. Alternatively, one of the land classes could be dropped in favor of including a constant term. The model result is unchanged however, the only difference is that the coefficients on land classes then represent the arithmetic difference in value between the subject land class and the excluded land class.

The land class coefficients are best interpreted as dummy variables representing distinct soil categories. That is, it is best to interpretations a land variable valued at one with all other land class variables at zero. The coefficient on a land class therefore represents the implicit market price of an acre of that quality of land except as modified by other explanatory variables in the model, specifically distance and time.

4.1.3 Water

Irrigation water is critical to agricultural production in this area which receives only eight inches of precipitation per year. A full supply of water can improve crop yields over a less than adequate supply. Full delivery in dry years, when less-well endowed water districts are rationing supplies, is especially valuable. Receiving irrigation supply at a lower cost per acre-foot also provides an economic advantage. The four local irrigation districts hold water rights of different amounts and priorities, divert from different streams, and convey and store water in different sized facilities. These differences make it reasonable to expect differences in water endowments across the four districts. In addition to the four separate irrigation districts, 26 of the properties in the sample obtain irrigation water pursuant to "Other" individual water rights.

It was hoped that this study could identify the water endowment associated with each sale in the data set. This would enable water to be specified as a distinct variable in units of acre-feet per year per acre. (Irrigation water is typically measured in acre-feet; one acre-foot of water covering an area of one acre to a depth of one foot.) Unfortunately, records of irrigation water use are poor or non-existent in Oregon. Detailed and reliable estimates of irrigation water use in the study area could not be obtained. Available information indicated an average water delivery of approximately 3.5 acre-feet per acre per year for all four districts. More detailed and accurate information would be needed to enable regression analysis based on the differing water endowments. Beyond the difficulty of determining water entitlement for the four districts is the even greater difficulty of estimating water entitlement for the 26 properties with other water rights.

As an alternative to specifying water as a distinct variable, water was instead included as an aspect of the land class variables. As determined by the county assessor, LC1 through LC5 include irrigation water, LC6 and LC7 do not. Thus, the land class variables act as interaction terms between soil and water. That is, the value of an acre of class 1 land is the result of the combination of one acre of class 1 soil and one acre's worth of water entitlement.

It may be that land and water is most appropriately modeled as an interaction term since irrigation water rights are appurtenant to specific parcels of land by state law. This limits the ability to separate the water from the land in order to move some of the water to a location where it would be more productive. Crouter (1987), in his study of Colorado farms, found nonseparability between water and land variables. This result came from study of an area where transfers of water rights are much more fluid than in Oregon. This argues against nonseparability of land and water in the more restrictive legal environment involved in this study.

Since there are differences in the water endowment associated with the different water sources, the land class variables were disaggregated to distinguish between water source. For example, the LC3 variable was disaggregated into five variables, one for each source of water. This allows the regression to assign different values to the same soil class served by different water sources. Table 9 shows the land class variables included in the original specification.

4.1.4 Distance

Distances to Ontario, to Vale and to Nyssa were included in the model. Distance was represented both as a linear term, in miles from town, and as a nonlinear term, the reciprocal of miles from town. This created a total of six distance variables in the original specification. Distance to each town was represented by two variables each for a couple of reasons. First, theory supports either formulation. Distance from town may represent cost in time and money of transportation to and from town. If distance

Table 9 Land Class Variables in Original Specification

Water source	Land class 1	Land class 2	Land class 3	Land class 4	Land class 5	Land class 6	Land class 7
Old Owyhee	-	LC2oo	LC3oo	LC4oo	LC5oo	LC6	LC7
Owyhee Hiline	LC1oh	LC2oh	LC3oh	LC4oh	LC5oh		
Vale Oregon	-	-	LC3v	LC4v	LC5v		
Warm-springs	-	LC2w	LC3w	LC4w	LC5w		
Other	-	LC2o	LC3o	LC4o	LC5o		

primarily reflects the cost of transporting, say, ten truckloads of harvest from ten acres of farmland a distance of ten miles, a linear relationship of distance to gas burned and minutes expended can be expected. Alternately, distance to town may represent opportunities for land appreciation as towns grow onto nearby farmland. In this case, the reciprocal function may be more appropriate.

In the absence of clear guidance for functional form, the literature on hedonics recommends allowing the data to identify the appropriate functional form. Sometimes this can be accomplished through use of a flexible functional form such as the Box-Cox transformation. In this case however, the analysis is already complicated by a joint test of heteroskedasticity and functional form of the equation. To include a flexible form transformation of the distance variables would make the analysis computationally prohibitive. Instead both a linear and nonlinear form of distance was specified and tested for significance.

The second reason for including two variables for each distance is related to the lack of an intercept term in the model. Inclusion of two variables on, say, distance to

Ontario allows them to work against each other. For example, as distance from Ontario increases, one variable can add value as the other variable subtracts value but at a different rate. This results in the two variables canceling each other out at a model-determined distance from town. Within that distance, the sum of the distance terms is a positive contribution to the property value. Outside that distance, the two terms sum to a negative contribution to the property value.

This has advantage because lack of an intercept term shifts part of the role of an intercept onto the land class dummies. If there was only one distance term, say, linear distance from town, then when distance equaled zero the land value has a premium for proximity which must be included in the land class coefficient because the distance variable is zero. Including two distance terms allows the land class values to correspond to an intermediate distance, near the median or mean distance for the sample. This may serve to minimize bias of estimation.

4.1.5 Time

There may be a time trend in property prices due to inflation or shifts in the demand or supply curves. A flexible form test of the appropriate specification of the time variable would frustrate the ability to perform other tests on the model. Any gain in accuracy with such a formulation would probably be offset by restricted ability to perform other tests. For this reason, the effect of time on property values was represented as a linear and additive term in units of months.

In order to minimize the possibility of bias, the zero value of the time variable was set at the midpoint of the sample. Sales after that point in time were assigned positive numbers reflecting the number of months elapsed since the midpoint. Sales before the midpoint were assigned negative numbers reflecting the number of months prior to the midpoint.

4.1.6 Size

Size of the property sold is often included as an explanatory variable in land sales. This is based on the common finding that larger parcels sell for less per acre than otherwise equivalent smaller parcels. This may be due to economies of scale in transaction costs or due to a thinner market among larger properties. If the unit price falls with increasing parcel size, all other attributes being equal, then the best fit equation would not be linear. The flexible form Box-Cox transformation enabled testing for linearity and thereby testing for the influence of parcel size on unit price. If sales involving larger properties were associated with lower unit prices, then the flexible functional form would demonstrate a nonlinear relationship.

4.1.7 Residential Permits

The number of lots permitted for residential use on the EFU land was included as an explanatory variable. To maintain consistent units, this variable was expressed as lots per total acres sold, in short, lots per acre. In this way, a variable in lots per acre multiplied by a coefficient in dollars per lot gives a contribution to value in dollars per acre, the units of the dependent variable.

4.1.8 Improvements

An accurate measure of this independent variable, improvement value, is unavailable since neither the buyer nor seller identifies the market value they may or may not assign to improvements. Since market value of improvements is unobservable, an instrument is used in its place. The instrument chosen was the County Assessor's assessed value of improvements. This is the best available information regarding the value of improvements on the properties.

To be consistent with the units of the dependent variable, improvements were expressed in units of value of improvements per acre. The coefficient associated with this variable will reflect the ratio between the market value of improvements and the assessed value of improvements. If the coefficient is greater than one, then the market is placing a greater value on the improvements than the Assessor's Office. Conversely, if the coefficient is less than one, then the market is placing a lower value on the improvements than the assessor. The expectation is that the coefficient will be less than one since purchasers of farms often have in mind a quite different use for the land than the previous owner. This results in buildings being worth less to the new owner than their nominal or replacement value would suggest.

4.1.9 Summary of Variables

Table 10 provides a list of the 31 explanatory variables included in the original model specification.

Table 10 List of Variables in Original Model

LC1oh,
LC2oo, LC2oh, LC2w, LC2o,
LC3oo, LC3oh, LC3v, LC3w, LC3o,
LC4oo, LC4oh, LC4v, LC4w, LC4o,
LC5oo, LC5oh, LC5v, LC5w, LC5o,
LC6, LC7,
DISTO, RDISTO, DISTV, RDISTV, DISTN, RDISTN,
MONTHS LOTS, IMPR

Table 11 provides a description of the variables included in the original model. For clarity of presentation, the land class variables are shown as aggregated terms rather than showing each water district for each land class. Table 11 shows units for both the variables and the coefficients on the variables. Note that in each instance the variable multiplied by its coefficient results in units of dollars per acre.

Table 11 Description of Variables Included in Original Model Specification

Variables			Coefficients
Type	Name	Units	Units
dependent	PRICE	sale price / total acres	--
land class	LC1 [1]	class 1 acres / total acres	$ / class 1 acre
	LC2 [1]	class 2 acres / total acres	$ / class 2 acre
	LC3 [1]	class 3 acres / total acres	$ / class 3 acre
	LC4 [1]	class 4 acres / total acres	$ / class 4 acre
	LC5 [1]	class 5 acres / total acres	$ / class 5 acre
	LC6 [1]	class 6 acres / total acres	$ / class 6 acre
	LC7 [1]	class 7 acres / total acres	$ / class 7 acre
location	DISTO	road miles to Ontario	($ / acre) / mile
	RDISTO	reciprocal of distance to Ontario	($/acre)(1/mile)
	DISTV	road miles to Vale	($ / acre) / mile
	RDISTV	reciprocal of distance to Vale	($/acre)(1/mile)
	DISTN	road miles to Nyssa	($ / acre) / mile
	RDISTN	reciprocal of distance to Nyssa	($/acre)(1/mile)
time	MONTHS	months since June 1993	($ / acre) / month
residence permit	LOTS	lots / total acres	$ / lot
buildings	IMPR	assessed improvement value / total acres	market value / assessed value

1 - in original specification, land class variables are disaggregated as shown in Table 9

4.2 Model Testing

Model specification is often an iterative process of specifying a model, testing that specification and respecifying the model. Care must be taken to avoid "data-mining," that is, to avoid the mistake of allowing the data to guide the theory. Correlation in the absence of causation or peculiarities of a given data set can result in a model that fits the data well but is misleading in theory.

On the other hand, in the absence of theory to guide selection of functional form, it is advised to let the data determine the functional form for a model. This results in specification, testing, and respecification. Another reason for iteration between specification and testing is due to interactions between various dimensions of the problem. For example, in this model it was necessary to test and correct for heteroskedasticity, test for linearity and specify functional form, test for and exclude relevant variables with t-values less than one, test the data for structural change, and test for equivalence of related variables and aggregate if equivalent. Not only do these tasks individually require respecification, but the order in which these tasks are conducted affects the results of subsequent tests. In order to ensure robustness of results, it is necessary to change the sequence of testing and re-execute the procedure to observe the resulting impact.

4.2.1 Discarding Variables

It is well known that excluding a relevant variable from a model causes bias as other variables with which it is correlated "assume some of the burden" of explaining the dependent variable. For this reason, it is erroneous to discard a variable simply because it does not meet a test of statistical significance. However, it is less well known that when the t-value of a variable is less than one, dropping that variable will reduce the mean square error of each remaining coefficient (Rao, 1971).

Three variables in the original model were shown to have t-values less than one. This result was consistent no matter whether the t-value was checked before or after the other tests and respecifications conducted. The three variables so identified and therefore dropped from the model were the distance and reciprocal of distance to Nyssa and the distance to Vale. The second specification of the model contains 28 variables, three less than the original specification.

4.2.2 Heteroskedasticity

The model was tested for heteroskedasticity. The Breusch-Pagan and Goldfeld-Quant tests were applied. The Breusch-Pagan (B-P) test is based on the idea that the variance is related to a linear combination of known variables. In this case, the explanatory variables in the second model were used in an auxiliary regression to explain the squared residuals from the second model. The B-P hypotheses and test statistic were as follows.

$$\sigma_i^2 = \alpha_0 + \alpha_1 X_{1i} + \alpha_2 X_{2i} + \ldots + \alpha_{28} X_{28i}$$

H_o: $\alpha_0 = \alpha_1 = \alpha_2 = \ldots = \alpha_{28} = 0$ $\quad$ H_a: at least one $\alpha \neq 0$

$$BP = \frac{SSE_{AUX}}{2\left(\frac{SSE_{SECOND}}{N}\right)^2} \sim \chi^2_{(28)}$$

Analysis of the second model showed a test statistic of 486, well above the 5% critical value of 41. Therefore, the null hypothesis was rejected and heteroskedasticity was indicated.

The Goldfeld-Quant (G-Q) test is based on the idea that if the data set can be sorted according to the magnitude of the variable thought to be related to the error variance, then a test can be made comparing the variance of a subsample from the high end of the data against the variance from a subsample at the low end of the data. Typically, observations in the mid-range of the sample are excluded from either subset.

The G-Q test, therefore, requires foreknowledge of which variable is related to the error variance. The auxiliary regression performed for the B-P test provides that sort of information. Of all the explanatory variables, when regressed against the squared residuals from the second equation, the variable for assessed value of improvements showed the highest t-value, 3.86. It is understandable that as improvement value goes up, the variance of the overall price per acre would also go up.

To further explore the form of the heteroskedasticity, another regression was performed to see if the squared residuals were related to the expected value of the dependent variable. This regression showed a t-value of 4.95 on the expected value of price per acre. It is reasonable to find that variability in price per acre increases with increasing price per acre. More expensive land has more attributes and more valuable attributes, leading to greater variance in unit price. Also, fewer transactions provide less information to buyers and sellers to indicate price at which willingness-to-pay equals willingness-to-accept.

To perform the G-Q test, the second model was estimated and $\hat{y}$, the expected value of the dependent variable, was generated. This was then used to sort the data and two subsamples of 100 observations each were selected, leaving 25 observations in the middle. Designating the low-unit-priced properties as sample A and the high-unit-priced properties as sample B, the hypotheses and statistic of the G-Q test were as follows.

$$H_O: \sigma_A^2 = \sigma_B^2 \qquad H_A: \sigma_A^2 < \sigma_B^2$$

$$\frac{SSE_B/(B-2)}{SSE_A/(A-2)} \sim F_{B-2,A-2}$$

where A and B are the number of observations in each subsample. The G-Q statistic was 4.37, exceeding the 5% critical value of 1.4, thus the null hypothesis was rejected and once again heteroskedasticity was indicated.

Figure 6 provides a graphical representation of the relationship between the squared residuals and the expected value of the dependent variable from the second

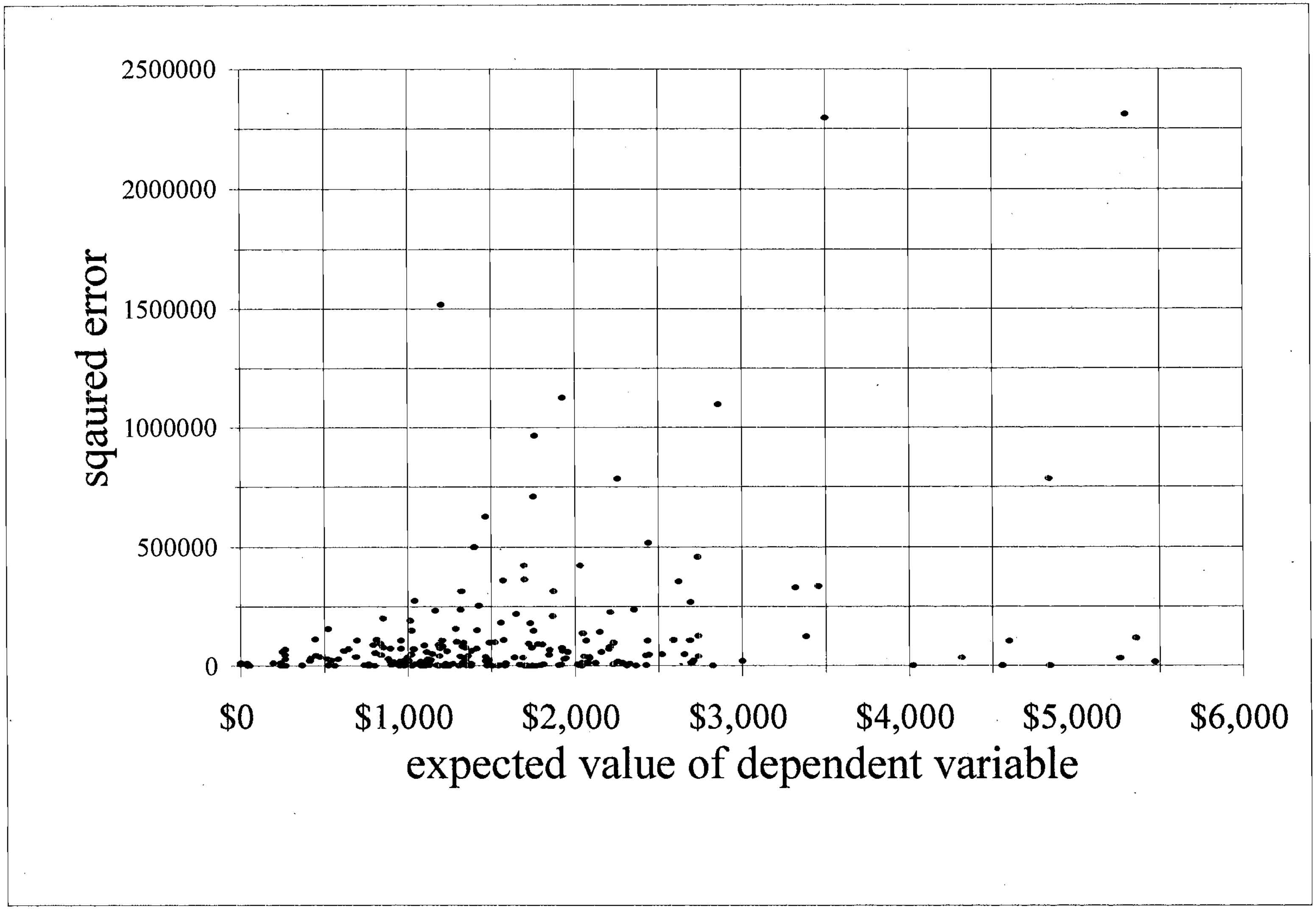

Figure 6 Residuals from Second Specification

equation. This figure shows increasing vertical scatter of the data points as the plot moves to the right. That is, there is a greater variation in the squared residuals as the price per acre increases.

Indication of the variable related to the error variance enables use of weighted least squares to correct for heteroskedasticity. That is, if $\sigma_i^2 = \sigma^2 z_i^\delta$, then $e \sim N(0,\sigma^2)$

when $$\frac{y_i}{z_i^{\delta/2}} = \frac{X_i}{z_i^{\delta/2}}\beta + e_i \ .$$

To perform weighted least squares (WLS) regression, all variables in the model, both dependent and independent, are linearly transformed by dividing through by the square root of the variable related to the error variance. This yields efficient estimators and homoskedastic errors. In practice, this also has the effect of giving greater weight to those observations with less variance and less weight to those observations with greater variance. With knowledge of the structure of the heteroskedasticity, WLS can be applied to achieve a better estimation of the model.

4.2.3 Functional Form

Heteroskedasticity is manifest by nonstationary residuals. But nonstationary residuals can also result from misspecification. In particular, fitting a nonlinear relationship with a linear equation can yield residuals that appear much as heteroskedastic residuals appear. If there is heteroskedasticity present, then testing for functional form must incorporate simultaneous or joint testing of heteroskedasticity. Functional form was tested using the Box-Cox-heteroskedastic (BCH) model developed by Lahiri and Egy (1981).

The Box-Cox-heteroskedastic model entails joint testing of linearity and heteroskedasticity. The model uses the Box-Cox transformation on the dependent variable to test linearity and includes multiplicative heteroskedasticity to test for nonstationary error variance. The BCH model is as follows.

$$y^{(\lambda)}=X\beta+u \qquad u_i=z_i^{\delta/2}*e_i \qquad where \quad e_i \sim N(0,\sigma^2 I)\ .$$

In this study, z equals ŷ, the expected value of the dependent variable as calculated by the simple Box-Cox model.

The lambda coefficient indicates a linear equation if lambda is equal to one and a nonlinear equation if not equal to one. The delta coefficient indicates multiplicative heteroskedasticity related to ŷ if delta does not equal zero and no heteroskedasticity of that form if delta equals zero. Joint testing of lambda, delta and the beta coefficients is accomplished by maximizing the log-likelihood function. In the BCH model the log-likelihood function (L) equals

$$L(\lambda,\delta;y,X)=C-\frac{\delta}{2}\sum_{i=1}^{n}\ln z_i+(\lambda-1)\sum_{i=1}^{n}\ln y_i-\frac{n}{2}\ln\hat{\sigma}^2(\lambda,\delta)$$

where C is a constant. A trial-and-error search over values of lambda and delta is conducted to find those values that maximize the log-likelihood function.

In the BCH model, lambda and delta are unrestricted. By restricting delta to be zero, the BCH model collapses back to the simple Box-Cox model. Alternately, by restricting lambda to equal one, the BCH model becomes a WLS model. Restricting both lambda equal to one and delta equal to zero results in an ordinary least squares (OLS) model. Results of testing the second specification of the hedonic model are shown in Table 12.

Table 12 Results From Joint Testing of Heteroskedasticity and Functional Form

MODEL	LAMBDA (λ)	DELTA (δ)	MAXIMUM LOG-LIKELIHOOD
OLS	1.0	0.00	-1317.72
BC	0.67	0.00	-1299.51
WLS	1.0	1.49	-1275.66
BCH	1.02	1.48	-1275.63

This shows that application of the Box-Cox transformation to test for functional form would incorrectly indicate a nonlinear function by improving the log-likelihood function to -1299.51 from -1317.72 using OLS. Instead, correction for heteroskedasticity through weighted least squares provides a better fit, increasing the log-likelihood function to -1275.66. Furthermore, joint testing of the heteroskedastic transformation and functional transformation yields a non-significant improvement over weighted least squares alone. This is confirmed by a likelihood ratio (LR) test of the difference between the WLS and BCH models. That test is of the form,

$H_O: \lambda=1.0 \quad H_A: \lambda \neq 1.0$

$LR=2[L(H_A)-L(H_O)] \sim \chi^2(J)$

where J=1, the number of restrictions under H_O. In this case, LR= 0.06, far less than the 5% critical value of 3.84, thus the null hypothesis cannot be rejected and linearity is indicated. The third specification of the model thus contains the same coefficients and functional form as the second model, but in the third model weighted least squares is applied to adjust for error disturbance which varies as a function of the predicted value of the dependent variable.

4.2.4 Data Constancy

The data collected included all sales of EFU zoned property that had occurred in the previous five years. Since it was possible that the definition for EFU property may be broad enough to include situations and motivations substantially different from the rest of the participants in the market, tests were conducted to examine the constancy or robustness of estimation when applied to various "segments" of the sample. Purchase of mostly nonirrigated range land (ranches) may represent a market separate from that of irrigated farms growing primarily row-crops. Persons buying an expensive tract of land may participate in a market separate from those purchasing less expensive parcels and some purchasers of EFU property may be interested mostly in the opportunity to reside in a rural setting and be relatively more concerned about improvements and proximity to town and less concerned about soil quality.

In order to ascertain whether all farm sales included in the sample come from the same market, the sample was sorted to identify properties that may belong to a different market segment and tests conducted to see if those extreme-valued properties "fit" within the characteristic market. The sample was sorted by an attribute suspected to indicate a distinct market segment. The extreme-valued observations were excluded from model estimation. Then F-tests were conducted to see how well the estimated model could predict the price per acre of the extreme-valued observations.

This is referred to as the Chow predictive test, introduced by Chow (1960) as a remedy for situations where the related analysis of variance test was inapplicable. The analysis of variance test predated Chow's contribution but is commonly referred to as simply the Chow test because Chow was responsible for popularizing it (Maddala, 1992).

In the analysis of variance or Chow test the same regression is performed on the two subsamples, then an F-test is conducted to see if the corresponding coefficients are equal across the two subsamples. The null hypothesis is that the corresponding coefficients are equal across the two subsamples. This restriction is modeled by a regression on the full sample. The alternate hypothesis is that the corresponding coefficients are not equal across the two subsamples. This unrestricted model is represented by the sum of squared errors of the two subsample regressions. The hypotheses and statistic for the Chow or analysis of variance test is as follows.

H_O: $\beta_{A1}=\beta_{B1}$, $\beta_{A2}=\beta_{B2},\ldots,\beta_{Ak}=\beta_{Bk}$

H_A: at least one $\beta_{Aj}\neq\beta_{Bj}$

$$\frac{(SSE_{A+B}-(SSE_A+SSE_B))/k}{(SSE_A+SSE_B)/(T_A+T_B-2k)} \sim F_{(k,T_A+T_B-2k)}$$

When the smaller subsample, say B, contains too few observations to allow regression, (i.e., when $T_B < k+1$), then the Chow predictive test is employed. The predictive test is equivalent to testing whether the observations in the small or minority subset are within the prediction interval of the regression performed on the majority of the observations (Kennedy, 1993). In this test a distinct dummy variable is assigned to each of the observations in the minority subset. The null hypothesis is that each of the observational dummy variable coefficients equal zero. This is equivalent to performing the regression on the full sample. The alternate hypothesis is that one or more of the coefficients on the observational dummy variables are nonzero. This model allows each dummy coefficient to incorporate the entire residual of each of the minority observations. In this way, the minority observations don't affect the minimization of errors. This is the unrestricted model and is equivalent to regression on only the majority observations. The hypotheses and statistic of the Chow predictive test are as follows.

H_O: all $\delta=0$ $\quad$ H_A: at least one $\delta\neq0$

$$\frac{(SSE_{A+B}-SSE_A)/T_B}{SSE_A/(T_A-k)} \sim F_{T_B,T_A-k}$$

where Ta and Tb are the number of observations in subsample A and subsample B, respectively.

Figures 2 through 5 show the distribution of values of attributes that may indicate market segments. The sample was sorted and subdivided at breakpoints indicated on the graphs. Those breakpoints were selected at \$310,000 for total sale price, \$80,000 for assessed improvement value, 53% for percent of value in improvements and 400 acres of nonirrigated land. An additional test was made between properties with less or more than 40 acres of nonirrigated land since it was felt that persons purchasing more than 40 acres must have grazing planned for that land whereas less than 40 acres might be used for incidental uses of farm production.

The results of the Chow predictive tests are summarized in Table 13.

Table 13 Results of Chow Predictive Tests of Data Constancy

Characteristic	Demarkation between subsets	F-statistic	P-value
Total price	$310,000	1.44	0.14
% Improvement value	53%	0.99	0.40
Improvement value	$80,000	1.06	0.46
Nonirrigated acres	400 acres	0.90	0.55
Nonirrigated acres	40 acres	1.23	0.26

In each of the Chow predictive tests the null hypothesis could not be rejected, indicating the extreme-valued observations all fell within the characteristic sample. In other words the sample appears to derive from a single, non-segmented market.

4.2.5 Water Source

In the original specification, the land class variables were disaggregated corresponding to the source of water supply. This allowed the model to reflect different implicit prices on the same land class for the different sources of water. Review of the coefficients showed no consistent difference in prices between water sources. Several F-tests were conducted to evaluate the similarity or difference across water sources.

A priori knowledge was that Old Owyhee Irrigation District had the most senior right and Owyhee Hiline Irrigation District had the most storage capacity. It was expected that land served by these two districts would sell for more than land in the other two districts. Also, Warmsprings Irrigation District has substantial storage capacity, so it was expected that land served by Vale Oregon Irrigation District would sell for the least among the four water districts. Information on relative costs of service between the districts was not obtained, though that might impact land values also.

Little is known about the "Other" water sources, except that many are rights to pump directly from the Snake River, the Malheur River or local drainage ditches. It is not known whether the physical supply from these sources is adequate, whether they are administered by priority or whether the water is obtained at greater or less cost than water from a irrigation district. One thing is certain, there must be more variability of water endowment and water cost among the properties with Other water sources than among properties served by a given water district.

Tests were conducted to see if land values varied according to water source as *a priori* knowledge suggested. Table 14 summarizes the hypotheses tested regarding the source of water supplies. As can be seen, the sales included in this study show land value to be equivalent regardless of the source of irrigation water.

Table 14 Results of Tests on Equality of Water Sources

H_A	H_O	F	Outcome
sources not all equal	$\beta_O=\beta_H=\beta_V=\beta_W=\beta_T$	1.50	reject H_o @ 5%
districts not all equal	$\beta_O=\beta_H=\beta_V=\beta_W$	1.24	reject H_o @ 5%
'Other' sources not equal to districts	$\beta_O\&\beta_H\&\beta_V\&\beta_W=\beta_T$	2.20	reject H_o @ 5%
Old Owyhee & Owyhee Hiline > Vale & Warmsprings	$\beta_O\&\beta_H=\beta_V\&\beta_W$	0.04	reject H_o @ 5%
Old Owyhee & Owyhee Hiline & Warmsprings > Vale	$\beta_O\&\beta_H\&\beta_W=\beta_V$	0.83	reject H_o @ 5%

Note: O = Old Owyhee, H = Owyhee Hiline, V = Vale, W = Warmsprings, T = Other, & = aggregated

Because the source of water did not prove to be a significant cause of difference in land values, the land variables were aggregated across water source. This resulted in the fourth and final specification of the model, shown in Table 15.

Table 15 Final Specification of the Hedonic Model

$$y = X\beta + u\ , \qquad where\ u_i = \hat{y}_i^{1.49/2} * e_i \qquad e \sim N(0, \sigma^2 I)$$

Variable (X)	Coefficient Estimate (β)	Standard Error	T-ratio on H_0: β=0	P-value
LC1	2918	609	4.8	< 0.001
LC2	2100	154	13.7	< 0.001
LC3	1489	90	16.6	< 0.001
LC4	962	76	12.6	< 0.001
LC5	881	98	9.0	< 0.001
LC6	367	59	6.2	< 0.001
LC7	248	56	4.4	< 0.001
IMPR	1.17	0.076	15.5	< 0.001
LOTS	6208	2672	2.32	0.021
MONTHS	3.77	0.80	4.7	< 0.001
DISTO	-5.36	1.99	-2.70	0.007
RDISTO	278	93	2.99	0.003
RDISTV	-104	69	-1.52	0.131
R^2=0.92				

As can be seen, the equation is linear and the error disturbance is multiplicative heteroskedastic. There are a total of 13 explanatory variables, 12 of which are significant at the 5% level, 11 of which are significant at the 1% level. The percent of variation explained (R^2) is 92%. The model has been tested for heteroskedasticity, functional form, and data constancy.

5. INTERPRETATION

Model estimation provides a basis upon which interpretation of economic factors can be made.

5.1 Estimated Value of Farmland

The market value of land can be estimated using the hedonic model derived in this study and presented in Table 15. Estimation can be done for a specific parcel of interest or to identify representative values for land in a particular sector or area of interest. By assuming zero lots and zero improvements, the value of land is determined solely from soil class, distance to town and month of sale. For example, class 4 land located five miles from Ontario, 12 miles from Vale and sold in December 1993 would be expected to be valued at $1005[1].

5.2 Soil Quality

Soil quality has a large influence on the value of agricultural land. Figure 7 illustrates the implicit market price estimated for each class of agricultural land in the study area. These prices correspond to zero contribution from the distance and time variables; that is, the prices correspond to land sold in June 1993 at a distance of seven miles from Ontario. Property located closer or sold later would have a greater value, property located more distant or sold earlier would have lesser value. The difference in value between land classes would remain the same regardless of time or location.

The capability of soil to grow crops is a significant factor in agricultural productivity. More productive soils generate greater profit and greater profits are

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[1]That is, $962+3.77\times6-5.36\times5+278\times(1/5)-104\times(1/12)=1005$

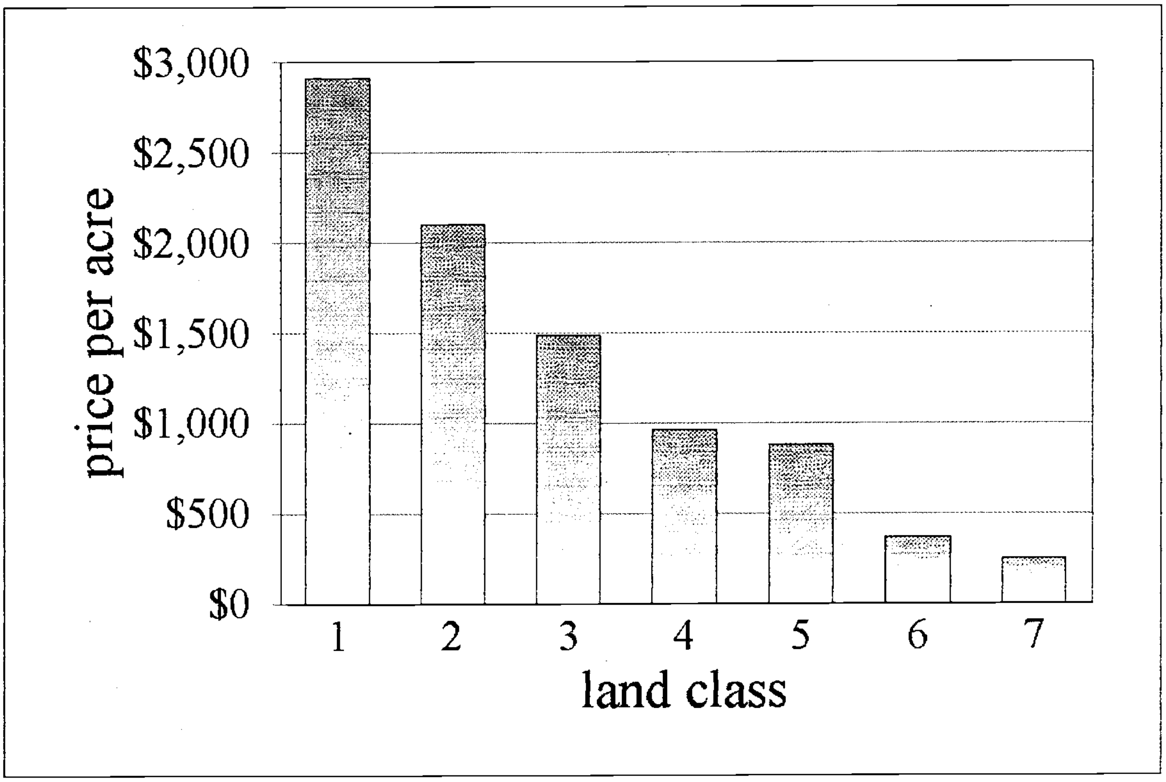

Figure 7 Estimated Land Prices

capitalized into higher land prices. Implicit prices in the study area for an irrigated acre ranged from \$2918 for class 1 land to \$881 for class 5 land. If this wide variation is representative of the influence of soil productivity on land values in other regions, then hedonic analysis of agricultural land that does not carefully account for soil quality could be biased by omission or inaccurate definition of this attribute. Selection of a "representative" land class (Crouter, 1987) or calculation of an arithmetic average land class (Xu et al., 1993) is likely to lead to inferior model estimation and conclusions. As Figure 7 shows the numerical identification of land classes does not linearly correspond to value.

5.3 Water Source

While the class of soil showed a strong influence on land value, the source of water did not significantly influence land values. Statistical tests showed no significant difference in implicit land prices across the four water districts or between the water districts and the other water sources. This went against the expectation that differences in water rights and facilities would be reflected in land values. It may be that the sample size was insufficiently large to discern statistical difference. In particular, it should be noted that there were only nine sales of land under the Old Owyhee district and only 18 sales of land served by the Warmsprings district.

On the other hand, the model result may demonstrate that, in fact, there is little difference in water endowment and unit price of water between the various water sources. Available information indicates average annual deliveries approximate 3.5 acre-feet per acre for all four districts. It may be that differences in water endowment are insignificant. Perhaps differences on paper are not translated into differences in practice due to slack administration of water right priorities and diversion amounts. Or it may be that differences in water endowment do exist but are too small to affect agricultural production.

To the extent there is a common perception that some districts comprise less valuable lands, it may be that this can be explained by a preponderance of poorer quality soils rather than less favorable water endowment. By determining an average mix of soil classes and average distance to Ontario and Vale for each district based on the farm sales transacted during 1991 through 1995, representative land values were estimated for each water district. The land values exclude residential lots and improvements and correspond to the end of this study's sampling period, December 1995. The district land values are representative only to the extent that the properties sold during the five year sampling period are representative of all farms in the respective district. Table 16 shows a representative value for the Vale district that is considerably less than the other districts. This is largely due to inferior soils served by that district. The common perception of lower values under the Vale district may be more attributable to soil quality than water endowment.

Table 16 Representative Values of Irrigated Land

Irrigation District	Representative Price Per Acre
Old Owyhee	1993
Owyhee Hiline	1233
Vale Oregon	1015
Warmsprings	1402

5.4 Single Market

Though each of the different water sources could present distinctly separate supply functions for irrigation water, apparently the water supply functions are sufficiently similar or the value of land associated with the water supply functions are sufficiently similar that the land market is not stratified by source of water supply.

Furthermore, tests of extreme-valued sales confirm the sample derives from a single market. No statistical difference was found associated with sales involving large transaction price or sales dominated by the value of improvements. No difference was found between sales primarily for ranching as contrasted to sales primarily for irrigated crop production.

5.5 Linearity

Analysis using a joint test of heteroskedasticity and a flexible functional form showed the appropriate model to be linear. This implies that land can be costlessly repackaged, i.e., that one parcel of 80 acres is valued equivalently to two parcels of 40 acres and vice versa. This runs counter to common findings of economies of scale with increasing property size.

Interestingly, testing for linearity by use of the commonly recommended and practiced procedure of Box-Cox transformation was shown to be misleading in this case. Estimation using the Box-Cox procedure indicated a strongly nonlinear function. This indication was shown to be incorrect once the model was adjusted for the presence of heteroskedasticity. This serves as a warning to other research involving use of the Box-Cox transformation for selection of functional form: use of the Box-Cox procedure without evaluation of the error structure can lead to incorrect model specification.

5.6 Values of Attributes

While water was of primary interest in this study, each of the attributes included provides information.

5.6.1 Value of Permitted Residence

Hedonic analysis confirmed the hypothesis that non-conforming use residence permits on exclusive farm use (EFU) land would have significant value. A permit to reside on EFU land in the Ontario-Vale-Nyssa area was estimated at $6208 per residence.

This is far greater than the "market value" assigned to these half-acre lots by the county assessor's office. A special assessment is applied to the lots based on the market value per acre of the contiguous land (excluding improvements) under the same ownership. Thus, the lots are assessed for taxes at the estimated average market price of the adjacent agricultural land. In this sample, the median and mean assessed value of land (excluding improvements) per half-acre is $440 and $513, respectively.
This study shows the value of a residential lot on EFU land far exceeds the value of that land for agricultural production.

5.6.2 Improvement Value

Model estimation placed a coefficient value of 1.17 on the variable representing improvements. This means that buildings on EFU land in the study area were valued by the market at a level 17% greater than the assessed value of those improvements. This might be explained by a tendency for the assessor's office to make conservatively low estimates of property value to avoid contested assessments. Since the time variable indicated only slowly increasing market values, it is not likely that market values of improvements are increasing faster than the assessor's estimate of price appreciation for improvements.

Market values greater than assessed values seems to refute the *a priori* hypothesis that the value of farm buildings is discounted by new owners because of farming plans that diverge from the prior owners. The assumption embedded in this hypothesis is that the assessed value represents the nominal or replacement value of the improvements.

However, if the assessed value is well below the replacement value, the market value could be greater than the assessed value and still be less than the replacement value.

5.6.3 Time Value

The coefficient on time appreciation was estimated at $3.77 per acre per month. The zero coordinate for this variable was June 1993. Properties transacted after this date show greater value, properties sold before this date show lesser value. The change in value over time is equivalent to $45/acre/year or 3.2% per year of the median farm price. During this same period, the U.S. consumer price index increased an average of 3.5%. This indicates appreciation of agricultural property values in the Ontario-Vale-Nyssa area has approximately matched the general rate of inflation.

Figure 8 shows a plot of residuals versus the time variable, i.e., month of sale. This graph shows a fairly uniform scatter of positive and negative residuals across all months of sale. This indicates specification of the time variable as linear and additive is an adequate representation.

5.6.4 Location Value

Proximity to Ontario was shown to have a positive value as expected. Both variables, distance and reciprocal of distance to Ontario were statistically significant suggesting that value of proximity is not linearly related to distance. Figure 9 shows the combined effect of the DISTO and RDISTO variables. At distances less than 7.2 miles from Ontario, EFU land receives a premium for proximity in a rate strongly nonlinear to distance. At distances greater than 7.2 miles, EFU properties lose value at an essentially linear rate of $6 per acre per mile.

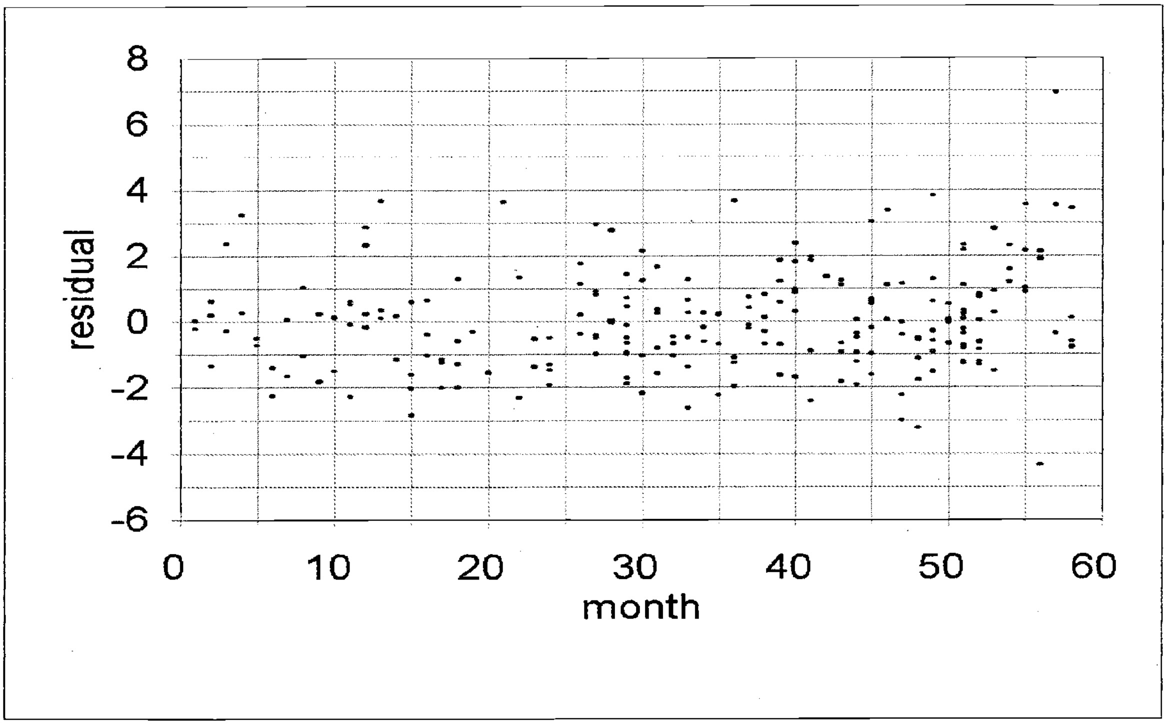

Figure 8 Plot of Residuals Versus Month of Sale

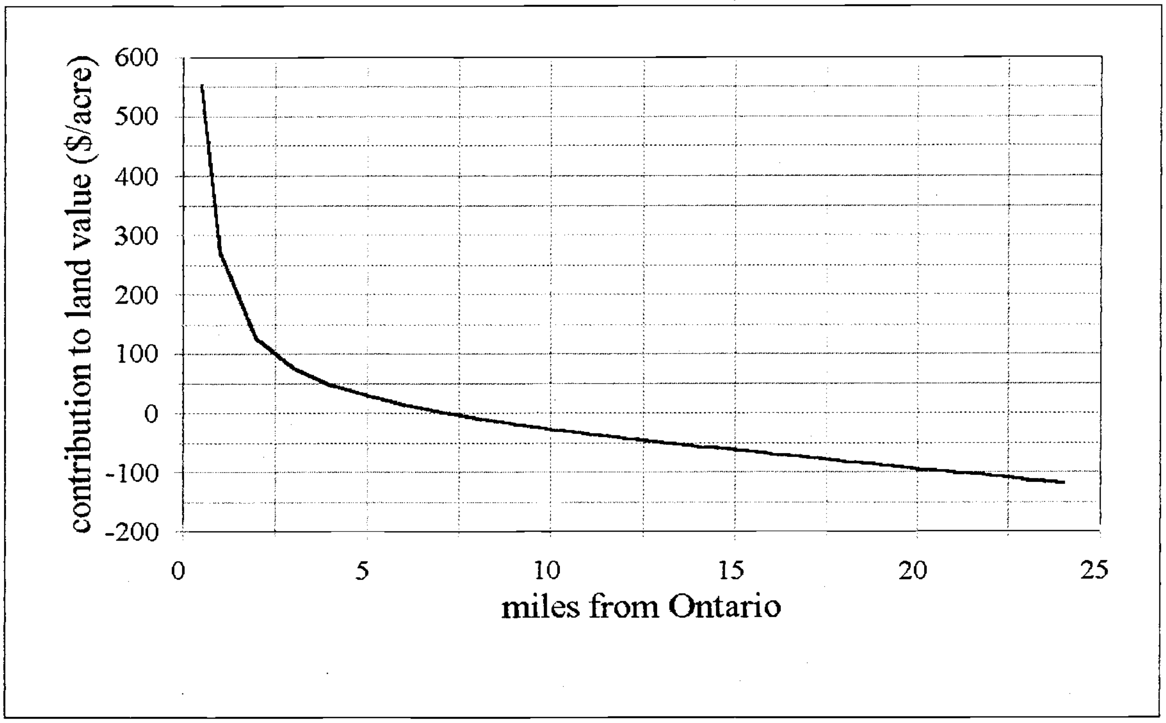

Figure 9 Influence on Land Value of Distance to Ontario

Distance to Vale was found to be statistically insignificant (p-value on reciprocal of distance to Vale was 13%). Since the absolute value of the t-ratio was greater than one (t = -1.52), this variable was not dropped from the model. The estimated coefficient on RDISTV was -103, opposite of the expected sign. Effect on modeled property values would be subtraction of $104 per acre at a distance of one mile, $52/acre at two miles, $35/acre at three miles, $26/acre at four miles, etc. This is probably the result of peculiarities in the data, since there is no apparent reason for disamenity associated with proximity to Vale.

5.6.5 Value of Water

Lastly, we come to the valuation of water, the primary objective of this study. Figure 7 shows the estimated market values for the seven land classes. Land classes 1 through 5 include irrigation water, classes 6 and 7 do not. In this region, land without irrigation provides scant productivity regardless of fertility (Knudsen, 1996). Because of this, the value estimated for Class 6 land represents a close estimate of the value of Class 1 through 5 land without water. By subtraction, the value of water can be determined. Table 17 demonstrates this calculation.

Row 1 of Table 17 reiterates the marginal value of each land classes as estimated by the hedonic model. Row 2 is the marginal value of nonirrigated land as estimated by the model. Row 3 is the difference between row 1 and row 2. Row 3 values represent the marginal value of irrigation water, net after cost of delivery, in units of dollars per irrigated acre. The row 3 values represent the present worth of the future string of annually recurring water delivery to one acre. These present worth values can be converted to an annual value as shown in row 4.

The water values per irrigated acre shown in row 3 can also be converted to water value per acre-foot of water delivered perennially by dividing through by the average water delivery of 3.5 acre-feet per year (row 5). The result is shown in row 6 and is the present value of one acre-foot of water provided each year perennially.

The present value of an acre-foot of water supplied perennially can be converted to a value for one acre-foot of water supplied once by annualizing. A discount factor of 6% over an infinite time horizon was used for this calculation. Row 7 shows the resulting estimate of marginal value of one acre-foot.

Table 17 Calculation of Value of Irrigation Water

		Soil Class				
		1	2	3	4	5
1	Value of irrigated land per acre	2918	2100	1489	962	881
2	Value of nonirrigated land per acre	367	367	367	367	367
3	Value of water per acre	2551	1743	1122	595	514
4	Annual value of water per acre[1]	153	105	67	36	31
5	Average annual water delivery per acre	3.5	3.5	3.5	3.5	3.5
6	Value of water per acre-foot (delivered perennially)	729	495	321	170	147
7	Value of water per acre-foot (delivered one time)[1]	44	30	19	10	9
	1- Based on 6% discount, infinite horizon					

In summary, the marginal value of water on a per acre basis ranges from $514/acre to $2550/acre depending on soil quality. On a one-time use basis, the value of water ranges from $9/acre-foot to $44/acre-foot, again depending on the soil quality.

5.7 Comparison of Land and Water Values

The values estimated for agricultural land values can be compared to land value estimates prepared and used by the County Assessor's Office in their valuation of EFU property. Table 18 provides this comparison. The assessor's office estimate is based on a combination of reported land rents and an estimate of land profit potential.

Table 18 Comparison of Estimated Values of Agricultural Land ($/acre)

	1	2	3	4	5	6	7
Hedonic analysis	2918	2100	1489	962	881	367	248
Assessor's estimate	2850	1813-2600	1246-1750	850-1200	400-567	125-284	30-85

As can be seen, in classes 1 through 4 there is close agreement between the implicit market prices revealed by hedonic analysis and the assessed valuations assigned by the county assessor. In land classes 5, 6 and 7 the implicit market prices exceed the assessed valuation.

Recall that exclusive farm use property is assessed according to its agricultural productivity. Where the productivity is high, the market valuation matches the assessor's estimate of agricultural value. On the other hand, where productivity is low, the market valuation exceeds the estimate of agricultural value. This may be explained by utility satisfaction from owning and living on rural property that exceeds the value of agricultural production.

The estimates of water value can be compared to the water lease arranged by the Bureau of Reclamation from property near Ontario in 1994 - 1996. In that lease, annual payments were made both on an acre-foot basis for water not pumped from the river and for an option to purchase the farm. The payment for foregoing pumping was $7 per acre-foot. The lump sum annual payments for the purchase option were $225,000 or $14 per acre-foot not pumped. That makes a total of $21 per acre-foot. The primary crop on the leased farm was sugar beets which require a soil capability class of LC3 or better. The value of water on class 3 land was estimated in this study at $19 per acre-foot delivered to the farm. Water at the bottom of a high pump lift, which is the situation at this farm, would be worth less. The marginal cost per acre-foot of pumping water from the river would be directly subtracted from the productive value of the water on the farm. Knowledge of the pumping costs and types of soils irrigated on the leased farm would enable a closer comparison of water prices.

5.8 Strategy for Salmon Recovery

An agency, such as the Bureau of Reclamation, which is looking to buy water in such large amounts and for the purpose of severing it from the land acts essentially as a monopsonist. There is no other buyer in this category. A monopsonist buyer can discriminate and obtain water at the least cost per acre foot. If an agency bids $8 or $9 per acre-foot (one time use), the land that is least productive under irrigation will be offered for sale. This minimizes the cost to taxpayers and minimizes the reduction of agricultural productivity in the area.

6. SUMMARY AND CONCLUSIONS

Several useful conclusions can be extracted from this study. These conclusions are summarized as follows. Points of departure for further studies related to this one are outlined in the final part of this chapter.

6.1 Conclusions Applicable to Hedonic Analysis of Agricultural Land Sales

1. Hedonic price analysis of farm sales provides an easy and reliable technique with which to reveal the non-observed market price of irrigation water. Data requirements are generally easily satisfied by a visit to the county assessor's office, where much of the basic data needed on acreages, soil types, sales price and value of buildings are already assembled. Then once the data are collected, relatively simple tools of regression analysis are sufficient to achieve satisfactory explanation of the value of the dependent variable. Interpretation is simple and straightforward, at least in the circumstance of a linear price function which was the case in this study and which may be expected in other studies of agricultural land sales. Finally, results have the advantage of reflecting actual market transactions rather than being based on simplifications and simulations of production and trade functions.

2. Irrigation water can be valued as the difference in market price between land receiving irrigation water and land with equivalent soil quality not receiving irrigation water. Furthermore, in arid regions irrigation water can be valued as the difference in market price between land receiving irrigation water and the best quality land not receiving irrigation. This is because in regions where irrigation is so crucial to growing any type of crop, the absence of irrigation creates an upper limit on the agricultural value of land that is less than the value of any irrigated land.

3. The value of irrigation water is strongly influenced by the quality of the soil on which it is applied. In this area the value of water varies five-fold depending on the soil class of the land. The soil capability classes, denoted as 1 through 7 by the SCS

soil surveys, represent categoric variables, not a continuous variable. Conversion of the seven capability classes into a single soil index variable can lead to loss of critical information.

4. The Box-Cox technique for evaluation of functional form is misleading in the presence of heteroskedasticity. Without adjustment for heteroskedasticity, the Box-Cox technique is biased toward indication of nonlinearity. While the literature on hedonic analysis recommends use of the Box-Cox technique to evaluate functional form, application of the Box-Cox flexible functional form without regard to nonstationary errors can lead to incorrect conclusions.

5. Model specification is an iterative process of specification, testing and respecification. Characteristics that lead to respecification include testing and adjustment for heteroskedasticity, testing for and exclusion of variables with t-values less than one, testing for and aggregation of related variables that are not significantly different from each other, and testing for and isolating part(s) of the sample not representative of the characteristic market. While care must be taken to avoid data mining, these are examples of circumstances which require testing and respecification of the model. Furthermore, the sequence of these tests and adjustments to the model affects the result of subsequent tests. This necessitates repeated trials using different sequences of tests to observe the robustness of test results.

6. In this area, agricultural land can be costlessly repackaged, that is, the hedonic price function for agricultural land is linear. In the absence of governmental restrictions on land transfers, it is reasonable to expect this condition to be found in study of agricultural property in other areas.

6.2 Conclusions Applicable to the Ontario-Vale-Nyssa Agricultural Area

7. The value of water in irrigation is strongly influenced by the quality of the soil on which it is applied. The implicit market price of delivered irrigation water ranges from \$514 to \$2550 per irrigated acre, depending on the crop growing capability of the

soil. Expressing the value of water in units of dollars per acre-foot (one time use) shows irrigation water deliveries range in value from $9 per acre-foot on the lowest quality soils irrigated to $44 per acre-foot on the highest quality soils.

8. No statistically significant difference was found in the value of irrigated acreage attributable to water source. Though the four irrigation districts hold different water rights and 12% of the properties studied hold other individual water rights, no difference in irrigated land prices was found between the districts or the other water rights for a given quality soil. It appears that the source of water supply does not influence the value of an acre of irrigated land in this area.

This suggests that the level and reliability of water endowment is either not significantly different between the various sources or that the differences in water endowment do not translate into significantly different levels of productivity. Since this is a surprising conclusion, it may instead be hypothesized that insufficient data was assembled to distinguish the difference in values across different water sources. To the extent that local perception commonly associates different land values with the various districts, this may instead be explained by a preponderance of poor quality soils in a specific district and a preponderance of high quality soils in another district.

Collection of additional observations on farm sales to expand the data base or collection of detailed information on water endowment to allow explicit modeling of water supply may reveal some difference in value between the various water sources.

9. The implicit market price of an acre of irrigated farm land ranges from $881 to $2918, depending on soil capability class. Representative values of irrigated land vary between the irrigation districts not because of different water endowments, but because of the preponderance of high or low quality soils. These representative values (based on the sample of farms included in this study) range from $1015 per irrigated acre under the Vale Oregon Irrigation District to $1993 per irrigated acre under the Old Owyhee Irrigation District.

10. Agricultural land in this area can be costlessly repackaged, for example, one parcel of 80 acres is equal in value to two parcels of 40 acres each and vice versa.

11. Farm sales in this area exhibit greater variability in unit prices as unit prices increase.

12. A bid price for irrigation water of $400-$500 per irrigated acre would be appropriate for a purpose such as the salmon recovery effort where the water is to be transferred off the land. This is the minimum value conferred by irrigation supply to agricultural productivity in the area. Irrigators generating less value from their irrigation water than the bid would be better off to accept the bid price. Acceptance of the bid would result in the least productive irrigated lands being fallowed. This would minimize the impact on agricultural production in the area and would minimize the funds needed to provide a given amount of water for salmon recovery.

13. The value of a nonconforming use permit for a residential lot on Exclusive Farm Use property in the Ontario-Vale-Nyssa area is estimated at $6200.

14. Proximity to Ontario has a small positive influence on agricultural land values in this area. Distance to Vale or Nyssa does not have a significant influence on land values.

15. The appreciation of agricultural land values in this area approximated the US CPI rate of inflation during the years this study is based on: 1991 through 1995.

16. Buildings on agricultural land in this area during this study period were priced by market participants an average of 17% higher than the assessed value assigned by the county assessor's office.

6.3 Related Studies

Hedonic analysis of farm sales can be useful for estimating an appropriate bid or offer price for land or water. This may also be useful in the local assessor's office. In particular, hedonic analysis provides perhaps the only means with which to estimate the market price of residential lots on agriculturally zoned property.

Hedonic price analysis of land sales that include federal grazing allotments may enable revelation of a market price on grazing allotments.

Hedonic analysis to reveal the market price of water could be applied to other localities. It would be interesting to see if regional attributes such as climate could be incorporated into a hedonic model that spanned several markets. It would be informative to study a setting where detailed information about water supplies and water rights could be quantified and incorporated into the model.

Transfer of irrigation water off land in northern Malheur County would have local impacts which may merit analysis. Increased river flows may benefit salmon survival and water-based recreation. Sale of irrigation rights would generate funds that may be spent or re-invested locally. Reduced demand for agricultural inputs, such as fertilizer or farm implements, as well as reduced demand for processing of agricultural yields may cause a decline in associated sectors of the local economy. The local tax base may shrink as land is converted to lesser value. Some of these impacts could be evaluated with input-output analysis.

Reduced water diversions would alter the regime of rivers and reservoirs. Return flow patterns and groundwater levels could be affected as land is removed from irrigation. Hydrological analyses would be needed to identify these impacts and devise means to insure non-injury to other water users. Water quality could be affected. Less water seeping from irrigated fields to the groundwater could increase the already high concentrations of nitrates in the local groundwater. Connor (1995?) suggested that removal of low-valued lands from irrigation in this area would increase nitrate concentrations by removing an important source of dilution. His study indicates high value crops receive greater application of nitrogen fertilizer and contribute greater loading of nitrates to the groundwater than low-valued crops.

Irrigation districts that lose service acreage would need to act to protect the interests of remaining irrigators. Since most operation and maintenance costs will continue as before, irrigation districts will want to insure continued payment of district assessments even after water is transferred out of the district. Also, since transferring part of the water out of the district will have no appreciable affect on the amount of water lost to reservoir and canal seepage, the districts will want to retain that portion of the water being transferred that was historically lost to seepage. These issues and others would need to be addressed to insure non-injury to others as a result of reallocation of water away from its historic use.

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APPENDIX: Northern Malheur County Farm Sales Data

Sale Price	Total Acres	Class 1	Class 2	Class 3	Class 4	Class 5	Class 6	Class 7	Bldg Lots	Assessed Improv. Value	Months since 12/90	Miles to Ontario	Miles to Vale	warm	vale	owyhi	oldowy	other
225000	124.7	0	74	45.5	0	0	4.7	0	1	30930	36	17	3	1	0	0	0	0
65000	68.6	0	0	47.5	0	0	12.5	8.1	1	8200	24	21	7	1	0	0	0	0
150000	72.7	0	0	0	0	24	0	47.7	2	70240	54	19	5	1	0	0	0	0
110000	78.2	0	0	27	0	23.5	24	2.7	2	29100	52	17	1	1	0	0	0	0
247050	214.3	0	0	26.5	39.5	61.5	10	76.3	1	23760	41	18	4	1	0	0	0	0
1346500	5534.1	0	0	335	82.7	32.9	637	4444.8	4	147020	51	19	5	1	0	0	0	0
165100	194.7	0	0	63	34	0	11	86.2	1	34530	4	21	7	1	0	0	0	0
42500	40	0	0	0	25	0	0	15	0	120	51	20	6	1	0	0	0	0
72500	38.5	0	0	33.5	0	0	0	5	0	0	28	7	4	1	0	0	0	0
40000	33.7	0	0	30	0	3.7	0	0	0	0	31	9	2	1	0	0	0	0
130000	82.7	0	0	29.5	28.5	2	15	6.7	2	57670	43	14	0	1	0	0	0	0
40000	23.9	0	0	23.4	0	0	0	0	1	14350	18	12	1	1	0	0	0	0
60000	40.7	0	0	37.7	0	0	2.5	0	1	14780	18	15	1	1	0	0	0	0
111600	79.1	0	0	30	24.5	17.8	0	6.3	1	27800	34	7	7	1	0	0	0	0
167222	79.3	0	46.5	3.5	24.3	0	5	0	0	0	30	5	9	1	0	0	0	0
100000	72.34	0	67	1	2.5	0	1.34	0	1	27140	56	5	9	1	0	0	0	0
370000	379.4	0	0	47	114	19	49.3	149.1	2	136950	48	19	5	1	0	0	0	0
141000	78.1	0	0	57	12.5	0	0	8.6	0	0	28	0	16	1	0	0	0	0
96000	24.56	0	0	0	0	12.66	0	11.4	1	42970	53	21	7	0	1	0	0	0
127025	79	0	0	62	13.5	0	0	3	1	6700	50	21	7	0	1	0	0	0
230000	235	0	0	0	211.5	6	7	10	1	38360	44	21	7	0	1	0	0	0
150000	120	0	0	0	58	0	30.5	30.5	2	73960	7	23	9	0	1	0	0	0
41000	120.1	0	0	0	30	0	39.5	50.6	0	0	52	22	8	0	1	0	0	0
87300	151	0	0	0	36.5	53	51	10	1	13170	3	22	8	0	1	0	0	0
105000	164.25	0	0	0	38.5	73.45	20.5	31.3	1	23840	53	18	4	0	1	0	0	0
139000	355.9	0	0	67	5	0	3	280.9	0	0	52	22	8	0	1	0	0	0
81600	154.2	0	0	0	54.5	75.7	2.5	21	1	26170	11	17	3	0	1	0	0	0
67500	50.8	0	0	0	20.7	21	8	0.6	1	22230	51	16	2	0	1	0	0	0
85000	39.1	0	0	0	0	22	15.5	1.1	1	73710	9	17	3	0	1	0	0	0
9500	40	0	0	0	0	15	6	19	0	0	29	17	3	0	1	0	0	0
386915	282.5	0	0	226.7	13.4	0	2.4	39	2	95280	52	21	7	0	1	0	0	0
122615	81.8	0	0	65.8	14	0	0	2	0	0	40	21	7	0	1	0	0	0
166000	681.3	0	0	70.6	41	12	31	526.2	1	49470	10	21	7	0	1	0	0	0
426418	857.5	0	0	0	135.7	61.2	21.2	637.9	3	148770	51	20	6	0	1	0	0	0
45000	36.2	0	0	0	16.5	9.7	0	9.5	1	16820	1	20	6	0	1	0	0	0
43500	42.3	0	0	0	7	18	0	17.3	0	0	46	20	6	0	1	0	0	0
140000	283	0	0	0	122.3	27.5	4	129.2	0	20970	52	19	5	0	1	0	0	0
73500	37.5	0	0	0	2.7	31.3	0	3	1	31910	31	18	4	0	1	0	0	0
75000	38.8	0	0	0	0	16	0	22.3	1	26690	40	18	4	0	1	0	0	0
95000	85.5	0	0	0	20.7	48	13.5	2.8	1	23870	57	17	3	0	1	0	0	0
237400	140.4	0	0	0	98	32	6.9	3	1	75890	45	17	3	0	1	0	0	0
89000	118	0	0	0	63	0	52.5	2	1	33950	5	15	1	0	1	0	0	0
60000	108.5	0	0	0	34.3	26.5	44.4	2.8	1	15150	23	15	1	0	1	0	0	0
139100	124.9	0	0	0	86	22	15.8	0.6	1	44430	27	16	2	0	1	0	0	0
108000	74.4	0	0	0	61.4	0	12.5	0	1	43780	48	17	3	0	1	0	0	0

Sale Price	Total Acres	Class 1	Class 2	Class 3	Class 4	Class 5	Class 6	Class 7	Bldg Lots	Assessed Improv. Value	Months since 12/90	Miles to Ontario	Miles to Vale	warm	vale	owyhi	oldowy	other
165000	48.3	0	0	0	28	19.8	0	0	1	72640	39	17	3	0	1	0	0	0
105000	102.9	0	0	0	98.8	1.5	1	1.1	1	26190	48	17	3	0	1	0	0	0
75000	31.2	0	0	0	30.7	0	0	0	1	26510	53	17	3	0	1	0	0	0
280000	264.1	0	0	0	209	37	1	15.6	3	42770	37	18	4	0	1	0	0	0
90000	70.1	0	0	0	44.5	20	3	2.1	1	18260	37	19	5	0	1	0	0	0
150000	133.2	0	0	0	76	28	0	28.7	1	48490	58	20	6	0	1	0	0	0
115000	117.8	0	0	0	55.5	17.5	0	44.3	1	24050	33	19	5	0	1	0	0	0
130000	70.4	0	0	0	69.1	0	0	0.8	1	46990	58	18	4	0	1	0	0	0
89500	79.1	0	0	0	69.5	0	9.1	0	1	43080	40	17	3	0	1	0	0	0
133800	83.5	0	0	0	69	4.7	8	1.3	1	53850	45	16	2	0	1	0	0	0
178500	221.5	0	0	0	95	53.6	70.8	1.1	2	44310	43	16	2	0	1	0	0	0
89000	39.8	0	0	0	29.5	6	2.7	1.1	1	46280	49	26	12	0	1	0	0	0
70000	79.2	0	0	0	42	27.7	9	0	1	7160	2	26	12	0	1	0	0	0
130000	87.5	0	0	0	82.7	0	4.3	0	1	11620	56	26	12	0	1	0	0	0
60000	38.2	0	0	0	28	2.2	7.5	0	1	12020	12	25	11	0	1	0	0	0
44000	38.2	0	0	0	28	2.2	7.5	0	1	12910	27	25	11	0	1	0	0	0
68000	40	0	0	0	30	0	9.5	0	1	27480	47	25	11	0	1	0	0	0
120000	110.4	0	0	69	36	4	0	1.4	0	0	2	23	9	0	1	0	0	0
135000	88	0	0	0	79.5	0	6.2	1.8	1	21780	40	23	9	0	1	0	0	0
15000	28	0	0	0	0	7	13	8	0	0	21	24	10	0	1	0	0	0
290000	427.3	0	0	0	105	175.1	103.5	43.2	1	61710	24	24	10	0	1	0	0	0
30000	39.3	0	0	0	0	27	6.3	5.5	1	9400	17	25	11	0	1	0	0	0
65000	39.7	0	0	0	0	33.7	4.5	1	1	20990	37	25	11	0	1	0	0	0
75000	86.1	0	0	0	0	51.8	30.8	2.5	2	31760	33	25	11	0	1	0	0	0
107500	138.2	0	0	0	46	25.8	33.9	32	1	12980	53	26	12	0	1	0	0	0
55200	78.2	0	0	0	0	62.5	2.7	12.5	1	23330	7	26	12	0	1	0	0	0
72500	90.6	0	0	0	0	75.5	4.6	10.5	0	0	38	24	10	0	1	0	0	0
260000	237.3	0	0	0	65	115.4	13.5	42.4	2	70620	35	22	8	0	1	0	0	0
89500	153.9	0	0	0	32.5	85.7	32.3	2.9	1	33090	35	22	8	0	1	0	0	0
120000	192.5	0	0	111.5	9	10	14	47.5	1	4780	17	21	7	0	1	0	0	0
92000	70.4	0	0	54.5	0	0	15.9	0	0	0	18	21	7	0	1	0	0	0
195000	186.7	0	0	55	54	53	16.5	7.7	1	10400	16	21	7	0	1	0	0	0
77500	41.3	0	0	0	0	27.5	9.8	3.5	1	33780	29	19	5	0	1	0	0	0
37000	39.1	0	0	0	14.4	23	1	0.2	1	9510	8	19	5	0	1	0	0	0
180000	158.4	0	0	16	34	0	8.5	99.4	1	31140	54	21	12	0	0	1	0	0
115000	98.9	0	0	27	32	31.9	7.5	0	1	10020	38	20	14	0	0	1	0	0
150000	476.4	0	0	0	50.5	5.5	19.5	400.4	1	41130	32	21	15	0	0	1	0	0
125000	94.2	0	0	0	40.5	19	22	12.2	1	44880	40	21	15	0	0	1	0	0
50000	43.4	0	0	0	42.9	0	0	0	1	11380	1	21	16	0	0	1	0	0
130000	94.2	0	0	0	40.5	19	22	12.2	1	52060	50	22	17	0	0	1	0	0
75000	77.2	0	0	0	71.3	0	4.9	0.5	1	38020	41	14	13	0	0	1	0	0
112000	38.1	0	0	0	37.1	0	0	0	2	52810	33	14	13	0	0	1	0	0
125000	60	0	0	46	7	0	6.5	0	1	17620	49	15	12	0	0	1	0	0
135000	77.8	0	0	75.2	0	0	2.1	0	1	49990	39	16	11	0	0	1	0	0
112800	80.9	0	0	0	28.5	15	31.6	5.3	1	48320	11	16	11	0	0	1	0	0

Sale Price	Total Acres	Class 1	Class 2	Class 3	Class 4	Class 5	Class 6	Class 7	Bldg Lots	Assessed Improv. Value	Months since 12/90	Miles to Ontario	Miles to Vale	warm	vale	owyhi	oldowy	other
68000	98.7	0	0	0	29.5	27.5	33.6	7.6	1	13490	51	16	11	0	0	1	0	0
56500	98.7	0	0	0	29.5	39	22.1	7.6	1	10670	29	16	11	0	0	1	0	0
104000	98.7	0	0	0	29.5	27.5	33.6	7.6	1	9980	55	15	11	0	0	1	0	0
145000	76.9	0	0	72.5	2	0	1.9	0	1	39590	38	14	12	0	0	1	0	0
160000	102.1	0	0	37.5	48	0	16.1	0	1	18590	47	16	13	0	0	1	0	0
149000	96.5	0	0	0	85	0	11	0	1	42470	51	17	13	0	0	1	0	0
115000	76.8	0	0	0	55	20.2	1.1	0	1	11370	54	18	14	0	0	1	0	0
65000	24.4	0	0	0	22.2	0	0	1.7	1	33200	14	16	15	0	0	1	0	0
180000	93.6	0	0	42.5	46.2	0	3	0.9	2	66800	58	16	15	0	0	1	0	0
220000	160.1	0	0	0	0	71.6	25.4	62.6	1	36190	56	5	13	0	0	1	0	0
200000	160.1	0	0	0	0	66	31	62.6	1	48910	42	5	13	0	0	1	0	0
127500	78.6	0	0	19.3	32.8	0.4	23.7	1.9	1	37840	11	5	13	0	0	1	0	0
60000	158.8	0	0	0	6	68.2	21	62.6	2	3330	15	5	13	0	0	1	0	0
38000	39.5	0	0	0	0	22.2	16	1.3	0	13370	12	6	14	0	0	1	0	0
95000	119.3	0	0	0	65	7.3	11.3	35.2	1	15270	35	6	14	0	0	1	0	0
58000	39.5	0	0	0	0	22.2	15.5	1.3	1	14180	22	6	14	0	0	1	0	0
99000	40	0	0	0	17.6	0	21.9	0	1	48510	27	7	15	0	0	1	0	0
62500	48.4	0	0	0	31.7	4.5	6.5	5.2	1	16690	29	7	15	0	0	1	0	0
112500	44.5	0	0	0	16.5	13.5	14	0	1	48030	33	8	16	0	0	1	0	0
204520	136.1	0	0	108	6	8	10.1	3	2	45970	32	9	15	0	0	1	0	0
75000	78.4	0	0	0	61.5	5.5	11.4	0	0	0	51	10	14	0	0	1	0	0
150000	70.8	0	0	70.8	0	0	0	0	0	0	51	10	14	0	0	1	0	0
476530	248.5	0	0	195.9	32	6	11.6	2	2	150570	51	10	14	0	0	1	0	0
182500	448.2	0	0	93.5	101	4.3	24	225.4	0	97970	15	11	14	0	0	1	0	0
87500	38.1	0	0	33.6	3	0	1	0	1	29500	49	12	13	0	0	1	0	0
211000	231.4	0	0	131.5	59.3	16	23.6	0	2	85200	47	12	13	0	0	1	0	0
136000	1054.6	0	0	0	59	14	0	981.6	0	0	17	11	6	0	0	1	0	0
170000	159.6	0	0	0	7	33.2	18.3	100.6	1	66820	52	14	2	0	0	1	0	0
106000	53.8	0	0	0	32.5	10.5	9.8	0.5	1	54030	47	12	2	0	0	1	0	0
36000	39	0	0	0	0	1	0	37.5	1	6050	36	12	2	0	0	1	0	0
50000	43.5	0	0	0	10.5	14.5	18.5	0	0	21740	15	13	1	0	0	1	0	0
63000	42.8	0	0	0	12	24	6.3	0	1	6420	35	1	12	0	0	1	0	0
232500	146.5	0	0	0	92	12.5	20	21	2	67320	34	2	12	0	0	1	0	0
240000	135.8	0	0	0	91.1	12	12.5	19.7	1	108920	38	4	13	0	0	1	0	0
700000	310.1	0	0	304.1	0	0	0	5.5	1	2590	4	2	10	0	0	1	0	0
94000	19.4	0	18.9	0	0	0	0	0	1	32370	45	2	10	0	0	1	0	0
220000	183.1	0	0	99.1	0	77	0	6.5	1	13500	45	3	10	0	0	1	0	0
145000	71.6	0	0	0	61	0	10.1	0	1	41110	30	3	10	0	0	1	0	0
176000	75	0	0	72.6	0	0	0	2.4	0	0	45	3	10	0	0	1	0	0
209020	39.1	0	0	38.6	0	0	0	0	1	124630	51	4	9	0	0	1	0	0
295000	286.8	0	0	40.1	106.2	29	84.5	26	2	98050	44	5	8	0	0	1	0	0
115000	44.9	0	0	0	0	22	0	22.4	1	72480	49	6	7	0	0	1	0	0
45000	36.2	0	0	0	13	10	12.7	0	1	24140	15	5	6	0	0	1	0	0
122000	76.9	0	0	0	39.4	17.5	19	0	2	48020	52	6	7	0	0	1	0	0
90000	118.3	0	0	0	70.8	5	7	35	1	570	37	6	7	0	0	1	0	0

Sale Price	Total Acres	Class 1	Class 2	Class 3	Class 4	Class 5	Class 6	Class 7	Bldg Lots	Assessed Improv. Value	Months since 12/90	Miles to Ontario	Miles to Vale	warm	vale	owyhi	oldowy	other
135000	78.3	0	0	0	21.5	11.5	42	2.8	1	109380	44	6	7	0	0	1	0	0
91100	76.9	0	0	0	25	50.5	0	0.9	1	20100	29	6	8	0	0	1	0	0
140000	79.2	0	0	0	46	11	21.7	0	1	68390	33	5	9	0	0	1	0	0
197000	39.25	0	0	0	17.75	18	3	0	1	78040	55	5	9	0	0	1	0	0
25000	25.4	0	0	0	25.4	0	0	0	0	1930	39	4	10	0	0	1	0	0
61500	31.7	0	0	0	29.2	0	0	2	1	18400	50	3	11	0	0	1	0	0
216000	37.7	0	0	0	32.2	5	0	0	1	120920	29	3	11	0	0	1	0	0
390000	130.5	0	0	109.5	19	0	0	1.5	1	51440	13	2	12	0	0	1	0	0
90000	68.6	0	0	27.5	33.5	0	1	6.1	1	36500	48	19	5	0	0	1	0	0
50000	48.1	0	0	0	26	6	0	15.6	1	15470	30	4	22	0	0	1	0	0
135000	77.2	0	0	0	23.5	25.5	0	27.7	1	61880	28	3	21	0	0	1	0	0
250000	115.2	0	0	0	84	28.3	1	0.9	2	117610	26	3	21	0	0	1	0	0
143000	77.2	0	0	0	23.5	25.5	0	27.7	1	71160	44	3	21	0	0	1	0	0
47000	22.2	0	0	0	8	13.7	0	0	1	19460	29	2	20	0	0	1	0	0
52000	40.2	0	0	0	31.7	0	0	8	1	7880	12	2	20	0	0	1	0	0
76000	40.2	0	0	0	31.7	0	0	8	1	17880	52	2	20	0	0	1	0	0
60000	25.2	0	0	24	0	0.7	0	0	1	27310	2	6	24	0	0	1	0	0
48000	37.2	0	0	0	37.2	0	0	0	0	0	51	5	23	0	0	1	0	0
218500	38.3	0	0	0	35.5	0	2.3	0	1	137860	45	5	23	0	0	1	0	0
139500	96.8	0	0	0	72	7	11	6.3	1	19040	43	5	23	0	0	1	0	0
77600	79.9	0	0	0	30	19.5	29.9	0	1	14330	10	5	23	0	0	1	0	0
180688	158.2	0	0	0	143	3	7.5	3.7	2	46100	29	5	23	0	0	1	0	0
72500	38.9	0	0	25.5	9.5	0	3.4	0	1	31710	20	4	22	0	0	1	0	0
93727	79.8	0	0	0	57.5	7	14.8	0	1	15110	9	3	21	0	0	1	0	0
108000	62.9	0	0	0	62.4	0	0	0	1	41520	32	3	21	0	0	1	0	0
55000	38.8	0	0	0	22	16.3	0	0	1	15240	44	3	21	0	0	1	0	0
89500	36	0	0	0	17.5	0	17.5	0	2	45110	11	2	20	0	0	1	0	0
85000	77.4	0	0	0	26	18	32.4	0	2	32550	47	1	19	0	0	1	0	0
110000	25.7	0	0	0	0	19.5	5.7	0	1	77980	27	1	19	0	0	1	0	0
30000	12.31	0	0	0	6.81	0	5.5	0	0	0	57	1	19	0	0	1	0	0
140000	25.7	0	0	0	0	19.5	5.7	0	1	89680	46	1	19	0	0	1	0	0
135000	77.9	0	0	0	63.5	0	12.5	1.4	1	40520	31	2	20	0	0	1	0	0
125000	57.2	0	0	0	54	0	2	0.7	1	40100	39	2	20	0	0	1	0	0
223120	77.5	31.4	23.3	20.3	0	0	2	0	1	21270	27	9	27	0	0	1	0	0
130000	358.2	0	0	0	38	54.3	31.5	233.9	1	810	41	9	27	0	0	1	0	0
95000	99.1	0	0	0	40.3	9.1	11.3	37.4	2	33660	18	9	27	0	0	1	0	0
110000	155.5	0	0	0	9	63.9	22	60.1	1	30280	16	9	27	0	0	1	0	0
95000	358.2	0	0	0	38	54.3	31.5	233.9	1	430	14	9	27	0	0	1	0	0
400000	154.6	129	21	0	0	0	0	3.8	1	0	27	9	27	0	0	1	0	0
180000	89.4	0	41.3	0	44.8	0	0	2.8	1	28870	31	8	26	0	0	1	0	0
70000	84.2	0	0	0	51.4	28.1	1.9	2.3	1	22700	30	7	25	0	0	1	0	0
79000	35.9	0	0	0	0	15.2	13.5	6.7	1	32490	43	6	24	0	0	1	0	0
50000	35.9	0	0	0	0	15.2	13.5	6.7	1	10440	26	6	24	0	0	1	0	0
70500	78.8	0	0	0	65.5	9.6	2.2	0	3	19290	6	6	24	0	0	1	0	0
92000	30.5	0	0	0	23.1	7.4	0	0	0	41990	46	7	25	0	0	1	0	0

Sale Price	Total Acres	Class 1	Class 2	Class 3	Class 4	Class 5	Class 6	Class 7	Bldg Lots	Assessed Improv. Value	Months since 12/90	Miles to Ontario	Miles to Vale	warm	vale	owyhi	oldowy	other
219510	69.8	0	69.3	0	0	0	0	0	1	5900	27	12	14	0	0	0	1	0
465000	123	0	112	0	0	0	10.5	0	2	349170	33	12	13	0	0	0	1	0
166000	36.1	0	35.6	0	0	0	0	0	1	72010	44	15	16	0	0	0	1	0
380000	118	0	115	0	0	0	3	0	1	30000	55	11	15	0	0	0	1	0
205000	95.3	0	76.5	2	0	0	16.8	0	0	33150	28	12	15	0	0	0	1	0
307500	235.4	0	68.5	42.5	100.1	4.5	12.8	6.5	1	580	48	0	13	0	0	0	1	0
107500	46.1	0	45.2	0	0	0	0	0.9	0	0	28	1	12	0	0	0	1	0
267000	152.7	0	85.1	44	11.5	0	0	12.1	0	0	48	2	12	0	0	0	1	0
191000	94.6	0	92.6	0	2	0	0	0	0	0	23	2	12	0	0	0	1	0
97500	58.7	0	31	16.9	0	0	10.3	0	1	0	13	14	16	0	0	0	0	1
1500000	5362.3	0	0	308.9	112.4	145.9	119.6	4673.3	4	228570	49	20	6	0	0	0	0	1
8000	79.1	0	0	0	0	0	20	59.1	0	0	43	17	3	0	0	0	0	1
135000	32.7	0	0	15	10	5.7	0	1.5	1	92400	50	13	0	0	0	0	0	1
89000	178.1	0	0	0	0	30	141.6	6	1	10970	12	15	1	0	0	0	0	1
168000	69.43	0	0	0	62.5	0	0	6.43	1	3790	58	1	16	0	0	0	0	1
89500	39.4	0	0	35	0	0	3.5	0.4	1	11230	19	0	16	0	0	0	0	1
95200	2160	0	0	0	0	0	0	2160	0	0	13	27	17	0	0	0	0	1
70000	24.8	0	0	24.3	0	0	0	0	1	23860	34	5	23	0	0	0	0	1
56000	24.8	0	0	24.3	0	0	0	0	1	23320	6	5	23	0	0	0	0	1
65000	40	0	0	39	0	0	1	0	0	0	8	5	23	0	0	0	0	1
173000	80.2	0	0	77.5	0	0	2.2	0	1	24210	49	5	23	0	0	0	0	1
245000	85.7	0	0	0	0	75.5	9.2	0	2	67110	26	0	18	0	0	0	0	1
45000	37.3	0	0	31.6	0	0	5.2	0	1	0	5	11	29	0	0	0	0	1
231550	1687.9	0	0	27	16	10	0	1634	1	31700	3	21	39	0	0	0	0	1
150000	54.6	0	42.7	1.3	0	0	10.6	0	0	0	49	17	35	0	0	0	0	1
112500	39.1	0	38.6	0	0	0	0	0	1	43160	49	16	34	0	0	0	0	1
440000	187.9	0	149	35.1	0	0	2	0.5	2	45240	51	15	33	0	0	0	0	1
1000000	417.6	0	0	371	25.5	0	0	19.6	3	213800	39	11	29	0	0	0	0	1
25000	40	0	0	0	8.5	0	4.5	26.5	1	12920	36	30	29	0	0	0	0	1
65000	49.6	0	0	16	24.1	0	7	2	1	19970	29	9	17	0	0	0	0	1
58000	22	0	0	0	2.5	12	7	0	1	21010	41	26	12	0	0	0	0	1
160000	58.2	0	0	57.7	0	0	0	0	1	70320	36	0	12	0	0	0	0	1
194000	91.9	0	90.9	0	0	0	1	0	0	0	31	0	12	0	0	0	0	1
127500	31.7	0	0	0	0.5	14.7	15.7	0.3	1	84330	29	23	9	0	0	0	0	1
160000	42.8	0	0	31.5	0	1	9.8	0	1	71450	40	5	23	0	0	0	0	1
102050	1188.3	0	0	0	0	0	2	1186.3	0	0	45	26	12	0	0	0	0	0
13275	177.9	0	0	0	0	0	59.7	118.2	0	0	11	27	13	0	0	0	0	0
75000	1084.1	0	0	0	0	0	0	1084	0	0	24	25	11	0	0	0	0	0
64500	65.5	0	0	0	0	0	0	65	1	36160	26	9	14	0	0	0	0	0
108000	65.5	0	0	0	0	0	0	65	1	30770	57	9	14	0	0	0	0	0
120000	478.8	0	0	0	0	0	3.5	475.3	0	0	55	28	14	0	0	0	0	0
61500	47.6	0	0	0	0	0	0	47.1	1	30020	31	14	2	0	0	0	0	0
204352	3714.9	0	0	0	0	0	11	3703.5	0	0	24	12	17	0	0	0	0	0
35000	313.8	0	0	0	0	0	262	51.8	0	0	22	6	24	0	0	0	0	0
144000	2215.4	0	0	0	0	0	0	2215	0	0	16	23	41	0	0	0	0	0