AN ABSTRACT OF THE THESIS OF

Brent L. Grasty for the degree of Master of Science in Forest Resources presented on September 24, 1990.

Title: Economic Impacts of Federal and State River Protection on the Rural Residential Housing Market: The Upper Deschutes River, Oregon.

Abstract approved: ______________________________
Rebecca Johnson

Hedonic Pricing is an effective and versatile method of estimating the relationships between market prices and environmental quality in a world of changing natural resource decisions. One natural resource policy not yet studied using Hedonic Pricing is the protection of free-flowing rivers. As the pressures of development and outdoor recreation increase, the public is demanding greater emphases toward, maintaining the values of these river and related land resources. There is perhaps no other natural resource which is more complex to manage, or which demands a greater breadth of management resources. Hedonic Pricing affords policy makers and the public the opportunity to study specific market effects of waterway management decisions.

The objectives of this thesis are to evaluate, through Hedonic Pricing, the impacts of increasingly common river management systems and planning. The Upper Deschutes River in Central Oregon is a member river of the Federal Wild and Scenic Rivers Act and the Oregon Scenic Waterway Act. The impacts of these programs on the river corridor housing market are evaluated. State and local actions implemented to maintain the high quality of the Upper Deschutes River resources are also studied. An Hedonic Pricing model of the river corridor housing market is developed. The response of private property sales prices to the network of river protection strategies is evaluated under alternative hypotheses.

Specification of the river protection variables includes indicator (dummy) variables corresponding to formal designation of the Upper Deschutes River to the state and federal programs. Additionally, a lagged polynomial function is defined to model the effect of the less comprehensive river management policies. The results of this analysis suggest a positive and significant relationship between sales prices and resource protection policies modelled in both forms. Resampling techniques are used to study the performance of the parameter estimates.

Economic Impacts of Federal and State River Protection on the Rural Riverside Housing Market: the Upper Deschutes River, Oregon

by

Brent L. Grasty

A THESIS

submitted to

Oregon State University

in partial fulfillment of
the requirements for the
degree of

Master of Science

Completed September 24, 1990

Commencement June, 1991

APPROVED:

____
Professor of Natural Resource Economics in charge of major

____
Head of the Department of Forest Resources.

____
Dean of the Graduate School

Date thesis is presented ______ September 24, 1990 ______

Type by researcher for ______ Brent L. Grasty ______

ACKNOWLEDGEMENTS

The time spent at the College of Forestry has been made more satisfying and rewarding through the professional assistance provided by, and personal friendships established with a host of individuals. Foremost, I thank Dr. Rebecca Johnson for her openness and patience throughout my time at OSU. Becky, your advice and interest in this project have been invaluable; your friendship will travel with me.

Dr. Steve Daniels devoted a significant amount of time and effort to this project, and kept me focused as the study developed. Steve, your enthusiasm has been an inspiration; your skill with the written word, a lesson in communication.

The administration and staff of the entire College of Forestry, and particularly that of the Department of Forest Resources have been instrumental in the success of this study. Special thanks to Dr. Jack Walstad for his candid and personal interest in my work, and in nurturing an ongoing dialogue with students. Also, to Dr. Robert Beschta, for having the vision to see the importance of managing our land and water resources through all relative disciplines.

Two professors of the Department of Agriculture and Resource Economics were particularly helpful in developing the econometric analysis and final model. Thanks to Dr. Olvar Bergland and Dr. Alan Love.

I have been particularly fortunate in the friendships established with fellow students here. As always, too many to list, but notably, the Bob Squad, Bill Stack and Mark Brunson. One colleague deserves additional mention. Scott Gillilan shared the midnight oil, tables at Squirrels, and an interest in excellence with me I will always consider unique. You are a gifted fellow; thanks for the "carrot".

The Dillworth Foundation also should be recognized for their interest in my research, and financial assistance.

Finally, to my parents and family. You gave me the tools...

BLG
1990

In my family there was a fine line between fly-fishing and religion.
(Norman Maclean, 1976
A River Runs Through It...)

TABLE OF CONTENTS

CHAPTER ONE

THE ISSUE OF RIVER PROTECTION ECONOMICS

CHAPTER TWO

HEDONIC PRICING OF ENVIRONMENTAL IMPROVEMENTS

CHAPTER THREE

PROTECTION OF FREE-FLOWING RIVERS IN THE U.S.

CHAPTER FOUR

RESEARCH DESIGN AND ANALYSIS

CHAPTER FIVE

MODEL VALIDATION AND RESULTS

CHAPTER SIX

APPENDICES

LIST OF FIGURES

LIST OF TABLES

List of Tables (cont.)

ECONOMIC IMPACTS OF FEDERAL AND STATE RIVER PROTECTION ON THE RIVERSIDE HOUSING MARKET: THE UPPER DESCHUTES RIVER, OREGON

CHAPTER ONE

THE ISSUE OF RIVER PROTECTION ECONOMICS

INTRODUCTION

Management of free-flowing rivers is, and will continue to be among the most important and controversial natural resource issues in the western United States. Demand for high water quality and consistent water quantity is unquestionably increasing. Every current substantive piece of federal, state and local land use policy articulates an intent to manage surface water and related land resources effectively. Changing management direction, given the increasing stress on riverine systems, requires intensive analyses of the socio-economic and environmental consequences. Estimating the economic effect of protecting free-flowing rivers demands recognizing the importance of applying valuation techniques that incorporate traditional consumptive, and the expanding non-consumptive, values associated with the resource. One powerful technique meeting this criterion is Hedonic Implicit Pricing[1].

---

[1] Henceforth referred to as Hedonic Pricing.

Hedonic Pricing research estimates the relationship between overall sales price and the implied value of component characteristics of the product. "Implied" prices are interpreted as the expected change in overall price resulting from marginal changes in characteristics' quantities, other variables held constant. The Hedonic model developed in this thesis is used to estimate the implied price of protecting the Upper Deschutes River through a range of river management policies. Perhaps the most comprehensive policies affecting use and development of the Upper Deschutes River are designation to the Federal Wild and Scenic River (PL 90-542, 1968) and the Oregon Scenic Waterways (ORS 390.805-925, 1969) systems. This analysis incorporates these river protection strategies and others as characteristics of residential riverside properties.

Transaction evidence of upper Deschutes River corridor[2] residential property sales prices is analyzed to estimate the effect of river protection, using Hedonic Pricing. Hedonic Pricing theory identifies the value of a household as a function of the structural, neighborhood and site characteristics, and a measure of environmental quality (Freeman, 1978). Consumers will attempt to maximize the utility of real estate ownership based on the desired quantity of housing characteristics desired (Anderson and

---

[2] The "river corridor" is defined as sites within one quarter mile of either bank of the waterway.

Crocker, 1971).

Using this methodology, an econometric model of the housing market is developed through Ordinary Least Squares regression (OLS). Specification of the overall housing purchase function is the first step in the analysis. The factor of interest is the influence of river protection[3] policies. Specification of the economic function of river protection on housing prices may take many forms; alternative specifications are analyzed. Final specification of the river protection variable is incorporated into the overall model, and tested. The fundamental research hypothesis is that the Upper Deschutes River residential housing market perceives river protection as a benefit in the purchase decision. Given this hypothesis, Hedonic Pricing provides a unique opportunity to study the housing market response to formal river protection.

Research Objectives

The primary objective of this thesis is to determine the economic impact on the local river corridor housing market resulting from Designation[4] of the Upper Deschutes River as

---

[3] River protection policies include all formal and publicized river management actions that are directly related to enhancing or maintaining the natural character of a waterway. "Designation", as defined below, is a component of river protection.

[4] Used singularly, Designation refers to the joint designation of a river to the Federal Wild and Scenic Rivers Program and the Oregon Scenic Waterways system.

a Federal Wild and Scenic River and an Oregon Scenic Waterway using Hedonic Pricing. Additionally, sales prices relationships with more general river protection policies are incorporated. An Hedonic Pricing model is developed to determine the economic relationship between river protection and rural residential property sales prices. The study period is January 1, 1981 through May, 1989.

A procedural objective (following model specification and testing) is to examine the robustness of parameter estimates for the original model through several resampling methods.

Thesis Progression

In Chapter Two, the Hedonic Pricing literature on environmental quality improvements is reviewed. Chapter Three is an outline of the policies, history and implementation of the Federal Wild and Scenic Rivers and Oregon Scenic Waterways Acts. The Upper Deschutes River in Central Oregon became a member river of both Programs in 1988. The management actions leading to Designation are the basis for specifying the river protection focus variable. Building on this background, Chapter Four describes the research design and methodology. Results are presented in Chapter Five, with conclusions and applications of Hedonic Pricing to future free-flowing river policy decisions provided in Chapter Six.

CHAPTER TWO

HEDONIC PRICING OF ENVIRONMENTAL IMPROVEMENTS

INTRODUCTION

Hedonic Pricing is an econometric tool providing natural resource managers a versatile means of estimating certain economic impacts associated with environmental improvements. Using transactions evidence, the contribution to "product" value of a diverse set of environmental improvements may be determined. Hedonic Pricing research frequently proceeds with an examination of market phenomena in a two-stage process: model formulation and demand estimation. For purposes of the current study, the former only is developed. The emphasis in this research is in analyzing the function river protection policies play on the river corridor housing market, not on the overall market demand estimation of river protection.

Hedonic Pricing provides a versatile means of studying the market mechanisms involving natural resource policy decisions. Social perceptions, expressed through market prices, may vary between and within these policy decisions. Hedonic Pricing of environmental improvements permits analysis of the impacts of these changes between market segments and by incremental levels of improvements. The methodology lends itself to statistical testing and validation of results. This section reviews a broad range of

Hedonic Pricing applications to natural resource issues.

The literature review concentrates on benchmark empirical evidence supporting the application of Hedonic Pricing to the focus of this thesis: estimating the economic impact on river corridor private property sales prices resulting from protection[5] of the Upper Deschutes River. The theoretical issues raised in each environmental improvement study are discussed. The chapter concludes with an identification of several additional ideas suggested by Hedonic Pricing theory as significant to a characteristic's price estimation.

The Hedonic Pricing Model

Products (commodity or amenity) may be viewed as "bundles" of goods or satisfaction (Freeman, 1979). Hedonic Pricing is a method of analyzing the contribution to total price of these component characteristics. Housing market prices' response to environmental improvements have proved useful in determining the perceived value of environmental improvements and the magnitude of economic impacts resulting from these changes.

Freeman (1979a) described housing as consisting of several "characteristics categories". Neighborhood (N) components, such as public services and housing densities, have

[5] "Protection" is used to indicate policies aimed at maintaining the free-flowing character of a waterway that is eligible for designation.

consistently appeared in Hedonic Pricing models as significant. Property or Structural (S) characteristics include lot size, square footage, number of bathrooms and bedrooms, garage size, etc. Location, relative to services or attractions, has been modelled variously as access or distance to central commercial (or recreational) points along developed transportation routes. The "focus"[6], environmental Quality (Q) variables have been modeled in quantitative and qualitative forms. In Freeman's (1979a) notation, the model becomes:

$$P(R_{it}) = P(S_{it}, N_{it}, Q_{it}), \tag{2.1}$$

where $P(R_{it})$ is the price of residential site i in period t, and N_i includes the location characteristics.

After model specification, estimation of the implied price of environmental improvements is calculated by taking the partial derivative of Q_i with respect to total household sales price, $P(R_i)$, as in

$$Z_i = \frac{\partial P(R_i)}{\partial Q_i} \tag{2.2}$$

Z_i is the estimated effect of a marginal change in the environmental quality (Q_i) on sales price for property i.

A generalization concerning previous Hedonic Pricing research

---

[6] The variable or variables of primary interest.

is the substantial variation of the independent variable sets observed to be significant. This makes cross-market applications difficult, perhaps impossible in most cases. For instance, the significance of air pollution focus variables is highly dependent on the specific market analyzed (Pollinsky and Rubinfeld, 1977; Anderson and Crocker, 1971; and Ridker and Henning, 1967). This implies that the perception of environmental quality is not necessarily tied to discrete marginal amenity improvements, or may influence property values solely within certain ranges.

Previous Research in Hedonic Pricing of Environmental Improvements

Air Pollution Research - St. Louis, Missouri

The original Hedonic Pricing studies investigating environmental improvements estimated the economic impacts of changes in air quality on residential property values. Concentrations of airborne pollutants generally increase with proximity to the source, and with wind direction. Anderson and Crocker (1971) noted that it is easily demonstrated that if air pollution is a source of disutility, and if dosages of pollution vary over space, land rents will vary inversely with air pollutant levels. Affected adjacent property markets can be expected to capitalize air quality differences into property sales prices (Freeman, 1979b).

Ridker and Henning (1967) were the first to test this hypothesis using Hedonic Pricing. This research employed cross-sectional methods analyzing single-family dwellings' sales prices in the St. Louis, Missouri Standard Metropolitan Statistical Area (SMSA) for 1960. Census tract data provided a means of grouping households (by neighborhoods) for aggregate analysis. The environmental variable of interest were the observed sulfation (SO_2, SO_3, H_2S, AND H_2SO_4) occurring at dispersed monitoring sites during the study year.

Ridker and Henning found a strong negative relationship between sales price and air pollution. They estimated that, other variables held constant, a decrease in sulfation by .25μg/100cm^2/day led to an average increase in property values of between \$83 and \$249.

This first Hedonic analysis of air quality impacts focused on model specification, with an emphasis on studying the relationships between the focus variable and other independent variables. Ridker and Henning (1967) "residualized" highly correlated explanatory variables. Partial regressions of two highly correlated variables, whose inclusion in the model was suggested on _a priori_ grounds, provided a means of attributing the specific effect of significant variables solely to the respective coefficient.

Correctly specified, unbiased least squares (OLS) models exhibit residuals that are orthogonal among the independent variables (Ridker and Henning, 1967 and Pindyck and Rubinfeld, 1981). The resulting respecified model attributes to the transformed variable its estimated contribution (to household sales price), as well as the covariance between it and other explanatory variables. Ridker and Henning used this technique to incorporate the specific effect of air pollution on sites in poor neighborhoods where location was highly correlated with small house and lot sizes <u>and</u> with high sulfation counts.

Air Pollution Research - Los Angeles, California

Graves, et al. (1978) estimated the effect of marginal changes in air quality on the urban housing market in the Los Angeles, California SMSA during 1976. The focus variables were miles of visibility (VIS) and total suspended particulates (TSP) in the atmosphere at the site, neighborhood, and community levels. Increases in average sales prices were positively correlated with marginal declines in TSP. However, coefficients (sign and significance) for VIS varied depending on functional form, and the non-focus variable set included in the model. The research points out the importance of several critical factors in Hedonic Pricing.

First, the potential of suspected measurement error in the focus variable should be analyzed. This is particularly true with environmental amenity variables due to the range of possible perceptions attributed to the improvement by the housing market. Graves, et al. found that, while both focus variables measured atmospheric pollution, TSP was consistently more significant than visibility. This is contrary to theoretical expectations, where changes in visibility (VIS) would be the most recognizable by housing market members. This suggests that there may have been some variable omission (or measurement error), biasing the effects of pollution levels. At best, it is difficult to determine precisely what air quality criteria was being measured by alternative Q_i specifications.

Second, relative values of OLS coefficient estimates of the independent variable set may be profoundly affected by the functional form of the regression. Graves, et al. studied the relative stability of focus variables under alternative model transformations. They concluded that TSP was stable in most functional forms when exogenous sales price influences (such as income) were excluded. Interactions between either omitted variables or exogenous factors and visibility exhibited substantial variation in both sign and significance of VIS as alternative functional forms were examined.

Graves, et al. (1978) also analyzed the robustness of Hedonic Pricing estimates by comparing the minimum absolute deviations (MAD) with OLS regression results. The basis for this analysis is that an assumption of normality may bias parameter estimates, and that extreme outliers tend to be heavily weighted in the regression. Graves found the coefficients to be consistent between the original OLS model specification and the MAD results.

Noise Pollution in the Washington, D.C. SMSA

Nelson (1975) estimated the Hedonic Pricing housing market function of the Washington, D.C. SMSA for the year 1970. The focus environmental variable was average daily air transportation noise level (in decibels). Census tract data covering structural and neighborhood characteristics, as well as river adjacency, percent commercial/industrial market concentration, and two non-focus environmental quality variables measuring air pollution were included in the model. Marginal increases of one decibel in aircraft noise resulted in a $210 reduction in average property sales prices of urban and suburban households within the affected census tracts.

Nelson (1975) adopted a model-building technique wherein the focus environmental quality variable is initially omitted during model specification. The analysis proceeded with preliminary variable set selection, analysis of alternative functional forms on the right hand side variables, and tests for market segmentation <u>without</u> the focus variable included. The focus variable was subsequently added and its response to alternative model specifications studied. Nelson analyzed the focus variable robustness characteristic in several functional forms, including log-log, linear, semi-log, and inverse semi-log. This at least reduced the chance that the sample, functional form or the explanatory variable set is selected so as to summarily reject the null hypothesis for the focus variable.

Land Use Planning

Land use planning (zoning) is typically implemented to address problems of urban expansion and population growth threatening rural (and extra-urban) life-styles as well as fracturing of agricultural land (Dana and Fairfax, 1980, and Nellis and Maca, 1986). Chicoine (1981) developed an Hedonic Pricing model to examine the effect of zoning regulations on sales prices of residential and agricultural property at the urban fringe. The focus variables in this study were distance to the urban boundary, and alternative zoning classifications. Agricultural zoning effectively held sales prices below the potential of less restrictive land uses (for instance, commercial and industrial classifications). The institutional effect of agricultural zoning was to inhibit the expansion of the urban area, while commercial/industrial zoning favored growth. Chicoine hypothesized that commercial and industrial-zoned land ownerships negatively influenced adjacent agricultural land sales prices. Chicoine's study indicated that commercial/industrial development had a significant negative effect on property sales prices within the other, more restrictive zoning classes. The results suggested that the commercial and industrial zoning politically and economically influenced rezoning of agricultural land toward development, effectively further reducing sales prices of land still zoned agricultural.

This supports Rohse's (1987) description of the trends preceding the 1973 Oregon Land Use Planning statutes. Subdivision (for residential development) of agricultural-zoned lands at the urban fringe showed significant increasing trends prior to land use planning reforms, which limited agricultural land subdivision to alternate uses (Oregon Senate Bill 100, 1973).

Location and Access

Distance to the urban fringe was used in Chicoine's (1981) study to measure the relative effect of zoning as distance from the Central Business District (CBD) increases. Chicoine used access to transportation routes and services variables as surrogates for estimating the utility of site location. In the final specification, access elicited significant negative values. This suggests that the relationship between property location (relative to public and commercial services) and rural residential sales prices is negative.

The value of residential property relative to urban centers has been shown to vary among Hedonic Pricing studies, given the specific economic base and relative level of public services and negative externalities present. In Chicoines's analysis, the negative significance of the transportation route availability variables indicate that, for the sites studied, the benefits resulting from extra-urban residential living are considered more important than those resulting from living nearer the city.

Adjacency to natural resources has consistently shown a positive and significant relationship with residential sales prices (Epp, 1971). Epp developed an Hedonic Pricing model to analyze the effect of public investment projects on nearby private property sales prices. Epp concluded that both adjacency to lakes and rivers, and public investment in (publicly accessible) water projects increased average residential property sales prices along fifteen waterways in Pennsylvania. Epp also observed that tax revenues and property values increased after acquisition for public use, although in several cases there was an initial reduction during a period of uncertainty and/or after the initial project disruption period (for example, during construction).

Brown et al. (1977) investigated the effect of formal setbacks (and absolute width of these "aprons") surrounding three lakes in the Seattle, Washington SMSA. The study results supported the position that both the presence of a waterway view and adjacency to surface waterways raised average sales prices of residential properties.

Additionally, Brown noted that public access and public use of these aprons increased the value of residential properties as aprons increased to a width of 300 feet, thereafter declining. Average sales prices declined with distance from the waterway at a faster rate when a zoned public access apron was not present.

Property Degradation

Kriessel and Randal (1989) developed an Hedonic Pricing model to estimate the relationship between sales prices of lake shore property in the Ohio region of the Great Lakes. Adjacency to the waterway positively influenced property sales prices. However, substantial rates of erosion of lake frontage have resulted in property value declines through time. Of principal interest was the potential increase in average sales prices resulting from erosion abatement measures.

Kriessel and Randal merged the theories of asset pricing and Hedonic Pricing. The flow of benefits through time resulting from the household purchase decision was measured with asset pricing (wherein property values are determined using a combination of transactions evidence and property appraisals). Hedonic Pricing was employed to estimate the implied price of lake frontage, and its decline with erosion. The focus variable was time-to-complete-loss of the frontage, given no abatement efforts. Results revealed a significant positive relationship between erosion control and average sales prices.

Water Quality

Contributions to sales price of waterway-adjacent properties resulting from marginal improvements in water quality has been studied. Epp and Al Ani (1979) employed cross-sectional and time-series analysis to study the effect of incremental increases in water quality on riverside property sales prices in Pennsylvania. Three water quality focus variables were incorporated into the analysis: perceived water quality (a dummy variable indicating property owners' attitudes), actual water quality in standard Ph (logarithm of the hydrogen ion present in the body) units, and probability of flooding. All three variables were significant and of the expected sign. The conclusion is that riverside property owners are aware of these environmental issues and their awareness is reflected in sales prices.

Epp and Al Ani extended this study to investigate the implicit price of marginal water quality improvements on "clean" and "polluted" streams. Cross-sectional analyses compared the average sales prices between the two sample subsets. Indicator (dummy) variables were used to specify adjacency to the respective stream type. The results suggest substantial differences in the relationship between the focus variable and sales prices on the two types of waterways.

While the potential for flooding on "clean" streams was nearly three times greater, the marginal effect on sales price was not significant. Conversely, flood potential had significant, negative impacts on sales prices for polluted streams. Apparently, housing consumers shift the relative importance of other attributes when considering the purchase of properties with lower-quality environmental attributes.

General Issues in Hedonic Pricing Improvements

The Hedonic Pricing literature has primarily focused on urban settings, in part due to the difficulties of interpreting the housing market when the assumptions of market equilibrium, homogeneity and mobility of households are questionable (Freeman, 1979a). These assumptions are critical to the application of Hedonic Pricing, as discussed below.

Also, modelling the environmental quality variable may be measured and expressed in the Hedonic Price function in a variety of ways. The final sections of this chapter address the effects of an increasing probability of environmental improvement on sales prices due to speculation.

Market Assumptions

First, surpluses accruing to either suppliers or consumers of housing must be reflected in sales prices; that is, the assumption of (at least short term) market equilibrium must hold (Bartik, 1987). The presence of disequilibrium indicates that these surpluses are not completely reflected in sales prices. Hedonic Pricing estimates would be underestimated.

Second, homogeneity of the market must hold across the sample and through time. Homogeneity refers to the respective utility functions of households for a given level and combination of amenities (Freeman, 1979a). If this assumption is not made, the effects of a marginal change in the quantity of a given characteristic can not be estimated for the housing market as a whole. In a highly segmented market, there exists a high potential for large differentials in the price function for individual housing attributes, and therefore for the composite property value. Least squares results would, at best, be coincidental. Similar utility functions across the market is focal to Hedonic Pricing. Site/price differences can then be attributed solely to site characteristics among heterogenous locations (Cobb, 1977). Likewise, exogenous factors (eg., household tastes and income) are excluded because estimation of utility functions is not possible across households' budget constraints (Edmunds, 1984, p. 80). Radcliffe (1984) defends the position that omission of purchaser characteristics conforms to economic theory. Only characteristics of the purchased product are included in the Hedonic Price function, and only those with quantity variations across the market. This is because benefits are determined solely by the composition of the unique housing characteristics of a given site.

Third, mobility among potential housing purchasers is assumed to be equal across the market. Mobility refers to the ease of access to, and departure from the market. Limitations on geographical sub-units within the market, or substantial variation within the market makes Hedonic estimation unpracticable. Non-local purchasers theoretically experience a disadvantage of access to the market, expressed in cost of moving and pre-purchase transactions costs. All potential purchasers are assumed to have identical availability to the market. An alternative used to equate mobility among purchasers is to limit the physical area of the housing market size studied (Freeman, 1979b).

Fourth, the level of aggregation of transaction data guide the specificity of Hedonic Pricing estimates. Data sources of housing characteristics in the literature generally have been either local tax assessment offices or aggregate average values applied to the various neighborhoods or communities of interest. Assessed or appraised "market" values introduce substantial error into the data due to the individual subjectivity of the appraisal. Alternatively, aggregation provides simplicity in data collection, but loses adaptability in interpreting relative characteristics' contribution to site-specific housing prices. Individual property sales evidence is a justifiable enhancement to the analysis. This is particularly so in cases where environmental improvements have a more site-specific economic effect.

Speculation of Events Influencing Housing Prices

A final issue addressed in the current research is the effect on the housing market of **speculation** that an environmental improvement may occur. Market participants entertaining a purchase decision are assumed to be fully informed of market-related events. Early participants enhance their opportunity to gain the most from changes positively affecting their utility. At the same time, these early movers experience a greater degree of risk that their expectations will not be realized. This speculation activity by purchasers in the market has been found to apply to market-related environmental improvements.

Speculation that environmental quality changes are likely is cited as correlated with housing sales price increases (Epp, 1971). Epp found that as public works proposals (that increased the available recreation opportunities on nearby waterways) neared approval, property values increased. The hypothesis was that the rural residential property market perceived these projects as benefits to owners of nearby homesites. Ex post tax receipts exhibited a slight decline during project construction, but significantly increased following completion.

Zoning Changes

Hypothesizing that zoning changes affect property sales prices by altering land uses, Chicoine's (1981) research analyzed the implicit value of soil productivity in the Hedonic function. Rezoning from agricultural to industrial/commercial uses affected a large area in extra-urban Illinois. Following rezoning, soil productivity of previously agricultural lands became insignificant in the purchase price, while sales prices rose significantly above expected. That is, before actual rezoning (but subsequent to the initial public notices and planning), purchase prices rose, while the characteristic's price of soil productivity became insignificant. Chicoine's research again suggests that the potential for rezoning may negatively affect sales prices by changing the relative significance of housing (and land) characteristics'.

Knipe (1988) discusses the importance of assessing the probability of rezoning during the property appraisal process. Although widely recognized as varying substantially between individual appraisers, property appraisal analyses attempt to obtain "process" uniformity across the market. This is particularly difficult in circumstances of uncertainty. Knipe found that differences between buyers' maximum bid and sellers' minimum bid increases with the probability of rezoning (when rezoning would benefit the seller after institution). This disparity must be recognized in instances where environmental improvements effectively change allowable land uses.

Government Regulation

Previous analyses of the effect of speculation on sales prices has a substantial literature investigating the market effect of government regulation (Thompson, 1985). For instance, Blair, et. al. (1986) used time-series analyses to study the effect of motor-carrier deregulation. Using price per ton of freight at various calendar points before and after deregulation (dummy variable), the research indicated significant differences among firm's willingness to adjust rates. Blair noted a significantly slower response for firms in smaller markets, presumably due to less competition. That is, as the certainty of deregulation increased, carrier prices in more competitive markets anticipated the legislation and adjusted prices more rapidly than carriers in less competitive markets.

Research evaluating market responses to the potential institution of regulatory policies has examined the effect of speculation in the relationship between the stock market prices and government regulation. Schumann (1988) studied New York state's regulation of potential (often hostile) corporate takeovers. Increasing occurrence of takeovers has profound effects on stockholder wealth. New York state attempted to restrict this negative impact by instituting regulatory control. Schumann used time-series analysis of the average stock price change during the period regulation was considered, and until the legislation was enacted. The research employed "windows" reflecting administrative and legislative actions, assigning indicator variables to each. The average prices in, and between, windows was compared to the expected rate of price change, given no regulatory action. Significantly higher stock prices of the potentially affected corporations was observed during legislative action windows. Differences between actual and expected prices increased through, and until final passage of the legislation.

This brief discussion of the market effects of speculation substantiates two considerations. First, it is possible that speculation plays a role in the purchase price of residential property sales when river protection policies effect residential land uses. These policies include adjacent properties, and may act much like land rezoning. Second, it is possible to model the speculation relationship to market prices. Designation, and river protection policies in general, are developed, planned, and scrutinized by the interested public. As the probability of new policies increases, the market may capitalize (negatively or positively) this potential into sales prices. The Hedonic Pricing model is developed within this framework in Chapter Four.

Chapter Summary

Estimation of economic impacts resulting from environmental policy decisions is required by state and federal law (USDA, 1987). Hedonic Pricing has proved to be applicable to a diverse set of environmental improvements, when the underlying assumptions hold. Research in land use planning, air and water quality improvements, property loss and access values employing Hedonic Pricing has been discussed. Given the assumptions, natural resource policies are amenable to Hedonic Pricing analysis. Hedonic Pricing of non-marginal changes in the level of amenities associated with housing purchase decisions requires greater attention to the economic, social and statistical analysis. Changes in environmental quality must be perceived by the housing market, and quantifiable. The assumptions of full information, limited mobility (or limited scope of analysis), market equilibrium, and homogeneous household utility functions across a given study area must hold.

Hedonic Pricing analysis involves a unique set of econometric issues, not least of which are variable selection and model specification. A host of measurable as well as unquantifiable criteria are implicit in the housing purchase decision. Freeman's (1979) categories of structural, neighborhood, and environmental attributes are a reasonable initial framework, but local issues and economies must be carefully considered during model development, and definition of priors. As well, the functional form of the focus variables, and the relationships between the focus variable and other explanatory variables in the model may significantly influence the predictive potential of the model. Measurement of certain environmental characteristics in quantifiable terms is imprecise. For instance, it is unclear what a change from 50 ppm to 75 ppm of sulfate particulates in the atmosphere means to consumers of housing. The focus variable(s) must be clearly tied to housing and socio-economic theory.

The assumption of normality is a basic concern in the Hedonic Price function. The effect of extreme outliers, particularly under conditions of small sample size, depends on the robustness of the sample, and requires particular attention. Alternative methods of analysis, such as minimum absolute deviations, may be required.

The Hedonic Pricing literature suggests that measuring the impact on the local housing market along the Upper Deschutes River in Central Oregon meets the basic criteria for Hedonic Pricing analysis. The scope of the study area is assumed to minimize external effects influencing market processes.

After discussing the legal and policy environment in which these programs are managed, previous economic research of the river protection programs is reviewed in Chapter Three.

CHAPTER THREE

PROTECTION OF FREE-FLOWING RIVERS IN THE U.S.

INTRODUCTION

Previous research methodologies and results of estimating the value of protecting free-flowing rivers is the subject of this chapter. The complex nature of free-flowing rivers inherently requires dynamic planning and management direction, recognizing the broad range of demands on the resource. The linear character of waterways may spatially and temporally cross cultural, political and governmental boundaries. Protection of the nation's premier free-flowing rivers has been statutorily required by the federal government, and by most states (Black, 1987, Coyle, 1988).

A network of management policies mandating the inventory and planning of this rich and significant resource has developed. In Oregon, the Federal Wild and Scenic Rivers (PL 90-542, 1968) and the Oregon Scenic Waterway (ORS 390.805-925, 1969) programs jointly include over sixty major river segments. The environmental and socio-economic value of the rivers involved is substantial. As both programs expand, additional sectors of society are impacted. The literature regarding the economic and social effects of these programs' expansion is extremely limited. This is frustrating because it may be occurring without a full understanding of the immediate or long-term economic effects, particularly as protection of rivers impacts local economies.

Part I of this chapter briefly introduces the evolution of American natural resource policies affecting free-flowing rivers. The Federal Wild and Scenic Rivers and the Oregon Scenic Waterways Acts are outlined. Part II comprehensively reviews the literature of Federal Wild and Scenic Rivers' valuation. The available literature regarding the value of state river protection policies also is reviewed.

PART I. EVOLUTION OF AMERICAN WATER POLICY

The evolution of water resource policies in America is at least as extensive as that of any other natural resource. The earliest federal intervention in water resource management dates back to the beginning of the nineteenth century (Young and Haveman, 1985). Public good characteristics of water resources, and the limited financial capacity to develop projects locally, led to increasing involvement of the federal government in river management, particularly where interstate commerce was concerned (Black, 1987).

Initially directed toward limiting adverse effects (flooding, inconsistent irrigation supplies, etc.) and maintaining navigation routes, water resources projects developed into a major function of government. Water quantity and quality goals were expressed more frequently in national natural resource policies by the beginning of the twentieth century. The massive expansion of federal government involvement in water resource management by 1945 followed the growth (and commensurate increase in water requirements for industrial and agricultural practices) of the nation. By the late 1950's, a new focus of the government's role in water resource policy emerged: preservation of free-flowing rivers (Raisner, 1987).

Changing demands on the nation's water resources were expressed in the late 1960's and 1970's by preservation legislation, nationally and by individual states (American Rivers, 1984). During this period natural resource management agencies emphasized research in the growing societal and environmental values of **both** developed and undeveloped river reaches (Root, 1989).

Histories of the River Preservation Acts

The Federal Wild and Scenic Rivers Act (PL 90-542, 1968) and the Oregon Scenic Waterways Act (ORS 390.805-925, 1969) provide for the public protection of free-flowing river systems. Both programs have continued to expand with society's increasing demand for river recreation and concern for environmental preservation.

As of November, 1988, over 1,900 river miles and forty-four separate Oregon river segments are managed under the Federal

Wild and Scenic Rivers Act. Oregon leads the Nation in number of rivers within the System, and is second to only Alaska in river miles (3170 miles; Coyle, 1988).

The Oregon Scenic Waterways program likewise is one of the most extensive and oldest state river protection systems in the Nation (American Rivers, 1984). The system boasts segments of nineteen rivers and over 1,100 river miles (Oregon Division of Parks and Recreation, n.d.). A basis for understanding the potential economic impacts of both the federal and Oregon programs requires background into the letter and intent of the two Acts, as they pertain to private river corridor lands.

The Federal Program

The Federal Wild and Scenic Rivers Act (PL 90-542, 1968) provides that the rivers of the Nation which:

> "possess outstandingly remarkable, scenic, recreational, geologic, fish and wildlife, historic, cultural, or other similar values, shall be preserved in free-flowing condition, and that they and their immediate environments shall be protected for the benefit and enjoyment of present and future generations" (sec. 1a).

The Federal Wild and Scenic Rivers Act recognizes the trends of increasing public use, and awareness of the nation's premier rivers, and requires a continuing study process of rivers for additions to the program. Statutorily, administration of the Act is assigned to the Secretary of the Department of the Interior. However, the primary responsibility of managing a given river segment normally lies with the Federal land managing agency having jurisdiction over adjacent lands (USDI, National Park Service, 1987).

Where adjacent properties are primarily private, the National Park Service is the principal managing agency. It is clear from the legislative history (Utter, 1976) and recent research (Root, 1989) that the intent of the Act is to recognize the Nation's superior rivers, regardless of the principal ownership type.

Adjacent land included as part of the scenic corridor may not exceed 320 acres per mile on both sides of the river (sec. 3(b)). The managing agency has the discretion to define the designated adjacent lands by "visual corridor" standards (Doyle, 1989). These standards provide the managing agency the authority to decrease the physical area included in the designated reach to a maximum of that which is visible from the river.

Three categories of classification are provided by the Act: Wild, Scenic and Recreational. Each requires different management responsibilities, and specifies different use limitations (see Table 1).

Table 1. Federal Wild and Scenic River Classifications

CLASSIFICATION	DEFINITION - "A river that is...
WILD RIVER	"... free from impoundments and generally inaccessible except by trail, with watersheds or shorelines essentially primitive."
SCENIC RIVER	"...free from impoundments... largely primitive... and undeveloped, but accessible in places by roads."
RECREATIONAL RIVER	"...readily accessible by road or railroad,... with some development along shorelines, and ... which may have undergone some impoundment or diversion in the past." (sec. 2)

Threat of in-stream and diversion-based hydroelectric development are the main targets of Designation (Utter, 1976). The Act prohibits hydroelectric projects in all classifications. Mining is prohibited in the Wild River classification. The major effects (excluding allocation of funds) of Wild and Scenic River designation are provided in column two, Table 2.

Oregon Scenic Waterways Act

The Oregon Scenic Waterways Act (ORS 390.805-925), passed by Oregon voters in November, 1969, targets the protection of the natural and scenic values of Oregon's rivers. It names agencies - specifically the Oregon Department of Transportation, and subordinately the Division of State Parks and Recreation (Oregon Administrative Rules, Chapter 736, Division 40) - to manage rivers in the system, and to study

Table 2. Comparisons between Federal and Oregon River Protection Programs

Issue	Federal Wild and Scenic Rivers	Oregon Scenic Waterways
Hydro-electric development	Precluded	No Federal project exemption authority
Placer Mining	Precluded on Wild Reaches	Precluded
Condemnation Authority	Conditional on reaches with less than 50% public ownership	Yes
Allowable Uses	Pre-existing or minimal visual change	Must conform with Oregon Land Use "Goals" (Rohse, 1987)
Designation of Private Lands	Yes	Yes
Corridor Size	Maximum of 320 acres per mile	One-quarter mile from bank
Classification	Wild Scenic Recreational	Natural River Accessible Natural River Scenic River Nat. Scenic View Recreational River River Community
Designation Process	1) Congressional 2) Sec. of Interior 3) Gubernatorial	1) Administrative 2) Legislative 3) Initiative
Effect on Private Land	Required to inventory and identify uses	Existing uses protected, excluding substantial changes to river experience
Managing Agency	NPS, USFS, BLM, USF&W	Oregon DOT, ODPR

Notes on Abbreviations

NPS: National Park Service
USFS: U. S. Forest Service
USF&W: U.S. F&W Service
BLM: Bureau of Land Mgmt.
DOT: Dept. Transportation
ODPR: Oregon Div. Parks and Rec.

and propose potential additions. Criteria for designation include social, scenic, cultural, historic, archaeological, and a broad spectrum of environmental characteristics valuable to Oregon's leisure, physical and spiritual philosophies (OAR 736.40.020).

Oregon Scenic Waterways designation applies to land within 1/4 mile of high water on both sides of a river. Similar to the Federal Act, river planning must consider related adjacent lands within at least the visual corridor (Lilly, 1988). Significantly, the Oregon Program provides flexibility for river protection under natural conditions, as well as in reaches where substantive river-related land management and development exist. In other words, whereas rivers in their natural condition rank among our most valuable natural resources, reaches where mankind has conscientiously practiced a way of life, while preserving the waterway's integrity, are also recognized by the Act as valuable. The major effects of the Oregon Scenic Waterway program are listed in the third column of Table 2.

The most significant effects of Oregon Scenic Waterway designation is the prohibition of mining activities in all designated reaches, and the provision of funds for planning and management. Classifications are defined in Table 3.

Table 3. Classification of Oregon Scenic Waterways

Classification	Definition
Natural River Area (NRA)	Undeveloped, generally pristine, with no development or engineered access.
Accessible Natural River Area (ANRA)	Same as NRA, but accessible by road or railroad
Scenic River Area (SRA)	Some rural development, but screened from river view, and still natural in character.
Natural Scenic View Area (NSVA)	Same as SRA, but only one side of river exhibits development.
Recreational River Area (RRA)	Easily accessible with any, or a combination of commercial, agricultural or residential uses. River corridor view still natural.
River Community Area (RCA)	Densely developed area within a natural setting.

Source: Oregon Division of State Parks and Recreation Landowners Guide (1987).

Effect of "Dual" Designations

The Oregon and Federal river protection programs have been compared. While both Acts recognize similar waterway values for designation, the effect of "Dual" Designation is a comprehensive framework of provisions for allowable river and related land uses. Pronounced alterations to the visual corridor and instream values are prohibited (grandfathered activities, excepted). Dual Designation clearly precludes new, large-scale mining and bank manipulation, and hydroelectric damming or diversions. Finally, both programs provide ultimate condemnation authority to the land managing agencies. Oregon natural resource managers interviewed indicated that this was the final option utilized to enforce the planning of formal river protection, and only when compromise is impossible (Lilly, 1989). Compromise, in this sense, indicates cooperation from the landowner to alter timber management techniques from clear-cutting to single-tree-selection harvest, for example. Significantly, land management practices which have traditional and cultural foundations, and that can be practiced in a manner avoiding visual disruption, are given every opportunity to be maintained (Lilly, 1989 and Doyle, 1989).

PART II. VALUATION OF FEDERAL WILD AND SCENIC RIVERS

As of January 1, 1989, the Federal Wild and Scenic Rivers program affects public and private land management in thirty-five states, with study rivers in five others (Coyle, 1989). The Act requires an inventory of the environmental and socio-economic impacts associated with potential additions to the system (PL 90-542, Sec. 4b, 1968). The nature of this resource requires unique methods to estimate the values associated with those characteristics which led to designation. A number of studies have attempted to quantify the value of Wild and Scenic Rivers.

Instream Flow Values

Garn (1986) investigated the values of varying levels of instream flow volumes of the Wild and Scenic Red River in New Mexico. The result of this first effort by a federal Wild and Scenic River managing agency (the Bureau of Land Management) to value federal river protection provided the basis of testimony in successfully litigating a reserved instream water right for a system river (New Mexico v. U.S. B.L.M., 1976 in: Garn, 1986). Conflict on the Red River occurred when water withdrawals applications for mining activities would potentially have diminished instream river values. The situation demanded a quantification of these values, and required inventories of the hydrologic, biological and socio-economic values generated by alternative flow volumes.

Levels of stability for fish and wildlife populations, and impacts accruing to society, from incremental changes in flows were estimated. This analysis combined fish and wildlife habitat "welfare" estimates from the New Mexico Fish and Wildlife Department (and associated impacts from resultant changes of fishing and fishing success due to species survival levels), surveys of user group satisfaction (for different activities at varying levels of flow), upstream point source pollution levels, and comparisons of impacts resulting from incremental reduction in mining disturbances.

Estimates of user satisfaction focused on the principal user type, sport fishers. Visual and audio presentations were made to this group to elicit responses of minimum acceptable flows, before relocation to other streams, or cessation of the activity (see Hawkins, 1975 and BLM, 1979 in: Garn, 1986) Full quanitification of monetary values and benefit/cost analysis was not done.

The court decision favored the BLM's application for a reserved instream water right. The values estimated through Garn's analysis of river preservation set precedence for Federal Wild and Scenic River Designation reserved water rights. The recreational and environmental values of river protection identified for the Wild and Scenic Red River were effectively argued to produce the "highest and best" use of the river.

Timber Values

The only published report of the impact of federal designation on local economies evaluated harvest reductions on the timber base due to withdrawal of lands within the Salmon River, Idaho Scenic corridor (Herbst, 1972). Revisions of road construction plans resulting from Wild and Scenic designation, as well as timber revenue lost and recreation values accruing to local economies and in the nearby service sector were considered in the economic impact analysis.

The major recreational values identified were associated with the scenic river corridor related to whitewater rafting, fishing (usually in conjunction with rafting) and wilderness camping.

Use and access rights may change with alternate Wild and Scenic River classifications. User surveys were used to study the effect of classification differences. Questions were asked regarding changes in behavior resulting from decreasingly restrictive (moving from Wild, to Scenic, to Recreational) classifications, estimating the number of user days gained or lost to each user group. The maximum benefits generated under the three classifications was reached under a combination of Wild and Scenic classifications. Herbst hypothesized this to reflect the current highest and best uses being rafting in combination with reaching fishing areas for an essentially wilderness experience.

Public forest land benefits and costs from timber resources have long been analyzed through the concepts of discounting and present valuation (Faustmann, 1849). The idea is to compare these costs and benefits by discounting the flow over a given rotation length to current prices. Alternatives of management intensities and treatments affecting the resource area's overall "products" mix may be compared, and standards of economic efficiency met. Herbst applied this technique to flows of benefits under alternative conditions for the Wild and Scenic Salmon River. Under varying Faustmann rotations, and under each of the three federal designation classifications, the resulting increases in river protection benefits clearly outweighed the loss of timber revenues.

Valuation of Wild and Scenic River Program Additions

Walsh, et al. (1987) used Contingent Valuation (hypothetical market surveys) to estimate the present value of social benefits from protection of the three most highly used rivers in Colorado, the Elk, Cache la Poudre, and Colorado. Based on a fifty year planning horizon, and a 7.875% rate of interest (per U.S. Water Resources Council, 1983), the estimated net social benefits of river protection were $599 million. Of this figure, $113 million was actual use value, $486 million non-use (existence and option) values.

Walsh, et al. also investigated the economic potential of further Colorado river additions to the Federal Wild and Scenic river system. Maximum benefits accruing from designating additional Colorado waterways Wild and Scenic Rivers were achieved at fifteen of the remaining free-flowing river reaches in the analysis. The total estimated value of protecting these rivers was $1,521 million. This increase in benefits can be interpreted as a net increase of satisfaction for the affected economy, resulting from the perceived use and non-use values associated with the protection of these rivers.

While a substantial literature has developed regarding the values associated with water quality, white water recreation and wilderness river travel, Wild and Scenic River valuation and the impacts resulting from designation are lacking. This is unfortunate because one of the least understood, and most controversial characteristics of designation in Oregon is the effect on riverside private properties (see the Oregon Division of State Parks, Oregon Scenic Waterways Landowner guide, 1986, for instance). However, insights into how Wild and Scenic designation is perceived by the real estate market have been examined by professional land management agencies and research organizations.

Housing Market Perceptions and Federal Designation

The economic impacts potentially affecting riverside property values concern private ownerships and managing agencies alike (Lilly, 1989; Campbell, 1988). Although informal, opinions expressed by natural resource agencies managing the Wild and Scenic Rogue River in Southwest Oregon suggest that residential riverside property values have been buoyed by Designation (Leftman, 1989).

During the region-wide recession of the late 1970's and early 1980's, interviews with private river corridor property owners and local real estate agencies in the Rogue River basin indicated a marked increase in the stability of housing prices since the 1968 designation. One river planner for the

USFS stated that residents viewed designation as a "covenant" between landowners and managing agencies that unwanted or unexpected development would be prohibited within the scenic corridor (Conklin, 1989). USFS interviews with local real estate agents supported this conclusion.

The only research estimates of economic impacts on the adjacent housing markets hypothesized as caused by river protection are limited. The USDI National Park Service commissioned an analysis of property sales price changes following federal designation in 1978 of the Upper Delaware River (Coughlin and Keene, 1985). The Upper Delaware forms the border along parts of New Jersey, Pennsylvania, and New York states. Local governments and the National Park Service developed land use alternatives for riverside properties. Wild and Scenic classifications were Scenic and Recreational (American Rivers, 1988). Minimum lot sizes of five and two acres were proposed for the two classifications, respectively.

An inference occasionally drawn by land managers and the public is that no adverse impact on the rural residential riverside land market is caused by Designation (ie., state or federal). Housing prices appear to substantiate these attitudes. During a period of severe economic recession (1979-1983) in this region, a consistent upward trend of sampled Rogue River and Upper Delaware property sales prices occurred. Additionally, number of sales significantly increased for tracts larger than .8 acres. The upward trend seems to support the BLM (Leftmann, 1989) opinion that prices are buoyed following Wild and Scenic River designation. A significant reduction in sales prices and a decline in number of sales following formal river protection, would suggest the opposite.

Chapter Summary

Research regarding the economic impacts of Federal Wild and Scenic Rivers Designation is indeed limited. This is surprising, as the number of river addition proposals continue to increase. There are a range of opinions - some very emotional (Campbell, 1989 and Marlett, 1988) - regarding the impacts of federal and state river protection. Many of these attitudes are based on an insufficient empirical base.

Data regarding, and analysis of this growing body of protected water resources is essential to effectively choose among study rivers and among conflicting uses, and to provide local administrative bodies a clearer understanding of the benefits and costs of Designation.

The significance to Oregon of both river protection Acts is substantial. Investigating the full set of resource values associated with Federal and Oregon rivers' Designation is beyond the scope of the current research. However, estimation of the impacts of river protection on a significant sector of the affected local economy, the adjacent real estate market, may improve our understanding of the significance of water resource management interactions with market processes. Hedonic Pricing estimates can contribute to an evaluation of potential impacts accruing after Designation.

In the following chapter, the research design and methodology are discussed. The emphasis is in building the Hedonic Pricing model used to examine the economic impact of federal and state river protection policies on the Upper Deschutes River corridor real estate market.

CHAPTER FOUR

RESEARCH DESIGN AND ANALYSIS

INTRODUCTION

Estimating the economic impact on the Upper Deschutes River real estate market resulting from Federal and State of Oregon river protection is the primary objective of this analysis. The research focus is to specify the Hedonic Price function, relating riverside property sales price to site characteristics, and derive the implicit price of river protection within the overall model. This chapter describes the process used in the analysis.

A procedural objective of this study is to develop an Hedonic Price function which lends itself to validation from outside sources, through a control method, and/or through resampling techniques. Using standard OLS procedures, Creel and Loomis' (1989) technique of randomly dividing the overall pooled sample into specification and prediction subsamples is followed. This method of resampling permits both model specification and functional form testing, as well as a measure of validation of the model (Verbyla, 1989).

Sampling Methods

Housing market characteristics specific to the Upper Deschutes River corridor sites, as well as control rivers (the Little Deschutes and Fall Rivers), are analyzed. Pooled cross-sectional and time-series techniques are used. This method permits sequential examination of hypotheses throughout the research (Pindyck and Rubinfeld, 1981). Alternate specifications of river protection have been developed to examine the study objectives. Two specifications are carried throughout the analysis.

Hypotheses

H_1: The market value of river corridor residential properties adjacent to the Upper Deschutes River increase as a response to formal federal and State of Oregon river protection policies implemented during the period January, 1981 through May, 1989.

H_2: The river corridor housing market responds to the increasing certainty of administrative, public and other state and local protection policies affecting the acceptable uses and management of the Upper Deschutes River through positive price adjustments.

Dependent Variable

The primary factor of analysis is riverside residential property value. The dependent variable is title transfer sales prices.

Independent Variables

Factors suggested by Hedonic housing market theory as significant in the housing purchase decision are analyzed as components of river corridor property value. Explanatory variables are members of the structural, locational, neighborhood and environmental categories discussed by Freeman (1979a). Also considered are the set of property characteristics suggested by the summary statistics as unique to the Upper Deschutes River. The focus variable, river protection, is specified, studied to examine the effect on sales prices of river management policies, and included in the independent variable set.

Chapter Progression

This chapter contains four Parts. The criteria for study site selection and descriptions of the study rivers are discussed in Part I. The set of candidate regressors are fully described in Part II. In Part III, descriptive statistics characterizing the mainstem Upper Deschutes River sample as well as the overall pooled sample are provided. The methodology used in model specification and Hedonic Pricing of riverside residential property markets is introduced in Part IV. The methodology is divided into three sections: preliminary model specification without a focus variable, a river protection variable specification, and final model specification. The results of resampling analyses appear in the following chapter.

PART I. STUDY RIVER SELECTION CRITERIA

Economic significance to the local economy

Formal Designation may influence the allowable land uses within the scenic corridor. The change in river corridor residential property sales prices that is correlated with Designation may be significant. Estimation of the implied value of Designation should be a relevant issue to the local economy, and to river resource managing agencies. Potential local impacts include tax rate changes, acceptable and allowable land uses, and in-migration by non-local housing purchasers as the outstanding resources of the river are publicized.

Availability of Data

Hedonic Pricing requires data on the entire range of market variables influencing the housing purchase decision. Both minimum sample size (set at 200 observations) and availability of quantitative and qualitative data are required. Freeman's (1979a) `housing characteristics categories provide a means of verifying the presence of a full set of qualitative and quantitative real estate characteristics for the study market.

Limited extra-market influences

The target housing market should be unique and well-defined, with minimal influence from outside markets. Following

Freedman (1979b) and Young and Haveman (1985), this may be accomplished by confining the sample to a limited geographical scale. Regardless, the presence of market segmentation within the sample is examined. Heterogeneous markets within the sample are separated from the pooled sample.

Validation Measures

The lack of precedence in using Hedonic Pricing to estimate the impacts of river protection policies precludes the reliance on previous Hedonic Pricing research to validate the current model. Three conditions are established to minimize error, and validate the model estimates. First, presence of comparable, non-Designated river systems exist for cross-sectional analysis. Second, housing market transactions evidence is available for comparison with the structural characteristics' implied prices generated from the final model. Using individual property transactions permits verification of model coefficients through comparison with existing county and state records. Finally, the sample size is suitable to conduct resampling analyses.

Rationale for Upper Deschutes River Selection

A focal point for recreation and tourism, the Upper Deschutes River receives substantial natural resource and land-use planning attention (University of Oregon, 1985; Ragatz, 1985). River corridor housing market data are available from local, county and state sources. While Deschutes County is experiencing significant immigration, it is assumed that this effect can be incorporated into the analysis. Resampling procedures are applicable to the data.

The target section of the Upper Deschutes River was designated a Federal Wild and Scenic River in October, 1988 (Oregon Rivers Omnibus legislation). Nearly identical reaches were Designated an Oregon Scenic Waterway in November, 1988, the major difference being the respective reach classifications. Housing market transaction data is also available for properties adjacent to two tributaries of the Upper Deschutes River (Fall River and the Little Deschutes River), and within Deschutes County. Finally, housing market data for the region (United States Bureau of Labor Statistics, 1990), and from local sources, are available to examine the Hedonic Pricing estimates.

Study Area Description

The Upper Deschutes Basin lies south and southwest of the City of Bend in Central Oregon in Klamath and Deschutes counties. The basin is bounded on the west by the Cascade mountain range, and on the east by ancient Harney Lake (the western edge of the Great Basin). Many sites adjacent to the Upper Deschutes River (and the control tributaries) have open vistas of the visually dominant Three Sisters and Bachelor Butte peaks. Forested areas are composed principally of

Ponderosa pine (P. ponderosa) and Lodgepole pine (P. contorta) stands. The mainstem Deschutes River passes from its source at Lava Lake in the Deschutes National forest through basalt formations and is largely confined to the existing channel. The one exception is the reach located from approximately river mile 200 (above Sunriver, Oregon) for fifteen miles downstream, where the confluences of Fall and the Little Deschutes Rivers occur. In this stretch, the rivers are still quite actively meandering.

Lateral channel movement occurs along most of the Little Deschutes, where concern is frequently expressed by private property owners regarding loss (and gain) of river frontage. Fall River is relatively stable and is densely vegetated. Figure 1 shows all river segments within the study area.

Sample Scope and Variable Selection

The study areas from which observations have been drawn are as follows:

> Mainstem Deschutes River: From Wickiup Reservoir (RM 226.6) downstream to the intersection of the river and the Bend Urban Growth Boundary (RM 171).
>
> Little Deschutes River: From the Klamath County Border (RM 44) to the confluence with the mainstem Deschutes River.
>
> Fall River: Source to the confluence with the mainstem Deschutes River (8 miles).

The sample is drawn from the population of property sales within one-quarter mile of the Deschutes, Fall and Little

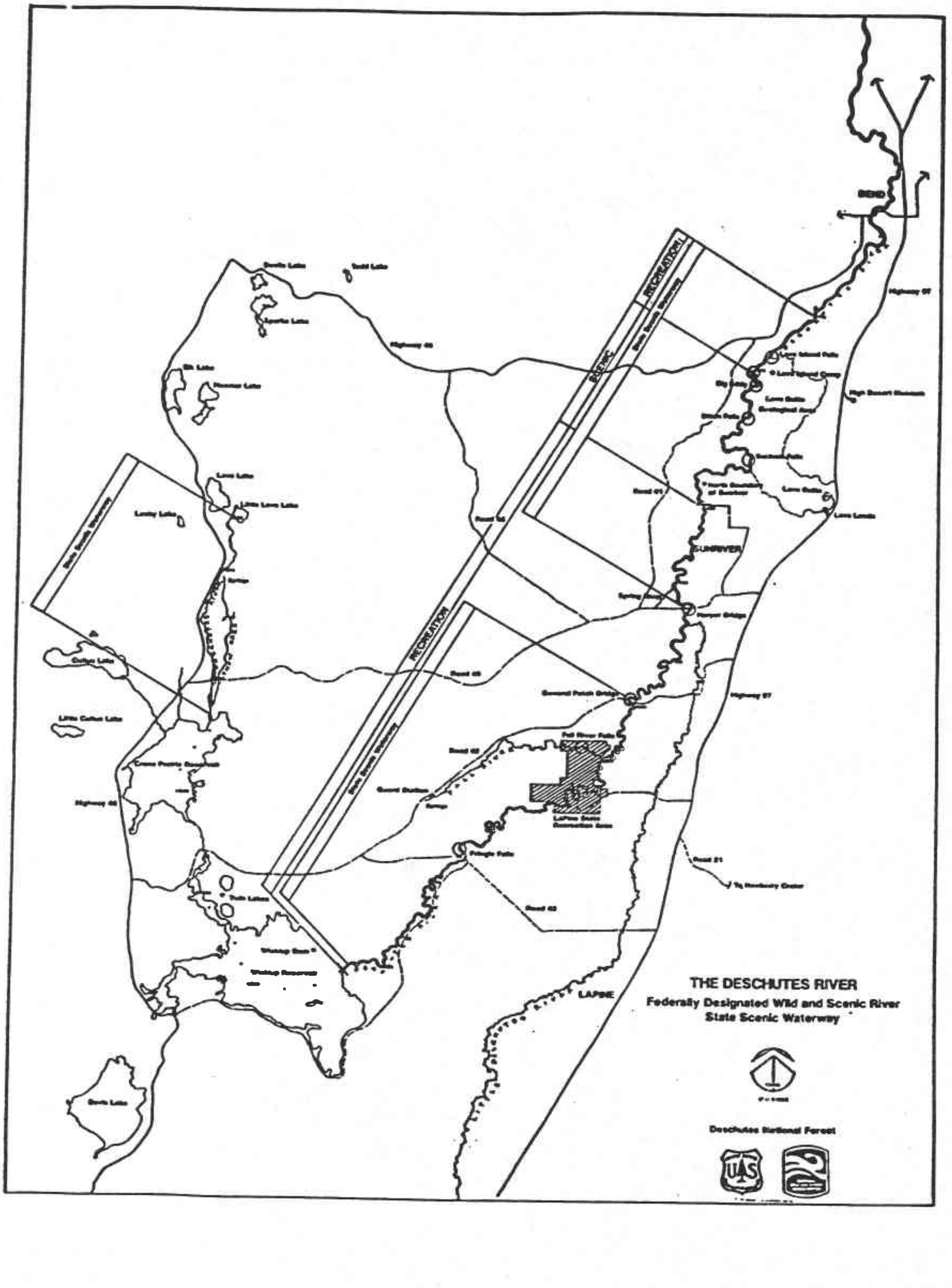

Figure 1. Upper Deschutes River Basin and Tributaries.
Source: U.S.F.S. Deschutes National Forest, Bend District.

Deschutes Rivers, in Deschutes County. The north and west banks of the mainstem Upper Deschutes River are almost entirely publicly-owned.

The sample is limited to "confirmed" sales, recognized by the Deschutes County Assessors Office as transactions between unrelated parties made at real market prices (Deschutes County Sales Ratio Report, 1989). Due to variations between average sales prices by lot size, the sample is limited to rural residential properties of not more than ten acres. The sample is also constrained to purchases of single family dwellings.

Exceptions to Basic River Corridor Sample Definition

Exceptions to the one-quarter mile river corridor benchmark are applied to all sites where physical separations from the river exist. It is possible that river protection policies have the most direct effect on properties adjacent to the waterway. However, changes in allowable land uses within the one-quarter mile corridor also occur, and sales prices may respond accordingly. Hence, physical boundaries separating lots from the river are the geographical limit used in this study for candidate properties. Appendix A provides examples of real exceptions to the one-quarter mile rule. Table 4 lists percentages of public and private ownership, by reach of all rivers. The mainstem is over 50% publicly-managed.

Table 4. Aggregate Ownerships by Study River

River/Reach	Percentages	Comments
Upper Deschutes River (overall)	35% Private 65% Public	Reach length: 54 mi.
Sunriver (east bank of mainstem)	90% Private 10% Public	Reach length: 5 miles
Little Deschutes River	83% Private 17% Public	Reach length: 47 mi. (in Deschutes county)
Fall River	50% Private 50% Public	Reach length: 8 miles

PART II. DATA COLLECTION AND EXPLANATORY VARIABLE SET

Data collection involved interviews with land use managers, appraisal analysts, and other contacts in the City of Bend, Deschutes County, State of Oregon and Federal planning and land management agencies. A majority of the property sales information and housing characteristics data came from the Deschutes County Assessor's Office. The Deschutes County Clerk and Land Planning and Development Commission supplied critical information regarding property ownerships, statutes influencing riverside land management, and research sources used during the Deschutes River Study process (1983-85). Property taxation and administrative data regarding Sales Ratio Studies (OAR 309.200, 1985) and Oregon Property Tax Laws (OAR, Chapters 306 and 308, 1985) were provided by the Department of Revenue, Analysis Section in Salem (Oregon Department of Revenue, 1986) .

Initial Variable Set Definition

Taxation data are collected for all tax lots within all counties in the state of Oregon on a six-year cycle (OAR 150, Sections 303-412, 1986). Separate tax lot histories are retained by the Deschutes Count Assessors Office for all platted properties. The data include information on structural, interior accessories (separate from furniture), lot size, utilities and development, property and building "classes", zoning, tax levies and appraisal values. Appendix B supplies the entire set and descriptions of original data collected.

United States Bureau of Labor Statistics deflation indices were used to adjust sales prices to base years. The Consumer Price Index for all Urban housing sales prices (CPI-U, 1980-1989) for the Western Region was used for deflation to base years 1982-84. This index is a seasonally corrected adjustment. Effort was made to obtain or develop local county or state indices for specific comparison among property classes (see Appendix C). These data are not retained in a usable form, or are not available. The CPI-U data is used as the best adjustment available to normalize housing prices to base values.

A unique set of locational and ownership characteristics have been examined as potential explanatory variables of the Upper Deschutes River corridor housing market. Based on a report by Coughton and Keene (1988), and to provide for examination of market segmentation by owner origin, primary residence of river corridor housing market purchasers is included. Primary residence is defined as the address of record for taxation correspondence. Residence is included in the model as indicator (dummy) variables of three sub-categories: In-county (LOCAL), other Oregon (ORE), and out-of-state (REC).

Lot size (AREA) was calculated for each property using the HP "Digitizer" program (Hewlett Packard Digitizer, 1982). County Cadastral maps were used, and all ownerships possessing title to adjacent property were analyzed as single lots. This adjustment facilitated the analysis, and in all cases the title transfer of separate properties occurred in the same transaction. Cadastral maps also served as the basis for the riverside (RIV) and golf course (GOLF) adjacency determination.

Distances from residential sites to public amenities and services were utilized as proxies for some of the benefits resulting from lot site selection (following Kriessal and Randall, 1989), and were also calculated using the HP Digitizer program. For all sites, distances were calculated from the center of the respective Rectilinear Section. All distance variables are expected to exhibit a negative sign, varying inversely with sales prices. The shortest county, USFS, or state transportation route was recognized. This method permitted ease of computation, and reflects an attitude that fractions of a mile are not a component of the purchase decision.

The economic impacts from recreation in Deschutes county have been well documented (Ragatz, 1986). The presence of a large number of lodging facilities and an extensive leasing system for short-term vacation lodging, especially during the winter led to the initial inclusion of distance to Mt. Bachelor (DMB). The importance of the Mt. Bachelor ski area to the economy of Deschutes County has been recognized in a number of studies (Ragatz, 1986; and University of Oregon, 1985). Winter recreation, based from this resort, is a substantial part of this total.

Distance to school (DSCH), reflects a household purchaser's priorities based on enrolling children at the elementary school level. Elementary schools are used due to the independence of school children in higher levels of education. Educational institutions at the grade school level has proved significant in previous Hedonic Pricing studies in urban settings (Ridker and Henning, 1967). The DSCH variable reflects the Bend/La Pine School District subdivisions (Nichol, 1989)

The influence of public services protecting life and home have proved significant in previous Hedonic Pricing models.

Distance from applicable fire department (DFIRE) and police sub-station (DPOL) reflect this, and are again based on distances from center of the Rectilinear Section.

PART III. DESCRIPTIVE STATISTICS

This section examines the structure of the Upper Deschutes River corridor residential housing market. As mentioned, market segmentation can substantially limit the application of Hedonic Pricing theory (Freeman, 1979; Nelson, 1989). Pooling of the mainstem and control rivers is intended. Tests are conducted to examine the appropriateness of pooling.

The overall pooled sample was analyzed as three sub-reach groups: the mainstem Upper Deschutes river, excluding Sunriver; Sunriver as an independent reach; and the control rivers. Individual analyses of Sunriver was executed to examine the unique distribution of services and composite structural and neighborhood variables within this community. It is possible that the effect of Designation upon these ownerships may differ from observations in the other reaches. This may be particularly true as pertains to the neighborhood and locational characteristics, due to higher housing densities and member-resident services. F tests (Chow, 1960) are used to test this hypothesis at the end of Part III.

Four river corridor housing market characteristics are discussed to highlight the composition and heterogeneity of the sample subunits. These are: 1) percentage of lots with residential development, 2) lot size class distribution, 3) primary ownership residence by reach, and 4) percent of ownerships with riverside adjacency. Each characteristic is unique to a given site, but significant differences among reaches may indicate market segmentation.

Sample Composition by Development Categories

The percentage of lots with residential development is analyzed to characterize the sales price component attributed to the presence of residential structures. Potential impacts resulting from river protection may be expressed in the Hedonic Price function for developed properties, unimproved properties, and properties with mobile homes. However, an order of magnitude difference is likely between the first and the latter two categories. Also, it is possible that capitalization of river protection into the housing purchase price is expressed by a significantly different rate or magnitude among the three groups. This is hypothesized to result from a different set of expectations expressed among potential purchasers. Figures 2 and 3 compare pooled samples with the mainstem Deschutes and Sunriver reaches.

There is little evidence from Figures 2 and 3 to indicate market segmentation by reach. While a slightly higher presence of mobile homes exists on the control and mainstem

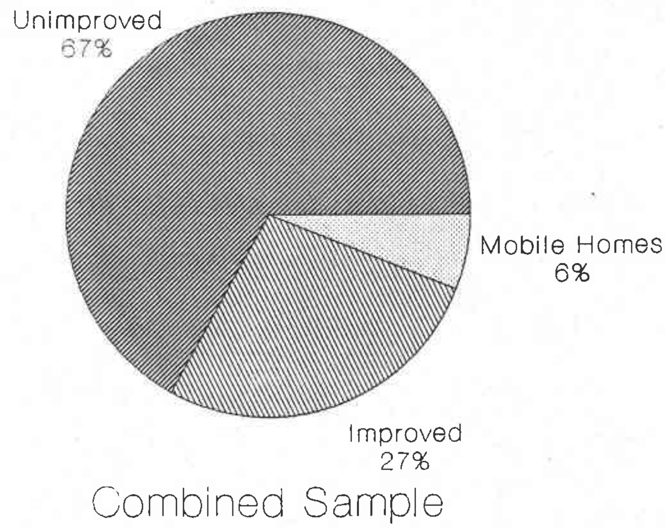

Figure 2. Overall Pooled Sample River Corridor Development Percentage by Reach. "Improved" refers to residential structures; "Mobile" to sites with a mobile home present a time of sale.

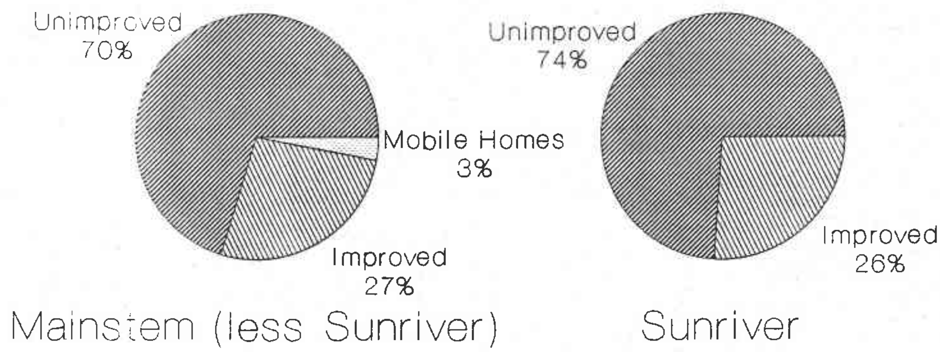

Figure 3. Mainstem and Sunriver Subsamples Development Percentage by Reach.

reaches than in the Sunriver reach, the difference is small (test results appear in the following section). It is interesting to note the high percentage of properties which sold as bare land. This is particularly surprising in the Sunriver area, as a large number of lots are owned by residential development organizations. The statistic is less substantial when it is recognized that over half of the observations are from pre-1987, when building in Deschutes County significantly increased.

Average Sales Price by Lot Size

Coughton and Keene (1989) noted significant differences between sales prices per acre of lots smaller than one acre, those between one and five acres, and over five acres. Maximum prices-per-area occurred in the smallest category,and declined significantly for the larger categories (the largest properties were associated with agricultural uses.) This relationship appears to hold for the pooled sample. Figure 4 shows average sales prices by lot size categories.

Average sales prices per lot size in the pooled sample follows a general pattern of decline until lot size reaches eight-tenths of an acre. It is possible that the effects of Designation have a different impact on smaller acreages since the smaller lot sizes tend to be recreational properties, and not multi-use (or small-farm use) sites. However, the statistics indicate a significantly different relationship

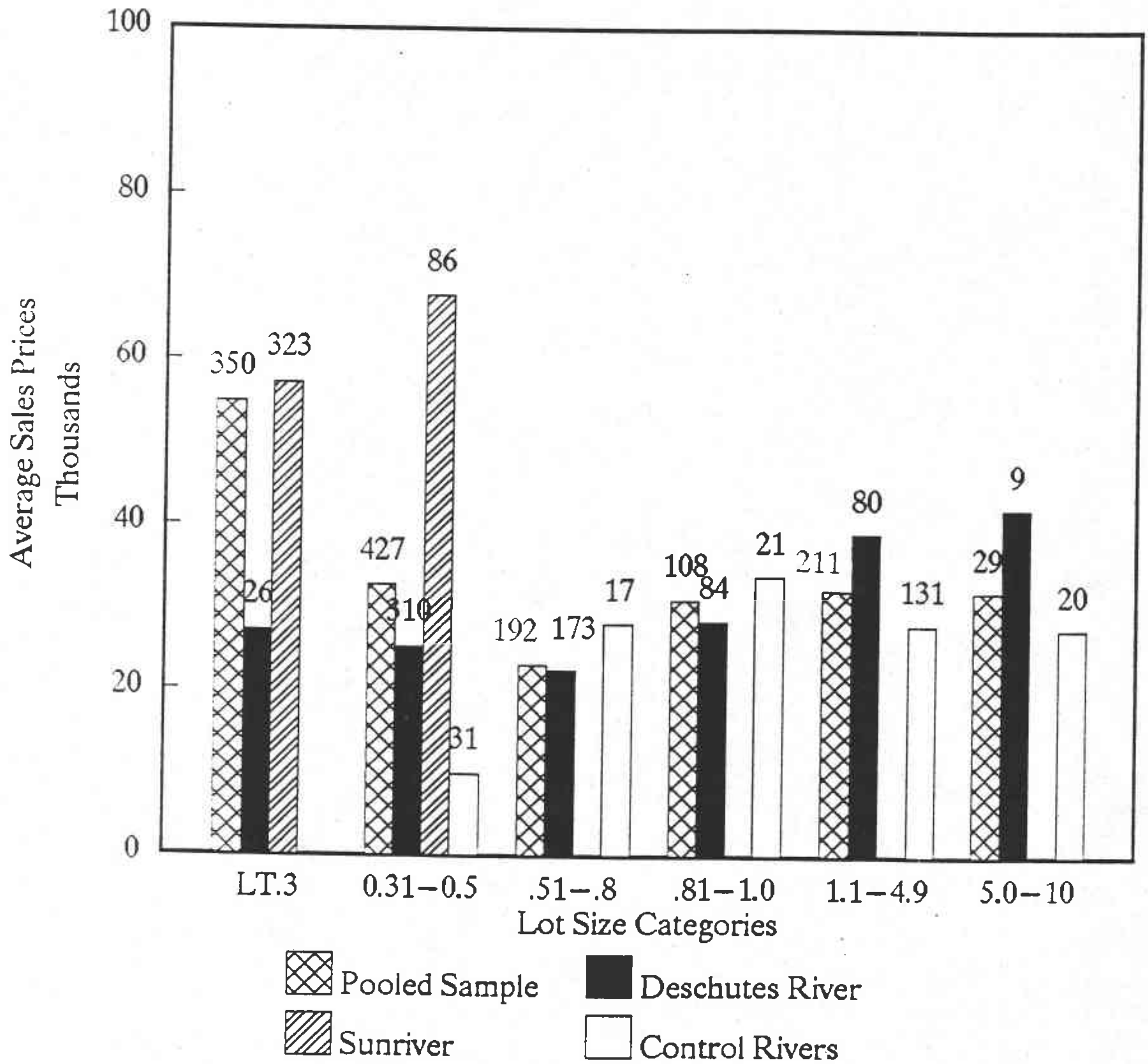

Figure 4. Average Sales Prices per Acre by Reach. Values above columns are number of observations in each category. Omitted categories indicate insufficient number of observations.

when reaches are observed individually.

The Upper Deschutes river properties average sales prices per acre exhibit a relatively constant level until lot size exceeds one acre. Larger lot size categories average sales prices per acre for mainstem properties suggest a significantly different relationship, climbing to over $40,000/acre for lots between one and ten acres. It is hypothesized that the larger lots are used for a greater assortment of activities (including subdivision potential).

No inference may be drawn for the Sunriver lots greater than one-half acre (due to lot size limits in this community), but the smaller classes' average sales prices per acre suggest a contrasting relationship to previous research (Coughlin and Keene, 1985), and in comparison with the mainstem and control reaches. The .31-.5 category exhibits nearly $15,000 greater average sales price per acre than the .01-.3 category, $35,000 greater than the mainstem sample. This suggests dissimilarity between the mainstem and Sunriver subsamples.

While no observations appear in the smallest lot size class for the control reaches, average sales prices per acre appear to adhere to prior expectations, generally climbing until a maximum average price per lot size category of one acre, thereafter falling.

Primary Owner Residence

The ratio of property sales among local, non-local and out-of-state purchasers is also analyzed. The prior expectation for this examination is that non-local Deschutes County property ownerships are primarily recreational. These non-local real estate buyers may be willing (and able) to pay a premium for river corridor sites. Primary owner residence is determined using Deschutes County tax statement zip codes. Figure 5 compares the primary residence by study reach.

A different composition of purchaser origins exists between those in the Sunriver reach and the other reaches. Relatively few Deschutes County residents have title to Sunriver property (23%), while a higher percentage of out-of-state ownerships own river corridor property in Sunriver (35%). Among all categories of owner origins, the percentage of non-local Oregon ownerships are consistent across reaches. Excluding Sunriver, the remaining pooled sample averages are Deschutes (36%), Other Oregon (39%) and Out-of-state (25%). While the effect of owner origin is included as a candidate variable in the Hedonic Pricing analysis (using indicator variables), this further suggests some form of market segmentation between the Sunriver and remaining pooled subsamples.

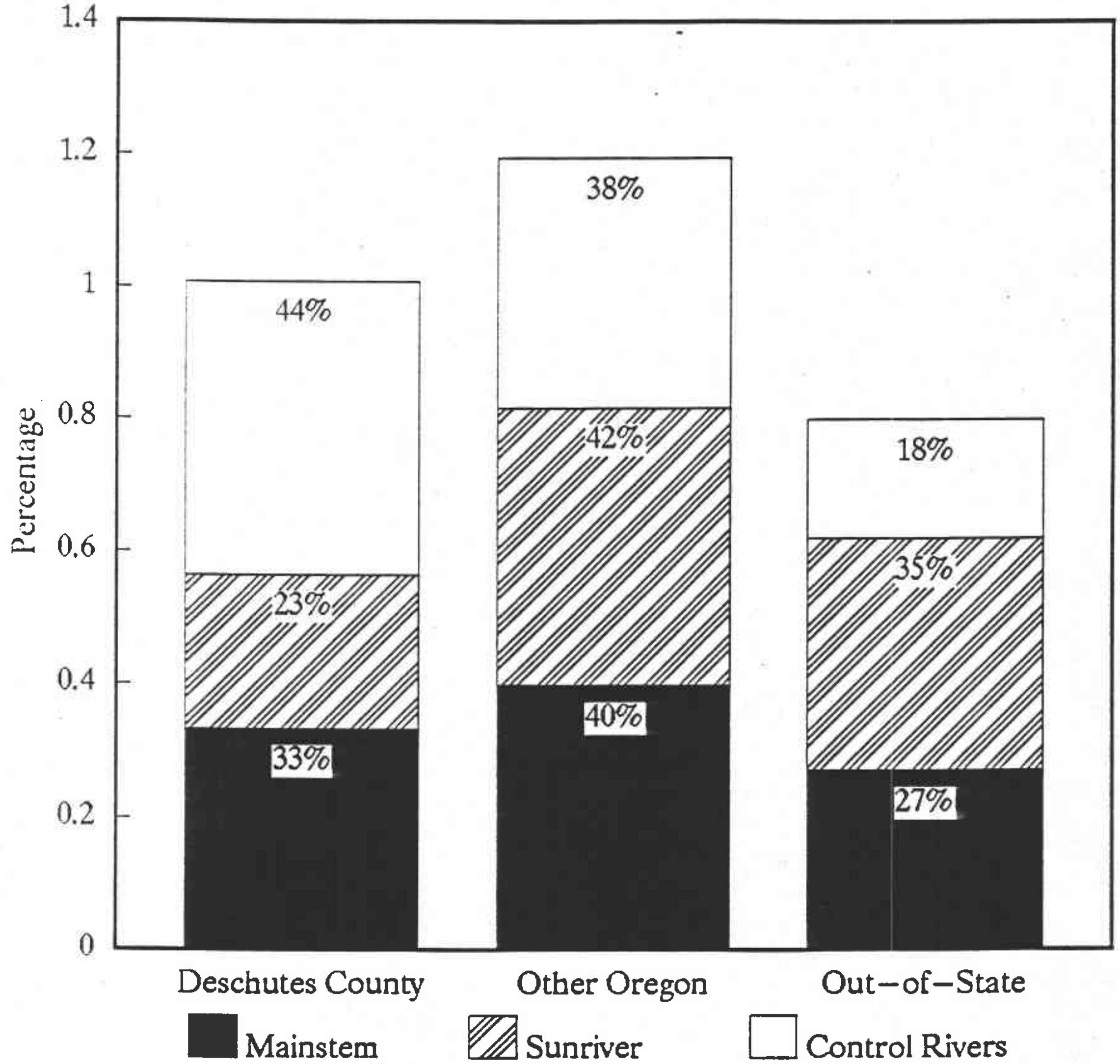

Figure 5. Primary Ownership Residence Distribution by River Segment (Mainstem segment excludes Sunriver). Control is the pooled statistics for Fall River and the Little Deschutes River.

Physical Adjacency to the Waterway

The boundaries of the Designated river corridor are left to the discretion of the managing agency, and considerable variation (along a given reach, as well as actual area effected between rivers) can result. Therefore, a third issue examined is percentage of lots adjacent to the river. The prior expectation is that riverfront property secures a higher purchase price (Kriessel and Randall, 1987). River protection may not be perceived as significant, regardless of official corridor width, if the property is effectively distant from the river. Additionally, the impact of a public commons area "apron", and access to the river may have a significant effect on both property sales price and the perceived effect of Designation. Figures 6 and 7 present the spatial distribution of properties on the three study subsamples.

Over a quarter of all observations are riverside properties. *A priori* expectations are that these will exhibit a significantly higher sales price. This characteristic is included in the set of household characteristics to examine its effect on sales prices.

Brown, et al. (1977) noted that public access to natural resources may influence real estate sales prices. In the present analysis, a number of properties are partitioned from the river by a public commons area, particularly in the

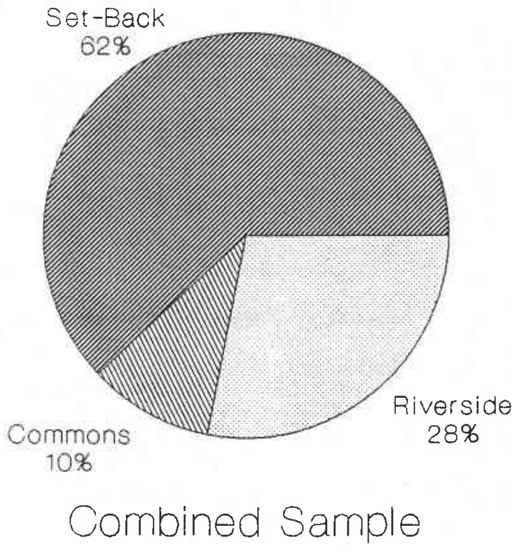

Figure 6. Pooled River Adjacencies - Total Sample (N=1397)

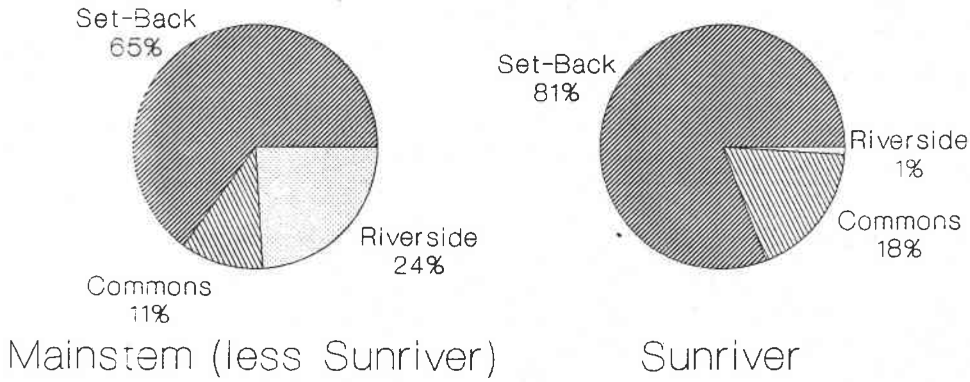

Figure 7. Riverside Adjacencies - Mainstem and Sunriver (Mainstem N = 717; Sunriver N = 451)

Sunriver reach. This characteristic is examined to discern any changes in sales prices resulting from ready access to the river without actual ownership of riverside land.

The Sunriver reach exhibits a marked difference in composition of river-adjacent lots in the sample. Substantially greater public access results in an increased percentage of set-backs, and a very small number of riverside homes (one percent). The control rivers are not significantly different from the mainstem sample average. This statistic again suggests that the composition of the Sunriver subsample may eliminate the opportunity for pooling with the mainstem. A further examination is made regarding sales prices of riverside, set-back and Commons properties.

Riverside and Set-back Sales Price Trends

The relationship between average sales prices of riverside and non-riverside properties gives a clear indication of the market value of river adjacency. This trend suggests that sales prices of river-adjacent properties may be responding to different market forces. It is assumed that the overall sample is homogeneous in the utility derived by river corridor ownership. If so, comparisons between set-back and riverside sales prices may be directly made. As expected, average annual sales prices for riverside properties on the Upper Deschutes River were greater than set-back properties (Figure 8). However, the trend declined through the first

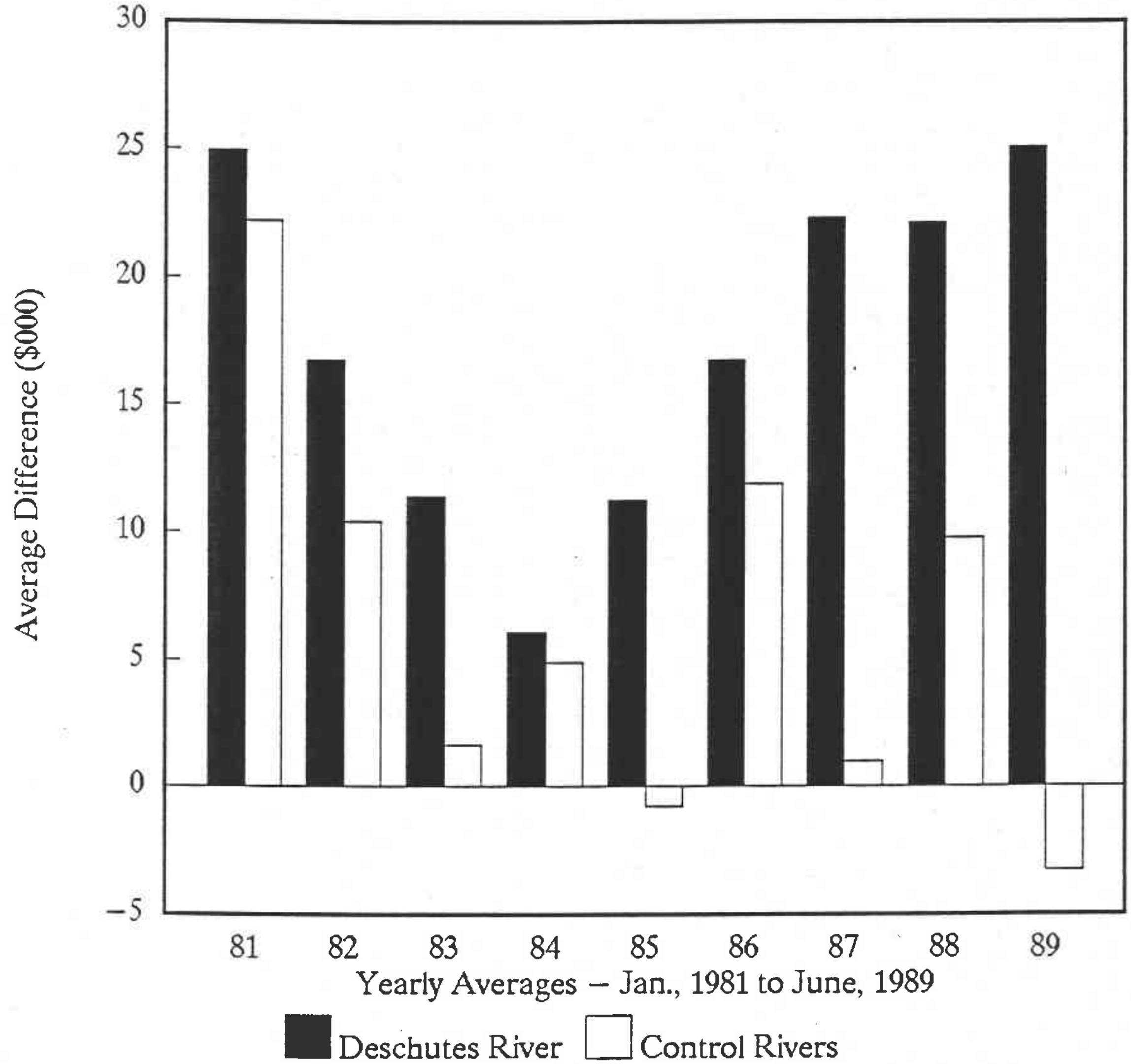

Figure 8. Trends of Average Sales Prices. A Comparison between the Average Annual Differences of Riverside and non-Riverside Property Sales Prices on the Upper Deschutes River (excluding Sunriver) and the pooled Control Rivers. Non-Riverside Properties are all sample lots exhibiting no river frontage ownership.

half of the sample period. By 1984, the difference between annual average sales prices for riverside property and non-riverside property had declined from a 1981 high of $25,000 to $6,000. After 1984, the trend reversed and by 1989 annual average riverside property sales prices were over $25,000 dollars greater. 1985 was the beginning of formal Upper Deschutes River protection actions. This is specifically the characteristic of river corridor real estate prices studied in this thesis. That is, do the relative river protection actions influence the performance of property sales prices significantly enough to result in a difference of the magnitude exhibited in Figure 8.

A similar relationship exists prior to 1984 for the pooled Fall and Little Deschutes River samples. Figure 8 also shows this relationship. The control rivers exhibit erratic riverside to non-riverside average annual sales price differences after 1984. Clearly, different market forces were affecting control rivers real estate sales.

The Upper Deschutes River and the pooled control rivers are responding to this apparently different set of market conditions, as exhibited by the varied performance of average set-back to river-adjacent sales prices. These differences are analyzed in the following chapter.

The emphasis in the present study is to compare the river protection actions present on the Upper Deschutes River as they effect river corridor property sales prices, and as they differ from the control rivers. Hence, analysis of market segmentation follows, with tests of hypotheses of sample equalities between the various subsamples.

Market Segmentation

Pooling the data from Sunriver with the other reaches may be inappropriate. Chow (F) tests of two regressions comparing the total (unrestricted) and total excluding Sunriver (restricted) samples, using the complete set of explanatory variables, led to the rejection of the hypothesis of reach equalities when Sunriver is included. This tests the equalities of two groups: the pooled sample without Sunriver, and an independent Sunriver analysis. The null hypothesis of subsample equalities could not be accepted (F stat=4.96, α=.05, 36, 1360).

Further, the Upper Deschutes River reach below Sunriver may be more appropriately pooled with Sunriver. Tests of beta coefficient equalities of reaches (upstream and downstream of Sunriver, Sunriver, and the pooled control river data set as dummy variables) were used. This test resulted in the rejection of the null hypothesis for equality between the Sunriver and downriver segment coefficients (t stat = 6.72, α=.05). The downstream reach was included in the mainstem sample for the remainder of the analysis. The hypotheses of equal beta coefficients for the remaining reaches could not be rejected (two tailed, .05 significance).

There is also some indication from the descriptive statistics that the control and mainstem samples should not be pooled. The unrestricted model was estimated on the pooled sample, using the full set of regressors. The restricted model was limited to an identical variable set regression on the remaining mainstem Upper Deschutes River reaches only. The null hypothesis of equality of the coefficients of determination could not be rejected ($F=_{1.24,}$ α=.05, 36, 866). The final overall sample size used in model specification is composed of 903 observations.

Part III Summaryy

Several inferences may be drawn from these descriptive statistics of sales properties. First, there may be a varied effect of river protection resulting from the definition of the Designated corridor. While officially listed as a part of a protected reach, non-adjacent properties may receive no benefits from Designation, and sales price may not be effected. The converse may apply to those reaches where commons access is provided, but the actual lot does not abut the waterway.

The methodology used to develop the Hedonic Pricing function for the Upper Deschutes river is described in Part IV of this chapter. Model specification, functional form analyses and validation techniques are described. Autocorrelation and heteroskedasticity are discussed at the end of Part IV. Results and conclusions appear in Chapter five.

PART IV - METHODOLOGY

Hedonic Pricing and River Protection Policies

In this section the Hedonic Pricing model of characteristics' prices of properties along the Upper Deschutes River is specified. Three steps are used in the analysis. First, the set of candidate explanatory variables are regressed on observed sales prices to develop a workable econometric model of characteristics prices in Section I. Resampling techniques are used to test model accuracy and robustness (Verbyla and Litvaitis, 1989). A random specification (or "training") subsample is selected to develop the preliminary model. A second verification subsample is withheld to validate the model specification.

Second, alternative specifications of river protection on the Upper Deschutes River are developed in Section II. It is assumed that the increasing probability of Designation (and other river protection policies) being formally implemented can be incorporated into the independent variable set. The same applies to general river protection actions of a less comprehensive nature. A list of river protection actions are included, and relationships between these and sales prices are evaluated. Four Designation Activities Variable (DAV) specifications are analyzed. Discussion of the final DAV specifications selection concludes this section.

Finally, overall model specification and functional form analysis is discussed in Section III. The river protection specifications (DAV) are added to the preliminary model and tests for autocorrelation and heteroskedasticity follow. Necessary adjustments are made for these problems, and subsequent regressions executed.

The final model is regressed on the verification subsample of observations to cross-validate. Results are discussed in Chapter Five. Bootstrap resampling techniques are also applied to the model to further examine the robustness of DAV. Results and discussion also follow in the final chapter.

Section I - Preliminary Model Specification

Variable Selection

The first stage of the Hedonic Pricing analysis develops the preliminary model of housing characteristics for the Upper Deschutes River housing market. The large sample size (N = 903, excluding Sunriver) permits the application of cross-validation techniques (Lachenbruch and Mickey, 1968), randomly dividing the pooled sample into specification and verification subsamples. Creel and Loomis (1989) used this technique to predict the number of deer hunting trips made by hunters as a function of success rates, site and personal characteristics, and costs. The technique provides an added measure of model validation (Verbyla, 1989).

Preliminary specification proceeds without a DAV, and includes functional form analysis, and selection of the initial housing market characteristics set. Alternative measures of river protection (DAV's) are added to the set of explanatory variables and the robustness of the focus variable is analyzed in Section III. The procedure reduces the possibility that the functional form or explanatory variable set is selected so as to always reject the null hypothesis for the focus variable equal to zero (Nelson, 1989).

Preliminary Variable Set Selection

The set of candidate explanatory variables includes continuous and a large number of indicator variables. Initial variable set selection proceeds with OLS regression results in the linear form. The overall sample is randomly divided into a specification (N=448) and verification (N=455) sub-samples. Preliminary variable set selection is carried out in the linear form. Subsequently, analyses of alternate transformations of the data and final functional forms are studied. Candidate variables are listed in tables 5 and 6.

Table 5. Structural Variables and Expected Sign

Variable	Definition	Expected Sign
SLSPR	Transaction price as recorded with tax office, adjusted for deflation	Dependent Variable
MO	Cardinal value for month of sale (N = 1,2,3,... 102)	-
AGE	Age of residential structure at time of sale (tenths of a year)	+/-
TOTSF	Total square footage of residential structure	+
MHSF	Total square footage of permanent residential mobile home.	-
LEVELS	Number of stories in residential structure.	+
BATH	Number of bathrooms. Half-bathrooms are defined as with W.C. and lavatory only.	+
BED	Number of bedrooms.	+
GAR	Square footage of enclosed automobile garage.	+
CPRT	Square footage of open automobile parking space.	+
FIRE	Number of fire places.	+
OUT	Aggregate square footage of all utility outbuildings.	+
DECK, PRC, PAT	Square footage of exterior Deck, enclosed porch, or patio, resp.	+ +
SOL HOT	Dummy variables for the presence of solarium or hot tub at sale.	+ +
AREA	Area of property, in tenths of acres.	+

Table 6. Locational, Neighborhood and Ownership Variables

VARIABLE	DEFINITION	EXPECTED SIGN
RIV	Dummy variable indicating ownership of riverside frontage.	+
GOLF	Dummy variable indicating property has frontage on a golf course.	+
PVD SEW H2O	Dummy variables indicating presence of paved access, sewer facilities and water service.	+ + +
DCBD	Miles to the Central Business District of Bend, Oregon.	-
D2CBD	Miles to the secondary Central Business District: the closest of Bend, Sunriver or La Pine.	-
DFIRE	Miles to the fire station of the appropriate district in which the property is located.	-
DPOL	Miles to the nearest police (city, county or state) station.	-
DSCH	Miles to the senior high school selected by the Bend/La Pine school district as primary choice for the area in which the property is located.	-
DMB	Miles to Mt. Bachelor ski resort.	-
LOCAL	Dummy variable indicating primary owner residence in Deschutes county.	-
ORE	Dummy variable indicating primary owner residence in Oregon, outside of Deschutes county.	-
REC	Dummy variable; non-Oregon residence	+

At least one variable from each of the characteristics (Structural, Neighborhood, and Location) categories was included in all specifications.

All housing market variables are considered potential members of the final specification. Variables are analyzed in alternative specifications, where applicable, to relate prior expectations of housing characteristics to the purchase decision. For instance, regressions are run with TOTSF and LEVEL included in the independent variable set. Housing market priors suggest these variables are significant in the housing purchase decision.

Preliminary Variable Set Analysis

Several interesting relationships are revealed in this stage of the analysis. A subset of regressors consistently exhibited statistical significance and were of the expected sign. Of the structural variables, TOTSF, MHD, AGE, MO and BATH supported the _a priori_ expectations in all analyses. However, anomalies exist for several of the structural characteristics, including exterior real estate amenities.

LEVEL and BED appear to measure some set of perceptions expressed by the real estate market other than defined. These variables are highly correlated with TOTSF (.87 and .72, respectively). BED exhibited a negative and insignificant sign and was dropped from further analyses.

Changing TOTSF and LEVEL to square footage by story made no improvement in the inference. TOTSF is retained, while LEVEL is omitted.

The distribution of observations for square feet of exterior amenities proved to bias the regression results. Both the high percentage of undeveloped properties and the limited number of observations without these amenities effectively forced these variables to act as weighted dummy variables. The expected significance of these factors in the purchase decision required further analysis before summarily dropping them from the analysis. Regression results for FIRE and the set of exterior site amenities led to the development of a composite index of the presence of these characteristics.

A set of exterior and interior amenities that, on a practical housing purchase decision level, performed contrary to theoretical expectations were combined into a single variable. These amenities are square footage of porch, patio, and deck; dummy variables for the presence of a fireplace, carport, outbuildings, hot tubs, solarium and garage. This additive modification eliminates a quality component for the amenity, but provides a measure of at least the presence of the structural/lot characteristic. Dummy variables, summed across all exterior site/lot amenities served as the discrete (truncated at the zero to nine range) variable STRUCT. An increase of one unit of this variable changes the intercept by the value of the coefficient (in the linear form), as with fundamental indicator variables. STRUCT exhibited a positive and significant relationship with the dependent variable.

H2O and SEW were insignificant in all regressions and were omitted from further analyses. While a significant component of an actual purchase decision, both variables may suffer from measurement error. Each is defined as a site characteristic in the Deschutes County Tax Assessor's appraisal process (Appendix D, p. 175). Site is defined as an Oregon Department of Environmental Quality approval for water and/or sewer development. The variable may not fully reflect the presence or absence (0/1) of the services, regardless of whether the property is developed. PVD was consistently significant and is the only site-adjacent public service variable retained for additional analysis.

Of the location characteristics, DMB and DCBD were the only variables to respond to OLS analysis as expected (negative and significant). The relatively limited response time of home and life protection services between La Pine, upstream and downstream housing communities, and possible presence of immediately-local damage and injury response plans for housing communities apparently disrupts the interpretation of the other Location variables. The distance to school (DSCH) variable may have a substantial amount of measurement error.

Parents have the right to ignore the Bend-La Pine School district's primary choice of school by residence location. D2CBD, DPOL, DFIRE, and DSCH were omitted from the analyses.

Coefficients of variables reflecting primary owner residence acted as expected. LOCAL and ORE exhibited a consistent negative sign, while ORE varied in significance. It is hypothesized that non-Deschutes county residents will pay a higher price for Deschutes River real estate, due to the benefits of living in this area. Additionally, lower transactions costs are associated with LOCAL purchasers, due to proximity and familiarity with the market. This was expressed in the preliminary model specification by a significantly decreased sales price related to LOCAL purchasers. A similar relationship existed for ORE purchasers compared to non-Oregon (REC) purchasers, but was omitted from further regressions due to lack of significance.

Finally, lot size (AREA) and adjacency to the waterway (RIV) were retained in further analyses due to prior expectations as well. The latter was consistently significant and of the expected sign. GOLF is dropped from the analysis due to singularity of data in the Sunriver reach. Preliminary model specification in the linear form is presented in Table 7, column 2.

Table 7. Preliminary Model Specification with Alternate Functional Form Analyses.

CHAR GROUP	(1) VARIABLE	(2) Linear	(3) Log-Dep.	(4) Log-Ind.	(5) Log-Log
STRUCTURAL	Constant	20285 (3.0233)	9.0558 (33.549)	37571 (2.1169)	9.0012 (12.542)
	MO	-71.518 (-3.3483)	-0.00373 (-4.349)	-2051.8 (-3.04)	-0.092 (-3.387)
	AGE	-826.04 (-2.1444)	0.0060 (1.116)	-208.18 (-1.565)	-.00668 (-1.243)
	AGE^2	22.036 (1.7419)	NA	NA	NA
	MHD	-16653 (-6.0801)	-0.24228 (2.2181)	-17634 (-6.492)	-.2594 (-2.362)
	TOTSF	17.412 (7.9725)	.0031 (3.5688)	16.458 (7.6287)	.0003 (3.41)
	STRUCT	2818.0 (2.8255)	.18639 (4.951)	2322.0 (2.4695)	.19313 (5.0797)
	BATH	9127.1 (4.3299)	.28248 (3.354)	8909.0 (4.2452)	.2882 (3.396)
PROX	RIV	12869.0 (9.4751)	.6818 (12.465)	12975 (9.544)	.6824 (12.414)
AREA	AREA	512.71 (.95543)	0.01975 (.91612)	662.19 (1.244)	.0185 (.861)
SERV	PVD	6613.50 (3.5780)	.27594 (3.7284)	6211.1 (3.3617)	.281 (3.755)
RES.	LOCAL	-2416.0 (-1.6939)	.0744 (.6519)	-2732.3 (-1.915)	.02288 (.3966)
LOCATION	DCBD	18.525 (0.15802)	.002218 (.4831)	-508.08 (-.2708)	.0218 (.2878)
	DPOL	-14.961 (-0.0643)	.00677 (.7235)	969.2 (.3876)	.0893 (.88356)
	DMB	-363.12 (-1.7428)	.000213 (.0254)	-7320.4 (-1.613)	.016 (.0875)
	R^2 F-stat N (t-stats in parentheses)	.73 87.552 448	.66 69.04 448	.73 93.1 448	.658 67.3 448

Analysis of Preliminary Variable Set in Alternate Forms

The preliminary model is further analyzed to develop the final independent variable set and functional form under the following transformations: linear, logarithmic, semi-log dependent, and semi-log independent. Alternate functional form analyses provides a means of analyzing the robustness of the variables and selecting the appropriate form of the final model. All variables are tested at the 90% significance level. Table 7, columns 3 to 5 indicate the results of this examination.

The period in which the lot sold (MO) is stable in all specifications, significant and exhibits a negative linear and log independent forms. _A priori_ considerations suggest retaining this variable because there is a high relationship to sales price. Regarding the structural variables, TOTSF, STRUCT, MHD and BATH are robust to the alternative functional forms and of the expected sign. AGE and AGE^2 are of the expected sign(negative), but AGE is significant in only the linear form(the log independent specification exhibited marginal significance).

Adjacency to a river (RIV) is highly significant and positive in all functional forms. LOCAL, in-county ownership, is of the expected sign, but is only marginally significant in the probability that non-local ownerships are willing to pay a higher price for property along the Deschutes river. LOCAL is retained in the following analyses.

AREA, size of the lot, is insignificant in all specifications. While a high percentage of the total number of sales includes bare land, the presence of structures appears to substantially negate the value of lot size. It is important to emphasize that all properties are limited to ten acres maximum, and all are zoned residential. The fact that non-residential uses are officially precluded (including commercial uses), and the predominance of lots with less than .8 acres (81%) may be the major causes of this result. Nonetheless, AREA is retained for final specification analyses when river protection specifications are included.

The site-specific public services variable (PVD) is stable and highly significant in all specifications. The location variables DPOL (distance to applicable police sub-station) and DCBD are insignificant and erratic between specifications. The perceived distance to police services is indicated to be a minor part of the purchase decision. DPOL is dropped from the analysis; however, DCBD is retained based on the significance of this factor in most previous Hedonic Pricing literature. Distance to Mt. Bachelor (DMB) is marginally significant in the linear and semi-log independent forms, and is retained.

Preliminary model specification resulted in the selection of a set of regressors and the linear form in subsequent analyses. No improvement in explanatory power was exhibited by semi-logarithmic dependent or log-log functional forms; however, the log-independent specification exhibited a high adjusted R^2 and second lowest mean squared error. Both the linear and semi-log independent functional forms are analyzed with DAV.

Section II. River Policy Changes Preceding Designation

Society enjoys a diverse set of use and non-use values from the Upper Deschutes River and its related natural resources. Many levels of public land and water management agencies and private interests allocate organizational resources to the river planning process. Identifying the significant actions leading to Designation, and modeling this effect in the Hedonic Price function is the focus of this subsection.

Event study approaches to modeling the effect of Designation activities have proved useful in studying the effect of qualitative changes on market prices (Halpern, 1983). In the current research, this technique is used to model the effect of preceding river management actions on observed sales prices of river corridor properties. Event study analysis evaluates parameter shifts in periods $t+n$, following the period t event. Any "abnormal" shifts are attributed to these events (Dyckman, et al., 1985). Grouping periods in which management or policy actions occurred into event "windows" permits hypothesis testing of cumulative effects on sales prices (Schumann, 1988). There are potential statistical risks in using this method, however.

The greater length of windows included in the analysis have the potential to introduce substantial noise into the market response, and makes interpretation difficult (Schumann, 1988). An extensive list of river management actions exists prior to actual Designation; selection of a subset to incorporate into least squares analysis potentially suffers from arbitrary inclusion. To reduce this potential, the following benchmarks are used.

First, only those management actions which were commonly publicized are considered. It is assumed in the current study that the effects of river management policies are capitalized into the housing market over time. A percentage of the prospective purchasers may speculate on the likelihood of economic gain before the policy action is formally instituted. Following this, increasing numbers of potential purchasers will acquire the information as the public is included in the planning process. Upon implementation of the new policy, the population of present and potential household purchasers are assumed to be universally cognizant of the change.

Second, candidate Designation Actions are selected based on the implied relationship to formal Designation. That is, a river-related public or management action is defined as influencing river management (either directly or indirectly), and either conflicting with, or supplemental to formal Designation to the State or Federal river protection programs. Principal attention is placed on actions which result in: 1) hydro-electric development approval or denial; 2) changes in land use planning affecting private riverside land holdings; 3) actions directly precipitating Designation legislation; and 4) research emphasizing the value to the local economy of protection of the Upper Deschutes River. Public and management actions having no relationship with the effect of formal Designation are removed from consideration.

Designation Actions are categorized based on their relationship to the effect of dual Designation. Designation Events (DE) are considered discrete policy actions directly relating to enactment of Designation, whether of a supplemental or conflicting nature to formal river preservation. For instance, legislative prohibition of hydro-electric (impoundment-type) development on the mainstem was enacted in 1985. This is effectively a result of federal Designation, and is considered a Designation Event. Designation Activities (DA) are defined as public water or related land resources management actions that (while not directly related to formal Designation) effectively change the allowable uses as if dual Designation had been enacted. Designation

Activities are essentially zoning changes in allowable land uses that may affect river corridor residential property sales prices. Information regarding hydroelectric project applications, construction set-backs from the river, changes in minimum streamflow requirements, etc. are included.

Examples of the assumed relationships between the Federal Wild and Scenic Rivers and Oregon Scenic Waterways Acts and river management policy actions prior to formal Designation are provided in Table 8.

Table 8. Examples of River Management Policy Actions and their relationship to formal Designation to the State and Federal River preservation Acts.

Relationship between River Management Policy and Formal River Preservation	Nature of River Management Policy <u>effect</u> compared to that of Formal State or Federal River Preservation	
	DIRECT Designation Events	INDIRECT Des. Activities
Conflicting	FERC approval of hydroelectric impoundments in Waterway	Public application for irrigation withdrawals
Supplemental	Legislative prohibition of damming in Waterway	Identifying positive recreational and biological values associated with natural waterway

Appendix E lists the entire set of river resource management actions taking place in Deschutes County during the study period. All actions are not included in the formal analysis, based on the relatedness to formal state and Federal river protection.

Each DE or DA is assigned a value of negative or positive one corresponding to the hypothesized benefit to property values resulting from actual Designation. These actions hold for all DAV specifications, and are shown in column three of Tables 9 and 10.

It is argued that all DAV specifications are uncorrelated with the structural and neighborhood variables in the Hedonic Pricing model. Partial correlations between regressors of less than the coefficient of determination (R^2) is recognized as having little deleterious influence on the model. A decision rule of no partial correlations greater than .20 was used. Only MO (time: period in which sale occurred) exhibited a partial correlation greater than this (.57), but DAV is developed directly as a time-dependent process. MO is retained on this basis.

Given statistical significance of the Designation Activities Variable (DAV), the analysis continues with determination of the implicit market price of DAV for the river corridor housing market. This value is obtained by taking the partial derivative of DAV with respect to overall household sales price (Griliches, 1967; and Freeman, 1979b).

Table 9. Upper Deschutes River Designation Activities*

Date	Action	Value**
March '81	Southern Canal Hydro approval	-1
May '81	Main Canal Hydro Permit granted	-1
Aug. '81	Crane Prairie Hydro Project Approved	-1
Aug. '82	Pringle Falls Hydro Project	-1
Nov. '82	Benham Falls Project Planning	-1
Apr. '83	Wickiup Reservoir Project proposed	-1
May '83	Pringle Falls Hydro Project approved	-1
May '84	Rep. Throop publicly suggests ban on hydro development on UDR.	1
June '84	Arnold Irrigation District proposes three impoundment/ withdrawal projects.	-1
Sept. '85	Release of UO and Ragatz surveys showing public support for protect.	1
Nov. '85	NPS/ ODSP&R support Designation	1
May '86	Final Deschutes River Study release	1
June '86	Oregon Rivers Initiative kick-off	1
July '86	County/City accept River Study	1
Aug. '86	ODSP&R identify reach classes	1
March '87	First Legislative hearing on Oregon designation.	1
June '87	ONRC study shows state favors both state and federal designation	1
Nov. '87	Headwaters reach designated to OSW	1

* Designation Activities are defined as public actions indirectly leading to the implementation of law or natural resource management policies that have the effect of Designation, as it pertains to riverside ownership rights and responsibilities.

** Negative and Positive values reflect the conflicting or supporting effect of the Designation Activity, respectively, as they relate to formal Designation.

Table 10. Upper Deschutes River Designation Events*

Date	Action	Value**
Nov. '84	FERC proposes approval of Benham Falls hydroelectric project.	-1
May '85	State Representative Throop presents legislation proposing ban on hydro-electric development on Deschutes River.	1
Sep. '85	Benham Falls Hydroelectric Project receives final approval from FERC.	-1
Following Oct. '88	All subsequent periods following Federal Designation 10/88 and Oregon Scenic Waterways Designation 11/88.	1

* Designation Events are Deschutes River policy actions directly resulting in management responsibilities parallel to that of "dual" Designation to both the Oregon and federal river protection programs.

** Negative and Positive values reflect the conflicting or supporting effect of the Designation Event, respectively, as they relate to formal Designation.

For this analysis the calculation is in the following form:

$$Q(DAV_{it}) = \frac{\partial HP_{it}}{\partial DAV_{it}} \qquad (4.1)$$

where $Q(DAV_{it})$ is the implied marginal value of river protection for site i in period t. HP_{it} is the specification for sales price from the Hedonic formulation, and DAV_{it} is the river protection variable. Given the set of river protection management actions preceding the sale, the value of $Q(DAV_{it})$ indicates the increase in expenditure required to purchase a site (and the associated structural and site amenities) of Deschutes River corridor property.

Specification of the Designation Action Variable (DAV)

Modelling river protection in Hedonic Pricing presumes that a correlation between river protection policies and property sales prices exists. The precise form of this specification is unknown. Therefore, a series of trials examining this relationship was employed. The effect of river protection on the river corridor housing market is hypothesized to be reflected in market prices in one (or a combination) of four forms. In developing the Hedonic analysis, each estimate is analyzed for its explanatory character.

Designation Actions in alternate combinations have been analyzed in this DAV specification process. Theorizing that Designation Events profoundly effect the public (and the river corridor housing market members') perception of the allowable uses and future management of the river, DE is analyzed separately as well as in combination with DA. Likewise, DA is separately studied for the effect the included actions have on sales prices. Finally, the effect of the distribution of information regarding proposed management actions is considered. Each of these specifications are discussed, after which results of the final overall model specification and regressions are listed.

Specification of Formal Designation

First, formal Designation of the Upper Deschutes river is modeled as a discrete event, DAV1. Econometrically, specification is a 0/1 vector taking the value one if Designation has been enacted in period t, and zero otherwise, for all mainstem Upper Deschutes River observations. Designation occurred in October and November of 1988, to the federal and Oregon programs, respectively. DAV1 in these and ensuing periods retains the value unity.

The use of dummy variables is commonly included in OLS analyses to examine the effect of qualitative changes on quantitative values (Kennedy, 1981). The dummy variable coefficient shifts the intercept of the OLS regression, and reflects the expected change in the dependent variable (Radcliffe, 1984).

The OLS Hedonic model takes the form,

$$HP_{it} = \alpha + \beta_1 S_{it} + \beta_2 N_{it} + \gamma (DAV1_{it}) + \epsilon \qquad (4.2)$$

Where, HP_{it} is the predicted household sales price of site i in period t as a function of the Structural (S_i) and Neighborhood (N_i) characteristics, in addition to $DAV1_{it}$. The coefficient γ reflects the expected change in HP_{it}, given that Designation has occurred.

Figure 9 shows the relationship between average sales prices of the pooled sampe and DAV1. Periods are quarterly-based for representation purposes only, statistical analyses were performed in the monthly form. Tree quarters of the study period exhibit the value one in this specification. A clear relationship between average prices and DAV1 is impossible to discern. Still, a general increasing trend is shown in the final one-quarter of the study period, preceding Designation. Management actions preceding Designation were publicized throughout the local and regional area and may also affect housing prices. These actions are considered next.

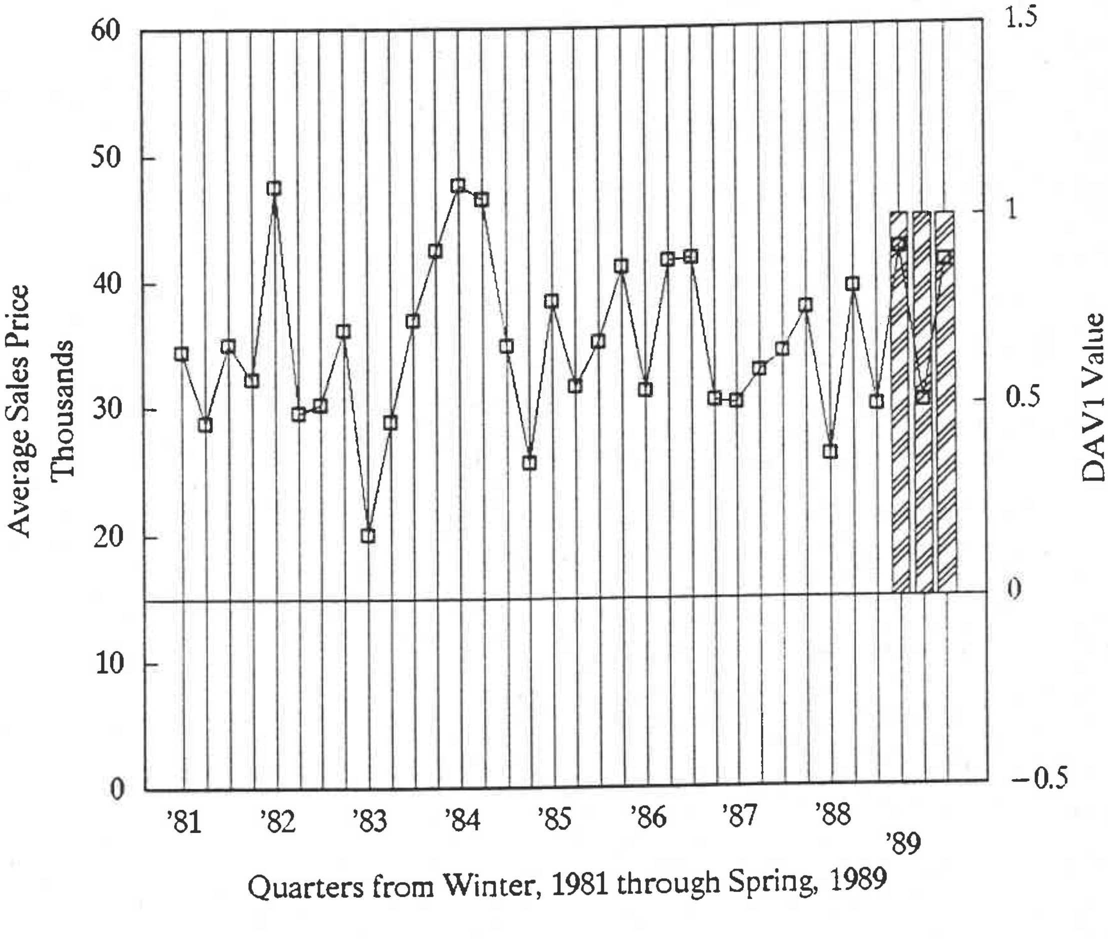

Figure 9. Average Sales Price of the Pooled Sample Observations and DAV1 (in columns). DAV1 has the value one in all periods in which Federal or State Designation has occurred.

Designation Activities Specification

An extension of 0/1 indicator variables is suggested by Pindyck and Rubinfeld (1980) as an improvement for interpreting regression results with multiple sets of indicator variables (1981, pp. 136-138). Here, a zero, one or negative one indicator variable is employed to model the range of DE and DA actions associated with their relationship to actual Designation. This specification explicitly includes event study techniques to examine the effect on the river corridor housing market of speculation that Designation may occur (Halpern, 1984). This follows Schumann's (1989) use of event windows to model the dispersion of information effecting market prices.

Assuming Designation enhances the quality of riverside property ownership (or reduces the risk of decline thereof), policy actions increasing the certainty of Designation may be positively capitalized into the market price over time. The kx1 DAV2 vector takes the value one (1) in period t. Conversely, where DA or DE actions permit development or land uses prohibited by Designation, the DAV2 vector in period t takes the value negative one (-1); and otherwise, zero. The model takes the form:

$$HP_{it} = \alpha + \beta_1 S_{it} + \beta_2 N_{it} + \gamma \sum_{w}^{w-1} DAV2_{wt} + \epsilon_i \qquad (4.3)$$

where the coefficient γ measures the average deviation during window w of the household's sales from that expected by least squares analysis without river protection. Other variables are as before. Figure 10 shows the relationship between DAV2 and the pooled sample quarterly average sales prices.

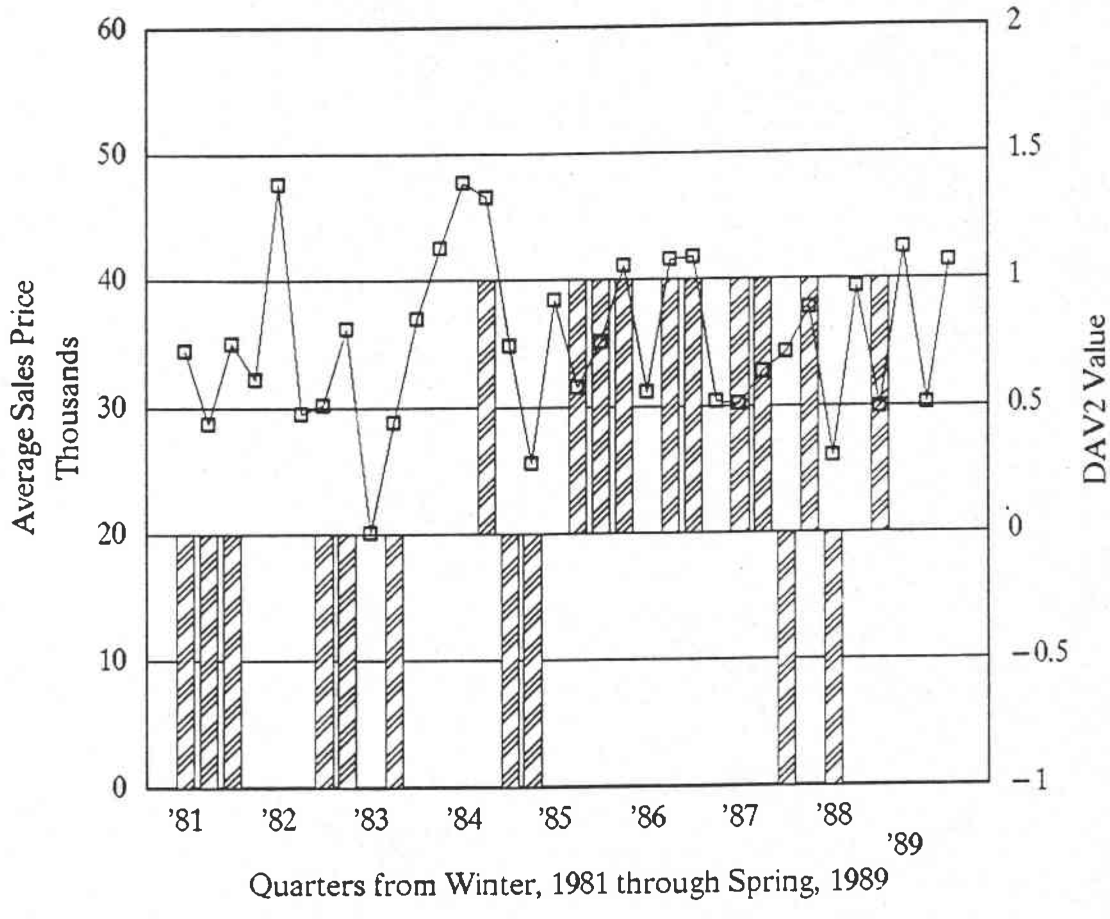

Figure 10. Average Sales Price of the Pooled Sample Observations and DAV2 (in columns). DAV2 has the value one in all periods in which Federal or State Designation has occurred. DAV2 (columns in the figure) takes the value one in all periods that Designation Activities are of a parallel nature to dual Designation occurs, negative one if conflicting.

There may be a positive relationship expressed by this comparison. The negative DA's preceding the Spring of 1984 correspond to a general decline in the pooled sample properties average sales prices. Additionally, from the Winter of 1987 forward, a general increase in the average sales price trend appears. This coincides with the Designation Activities preceding, and leading to formal ratification to federal and Oregon Designation. While there is a possible positive correlation between average prices and DAV2 values, it is questionable that sales prices of riverside property would respond this rapidly to the Designation Activities.

A further observation is that there may be a stronger relationship between DAV2 and average sales prices when the effect of the Designation action is lagged several periods back. A delay function may improve the explanatory power of the Hedonic. This led to modifying the DAV specification to incorporate a lagged structure into DAV.

Lagging the Effect of DAV

The third approach taken to specify DAV is based on the <u>Cumulative Dissemination of Information</u> theory proposed by Rogers (1983), and the reduction of risk resulting from the accumulation of information through time. This specification assumes that, for time period <u>t</u> the perceived likelihood of an event occurring is based on prior events in t-1, t-2, ... t-n, where n is the hypothesized limit of the effect. With this specification, capitalization of river protection into the housing market is incorporated over a period of time. The values for each period are summed over the selected time frame. This appeals to the concept of acquisition of information by a group through time, and is denoted as DAV3.

The hypothesis with this specification is that the combined effect of prior Designation Activities can be explained by an additive lagging structure, with most recent events receiving the greatest relative weight. River management actions within one year (twelve monthly periods) prior to the sale date are used as the relevant time range affecting sales prices. Actions occurring before this range are assumed to be fully capitalized into the market, or are of minimal influence by the transaction date.

The lagging structure for DAV3 is specified in polynomial form as follows.

$$DAV3_t = \sum [\ (1-\alpha)^{t} + (1-\alpha)^{t-1} + \ \ldots \ + (1-\alpha)^{t-n}\ ] \qquad (4.3)$$

where α is a non-negative integer between zero and one. This weighting (α's) control the rate at which the value of the Designation Activity for any given period decays through time. Sensitivity analysis of alphas between .05 and .30 (by

.05 increments) provided little information for the appropriate value for the specification. Selection of α =.3 was made to expedite decay of the effect of DAV, and to associate the greatest weight with Designation Activities nearest period t. All observations in each period ($DAV3_t$) retain equivalent values in this specification. The range of DAV3 is 1.9 to 2.9. Analysis of alternative time ranges (less than one year) and within-range periods (semi-annual and quarterly) showed no explanatory advantage over the monthly.

Calculation for DAV3, incorporating dummy variables for Designation Actions takes the form,

$$DAV_3 = \sum_{t}^{t-1} [D_t(1-\alpha)^{t} + D_{t-1}(1-\alpha)^{t-1} + \ldots + D_{t-n}(1-\alpha)^{t-n}] \quad (4.4)$$

D_t in equation 4.4 is the 0/1 dummy variable multiplier for Designation Actions occurring in period t. DAV3 decays to zero if no Designation Actions occurred during the previous eleven months.

Figures 11a and 11b refer to the first and second half of the study periods, respectively. Particularly in the latter, there is a stronger relationship between DAV3 and average sales prices of the pooled sample properties. Allowing for extremes in the sales price ratio (this includes developed and undeveloped sites, as well as highly landscaped locations) the peaks and rate of decay of DAV3 closely

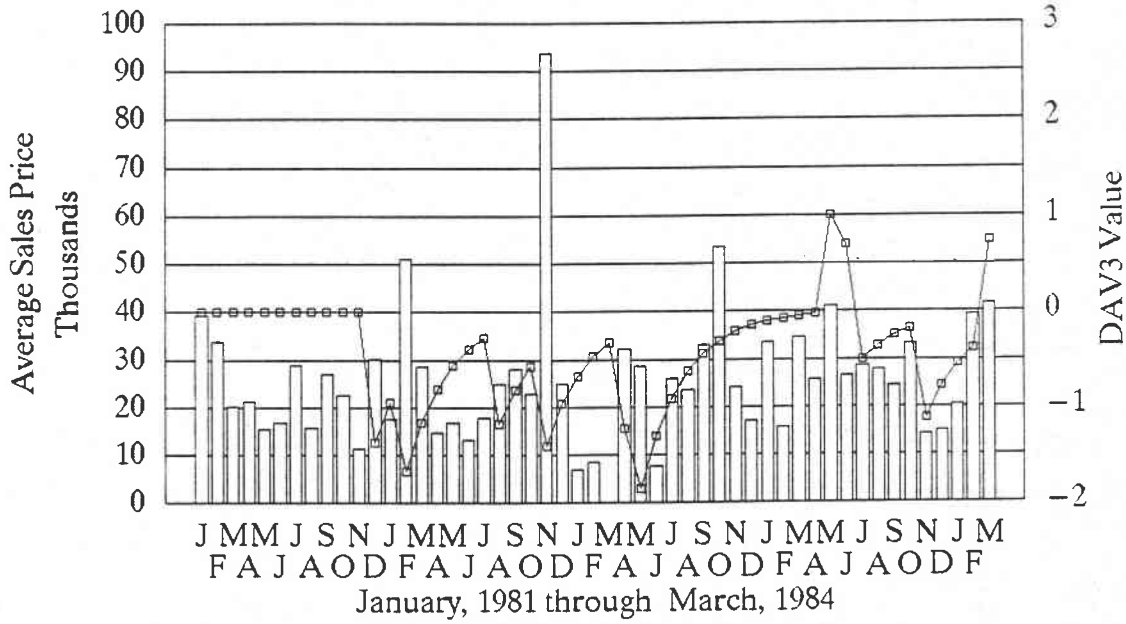

Figure 11a. First Half of Study Period Relationship between monthly Average Sales Prices (columns) and lagged DAV3.

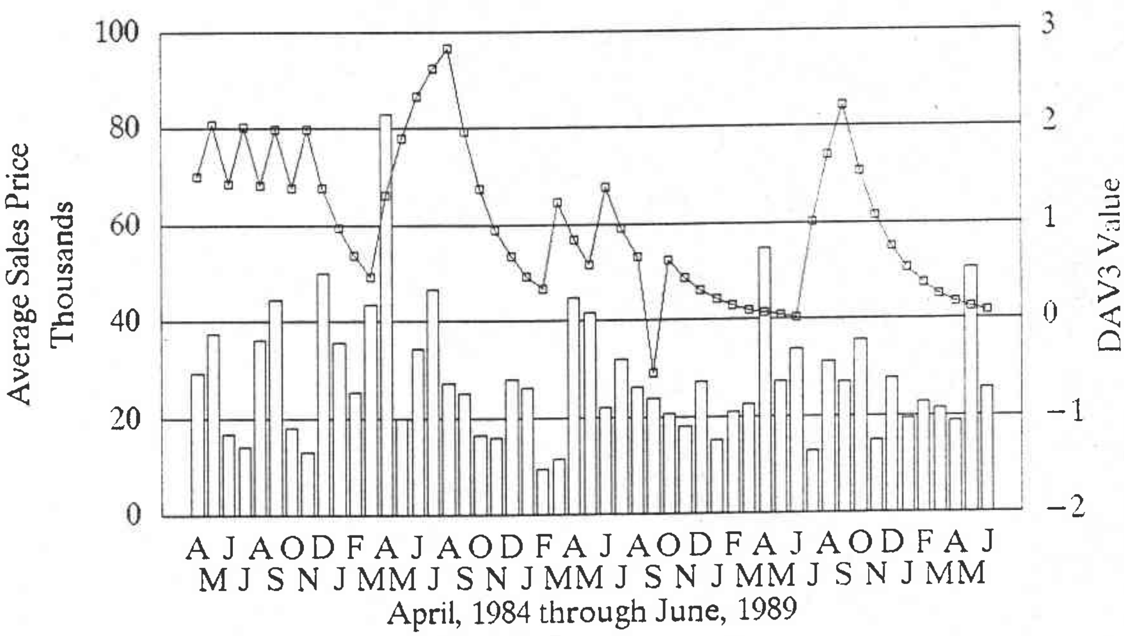

Figure 11b. Second Half of Study Period Relationship between monthly Average Sales Prices and lagged DAV3. Average Sales Prices (columns) of pooled properties on the Upper Deschutes River and control rivers. DAV3 is a lagging function of Designation Events, decaying through time. Missing values indicate no sales.

parallels the average sales prices occurring within four periods previous.

While this specification includes both Designation Events and Designation Activities, formal Designation to the state and federal river protection programs is explicitly excluded in this specification. Because this policy most comprehensively affects the management and use of river corridor properties, the following DAV specification incorporates Designation into the specification.

Combining DAV Specifications

The final specification analyzed is simply a combination of DAV1 and DAV3. Assuming that Designation does significantly affect riverside property values, it is likely that, while the discrete Designation Event theoretically should elicit the greatest response from property sales price and is clearly the most publicized, all (or a subset) of Designation Activities preceding legislation are also likely to be reflected in the market.

The model is in the form:

$$DAV4 = \sum_{t}^{t-1} [D_t(1-\alpha)^t + D_{t-1}(1-\alpha)^{t-1} + \ldots$$

$$\ldots + D_{t-n}(1-\alpha)^{t-n}] + DAV1 \qquad (4.5)$$

where DAV4 is the summation (of the lagged polynomial structure of) DAV3 and DAV1, and all other variables are as before.

This additive lagged decay structure lends a substantial degree of variability to the DAV specification. The correlation between Designation Events and changes in riverside property sales prices is positive, and the decay of DAV3 and declines in average sales prices appear to follow a similar slope and rate of decline for many sample periods. Including DAV1 values increases the correlation between DAV4 and the increasing values of pooled sample average sales prices. Figures 12a and 12b compare DAV4 and these average prices Upper Deschutes River and control rivers properties. It appears that a positive relationship does exist for this (riverside properties) subsample.

The next step in the analysis is model specification, combining the alternate DAV specifications. Provided that correlation between DAV and other independent variables does not exist, two specifications are further examined in the full, final specification model. Formal river protection imposes substantial alterations in the allowable uses of the river specifically, as well as riverside property. Further analyses include examinations of DAV1, Oregon state and Federal river Designation, on river corridor property sales.

DAV4, the additive decay function indicating major river management actions, may provide information on river

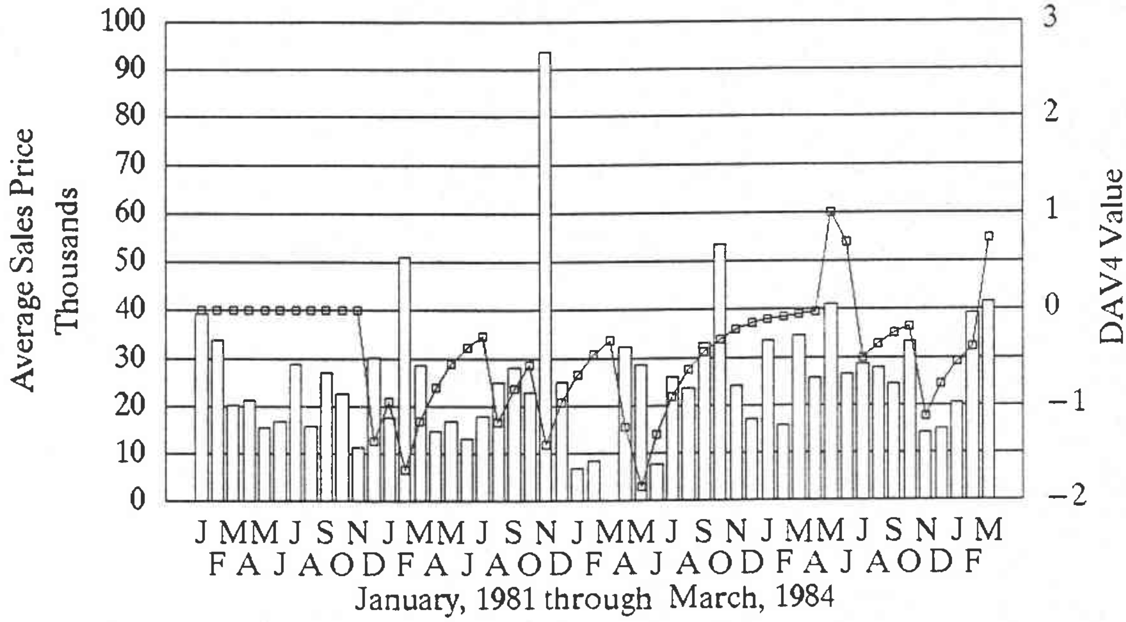

Figure 12a. First Half of Study Period. Relationship between monthly Average Sales Prices (columns) and lagged DAV4.

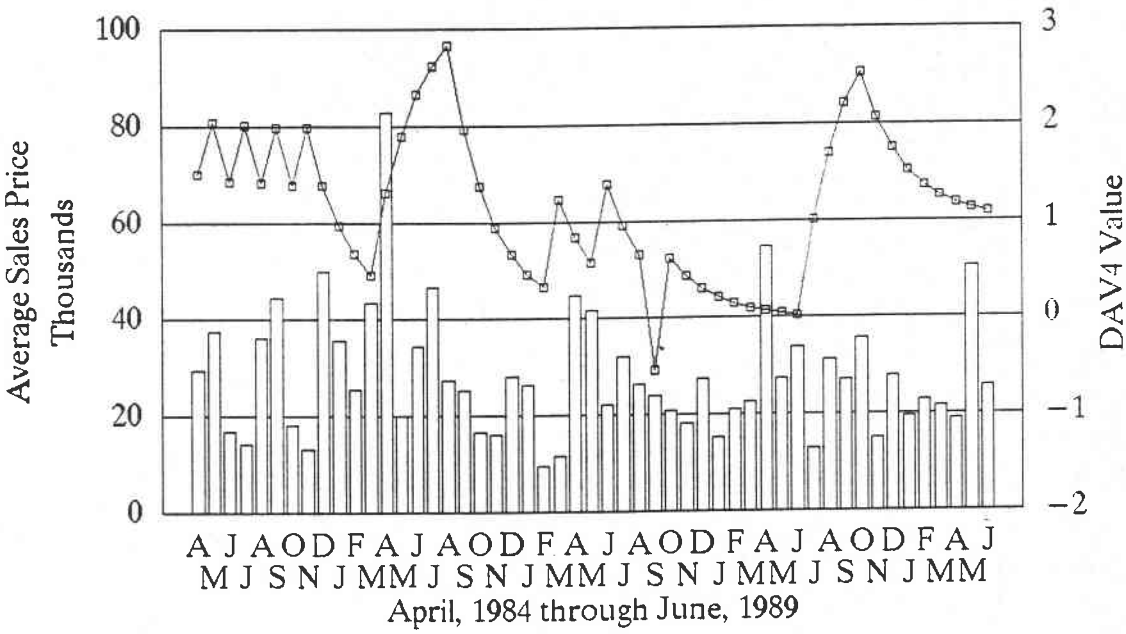

Figure 12b. Second Half of Study Period. Monthly Average Sales Prices of Upper Deschutes River and control river properties and DAV4. DAV4 is a lagged decay function of Designation Events, combined with the indicator variable value taking the value one if formally Designated.

protection policies' capitalization into the river corridor housing market. The lagged decay function conforms most closely to the hypothesized dissemination of information through a market, and best approximates the theory of real estate prices' response to market changes. These two DAV specifications are added to the preliminary model for final model development.

PART V. FINAL MODEL SPECIFICATION AND DAV

Final Variable Set Selection and DAV: Specification Sample

Designation Activity Variables are added to the preliminary variable set to specify the final model. Regressions of SLSPR on the preliminary variable set and DAV1 and DAV4 in the linear and semi-log independent forms showed stability between functional forms, expected signs relative to SLSPR, and significance of all preliminary variables with the exception of AREA, DCBD and DPOL. These are omitted from further analyses. Table 11 shows the final variable set with DAV1, the 0/1 indicator variable for formal Designation. The same set of household characteristics is shown in Table 12 and DAV4, the additive lagged river protection variable. Both the linear and semi-log independent transformation are provided.

In the linear form, the structural variable's coefficients indicate acceptable results (90% significance level). Average price per square foot of residential housing in

Deschutes County during the period 1981 through 1989 averaged $39 (per. comm. with Deschutes County Assessors Office, 1990). This figure is the sum market value of actual sales prices of completed Deschutes County homes, and includes numerous structural amenities. This figure also is not corrected for the value of exterior additions, structures, landscaping, acreage, etc. The estimated value of an average square foot of a residential structure in this study is approximated by the Hedonic Pricing regression as $18. This value is corrected for inflation, and adjusted to reflect a skeletal, albeit completed residential structure.

The significant negative coefficient of MHD (the presence of a mobile home) suggests that the average sales price of river corridor property is reduced by $15,488 when a mobile home is present. While no data exists to verify this figure, it is reasonable to expect a reduction in sales price of this magnitude when comparing property with permanent versus temporary structures. The coefficient for BATH indicates that each additional full bathroom increases the value of the river corridor residential structure by over $8,000.

Of the structural variables, STRUCT is least easily interpreted. The presence of any of the component characteristics (porch, patio, deck, fireplace, garage, carport, or other outbuildings) increases the average sales price of river corridor properties by over $3,000. This

Table 11. Specification Subsample Final Model with DAV1. DAV1 is a 0/1 dummy variable equal to one in all periods including and following formal Designation.

Characteristic Category	(1) Variable	(2) Linear	(3) Log-Ind.
	Constant	19949 (5.8278)	42586.0 4.0952
Time	MO	-91.551 (-3.9577)	-2194.3 -3.1414
Structural	AGE	-823.63 (-2.1543)	-856.84 -2.2272
	AGE^2	23.069 (1.8414)	23.436 1.8589
	MHD	-16105 (-5.9467)	-16586.0 -6.1056
	TOTSF	17.256 (8.0281)	16.958 7.8489
	STRUCT	3066.8 (3.1369)	3122.0 3.1789
	BATH	9100.0 (4.3812)	9298.0 4.4491
Ownership	LOCAL	-2407.4 (-1.7362)	-2704.6 -1.9461
Neighborhood	PVD	6301.1 (3.5807)	6513.1 3.7130
Location	RIV	13101.0 (9.9169)	13153.0 9.9343
	DMB	-302.82 (-2.2730)	-8402.8 -2.5653
River Protection	DAV1	6153.2 (2.3187)	4029.2 1.5892
R^2........................		.730	.731
F-stat.....................		103.9	102.4
N...........................		448	448
(t-stats in parentheses)			

Table 12. Specification Subsample Final Model with DAV4. DAV4 is the additive lagged decay function. DAV4 combines a twelve month lag structure on major Designation Events preceding formal Designation and a 0/1 indicator variable taking the value one in all periods following Designation.

Characteristic Category	(1) Variable	(2) Linear	(3) Log-Ind.
	Constant	22216 (5.6470)	55545 (4.5872)
Time	MO	-826.04 (-2.144)	-5860.9* (-3.387)
Structural	AGE	-907.52 (-2.2145)	-889.53 (-2.1731)
	AGE^2	25.764 (1.8639)	24.408 (1.8403)
	MHD	-15488 (-5.2789)	-15715 (5.3862)
	TOTSF	17.955 (7.8336)	17.610 (7.7134)
	STRUCT	3264.2 (3.0940)	3284.7 (3.1243)
	BATH	8210.9 (3.6459)	8465.4 (3.7734)
Neighborhood	RIV	13079 (8.9453)	13078 (8.9902)
	PVD	6596.6 (3.3770)	6693.8 (3.4669)
Ownership	LOCAL	-3063.6 (2.0137)	-3041.1 (-2.0028)
Services	DMB	-304.54 (-2.0899)	-7848.6* (-2.1963)
River Protection	DAV4	1709.3 (2.1282)	1876.8 (2.2741)
R^2..............................		.730	.729
F-stat..........................		89.46	89.93
N*..............................		396	396
(t-stats in parentheses)			

*N equals 396 due to loss of first 11 months with lag structure.

index does little to specifically explain changes in property values responding to the quality of these amenities. However, the component characteristics of STRUCT clearly increase the value of residential property and are explicitly included in the set of regressors to differentiate the value between dissimilar sites.

Within the entire variable set, RIV is consistently the most significant. Average sales prices of river-adjacent property is estimated to be over $13,000 greater than set-back sites. This estimate appears to be within an acceptable range[7]. The disparity between the study sample and aggregate average sales prices (a difference of $9207) is acceptable. The Upper Deschutes River has a greater demand for housing, presumably due to proximity to river related resources and recreation sites, and adjacency to the National Forest. It should be noted that the aggregate averages reflect values from Bend downstream, to the point where the river reaches the desert, an arguably less desirable residential location. In fact, non-riverside averages may be overestimated due to the inclusion of Black Butte, a significantly higher price class of residential properties (DCA Sales Ratio Rolls, 1980-1989).

---

[7] For the study period 1981-1989, the average sales price of Deschutes County river corridor properties was $58,722. Average sales prices for all other property classes for the same period was $49,515. (From Deschutes County Assessors Sales Ratio Study, Roll years 1981-1990).

Implicit Prices from Specification Analyses

The implied price of river protection is calculated using equation 4.1. Taking the partial derivative of SLSPR with respect to DAV1 or DAV4 in this case is precisely the value of the coefficient in the linear model. In other words, the average characteristic price of river protection resulting from marginal changes in river corridor management policies is approximately $6153 and $1709 for DAV1 and DAV4, respectively.

The substantial differences between the implied prices of the DAV1 and DAV4 specifications results as a function of the alternate specifications. OLS analyses in the linear form have a direct relationship with the numerical values; in this case, the greater average numerical value of DAV4 (relative to DAV1) reduces the parameter estimates in the regression.

Before proceeding by applying the final Hedonic Pricing model to the verification subsample, the potential problems resulting from using the present cross-sectional and time series data is discussed.

Tests for Auto-correlation and Heteroskedasticity

Pooling of time-series and cross-sectional data has been avoided in the majority of previous Hedonic Pricing research. Single period, or single market analyses substantially decreases the potential for error introduced into the model by characteristics prices' relationships to time, or across markets. The present study includes both cross-sectional and time-series data to provide a measure of model validation, and to reflect the effect of river protection policies over time. This introduces substantially greater requirements on the researcher to respond to the issues of auto-correlation and heteroskedasticity. Before final model application to the Verification subsample, tests for auto-correlation and heteroskedasticity are executed with the final variable set. The analysis is conducted on the overall sample (excluding Sunriver) to permit any necessary adjustments prior to final Verification subsample analyses.

Autocorrelation

Auto (or serial) correlation is frequently a problem in time-series analyses. Autocorrelation results when errors of different (often adjacent) time periods or cross-sectional observations are correlated. Autocorrelation occurs due to measurement error correlations in the error term or due to correlation over time from omitted variables in the regression (Judge, et al., 1982). In the case of the present study, this implies that changes in the explanatory variables in a given time period are not completely capitalized into the market in that period.

Generally, autocorrelation will not effect the consistency or unbiasedness of the OLS estimators, but may affect their efficiency (Pindyck and Rubinfeld, 1981, pp. 152-158). This results in larger estimated standard errors of the OLS regression than the true standard errors. The effect is to bias the standard error of the regression downward.

A special analysis of the presence of autocorrelation in the present study is required because no single observation (or aggregate average for a geographic area) is followed throughout the study period. The accepted test is the Durbin-Watson test (1951). The Durbin-Watson value will lie in the zero to four range, with a value near two indicating no first-order serial correlation.

The null hypothesis of no positive autocorrelation is tested in the range,

$$H^{\circ}: d_1 < d_u < DW$$

$$H^{a}: d_1 > DW$$

Where, for tests of positive auto correlation, d_u is the Upper bound to the rejection region, and d_l is the lower bound to the acceptance region (Durbin-Watson, 1951). DW is the calculated Durbin-Watson statistic. The range between d_l and d_u is undefined and no conclusions may be drawn.

Three examinations of the data for auto correlation are made. We make a first approximation of the presence of autocorrelation in the sample using monthly averages of all variables in the preliminary model and apply the Durbin-Watson test. While difficult to interpret, this method at least provides a means of testing the presence of auto-correlation with aggregate values directly originating from the data set. The value lies in the inconclusive range (DW=1.69: α=.05; k=12, N=448).

Second, forecasting techniques were used to examine the potential existence of time-series relationships specifically in sales prices. Changes through time of average monthly sales prices were decomposed into cyclical, seasonal, trend and irregular (inexplicable) factors (following Levenbach and Cleary, 1984). Once the corrections for the seasonal and cyclical components are made, and assuming the irregular component is associated with these, regression analyses are used to determine (and correct for) the correlation between time and sales price. The forecasting analysis on the base data sales prices indicated no correlation between sales prices and time (.10 significance). Although not directly an analysis of autocorrelation, the monthly sales price medians analysis indicated that adjustments for trends during the study period are unnecessary.

A further examination, although not implemented in the final model, may provide a basis for additional research in the future. The aggregate (time-neutral) explanatory and dependent variables are decomposed into sequentially smaller periods and F tests applied to analyze improvements in explanatory power. The restricted model is the higher-aggregation data set; the unrestricted model allows the coefficients of the decomposed variable to vary. Each explanatory variable of the final model was examined independently from all other variables. This permits analysis of at least the improvement in inference that may result from allowing cross-period correlations to be reflected by greater decomposition of the data.

The decomposition of variables to the monthly form indicated that the decomposition of five variables may be required. The variables are MHD, TOTSF, BATH, RIV, and PVD. To carry this examination out, TOTSF would be included in the final Hedonic Pricing model as a J x N matrix of observations, where J is the number of periods in the sample. This is a preliminary step to Generalized Least Squares adjustments to further correct problems with autocorrelation. Several GLS procedures are suggested (Cochrane-Orcutt, 1949; and Hildreth-Lu, 1960) to generate the adjustment for the effected variables.

The unique case present in the current study wherein no single observation or aggregate value is followed throughout the entire study period requires special generalized least squares adjustments. This approach is not pursued. The preliminary model has been examined for time-series relationships, with none apparent. The Durbin-Watson (1951) procedure has been applied to an aggregate averages model, and no conclusive evidence of autocorrelation exists. While a common problem in time-series analysis, further adjustments are ignored. In any case the results should not suffer from statistical bias or lack of consistency. Efficiency may be the real limit to the results found here, if autocorrelation does indeed exist. Attention is turned to problems of unequal variances in the cross-sectional analysis.

Tests for Heteroskedasticity

In the present study heteroskedasticity, or non-equal variances between the parameters of the control and mainstem river observations, may be present. Here, the problem is a potential loss of efficient parameter estimates. The OLS regression will yield unbiased and consistent estimates, but statistical inference using standard t and F tests is limited if non-equal variances exist.

Even though pooling the control and study rivers is appropriate (given F-test results), the variances between the two samples may be statistically different. Existence of significantly different variances between the two samples will lead to inefficient estimates, biased toward the greater-variance sample (Pindyck and Rubinfeld, 1981, pp. 143-152). Bartlett's test (Mood, 1968) is the standard test of heteroskedasticity when error variances change directly with independent variables, which is the most likely problem here.

Under the assumption of homoskedasticity, the statistic will be distributed as a chi-square with G-1 degrees of freedom, where G is the number of groups (Hoel, 1955). The results of this test indicate that heteroskedasticity is present (Chi^2=14.1; $_{\alpha=.05,\ 2}$).

The accepted transformation to generate unbiased estimators in the presence of heteroskedasticity is generalized least squares estimation (Pindyck and Rubinfeld, 1981). The general form of heteroskedasticity differs from the classical model only due to error variances differing between observations. The objective of generalized least squares is to transform the original data set to generate a variance-covariance matrix with the classical model assumptions of constant variance. We leave this to further research, however. The argument for limiting further adjustments is that the focus variable, DAV is assumed to have constant variance within the Upper Deschutes River subset of observations (control observations are uniformly zero). Additionally, the parameter estimates of coefficients and standard errors, while inefficient, are assumed to be consistent and unbiased.

Chapter Summary

The final specification variable set includes ten housing characteristic variables and DAV. We retain both DAV1 and DAV4 for further analysis and discussion. Of interest here is the implied price of river protection, as specified by these two variables. The response of the river corridor housing market to river protection is unknown. Retaining both DAV1 and DAV4 permits our analysis a greater range of inference regarding the impacts of river protection policies.

The secondary research goal of this study is to test the accuracy of the model developed above. The large sample size (799 observations, excluding Sunriver) permitted substantial flexibility in testing the robustness and accuracy of all variables. Chapter Five discusses the results of two resampling techniques employed in these tests.

CHAPTER FIVE

MODEL VALIDATION AND RESULTS

INTRODUCTION

Based on the analyses and results of the preceding chapter, river protection appears to have a strong and significant positive affect on Upper Deschutes River corridor property sales prices. Tests of hypotheses suggest that the specification of river protection in the Hedonic Pricing model adheres to theoretical expectations of the housing characteristics' prices response to these policies (given adjustments for heteroskedasticity, and an assumption that autocorrelation is not present). This chapter addresses these issues and provides results from applying the specification model to the separate verification subsample, and resampling analyses.

The analysis proceeds in two stages. First, the results of cross-validating the specification sample model with the verification subsample are discussed. Several questions arise from these results. Primarily, three variables become insignificant in the verification analysis, and lead to examining results on an overall sample analysis.

Second, resampling through the bootstrap technique is executed to: a) determine if the original model produces satisfactory results from a total-sample regression; b) examine the robustness of parameter estimates; and c) address the heteroskedasticity issue by applying DAV1 and DAV4 to the river-adjacent properties on the mainstem Upper Deschutes River, omitting the control observations. Discussion of final results, and conclusions appear at the end of this chapter.

Cross-Validation with Verification Subsample

The large sample size permits cross-validation of the Hedonic Price model developed from the specification subsample, without a problematic loss of degrees of freedom (Creel and Loomis, 1989 and Lachenbruch and Mickey, 1968). With the verification subsample, regressing SLSPR on the previously specified set of explanatory variables (including the two final DAV specifications) provides a test of the accuracy of the model in general, and the river protection variables specifically. The assumption is that statistical significance of DAV1 and/or DAV4 estimates in both subsamples provides substantive information on the mechanism of capitalizing river protection into the rural residential property market.

Verification subsample regression results, with DAV1 as the focus variable is provided in Table 13, columns two and three. The results of the specification procedure indicated no improvement in explanatory power with model transformations. The linear form was used to complete the

Table 13. Verification Sample Final Model with DAV1. DAV1 is a 0/1 dummy variable equal to one in all periods including and following formal Designation (Nov, 1988).

Characteristic Category	(2) Variable	(3) Linear
	Constant	16557 (4.4174)
Time	MO	-55.73 (-2.074)
Structural	AGE	-412.57 (-.688)
	AGE^2	9.2117 (.3702)
	MHD	-15996 (-5.7425)
	TOTSF	21.965 (7.4996)
	STRUCT	794.24 (.747)
	BATH	7133.3 (2.825)
Ownership	LOCAL	2807.7 (-1.799)
Neighborhood	PVD	8691.1 (4.2026)
Location	RIV	16859 (11.473)
	DMB	-275.84 (-1.8991)
River Protection	DAV1	6025.8 (2.277)
R^2........................		.65
F-stat....................		72.7
N..........................		455
(t stats in parentheses)		

analysis.

Coefficients of all variables retain the expected sign. In all but three cases, the parameter estimates are statistically significant (at the .10 level). Each of the significant regressors are of the same order of magnitude as those in the specification sample analysis.

The three insignificant parameter estimates pose a dilemma. Age of household (and AGE^2) became insignificant when regressed on the verification subsample, as is the case with STRUCT. It is expected that essentially equivalent subsamples for all variables result from the random selection process. This is apparently not the case. For AGE, AGE^2 and STRUCT, there is a significant difference between these variables in the two subsamples, and consequently regression results.

Nonetheless, the analysis proceeds based on the objectives of this research. Overall model specification is basic to Hedonic Pricing, but the primary objective is to study the specific relationship between river protection and sales prices. For the present, the current model is accepted, and we concentrate on the response of the focus variable.

In the verification subsample regression, DAV1 is significant and positive in both functional forms. The inference is that

DAV1 has a significant, positive relationship with sales prices of riverside residential properties. However, this still leaves the question of appropriate specification of river protection policies in the indicator variable form. It remains potentially unrealistic to assume that the market would respond so comprehensively and instantaneously to actual Designation. It is possible that the well-publicized Designation Activities preceding actual Designation developed wide-spread (and supportive) anticipation for the eventual implementation of the laws. However, the change in sales prices responding solely to legislative approval of Designation is questionable. Hence, DAV1 is replaced by DAV4 and included in the set of explanatory variables.

The results of this regression are provided in columns two and three of table 14. AGE, AGE^2, and STRUCT are again insignificant, as would be expected. However, time (MO) also becomes insignificant at the .10 level. The sole explanation for this change is the stronger correlation between the DAV specification and MO (partial correlation equals 0.573).

In both the linear and semi-log independent form, DAV4 is insignificant. Again this is surprising based on the random sampling procedure. No inferences can be drawn regarding the implicit value of DAV4 in the overall Hedonic model. The contrasting results between the specification and verification subsamples regressions elicits a number of

Table 14. Verification Sample Final Model with DAV4. DAV4 is the additive lagged decay function. DAV4 combines a twelve month lag structure of major Designation Activities preceding formal Designation and DAV1 (a 0/1 indicator variable taking the value one in all periods following Designation).

Characteristic Category	(2) Variable	(3) Linear
	Constant	16701 (3.75)
Time	MO	-34.39 (-0.954)
Structural	AGE	-636.6 (-.97)
	AGE^2	14.76 (0.549)
	MHD	-16274 (-5.4669)
	TOTSF	21.45 (6.954)
	STRUCT	721.8 (0.6399)
	BATH	8452.0 (3.0487)
Ownership	LOCAL	-2975.3 (-1.7460)
Neighborhood	PVD	9250.4 (4.1737)
Location	RIV	16423.0 (9.9804)
	DMB	-312.15 (-1.96)
River Protection	DAV4	998.5 (1.025)
R^2........................		.648
F-stat....................		62.79
N..........................		403
(t-statistics in parentheses)		

questions regarding the possibility of spurious results in this particular random subsample. To investigate this, the pooled mainstem (again excluding Sunriver) and control rivers are examined through the bootstrap resampling technique in the following section.

Resampling the Pooled Data Set through Bootstrapping

The conflicting results between the specification and verification stages of model specification and testing elicit the following question: are the insignificant estimates of the parameters DAV4, AGE, AGE^2, and STRUCT in the Verification sample simply anomalies associated with the randomly selected set of observations? The conflicting results in the verification stage challenged the original inferences drawn. Bootstrapping is conducted to further assess the robustness of the variable set as a whole, and specifically DAV1 and DAV4.

Bootstrapping a data set is a form of random resampling that allows analysis of results with solely the set of observations at hand (Efron, 1979). The bootstrap method is a nonparametric way of estimating standard errors. Bootstrapping has been applied to numerous econometric and statistical procedures, including two- and three-stage least squares, generalized least squares, multivariate analysis, and multiple linear regression with consistent results and interpretations (Freedman and Peters, 1984).

The technique is to repeatedly and randomly sample, with replacement, individual observations from the original data set (in the current case, the pooled set of observations) until some N is reached. N is the absolute number of observations in the original data set. Statistical analyses are then applied to the accumulated set of "pseudo-data" (Freedman and Peters, 1984), in this case, OLS. These steps are repeated until a sufficient number of estimates have been acquired to permit behavior analysis of the parameter of interest.

The basic regression model is

$$\underset{nx1}{Y} \equiv \underset{nxp}{X}\ \underset{px1}{\beta} + \underset{nx1}{\epsilon} \tag{5.1}$$

where the data matrix **X** has full rank p and its first column is uniformly equal to one, to provide for an intercept. In Peters and Freedman's (1984) notation, the elements of vector ϵ are unobservable disturbance terms and are independent with theoretical distribution **F**. While unknown, **F** is assumed to have mean zero and variance σ^2.

The OLS β_{pred} (Beta matrix) estimates are:

$$\beta_{pred} \equiv (X^TX)^{-1}X^TY \tag{5.2}$$

Bootstrapping provides a means of estimating the distribution ψ of $(\beta_{pred} - \beta)$. ψ depends on **F**, the common theoretical distribution of the errors. Formally, the frequency of ψ is interpreted by: 1) generating many sets of pseudo-data;

2) computing the β_{pred} estimates from equation 5.1; and 3) ψ is the distribution of errors in $(\beta_{pred} - \beta)$. The idea is to approximate ψ by ψ_{pred}, which is an estimate derived through the bootstrap cycles. Peters and Freedman note that the simplest ψ_{pred} is the empirical distribution of the errors.

Freedman (1981) suggested that applying the bootstrap technique to random data observations is particularly appropriate when perturbations between periods is not extreme. Although there is evidence in the current data set that the effect of time on sales price could be a factor, the structure of the data does not conclusively indicate autocorrelation. One final note on the appropriateness of bootstrapping the current data set: Peters and Freedman (1984) indicated that the results of the bootstrap procedure have performed well in assorted complex statistical procedures, with reliability declining as the explanatory variable set approaches N. In the current study, the number of regressors is substantially lower than the number of observations.

Verbyla (1989) indicates that 200 to 1000 cycles are preferred for the bootstrap. Computer limitations restricted the actual number of cycles executed in the bootstrap procedure to 150. While a complete expression of the distribution of statistical results may suffer, the basic structure of the distribution should result from 150 cycles.

Table 15 provides the average coefficients and standard errors for the final model (with DAV4) for the pooled sample. The average values of coefficients and standard errors indicate that repeated resampling reveals significance in all regressors (.10 significance level). While an argument can be made that resampling through bootstrapping indicates that a strong positive relationship between sales prices and DAV4, it is difficult to infer any specific economic effect. The estimated value of DAV4, in this case $1,883 (from equation 4.1), can only be interpretted as a significant effect on sales prices, incorporating the specific effect of formal Designation.

Figures 13a and 13b reveal the distribution of coefficients and t-statistics for DAV4 from the linear bootstrap procedure. In Figure 13a, the distribution of the estimated DAV4 coefficient is centered about the mean value ($1,883), and indicates a normal distribution. The semi-log independent specification showed similar relationships, but is not provided. Also not provided (due to the a priori expectations for capitalization of river protection impacts discussed above) are the bootstrap results for DAV1. The average coefficient estimate and t-stat for DAV1 were $9,744 and 3.12, respectively.

Table 15. Average Values of Bootstrap Procedure with Final Variable Set and DAV4 (additive lag river protection value).

Characteristic Category	(1) Variable	(2) Linear
	Constant	22848.5 (2664.1)
Time	MO	-115.6 (22.5)
Structural	AGE	-689.7 (329.4)
	AGE^2	23.8 (12.0)
	MHD	-16274 (1887.9)
	TOTSF	19.81 (1.75)
	STRUCT	1276.5 (714.9)
	BATH	11403 (1599.1)
Ownership	LOCAL	-3737.7 (1035.8)
Neighborhood	PVD	4871.9 (1367.5)
Location	RIV	14828.5 (989.4)
	DMB	-375.4 (99.0)
River Protection	DAV4	1883.3 (561.1)
N........................ (Standard Errors in Parentheses)		799

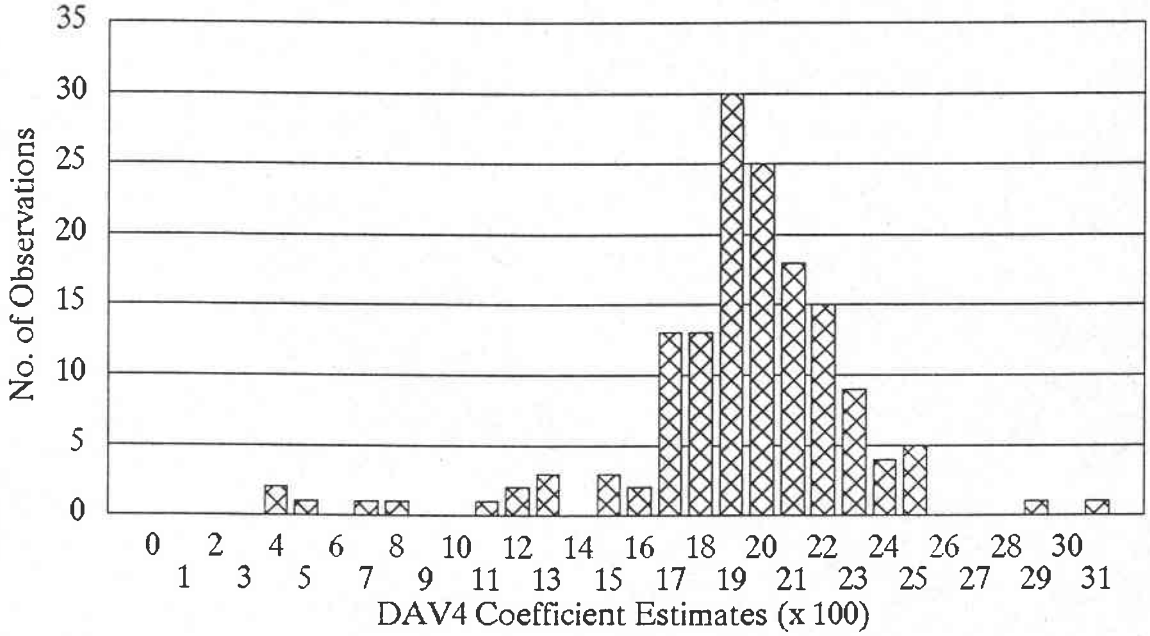

Figure 13a. Distribution of the coefficient for DAV4 from the bootstrap procedure. Bootstrap executed with 150 cycles and thirteen regressors.

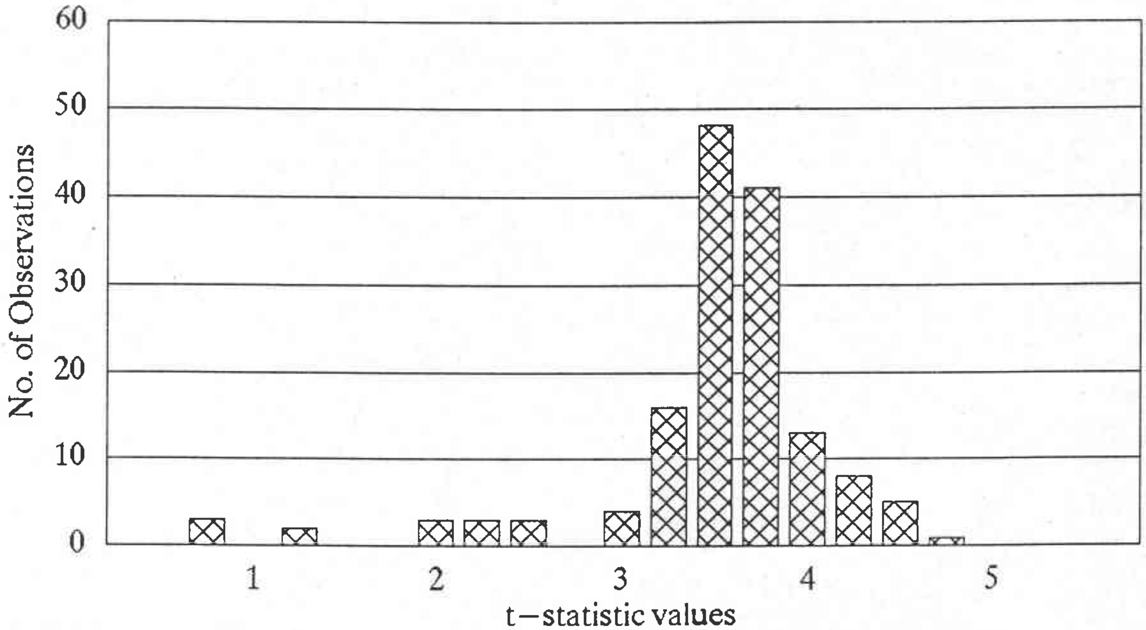

Figure 13b. Distribution of t-statistics for DAV4 (additive lag specification for river protection of the Upper Deschutes River. Bootstrapping is executed with 150 cycles and thirteen regressors on sales price (N=799)

The inference drawn from the bootstrapping procedure is that the verification subsample results provide no substantive information regarding the magnitude of effects resulting from river protection. However, resampling through the bootstrap procedure contradicts this result. While an individual random subsample of sales prices drawn from the set of mainstem and control river observations may be uncorrelated with DAV4, repeated resampling suggest that this is the exception. One further analysis is conducted using the bootstrap procedure, to address the heteroskedasticity issue.

Mainstem Sample Analysis

A number of questions still remain concerning how river protection is specifically capitalized into the Upper Deschutes River corridor housing market. First, the maximum width of the Designated corridor for the state and federal programs is one-quarter mile and 320 acres per mile, respectively. As discussed above, however, the official designated corridor may be substantially narrower, depending on topography, residential densities, or agency planning goals. For example, during the public involvement stage in the Upper Deschutes River planning process, the Deschutes National Forest, Bend District office contacted only those property owners with title to riverside property (and whose property is adjacent to public commons areas) (Doyle, 1990 and Deschutes County Assessors office communication, 1990).

Further, the range of priorities for different characteristics associated with river corridor property ownerships vary, and may be significantly different between riverside and set-back properties. For some sites, it is likely that the river (access, visibility, recreation, etc.) is expressed as the primary draw for the final purchase decision; in others the view, solitude, or wilderness proximity may be expressed as most important. The following analysis assumes that river protection affects river-adjacent property sales prices only.

Figures 14a and 14b are an extension of the analysis in Chapter Four regarding the relationship between DAV4 and sales prices. Here, DAV4 is compared with the sales price ratio of riverside (including commons-adjacent properties) and set-back average sales prices. There is a substantial improvement in the relationship when riverside properties are compared with non-riverside sites, and DAV4. This led to the following additional bootstrap analysis.

Bootstrapping the Mainstem Sample

Given the problems resulting from the possible presence of heteroskedasticity between the study and control rivers, and the large sample size (N=597) of the former, control observations are omitted to further study of the significance of the model developed and tested above. Here, DAV1 and DAV4 are associated with solely the river-adjacent properties

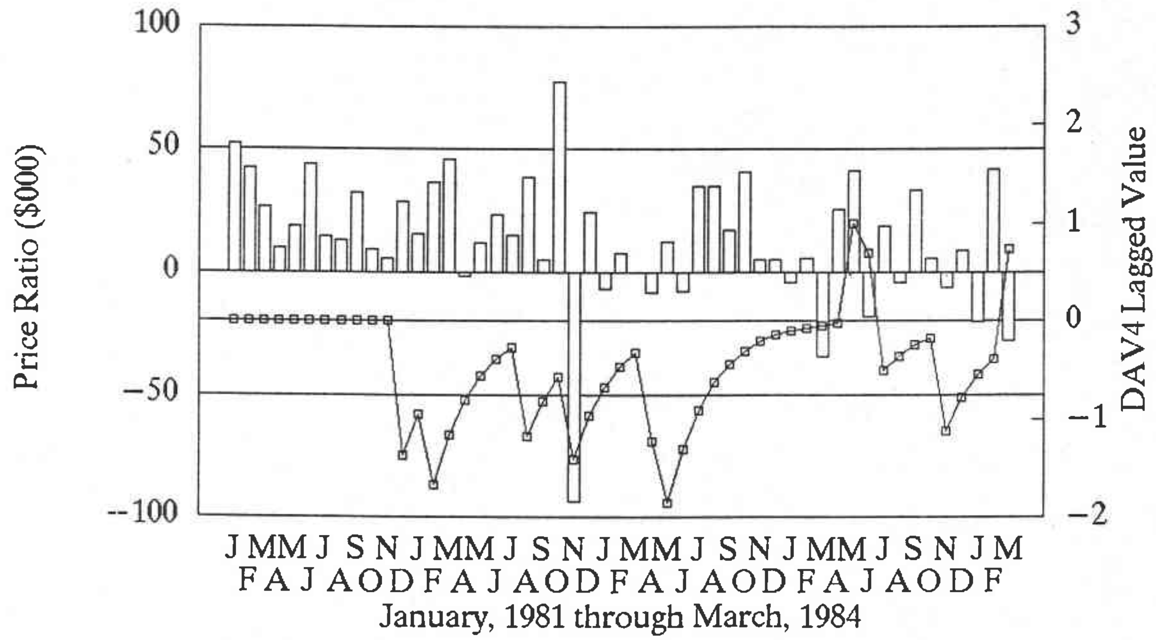

Figure 14a. First Half of Study Period Relationship between Sales Price Ratio (columns) and lagged DAV4.

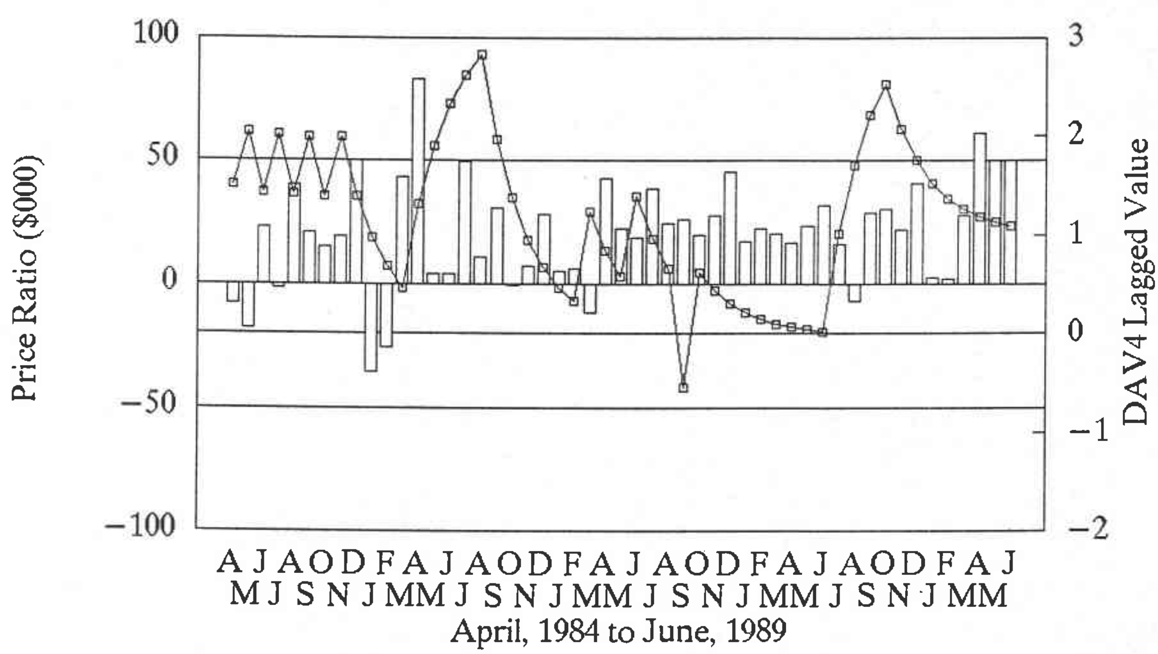

Figure 14b. Second Half of Study Period. Sales Price Ratio (columns) between Riverside and Set-back properties on the Upper Deschutes river and lagged DAV4. DAV4 is an additive lagged decay function modelling Designation Events.

(including those properties adjacent to riverside public commons land) along the Upper Deschutes River only. The identical variable set developed in the specification stage is used. In the log-log, semi-log independent and dependent, and linear forms, DAV1 and DAV4 both exhibited positive correlations (.10 significance level) with sales prices, and are relatively stable among transformations (Tables 16 and 17).

Bootstrapping the mainstem data set (linear form) with this model and DAV4 was executed to further examine the robustness of the parameter estimates. Table 18 lists the average coefficients and standard errors for all regressors with DAV4. Repeatedly resampling the mainstem subsample through bootstrapping reveals a consistently strong relationship between DAV4 and SLSPR. Figures 16a and 16b exhibit the distribution of estimated coefficients and t-statistics for DAV4.

Extrapolating from these data, the average implied price of DAV4 is $1,628, a change of $174 from the implied price of $1,454 for the traditional OLS analysis on the basic mainstem data set. A comparison of the regression and bootstrapping results is provided for DAV1 and DAV4 in Tables 19 and 20, column 2. The estimated (and mean) parameter values are consistent within each of the two stages of analysis. For DAV1, the pooled regression and bootstrap results differ by

Table 16. Regression results of Mainstem Upper Deschutes River and DAV1

CHAR GROUP	(1) VARIABLE	(2) Linear	(3) Log-Ind.	(4) Log-Dep.	(5) Log-Log
STRUCTURAL	Constant	19184 (5.7)	40035 (4.03)	9.16 (75.9)	9.334 (26.15)
	MO	-54.823 (-2.79)	-1744.2 (-2.79)	-.0036 (-5.13)	-.106 (-4.72)
	AGE	-578.6 (-1.41)	-581.2 (-1.42)	.0431 (2.93)	.0421 (2.855)
	AGE^2	13.625 (.88)	13.58 (.882)	-.00182 (-3.29)	-.0018 (-3.253)
	MHD	-18385 (-6.4)	-18556 (-6.45)	-.2511 (-2.435)	-.2663 (-2.577)
	TOTSF	17.64 (8.6)	17.6 (8.59)	.00027 (3.704)	.00027 (3.598)
	STRUCT	1666.6 (1.76)	1672.9 (1.76)	.0941 (2.77)	.0947 (2.776)
	BATH	10474 (5.27)	10542 (5.3)	.3328 (4.97)	.343 (4.81)
PROX	RIV	16001 (12.9)	16143 (13.05)	.8391 (18.89)	.8417 (18.94)
SERV	PVD	9883.3 (5.42)	9505.6 (5.41)	.265 (4.061)	.2728 (4.32)
RES.	LOCAL	-3189.1 (-2.498)	-3221.8 (-2.53)	-.04813 (-1.05)	-.0542 (-1.18)
LOCA-TION	DMB	-374.5 (-2.76)	-8338.2 (-2.665)	.0016 (.33)	.0193 (.17)
DAV	DAV1	9647.2 (3.57)	8708.6 (3.33)	.2592 (2.675)	.1917 (2.039)
	R^2 F-stat N (t-stats)	.70 135.6 682	.703 135.4 682	.681 122 682	.679 120.9 682

Table 17. Regression results of Mainstem Upper Deschutes River and DAV4

CHAR GROUP	(1) VARIABLE	(2) Linear	(3) Log-Ind.	(4) Log-Dep.	(5) Log-Log
STRUCTURAL	Constant	19097 (4.832)	44357 (3.73)	9.1965 (67.396)	9.656 (23.46)
	MO	-41.81 (-1.6)	-2462.1 (-1.99)	-.003699 (-4.11)	-.173 (-4.04)
	AGE	-818.4 (-1.83)	-803.4 (-1.8)	.04103 (2.657)	.0407 (2.63)
	AGE^2	19.53 (1.17)	19.3 (1.16)	-.00177 (-3.09)	-.00176 (-3.06)
	MHD	-18574 (-5.92)	-18533 (-5.92)	-.256 (-2.73)	-.2633 (-2.43)
	TOTSF	17.93 (8.114)	17.95 (8.15)	.0002796 (3.6664)	.00027 (3.56)
	STRUCT	1727.6 (1.68)	1748.7 (1.7)	.0972 (2.733)	.0986 (2.77)
	BATH	10816 (4.92)	10747 (4.91)	.3255 (4.293)	.3338 (4.41)
PROX	RIV	16198 (11.2)	16282 (11.3)	.8071 (16.155)	.8078 (16.22)
SERV	PVD	10524 (5.39)	10168 (5.33)	.2763 (4.0595)	.2827 (4.286)
RES.	LOCAL	-3304.8 (-2.31)	-3170.1 (-2.22)	-.05195 (-1.052)	-.0517 (-1.05)
LOCATION	DMB	-395.61 (-2.63)	-8757.5 (-2.52)	.000653 (.126)	.00372 (.03)
DAV	DAV4	1454.3 (1.65)	1609.2 (1.81)	.07069 (2.3179)	.07178 (2.34)
	R^2 F-stat N (t-stats)	.69 113.1 597	.69 113.3 597	.68 106.3 597	.68 106.2 597

less than $200. DAV4 estimates in the pooled sample range from $1,709 to $1,883.

Similar values also held for the mainstem analysis, where for DAV1 the OLS and bootstrap estimates are $9744 and $9647, respectively. DAV4 ranges from $1454 to $1628 for the same analyses.

Table 18. Average Values of Bootstrap Procedure with Final Variable Set and DAV4 on Upper Deschutes River only (in the linear form).

Characteristic Category	(1) Variable	(2) Statistics
`	Constant	23361.6 (3903.4)
Time	MO	-47.17 (25.43)
Structural	AGE	-1248.8 (443.6)
	AGE^2	30.8 (16.2)
	MHD	-14277.6 (3146.9)
	TOTSF	17.3 (2.1)
	STRUCT	3006.3 (999.3)
	BATH	9854.5 (2090.3)
Ownership	LOCAL	-4165.12 (1398.4)
Neighborhood	PVD	12218.9 (2037.6)
Location	RIV	14662 (1416.0)
	DMB	-543.8 (148.6)
River Protection	DAV4	1628.6 (883.1)
N........................ (Standard Errors in Parentheses)		597

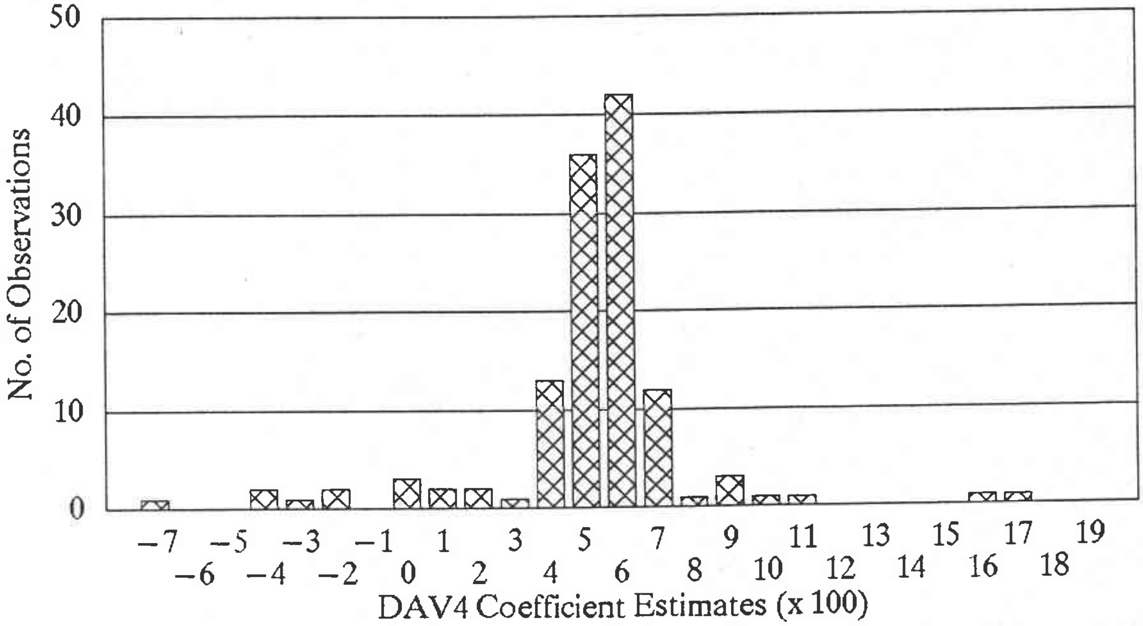

Figure 15a. Distribution of the coefficient for DAV4 from the bootstrap procedure on the Mainstem only.

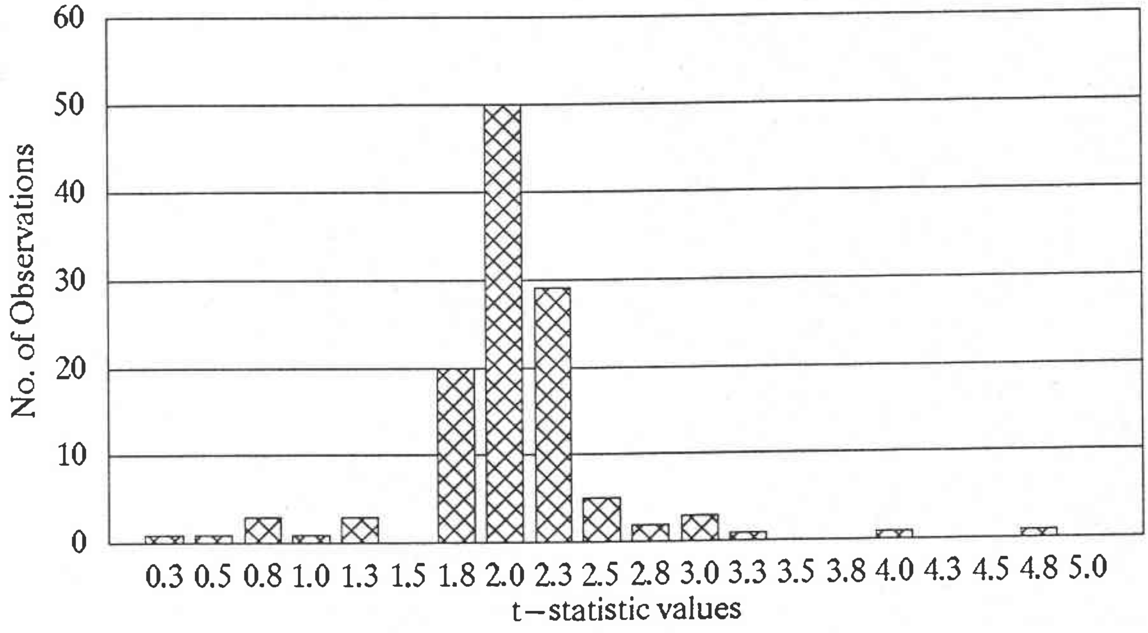

Figure 15b. Distribution of t-statistics for DAV4 (additive lag specification for river protection on the Upper Deschutes River only. Bootstrapping is executed with 125 cycles and thirteen regressors on sales price (N=597).

CHAPTER SIX

RESEARCH SUMMARY

Hedonic Implicit Pricing analysis has been applied to the Upper Deschutes River, Fall River and Little Deschutes River rural residential housing markets. Developing an Hedonic Pricing model for these markets was preliminary to the primary objective of studying the effect of river protection policies on the Upper Deschutes River housing market. The model developed has been examined through a series of validation techniques for two reasons. First, the obvious requirements for proper model specification in econometric studies demands analysis of all potential problems.

More specific to this study, however, is the unprecedented variable specification for river protection with Hedonic Pricing analysis. Estimating the economic impact of these policies to local markets requires a comprehensive understanding of the market under study. The Upper Deschutes River benefits from a broad range of management policies protecting this unique resource, and affecting the adjacent private ownerships. We have attempted to include these socio-economic issues in the formal specification of the river protection variable.

As modelled, the perceived value of these policies is significant in the river corridor purchase decision. A valuable characteristic of the housing market, the aggregate impact of protecting the Upper Deschutes river may be substantial. While combined as a single effect, formal implementation of Federal Wild and Scenic River and Oregon Scenic Waterways is statistically significant in the purchase decision. The estimated range of price impacts per property resulting from formal Designation is $6,153 to $9,744. The 0/1 specification indicates a substantial economic impact, and is easily interpretted.

Additionally, the actions preceding Designation are expressed as a positive impact on property sales prices. Combining and modelling these management actions into a single variable (DAV4) resulted in estimates ranging from $1,452 to $1,883 per river corridor property, depending on the river corridor width definition. Tables 19 and 20 summarize the results of the analyses for DAV1 and DAV4.

The practical inference from the DAV4 estimates is imprecise. While DAV4 is significant and stable in most functional forms, it is a substantial jump to defend the position that nearly $2,000 per property in benefits are affected on the Upper Deschutes River housing market. An increase of one unit in DAV4 is inferred from this analysis to result in approximately a $2,000 increase in sales price. But an increase of one unit in DAV4 is a result of a combination of factors preceding this unit increase (with the single

Table 19. Regression and Bootstrap Results for DAV1. All result from linear analyses. Aggregate values based on the total number of river-adjacent ownerships (671).

Analysis	(2) Implied Price
Specification Subsample DAV1 Applies to all mainstem properties (N = 448)	$6153
Verification Subsample. DAV1 Applies to all mainstem properties (N = 455)	Insignificant
Pooled Sample Bootstrap (N = 799) 150 Cycles in Bootstrap Procedure.	$6025
Mainstem OLS. DAV1 Applies to all riverside properties (N=682).	$9744
Mainstem Bootstrap (N = 682) 125 Cycles in Bootstrap Procedure.	$9647

Table 20. Regression and Bootstrap Results for DAV4. All results from linear analyses. Aggregate values based on the total number of river adjacent ownerships (671).

Analysis	(2) Implied Price
Specification Subsample. DAV1 Applies to all mainstem properties (N = 448).	$1709
Verification Subsample. DAV1 Applies to all mainstem properties (N = 455).	Insignificant
Pooled Sample Bootstrap (N = 799). 150 Cycles in Bootstrap Procedure.	$1883
Mainstem OLS. DAV1 Applies to all riverside properties (N=597).	$1452
Mainstem Bootstrap (N = 597) 125 Cycles in Bootstrap Procedure.	$1628

exception of the periods in which a unit increase resulted from formal Designation).

This distribution of the affect of riverprotection across a number of periods suggests that, for periods prior to formal Designation, the publicity and Designation Actions leading up to legislative action may each affect sales prices to some extent. Readers are cautioned to use care in extrapolating the coefficient estimates to single periods; all relevent periods influencing the periodic value must be considered. Nevertheless, it is with a high degree of confidence that the economic impact of river protection has a substantial and significant effect which increases the utility derived by housing "consumers".

The potential for applying Hedonic Pricing to other river management policies and other locations has, we hope, been encouraged. The technique has provided a means of addressing a host of questions unique to the Upper Deschutes River housing market. Different relationships on other rivers willcertainly exist, and no inferences to a universal impact resulting from Designation specifically, or river protection policies in general, are made. The Upper Deschutes River is a unique resource, and the composition of the significant housing characteristics specific to this river.

Natural resource management policy requires public involvement. Critically, land owners of riverside land are concerned with limitations of property rights and changes in their land values that may result from these management policies. This analysis may add to the available data with which managers can respond to the concerns of Upper Deschutes River ownerships. The implications of this research may benefit the current planning process for the recently expanded federal and state Designation systems.

Further development and study of the model and its limitations will improve the inferences that may be made. It is important to acknowledge that the study period encompasses a short time frame following formal Designation. Additional years' data will undoubtedly enhance the research. There are unanswered questions particularly regarding autocorrelation. Transformation via generalized least squares should improve the arguments offered here.

Nonetheless, application of Hedonic Implicit Pricing to the Upper Deschutes River housing market has a unique potential in environmental issues related to management policies. Finally, the opportunities for understanding the impacts of these resource management policies as they relate to society may increase our ability to defend and protect the valuable natural resources that increase our welfare and improve our standard of living.

BIBLIOGRAPHY

Atkinson, S. and T.D. Crocker. "A Bayesian Approach to Assessing the Robustness of Hedonic Property Values Studies". Journal of Applied Econometrics. 2(1987): 27-45.

Anderson, Robert J. and Thomas D. Crocker. "Air Pollution and Residential Property Values." Urban Studies, 8/3(1971): 171-180.

Atkinson, S.E. and Thomas D. Crocker. "A Bayesian Approach to Assessing the Robustness of Hedonic Property Value Studies." Journal of Applied Econometrics, 2(1987): 27-45.

Bartik, T. J. "Measuring the Benefits of Amenity Improvements in Hedonic Price Models." Land Economics, 64/2(1988): 135-147.

Bartik, Timothy J. "The Estimation of Demand Parameters in Hedonic Models". Journal of Political Economy, 95/1(1987): 692-697.

Bend Bulletin. The Deschutes: Lifeblood of Central Oregon. Edited by Bob Welch. Supplement to the Bend Bulletin, April 10, 1983. Pp 123.

Binder, John J. "On the Use of the Multivariate Regression Model in Event Studies." Journal of Accounting Research. 23/1(1985): 370-383.

Black, Peter E. Conservation of Water and Related Land Resources. Rowman and Littlefield, pubs. Totowa, NJ, 1987. Pp. 336.

Blair, Roger D., et al. "Motor Carrier Deregulation: The Florida Experiment." Review of Economics and Statistics, (2/1986): 159-164.

Bohm, Peter. "Estimating Willingness to Pay: Why and How?" Scandinavian Journal of Economics, (1979): 142- 154.

Brown, T., Gardner, M. and Henry O. Pollakowski. "Economic Value of Shoreline." Review of Economics and Statistics, 59/3(1977).

Brown, J. N. and Harvey S. Rosen. " On the Estimation of Structural Hedonic Price Models". Econometrica, 50/3(May, 1982): 765-769.

Campbell, Kevin. Telephone Interview with Mr. Campbell, landowner and active river user on the John Day River, Oregon. Monument, Oregon, 1988.

Chicoine, D. L. "Farmland Values at the Urban Fringe: An Analysis of Sales Prices." Land Economics, 57/3(8/1981): 353-363.

Cobb, Steven A. "Site Rent, Air Quality, and the Demand for Amenities." Journal of Environmental Economics Management. 4/3(1977): 214-218.

Cochrane, D. and G. H. Orcutt. "Application of Least Squares Regressions to Relationships Containing Autocorrelated Error Terms." Journal of the American Statistical Association, 44(1949): 32-61.

Conklin, Wm. Telephone Interview, Dec. 14, 1989. United State Department of Agriculture, Siskiyou National Forest, Grants Pass, Oregon. (1989).

Coyle, Kevin J. The American Rivers Guide to Wild and Scenic River Designation: A Primer on National River Conservation. American Rivers, Inc. Washington, D.C., 1988.

Coughlin, R.E. Telephone Interview. Coughlin and Keene Associates principal. December 14, 1989.

Coughlin, R.E. and J.C. Keene. "Effects on the Land Market of the River Management Plan for the Upper Delaware National Scenic and Recreational River." Report to the U.S. National Park Service. Coughlin, Keene and Associates. Philadelphia, PA, 1985.

Creel, Michael D. and John B. Loomis. "Theoretical and Empirical Advantages of Truncated Count Data Esimators for Analysis of Deer Hunting in California." In: Benefits and Costs in Natural Resources Planning; Interim Report No. 2. Western Regional Research Project W-133. Pp. 11-25, July, 1989.

Dana, Samuel T. and Sally K Fairfax. Forest and Range Policy - its Development in the United States. McGraw-Hill Co., New York, 1980.

Deschutes County and the City of Bend, Oregon. Deschutes River Study. Published by Deschutes County and the City of Bend, Oregon, 1986.

Deschutes County. Zoning Ordinances Publication No. PL-15. Deschutes County Offices, Bend, Oregon (nd., post 1987).

Deschutes County Assessor. Sales Ratio Study. Tax Roll Years 1980-1989. Bend, Oregon, 1989.

----- Telephone conversation with Pat Fabian. Employee, Deschutes County Assessor's Office. September, 1990.

Dilworth, J.R. Land Use Planning and Zoning. Seminar held at OSU, College of Forestry. Proceedings from a Short Course for Foresters, February 6-7, 1969. OSU Press, Corvallis, Oregon, 1971.

Downing, Paul B. "Factors Affecting Commercial Land Values: An Empirical Study of Milwaukee, Wisconsin." Land Economics, (February, (1973).

Doyle, D. Personal Interview with Mr. Doyle, River Planner for the Deschutes National Forest, Bend District. Bend, Oregon, Fall, 1989.

Durbin, J. and G.S. Watson. "Testing for Serial Correlation in Least Squares Regression." Biometrica, 38(1951): 159-177.

Dwyer, J.F., J.R. Kelly and M.D. Bowes. Improved Procedures for Valuation of the Contribution of Recreation to National Economic Development. Water Resources Center, University of Illinois (Urbana/Champaign). Research Report No. 128 (1977).

Dyckman, T.D. Philbrick, and J. Stephan. "A Comparison of Event Study Methodologies Using Daily Stock Returns: A Simulation Approach." Journal of Accounting Research. 22(1985): 1-30.

Epp, D.J. "The Effect of Public Land Acquisition for Outdoor Recreation on the Real Estate Tax Base." Journal of Leisure Research, 3/1(1971): 17-27.

Epp, D.J. and K.S. Al Ani. "The Effect of Water Quality on Rural Non-farm Residential Property Values." American Journal of Agricultural Economics, 61/3(8/1979): 529-539.

Efron, Bradley. "Bootstrap Methods: Another Look at the Jackknife." Annals of Statistics. 7(1979): 1-26.

Efron, Bradley. "Estimating the Error Rate of a Prediction Rule: Improvement on Cross-Validation." Journal of the American Statistical Association, 78/382(June,1983): 316-331.

Faustmann, M. "On the Determination of the Value Which Forest Land and Immature Stands Pose for Forestry." in M. Gane, ed. (1968). Martin Faustmann and the Evolution of Discounted Cash Flow. Oxford, Oxford Institute Paper No. 42 (1849).

Freedman, David A. and Stephen C. Peters. "Bootstrapping an Econometric Model: Some Empirical Results." Journal of Business and Economic Statistics, 2/2(April, 1984): 150-158.

-------. "Bootstrapping a Regression Equation: Some Empirical Results." Journal of the American Statistical Association. 79/385(1984): 97-105.

Freeman III, A. Myrick. "Hedonic Prices, Property Values and Measuring Environmental Benefits: A Survey of the Issues." Scandanavian Journal of Economics, (1979a):154-174.

-------. The Benefits of Environmental Improvement, Theory and Practice. Johns Hopkins University Press, Baltimore, MD 1979b, 272 P.

Garn, Herbert S. "Quantification of Instream Flow Needs of a Wild and Scenic river for Water Rights Litigation." Water Resources Bulletin of the American Water Resources Association, 22/5(1986).

Graves, P., et al. "The Robustness of Hedonic Price Estimation: Urban Air Quality." Land Economics, 64/3 (1988):220-233.

Griliches, Zvi ed. Price Indexes and Quality Changes: Studies in New Methods of Measurement. Harvard University Press, Cambridge, Massachusetts, 1971. Pp. 285.

Groll, B. J. Oregon Comprehensive Land Use Planning. Thesis at the Atkinson Graduate School of Management, Willamette University Press, Salem, Oregon (1982).

Guenther, William C. Analysis of Variance. Prentic-Hall, Inc., Englewood Cliffs, N.J., 1964. Pp. 18-22.

Halpern, Paul. "Corporate Acquisitions: A Theory of Special Cases? A Review of Event Studies Applied to Acquisitions." The Journal of Finance. 38/2(1983): 297-317.

Harrison Jr., D. and Daniel L. Rubinfeld. "Hedonic Housing Prices and the Demand for Clean Air." Journal of Environmental Economics and Management. 5(1978): 81-102.

Hawkins, Richard H. "Acoustical Energy Output from Mountain Stream Channels." Journal of the Hydraulics Division, ASCE Proceedings. 101/HY3(1975): 571-575.

Haveman, Robert H. Water Resource Investment and the Public Interest. Vanderbilt University Press, 1965.

Herbst, John R. A Methodology Study to Develop Evaluation Criteria for Wild and Scenic Rivers. Report of Forest Subproject. Water Resources Research Institute, University of Idaho, Moscow, ID (1972).

Hewlitt-Packard. Digitizer Program for Distance and Area Calculations. 1982.

Hildreth, G. and J.Y. Lu. "Demand Relations with Autocorrelated Disturbances." Bulletin No. 276, Michigan State University Agricultural Experiment Station. (1960).

Hoel, P. G. Introduction to Mathematical Statistics, 2nd Ed., New York: Wiley, 1955, p. 195.

Hoffman, R. C. and Keith Fletcher. America's Rivers: an Assessment of State River Conservation Programs. River Conservation Fund, Washington, D.C. (1984).

Kennedy, Peter. A Guide to Econometrics. The MIT Press, Cambridge, Mass., 1981. Pp. 171.

Ketchum, Paul. "A Citizen's Guide to Periodic Review." Landmark, (Fall, 1987): 37-47.

Ketchum, Paul. "Planning in Practice - Wallowa County." Landmark, (Spring, 1987): 22-26.

Knipe III, Wm. B. "Valuing the Probability of Rezoning." The Appraisal Journal. (Fall, 1988): 217-222.

Kriessel, W. and Alan Randall. "The Impacts of Lake Shore Erosion on Residential Property Values." In: Benefits and Costs in Natural Resources Planning; Interim Report No. 2. Western Regional Research Project W-133. (1989): 477-490.

Kusler, Jon A. "Model Riparian Habitat Protection Statute." In: Riparian Ecosystems and Their Management: Reconciling Conflicting Uses. First North American Riparian Conference, Tucson, AZ, April, 1985.

Lachenbruch, Peter A. and M. Ray Mickey. "Estimation of Error Rates in Discriminant Analysis." Technometrics, 10/1(1968): 1-13.

Leavenbach, H. and J.P. Cleary. The modern Forecaster: The Forecasting Process through Data Analysis. Wadsworth, Inc., Belmont, CA (1984).

Leftman, J. Telephone Interview. United States Department of Interior, Bureau of Land Management employee. Medford, Oregon, December 14, 1989.

Lilly, John. Personal Interview with Mr. Lilly, Director of Oregon Department of Transportation, Division of State Parks and Recreation. Salem, Oregon, May 15, 1989.

Loomis, J.B. and Richard G. Walsh. "Assessing Wildlife and Environmental Values in Cost-Benefit Analysis: Sate of the Art." Journal of Environmental Management, 22(1986):125-131.

Lord, William B. and Brad A. Paulsen. Federal Water Resources Planning: A Problem Analysis and Research Assessment. Policy Sciences Associates, Boulder, Colorado. Research Report, 80-2 (1980).

Lothrop, Robert C. "The Misplaced Role of Cost-Benefit Analysis in Columbia Basin Fishery Mitigation." Environmental Law, Vol. 16. Northwest School of Law, Lewis and Clark College Press, 1986.

McDonald, Bill. "Event Studies and Systems Methods: Some Additional Evidence." Journal of Financial and Quantitative Analysis. 22/4(1987): 495-504.

Mendelsohn, R. and George Peterson. "The Definition, Measurement, and Policy Use of Monetary Values." In: Amenity Resource Valuation, Venture Pub., State College, PA (1984): 53-64.

Mood, A. M. Introduction to the Theory of Statistics. New York: McGraw-Hill, 1950. Pp. 269-270.

Morrison, Michael L. "Influence of Sample Size on Discriminant Function Analysis of Habitat Use by Birds." Journal of Field Ornithology, 55/3(1984): 330-335.

Nellis, L. and Martin N. Maca. "The Effectiveness of Zoning for Agricultural Lands Protection; A Case Study from Cache County, UT." Landscape and Urban Planning, 13(1986) 45-54.

Nelson, Jon P. Economic Analysis of Transportation Noise Abatement. Ballinger Publishing Co., Cambridge, MA, 1978.

Oregon, State of. Property and Real Estate Taxation. State of Oregon Printing Office, Salem, Oregon. Oregon Administrative Rules, Chapters 306 and 308., Revised, 1989.

----- Oregon Scenic Waterways. Oregon Government, Salem, Oregon. Oregon Administrative Rules, Chapter 736, Division 40 (1986).

Oregon Department of Revenue. Assessor's Sales Ratio Procedures Manual. Urban-Rural Section, Assessment and Appraisal Division, Salem, Oregon. 150-303-437(1986).

Oregon Department of Transportation, Division of Parks and Recreation. Landowner's Guide to the Oregon Scenic Waterways Act. Salem Oregon, 1987.

Oregon Laws and Resolutions. House Bill 3019: Public Involvement in the Deschutes River Planning Schedule. Early, 1987.

-----. Senate Bill 945: Permit System of Recreational Use: Lower Deschutes River. Oregon Legislative Assembly, Early, 1987.

----- Senate Bill 100: Oregon's Comprehensive Land Use Practices. Oregon Legislative Assembly, 1985.

----- House Bill 2237: Ban on Hydro-electric Development on the Upper Deschutes River. Oregon Legislative Assembly, 1985.

----- Senate Bill 387: . Hydro-electric Project Fees Dedicated to ODF&W. Oregon Legislative Assembly, 1985.

----- Senate Bill 202: Commissioned Study of Lower Deschutes River Use. Oregon Legislative Assembly, 1985.

Oregon, State of. Division of State Parks and Recreation. Oregon State Scenic Waterways. A listing of the entire system, by river and classification. N.p., n.d. (post-1988).

Oregon, State of. Division of State Parks and Recreation. Recreational Values on Oregon Rivers (1987).

Oregon State Highways Division. Transcript of Scenic Waterway Hearing Held in Sweet Home, Oregon. State of Oregon Publication, Salem, Oregon, November 17, 1971.

Peters, Stephen C. and David A. Freedman. "Some Notes on the Bootstrap in Regression Problems." Journal of Business and Economic Statistics, 2/4(October, 1984): 406-409).

Raab, Johnathon D. "Wet Gold: Hydroelectric Power". Landmark, Fall, 1984, Pp. 3-11.

Radcliffe Jr., E. G. "A Theoretical Basis for Hedonic Regression: A Research Primer." AREUEA Journal, 12/1(Spring, 1984): 443-461.

Raisner, M.P. Cadillac Desert: The American West and its Disappearing Water. Viking Publishing, New York, NY. (1986): 582 P.

Ridker, Ronald G and John A. Henning. "The Determinants of Residential Property Values with Special Reference to Air Pollution." Review of Economics and Statistics, 49/2(May 1967): 246-257.

-----Economic Costs of Air Pollution: Studies in Measurement. Praeger Publishing, New York, NY, 1967.

Rohse, Mitch. Land Use Planning in Oregon, A No-Nonsense Handbook in Plain English. OSU Press, Corvallis, Oregon, 1987.

Root, Ann L. "The Wild and Scenic River Act: Problems with Implementation in Oregon." Masters Thesis, Department of Geography, OSU, (1989)

Schutjer, W.A. and M.C. Hallberg. "Impact of Water Recreational Development on Rural Property Values." American Journal of Agricultural Economics. 50/3(1968): 572-584.

Shelby, Bo and Mark Danley. Allocating River Use. USDA United State Forest Service. Publication No. R6/Rec./059. U.S. Government Printing Office, 1981.

Shonkwiler, J.S. and J. E. Reynolds. "A Note on the Use of Hedonic Price Models in the Analysis of Land Prices at the Urban Fringe." Land Economics, 62/1(2/1986): 58-63.

Schumann, P. "State Regulation of Takeovers and Shareholder Wealth: The Case of New York's 1985 Takeover Statutes." RAND Journal of Economics, 19/4(1988): 58-63.

Strong, E.J. and D. Hueth. "Estimated Recreation Benefits form the Oregon Steelhead Fishery: an Application of the Household Production Model." Department of Agricultural and Resource Economics, Oregon State University Press, 1984.

Thompson, Rex. "Conditioning the Return-Generating Process on Firm-Specific Events: A Discussion of Event Study Methods." Journal of Financial and Quantitative Analysis. 20/2(1985): 151-168.

University of Oregon. An Evaluation of the Benefits and Costs of Hydroelectric Development on the Upper Deschutes River. Community Workshop Department of Planning, Public Policy, and Management. University Publishing, Eugene, Oregon. (1985).

U.S. Congress. Federal Wild and Scenic Rivers Act. United States Congress, 90th Session. Public Law No. 90-542, October 2, 1968.

United States Department of Agriculture. Estimating Prices for Access to Opportunities for Hunting, fishing and Viewing Wildlife on Public and Private Lands. Final Report of the Natural Resources and Environmental Steering Committee on Wildlife and Fishing Access Prices. U.S. Government Printing Office, May 15, 1987.

United States Department of the Interior, National Park Service. Telephone Interview with Marjorie Thomas, Spring,1987.

U.S. Department of the Interior, Bureau of Land Management. Instream Flow Guidelines. USDI, BLM, Denver Service Center, Lakewood, CO, 1979, 57pp.

U.S. Department of Labor. Statistical Abstract of the United States, 1981-1989. Bureau of Labor Statistics, Washington, D.C. (1990).

Utter, Jack G. and John D. Schultz. A Handbook on the Wild and Scenic Rivers Act. University of Montana, School of Forestry, Missoula. 1976, Pp. 44.

Verbyla, David L. and John A. Litvaitis. "Resampling Methods for Evaluating Classification Accuracy of Wildlife Habitat Models." Environmental Management, 13/6(1989): 783-787.

Walsh, R.G., Sanders, L.D. and John B. Loomis. "Public Benefits of Wild and Scenic Rivers." Paper presented at the National Wilderness Research Conference, Fort Collins, CO, (July, 1985).

Washington State Department of Outdoor Recreation. Wild, Scenic and Recreational Rivers. A report by the Rivers Subcommittee of the Interagency Committee for Outdoor Recreation. State of Washington Publication, November, 1972.

Young, Robert A. and Robert H. Haveman. <u>Economics of Water Resources: A Survey.</u> Handbook of Natural Resource and Energy Economics, Volume II. Elsevier Science Publication, B.V., 1985.

APPENDICES

APPENDIX A

River Corridor Guidelines and Definitions

Due to the variation between maximum and official protected river corridor widths, a decision was made to universally define the set of observations within the study corridor based on physical partitions separate an individual lot from the river. The Federal Wild and Scenic Rivers Act sets the maximum corridor width at 320 acres. The Oregon Scenic Waterways Act defines a one-quarter mile half-width from each bank. Within this the administering agencies evaluate topography, population densities (and effects of altering allowable land uses), and resources described by the Acts. The final official corridor may vary from that which is visible from the river to the maximum.

Figure A.1. indicates the "effective" maximum physical limit of properties included for purposes of the present research. The first lots on the opposite side of a physical partition from the river are the maximum distance allowed. This decision is based on the premise that a partitioning from the river by roads, railways, or other easements would effectively limit the benefits received directly by the household, resulting from river protection.

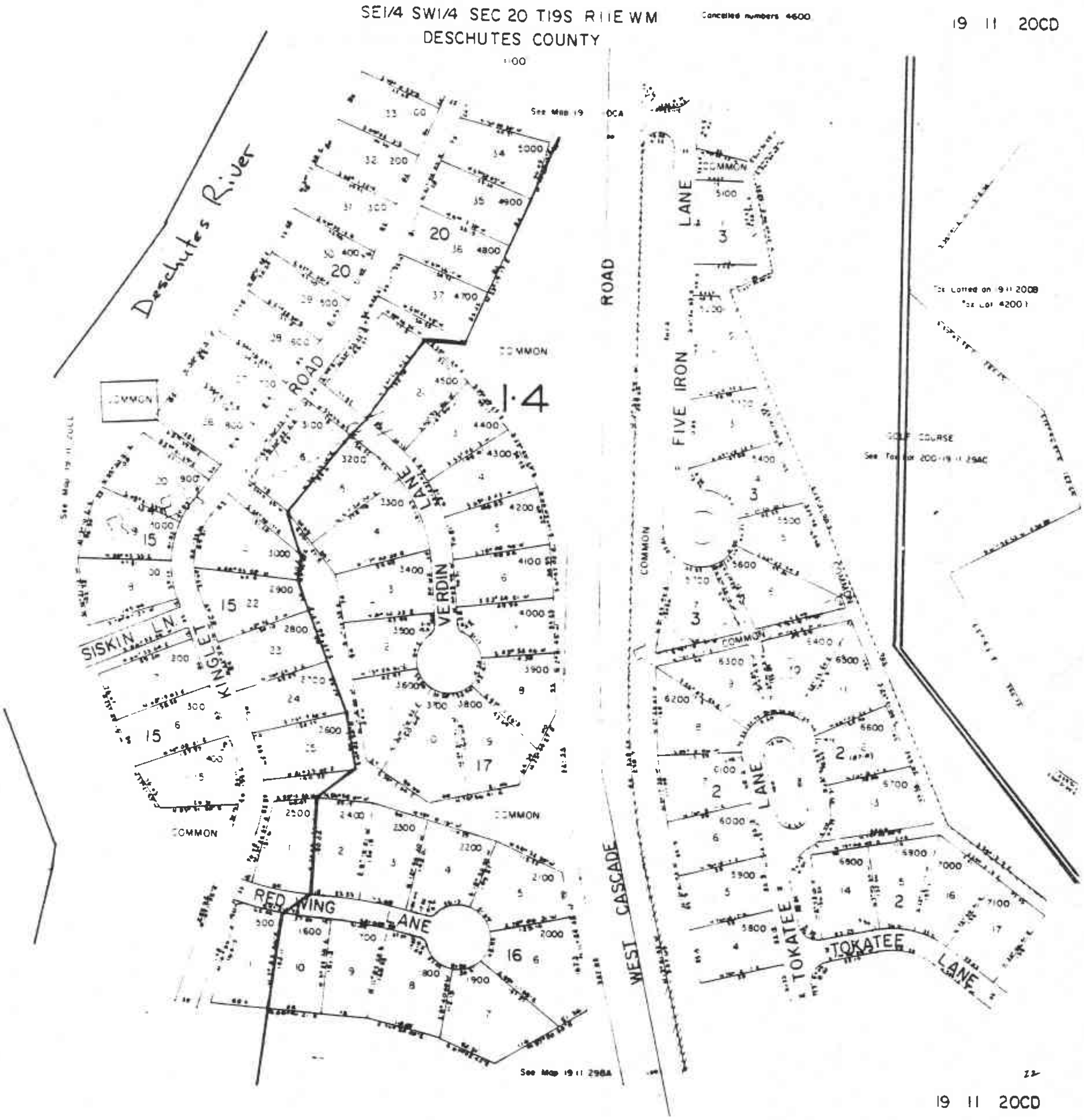

Figure A.1. River Corridor partitioning property sample selection in Hedonic Pricing of the Upper Deschutes River Residential Housing Market. Single dark line indicates effective corridor witdth used in analysis. All properties between river and effective corridor exhibiting ownership title transferall are included in the sample. Double dark lines mark actual one-quarter mile half-width from river.

Based on interviews with officials administering the Acts (Lilly, 1989 and Doyle, 1989), this corridor may in fact have been too wide. In the case of the Federal program, only those ownerships actually adjacent to the river were included in the planning process. Nonetheless, this corridor definition provides at least the opportunity to study the effect of river protection on those properties with a high access of receiving visual or access benefits from the policies.

APPENDIX B

Complete Property Characteristics List

The entire set of variables considered and property characteristics' data collected follows. These data were collected for all sites within the effective river corridor (Appendix A), provided the property experienced title transfer during the study period. This list is included to provide full definitions of all variables included in the analysis, and to underscore the opportunity available to expand this research. That is, additional characteristics' data, while unused is on file and available for future study.

Variables Included in Analysis

Dependent Variable

SLSPR - Confirmed property title transfer sales price recorded with Deschutes Count Assessor's (DCA) office.

Independent Variables

Structural Characteristics

AGE - If property exhibits a residential structure, date of construction completion is listed with DCA. Age is considered the age of this structure at the time of sale, and taken to the tenth of a year.

YEAR - all observations are recognized by their year of sale.

MHSF - title transfer of lots which included transfer of mobile home with the sale have been separately listed as mobile home square feet.

Independent Variables (cont.)

TOTSF - Total square feet, all levels (stories) of residential structure.

LEVELS - Number of stories in residential structure. Considers, main floor, basement, upper stories, and attic (greater than sleeping or storage purposes) each as a separate level.

BATH - Number of bathrooms in residential structure. Bathrooms are listed as whole numbers or the fraction (.5) for half-bathrooms.

BED - Number of bedrooms in residential structure.

GAR - Total square feet floor space of garage. Total square footage is used regardless of number of garages.

CPRT - Total square feet floor space of carport. Carport structures are interpreted by the source (DCA) as parking areas without walls.

FIRE - Number of fire places within residential structure.

OUT - Total square feet of all outbuildings, regardless of presence of residential structure.

DECK - square feet of deck areas, respectively, for all residential structures.

PRC - square feet of porch areas, respectively, for all residential structures.

PAT - square feet of patio areas, respectively, for all residential structures.

SOL - dummy variables indicating the presence of solarium.

HOT - dummy variables indicating the presence of hot tub. Hot tubs and spas have been equated.

POOL - dummy variables indicating the presence of swimming pool.

TEN - dummy variables indicating the presence of tennis court.

Land Characteristics

AREA - Area in acres (to one-hundredth of an acre). Tax lots exhibiting condominiums as a residential structure and commons as the surrounding land ownership are listed as having no land area.

RIVSID - Dummy variable indicating ownership of riverside property.

COMM - Dummy variable indicating commons property existing between private property and river.

GOLF - Dummy variable. Property adjacent to golf course.

GCOMM - Dummy variable. Possible property value effect by close proximity to golf course.

Neighborhood Characteristics

PVD - dummy variables for each tax lot regarding paved streets.

H2O - dummy variables for each tax lot regarding water (including a well, cistern or municipal supplies).

SEW - dummy variables for each tax lot regarding sewer (sand filter system, drainfield-approved, or municipal sewer system sites).

DCBD - distance to the nearest central business district. This means the applicable community for either Bend,Sunriver, or La Pine, Oregon. All tax lots have the distance to the Bend Central Business District entered as a continuous variable.

D2CBD - distance to the Bend, Oregon central business district.

DFIRE - distance to rural fire station serving each tax lot's area.

DPOL - distance from tax lot to the appropriate police station or substation.

DSCH - distance to the elementary school serving the indicated tax lot area.

DMB - distance to Mt. Bachelor ski area. Several routes are available for access. The input data is summarily the shortest road way route.

Primary Ownership Residence

(LOCAL, ORE, REC) - dummy variables indicating primary ownership. Indicate Deschutes County resident, other-Oregon and out-of-state, respectively. Determined using zip code for address registered with the Deschutes County Clerk's office for tax statement mailings.

Miscellaneous

TAX - Collected data on the property tax levy in effect at date of title transfer. Ignored in formal analysis.

MAP - All sample observations preliminarily selected based on location within one quarter mile of the study or control rivers. Selection process utilized Rectilinear Cadastral maps and all properties retain both a study "account" number and the rectilinear and tax lot number.

PROP - Deschutes County Assessor's office property classification number at the date of title transfer.

BLDG - Deschutes County Assessor's office building classification number at the date of title transfer.

ZONE - Deschutes County Planning and Development zoning classification in effect for lot at date of title transfer.

SURF - Deschutes County Assessor's office appraisal evaluation of structure surface siding at date of most recent appraisal prior to title transfer.

HEAT - Heating type for residential structure at date of sale.

POW - Dummy variable indicating presence of electrical power at date of title transfer.

APPENDIX C

Adjusting Property Sales Prices for Inflation

The index used to adjust all property title transaction's sales prices for inflation is the U.S. Department of Labor, Bureau of Labor Statistics Consumer Price Index for all West region urban housing. The rural nature of observations along the Upper Deschutes River requires explanation of the appropriateness in adjusting sales prices using an urban-based index. Substantial effort went into obtaining or developing better indices.

Attention focused on the ability to compare the behavior of adjusted sales prices for like properties for the local, state and regional housing markets. The final Hedonic Pricing model for the study river could then be statistically examined to contrast the impacts resulting from designation with the performance of sales prices for increasingly aggregated markets. However, the difficulties in acquiring the data for these adjustments proved insurmountable in an acceptable time frame.

In Oregon, there are essentially four sources of housing market data. The first and most comprehensive choice is the Oregon Department of Revenue (ODR), and subordinately the thirty-six county assessor offices. Oregon law requires annual analyses of all real estate transactions, by county within the state (OAR Chapters 306 and 308). Developing an adjustment for inflation with data would be relatively simple indices calculations, but for two problems. Ideally, the index developed could be increasingly disaggregated in property types. Riverside, developed, bare, etc. properties' sales prices are expected to exhibit different behavior responding to market changes. Segmenting the price indices into property types allows a realistic comparison base among sub-markets within the local, state and regional markets.

Unfortunately, the sole data retained by ODR for greater than five years are the department's True Cash Values. These data are inappropriate for indexing, based on the more subjective appraisal process. Within the Oregon government, the only alternative is to obtain the original sales data directly from each of the thirty-six counties; untenable give the study program time frame.

Second, to partition the data by use or type, property classes are used by the ODR and individual counties. These indicate developability, river adjacency, commercial, etc. The limitation here is that no two counties utilize a statewide property classification standard. Guidelines are currently being developed to standardize all counties (Roberts, ODR, 1990).

Another source for real estate sales information is the housing market survey industry. These data clearing-houses provide an excellent service, but are restricted to urban areas within Oregon. The objective is to obtain adjustments that, at the least <u>includes</u> the rural land market. Due to the specificity to urban markets, this data source was rejected.

Finally, U.S. Department of Labor, Bureau of Labor Statistics publishes seasonally adjusted and unadjusted consumer price indexes for a broad range of markets. The least aggregated of these for the housing market is the CPI-U (Urban markets) for the West region, Series D. This series is collected for urban areas between 75-150,000 population. A reasonable adjustment for the Deschutes county market (based on the general economic dependence on natural resource extraction and agriculture) is unusable as it was discontinued in 1986. The CPI-U, Series C (150,000 - 500,000) also was rejected due to the complete focus on large urban areas. Alternatively, the CPI-U indexes for Portland and Seattle are unusable due again to the specificity of the data sources.

This elimination process led to the final selection of the CPI-U for all West urban settings. While hardly the best possible index, we are forced to accept this adjustment for the present, and encourage the development of more appropriate indices. Further, the retention of the base sales information data by the Oregon Department of Revenue is strongly advised. Compiled accurately by individual counties, this source would be particularly useful located in the most appropriate central location: the Oregon Archives.

APPENDIX D

Deschutes County Assessor's Office Data Forms

Structural and site data in the Hedonic Pricing Analysis of the Upper Deschutes River was collected using individual tax lot data supplied by the Decshcutes County Assessor's (DCA) office. Depending on property and building classification of the individual lot, DCA tax lot packets included up to five tabular forms from the appraisal process. All study data collected for the structural and site characteristics derived from these sources. Preceded by a legend of symbols and abbreviations, each form is provided in the following pages of Appendix D.

Legend for the Deschutes County Assessor's Office Residential and Land Appraisal Forms

Description

The Residential and Land Appraisal Forms (Forms D.1. and D.2. contain the basic data used in the Hedonic Pricing analysis of the Upper Deschutes River. The following legend defines each abbreviation. The forms are completed for all tax lots within Deschutes County every six years.

Legend

APP Appraiser number.

QAD Quality Adjustment used by DCA for improvements in residential structure.

FB Factor Book.

PCLS DCA property class (see Table D.1.).

YBLT Year residential structure built.

SHP Exterior shape of residential structure.

SIZE Size of residential structure.

1) 2500 to 3000 sq. ft.
2) 3000 to 3500 sq. ft.
3) 3500 to 4000 sq. ft.
4) 4000+ sq. ft.

FND Foundation (yes or no).

RF Composition of Roof.

APL Interior appliances (ignored in this study).

BTH Bath fixtures present.

1)	Lavatory	5)	Tub
2)	Lavatory	6)	Shower
3)	W/C	7)	Jacuzzi
4)	W/C	8)	Spa

Residential and Land Appraisal Forms Legend (cont.)

HP Presence of Hot Pump.

FP Presence and type of fireplace.
1) Pre-Fab.
2) Plain Masonry
3) Elaborate Masonry
4) Free Standing
5) Elaborate Free Standing

BMT Basement (yes or no).
1) Unfinished
2) Low Cost Finish
3) Finished

BG Basement Garage.

UPS Upstairs or second floor.

ATT Attic.

CPF Appraiser's estimated cost per square foot.

DEP Depreciation estimate from last appraisal.

GA Garage Attached.

GD Garage Detached.

BG Garage Basement.

CA Carport Attached.

CD Carport Detached.

COC Concrete Flat.

WDK Wood Deck.
1) Plain
2) Plain with seats and rails
3) Plain built in to structure
4) Elaborate with seats and rails
5) Elaborate with shed roof
6) Elaborate, built in to structure

ASP Asphalt driveway.

PRC Porch (per cent of dwelling).

AC Acreage (only taken if greater than one acre).

Residential and Land Appraisal Forms Legend (cont.)

PVD Paved street to lot.

WTR Water service or well.

SWR Sewer service or drainfield.

STE Site approval for septic system (ODEQ).

H2O Irrigation water right.

Form D.1a. Deshcutes County Assessor's Residential Appraisal Form (abbreviated)

*rp

RESIDENTIAL APPRAISAL

PAGE .. OF

APP DATE / / QAD FB PCLS YR. BLT

SHP (1) SIZE 1 FND

RF

APL

BTH 1 2 3 4 5 6 7 8

HP FP 1 2 3 4 5

BMT 1 2 3 ______

BG 1 2 3 ______

UPS 1 2 3 ______

ATT 1 2 3 ______

[AREA]

OVER / UNDER BUILT (LUMP SUM)

TOTAL OF LUMP SUMS

DWELL-ING (2) ____ X ____ + ____ X ____ X ____ SUB-TOTAL A

[SQ] [CPF] [LUMP] [QAD] [DEP]

GA/GD/GB/CA/CD 1 2 3 ______ ____

[CLASS]

COC ______ ____

WDK 1 2 3 4 5 6 ______ ____

ASP ______

PRC 50 40 ______ ____

[AREA] [DEP]

OUTBUILDINGS (LUMP SUM)

TOTAL OTHER IMPROVEMENTS SUB-TOTAL B

TOTAL IMPROVEMENT VALUE (SUB-TOTAL A + B) TOTAL 1

TOTAL LAND AND SITE VALUE TOTAL 2

TOTAL PROPERTY VALUE (TOTAL 1 + TOTAL 2)

Form D.1b. Deshcutes County Assessor's Residential Appraisal Form (complete)

MAP NO. ______ **RESIDENTIAL APPRAISAL** ACCT. NO. ______

PHOTO NO. ______ CODE NO. ______ T L. NO. ______

VALUE SUMMARY

DWELLING—DEPRECIATED REPLACEMENT COST $______

GARAGE —DEPRECIATED REPLACEMENT COST $______

OTHER IMPROVEMENTS D.R.C. $______

TOTAL DEPRECIATED REPLACEMENT COST $______

OVER/UNDER IMPROVEMENT ______%

DISTRICT DEPRECIATION ______%

TOTAL ECONOMIC ADJUSTMENT ______% $______

RECORO OF LAST APPRAISAL ORS 308.234

APPR. ______ DATE ______ APPRAISED VALUE $______

APPR. ______ DATE ______ APPRAISED VALUE $______

APPR. ______ DATE ______ APPRAISED VALUE $______

BUILT 19____ COST $______ MO. RENTAL $______ SOLD 19____ AMOUNT $______ LIST PRICE $______

REMODELED 19____ COST $______ TERMS: W.D. CONT. TRADE DN. PMT $______

INT. INSPECTED: YES NO OWNER TENANT OTHER

CLASS	CURVE	STORIES		BASE FACTOR $	SQ. FT. ITEMS +	SQ. FT. ITEMS —	LUMP SUMS +	LUMP SUMS —
R1 R2	A B C D E F	1 1½ 2		SHAPE FACTOR ______%				
FOUNDATION	CONC BLK BRICK STONE FRAME WD BLK							
EXTERIOR	DBL SGL BOX SIDING: BEVEL RUSTIC VERT B&B SHAKE: WD ASB COMPO SHGL STUCCO BRICK: VEN SOLID 1 1½ 2 STY STONE CONC BLK PT FUR'D STUCCO							
ROOF	GAB HIP FLAT PITCH: LOW AVG STEEP SHINGLES: WD COMPO ALUM SHAKES: LT MED HVY BUILT-UP # RFG BAR TILE EXP BM							
1ST FLOOR	DBL SGL FIR PLY WD H WD CONC TILE CARPET RMS: LIV DIN FAM KIT UTIL HALL BATH BR DEN							
PARTITIONS	PLASTER DRYWALL COMPO CLD&PA T&G PLYWOOD TRIM: FIR H WD PANELING							
OTHER INTERIOR CONST.	CLASS: BUILT-INS: FIR H WD METAL CAB TOPS: PLASTIC LINO APPLIANCES: ELECT GAS OVEN RANGE DISHWASHER HOOD FAN DUAL: F A G							
LIGHTING	CLASS LOW VOLT INTERCOM							
PLUMBING	CLASS: / WATER ONLY — LAVATORY / TOILET / BATHTUB — STALL SHOWER / SHOWER DOOR — SINK / LAUNDRY FAC / WATER HEATER — FULL BATH / ½ BATH							
HEATING	CLASS: FURNACE: FA GRAV FL W OIL GAS HARD FUEL ELEC.: W UNITS BASEBD CL PAN CABLE: CLG FL H W.: BASEBD CONVEC RAD: FL CLG STOVE CHIMNEY TOTAL AREA HEATED ______ SQ. FT. X $______ P.S.F.							
FIREPLACE	CLASS: 1 STY 2 STY SGL BKD STKD C/R NO HEARTHS: PLAIN ELAB							
BASEMENT	NONE FULL ¾ ½ ¼ X UNFIN WALLS: CONC BLK FL: CONC WOOD CLASS: DAYLIGHT: FR ½ 1/3 ¼ CEIL: PLS DRYWALL COMPO PLYWD WALL CVR: FUR'D PLS DRYWALL COMP WD FLR CVR: ASPH TILE CORK LINO RMS: PLAY BR BATH LNDRY CAR NO RMS: HEAT: SQ. FT. X $							
ATTIC OR UPPER STORIES	CLASS: NONE ¾ ½ ¼ X UNFIN FIN: PLS DRYWALL COMP CLD&PA FLR: DBL SGL FIR H WD ASPH TILE VINYL LINO CARPET SUBFLOOR ONLY RMS: BR BATH HALL NO RMS: HEAT: SQ. FT. X $							
SPECIAL	PORCH: WD FR CONC							
RATING. PHYS COND P F A G FUNC. UTIL P F A G APPEARANCE P F A G			TOTALS	+ / —				

REMARKS:

SUMMARY OF DWELLING COMPUTATION

NET LUMP SUM ADJUSTMENT .... $______

DWELLING ______ SQ. FT. X ____ R2 UNITS = ______ SQ. FT. X $______ PSF = $______

TOTAL BASE COST .... $______

19____ COST INDEX ______% X QUALITY ADJ ______% = ______% MODIFIER X BASE COST = $______

REPLACEMENT COST .... $______

DEPRECIATION: ______% PHYSICAL X ______% FUNCTIONAL = ______% GOOD

DEPRECIATED REPLACEMENT COST (TRANSFER TO VALUE SUMMARY) $

COUNTY FORM—303-003 (A & A-A-3) (11-71) ORE. DEPT. OF REV.

Form D.2 Deshcutes County Assessor's Land Appraisal Form (complete)

PROPERTY CLASS ____________ **LAND APPRAISAL** ACCT. NO ____________

PHOTO NO ____________ CODE NO. ____________

RECORD OF APPRAISAL ORS 308 234	
SUB TOTAL A	$
INCREMENTS TO LAND B	$
GROSS LAND VALUE A + B	$
SITE ADJUSTMENTS ______%	$
TOTAL APPRAISED VALUE	$
APPR BY ____________ DATE ________ 19__	

MARKET DATA	REMARKS
PURCHASE PRICE $ ______	
DATE	
DEED ______ TYPE ______	
CONTRACT	
TRADE	
RENT	
LISTING	

ZONING	
RESIDENTIAL	
MULTI-FAMILY	
COMMERCIAL	
NEIGHBORHOOD COM'L	
LT. INDUSTRIAL	
HVY. INDUSTRIAL	
AGRICULTURAL	

AREA IMPROVEMENTS	
SIDEWALKS	
CURBS	
STREET	
WATER	
SEWERS	
ELECTRICITY	

SITE ADJUSTMENTS	%
ROAD TYPE O G P	
MI. TO ALL WTHR. RD.	
MI. TO MKT. CENTER	
TOPOGRAPHY	
VIEW	

STANDARD DEPTH	FEET
STANDARD DEPTH	
EFFECTIVE DEPTH	

COMPUTATION

DIMENSIONS OR ACRES	LAND CLASS	BASIC UNIT VALUE	ADJUSTMENT FACTORS			ADJUSTED UNIT VALUE	TOTAL VALUE
	← TOTAL ACRES		SUB TOTAL "A" (TRANSFER TO VALUE SUMMARY) →				

COMPUTER ____________ DATE ________ CHECKED ____________ DATE ________

COUNTY FORM - 303 002 (7-79)

Form D.3a. Deschutes County Assessor's Property Class Legend

Zoning/Location/Development

UNBUILDABLE

001	Unbuildable	Residential Zoning
002	Unbuildable	Commercial Zoning
003	Unbuildable	Cinder Pits
004	Unbuildable	DEQ Denial
007	Unbuildable	Multiple Housing
009	Unbuildable	With Improvements

RESIDENTIAL

110	Residential	Urban Land Only
111	Residential	Urban with Improvements
120	Residential	Suburban Land Only
121	Residential	Suburban with Improvements
130	Residential	Rural Land Only
131	Residential	Rural with Improvements
132	Residential	Rural Land with Site Only
150	Residential	River Front Land Only
151	Residential	River Front with Improvements
160	Residential	Golf Course Front Land Only
161	Residential	Golf Course Front w/Improvements
190	Residential	Zoned Open Space Land Only
191	Residential	Zoned Open Space w/Improvements

COMMERCIAL

210	Commercial	Urban Land Only
211	Commercial	Urban with Improvements
212	Commercial	Urban Improvements Only
220	Commercial	Suburban Land Only
221	Commercial	Suburban with Improvements
230	Commercial	Rural Land Only
231	Commercial	Rural with Improvements
251	Commercial	River Front with Improvements

INDUSTRIAL

310	Industrial	Urban Land Only
311	Industrial	Urban with Improvements
312	Industrial	Urban Improvements Only
320	Industrial	Suburban Land Only
321	Industrial	Suburban with Improvements
330	Industrial	Rural Land Only
331	Industrial	Rural with Improvements

Form D.3b. Deschutes County Assessor's Property Class Legend (cont.)

TRACT

410	Tract	Urban Land Only
411	Tract	Urban with Improvements
420	Tract	Suburban Land Only
421	Tract	Suburban with Improvements
430	Tract	Rural Land Only
431	Tract	Rural with Improvements
432	Tract	Rural Land with Site Only
450	Tract	River Front Land Only
451	Tract	River Front with Improvements

FARM LAND

500	Farm Land	Zoned EFU, Not Qualified, Vacant
501	Farm Land	Zoned EFU, Not Qual., Improved
532	Farm Land	Zoned EFU, Over 20 Acres, Dry
542	Farm Land	Zoned EFU, Hobby Farm
592	Farm Land	Zoned EFU, Over 20 Acres, Wet
523	Farm Land	Deferred, Commercial Zone
533	Farm Land	Deferred, Over 20 Acres, Dry
543	Farm Land	Deferred, Hobby Farm
593	Farm Land	Deferred, Over 20 Acres, Wet

FOREST LAND

620	Forest Land	Zoned F2, Land Only
621	Forest Land	Zoned F2, with Improvements
630	Forest Land	Zoned F3, Land Only
631	Forest Land	Zoned F3, with Improvements
648	Forest Land	Designated with Improvements
660	Forest Land	Designated Land Only

MULTIPLE HOUSING

710	Multiple Housing	Urban Land Only
711	Multiple Housing	Urban with Improvements
720	Multiple Housing	Suburban Land Only
721	Multiple Housing	Suburban with Improvements
730	Multiple Housing	Rural Land Only
731	Multiple Housing	Rural with Improvements
733	Multiple Housing	Time Share
741	Multiple Housing	Condominiums with Leased Land
751	Multiple Housing	River Front with Improvements
780	Multiple Housing	Planned Unit Devel., Land Only
781	Multiple Housing	Planned Unit Devel., Improved

Form D.3c. Deschutes County Assessor's Property Class Legend (cont.)

RECREATIONAL

810	Recreational	Public Golf Course Land Only
811	Recreational	Public Golf Course w/Improvement
820	Recreational	Suburban Land Only
821	Recreational	Suburban with Improvements
830	Recreational	Rural Land Only
831	Recreational	Rural with Improvements
850	Recreational	River Front Land Only
851	Recreational	River Front with Improvements
860	Recreational	Golf Course Front Land Only
861	Recreational	Golf Course Front w/Improvements
870	Recreational	Lake Front Land Only
871	Recreational	Lake Front with Improvements
872	Recreational	Lake Front USA w/Commercial Imps
881	Recreational	USA w/ Residential Improvements
882	Recreational	USA w/ Commercial Improvements

SUBDIVISION

910	Subdivision	Urban, Volumn Ownership
920	Subdivision	Suburban, Volumn Ownership
930	Subdivision	Rural, Volumn Ownership
950	Subdivision	River Front, Volumn Ownership

Form D.4. Deshcutes County Assessor's Mobile Home Appraisal Form (complete)

MOBILE HOME APPRAISAL Code_____ Acct. No. ________________ MR MP

Mobile Owner ________________ Land Owner ________________
Address ________________ Address ________________
City ________________ City ________________

Informant Owner Occupant
INSPECTED YES NO OWNER TENANT ____________ Ph ________ Date ________

Make ______ Serial No. ______ X No. ______ Year Mod. ____ Class ____
Year Purchased ______ Cost ______ Less Furn ______ Total ______
Size ____ X ____ = ____ Tip Out ____ X ____ = ____ Total ____ @ ____ = ____

ADJUSTMENT FACTORS

Wood Stove: Hearth ______ Chimney ______ = ______
Skirting: Wood ____ Metal ____ Plastic ____ Lin ft ____ @ ____ = ______
On Hitch Off ____ On Axles Off ____ On Wheels Off ____ = ______
Window Awnings .... Sq ft ____ @ ____ = ______
Porches-Decks (List on Reverse Side)
Foundations Type ______ Sq ft ____ @ ____ = ______
Roof Type: (Comp Shingle Fiberglass Metal) .... Sq ft ____ @ ____ = ______
Eaves, Length ____ Gutters, Length ____ Lin ft ____ @ ____ = ______
Appliances (built-in) ______ = ______
______ = ______
No. of Baths .... No. Bedrooms .... = ______
Hutch & Buffet ____ Wet Bar ____ = ______
Air Conditioning: Evaporative ____ Refrigerative ____ Tons ____ = ______
Other Tlr Imp (List) ______ = ______
______ = ______

VALUE SUMMARY

MOBILE HOME REPLACEMENT COST $ ______
GARAGE —DEPRECIATED REPLACEMENT COST $ ______
OTHER IMPROVEMENTS D.R.C. FROM BACK $ ______
TOTAL DEPRECIATED REPLACEMENT COST $ ______
OVER/UNDER IMPROVEMENT ____ %
DISTRICT DEPRECIATION ____ %
TOTAL ECONOMIC ADJUSTMENT ____ % $ ______

RECORD OF LAST APPRAISAL ORS 308.234

APPR: ____ DATE ____ APPRAISED VALUE $ ______
APPR: ____ DATE ____ APPRAISED VALUE $ ______
APPR: ____ DATE ____ APPRAISED VALUE $ ______
APPR: ____ DATE ____ APPRAISED VALUE $ ______
APPR: ____ DATE ____ APPRAISED VALUE $ ______
APPR: ____ DATE ____ APPRAISED VALUE $ ______

Replacement Value ______
Depreciation
Cond: F A G
____ Years Old % = ______
Cost Modifier % = ______
(TRANSFER TO VALUE SUMMARY) % = ______
$

CAT. ____ ______
CAT. ____ ______
CAT. ____ ______
CAT. ____ ______

Form D.5. Deshcutes County Assessor's Specially Assessed (Farm and Forest) Land Appraisal Form

PROPERTY CLASS ______________ **SPECIALLY ASSESSED LAND APPRAISAL** ACCT. NO. ______________

VALUE ZONE CODE NO.

REMARKS:

ACRES	LAND CLASS	19__ UNIT VALUE	19__ TOTAL VALUE	19__ UNIT VALUE	19__ TOTAL VALUE	19__ UNIT VALUE	19__ TOTAL VALUE	19__ UNIT VALUE	19__ TOTAL VALUE
TOTAL ALL ACRES									
TOTAL ACRES SPEC. ASSD.									
INCREMENTS TO LAND									
TOTAL WHEN SPECIALLY ASSESSED									

DATE OF APPR. ORS 308.345	APPR. BY	SUMMARY OF DESIGNATED FOREST LAND VALUES							
		Acres Designated		Acres Designated		Acres Designated		Acres Designated	
		True Cash Value		True Cash Value		True Cash Value		True Cash Value	
		Designated Value		Designated Value		Designated Value		Designated Value	
		Deferred Value		Deferred Value		Deferred Value		Deferred Value	

COUNTY FORM — 303.001 7-79

SP*89621-150

APPENDIX E

Complete Listing of River Management Actions Preceding Formal Designation

Introduction

The following abbreviated list describes the entire set of river management actions effecting the Upper Deschutes River between January 1, 1981 and June 1, 1989. While all actions are not members of the set of Designation Activities or Events used in the Hedonic analysis, the list provides a comprehensive chronology of the river management issues discussed prior to formal Designation of the Upper Deschutes River. Categories of management actions are used to distinguish by participants.

SCENIC WATERWAYS

<u>March 13, 1985</u> - Coalition for the Deschutes initiates membership drive with 10,000 mailers.

<u>May, 1985</u> - Oregon legislature passes HB 2237. Directs ODPR to study Upper Deschutes river as a potential designee.

<u>Nov. 22, 1985</u> - ODPR and NPS study results suggest designation of three segments of Upper Deschutes River.

<u>June 4, 1986</u> - Oregon Rivers Initiative begun with "Rendezvous" in Bend, Oregon

<u>Aug. 19, 1986</u> - Recommendations for Designation submitted by ODPR to Oregon legislature for consideration.

<u>Aug. 26, 1986</u> - Increasing attention in local media regarding Designation issues.

Scenic Waterway Management Actions (cont.)

Oct. 10, 1988 - Oregon Rivers Omnibus Bill passes.

Nov. 6, 1988 - Oregon Rivers Initiative (Ballot Measure 7) successful.

CITY AND COUNTY ISSUES

Dec. 14, 1983 - County Commissioners request formation of task force to develop basin plans.

Dec. 20, 1984 - Riverside Parkway Plan considered by County.

May/June, 1985 - Deschutes River Task Force holds seven public workshops on river planning.

May 20, 1985 - Deschutes county residents survey of river attitudes distributed.

July 24, 1985 - Further consideration of Parkway plan by DRTF.

Aug. 1, 1985 - Preliminary ranking of Deschutes River Study released.

Mar/May, 1986 - Release of Deschutes River Study.

June, 1986 - Public hearings on Deschutes River Study.

June 27, 1986 - Rimrock set-backs for future development rejected by city; accepted yb county.

July 1, 1986 - Deschutes River Study accepted.

STATE LEGISLATURE

May 11, 1984 - Rep. Tom Throop urges action against proposed hydro-electric projects.

Nov. 30, 1984 - FERC approval of Benham Falls hydro-project appears in Bend Bulletin.

Oregon State Legislature Actions (cont.)

April 30, 1985	-	Rep. Throop reveals intention to submit bill to restrict hydro-projects.
May 1, 1985	-	House passes HB 2239, limiting hydro projects to existing structure.
May 8, 1985	-	HB 2237 introduced, called the "No New Hydro-electric Dams on the Upper Deschutes River" bill.
June, 1985	-	Hearings on HB 2237.

RIVER MANAGEMENT

Feb. 23, 1984	-	Water Policy Review Board holds first of twelve statewide hearings on the effect of MSR's.
Aug. 15, 1984	-	Irrigation districts and river protection groups disagree on use of Minimum Streamflow Requirements.

RIVER USE STUDIES

Nov. 6, 1984	-	MSR study begins on Upper Deschutes.
April 16, 1984	-	Notes rafting on the Upper Deschutes increased from 2000 in 1978 to 21,000 in 1984.
Sept. 10, 1985	-	University of Oregon and Ragatz Associates studies released.
July 25, 1986	-	Results of OSU's Deschutes River Carrying Capacity study released.
Sept. 19, 1987	-	Designation of UDR Headwaters
Oct. 6, 1988	-	Federal Designation of UDR
Nov. 8, 1988	-	State Designation of UDR