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The "unusual" behavior of agricultural land prices is the subject of considerable debate and controversy and is the object of this research. There is little doubt that land prices have been increasing steadily since 1959 and dramatically throughout the decade of the 1970's. However, there is widespread disagreement among economists, appraisers, and other interested parties as to the causes of the dramatic increases in land prices.

Net agricultural income is undoubtedly an important factor in the agricultural land market. Yet, land prices have continued to increase in the face of steady and even declining net incomes. Other factors often considered as exerting considerable influences are inflation, pressures from an increasing population, incentives to attain economies of size through ranch enlargement, and capitalization of government farm program "payments" into land values.

The objective of this research is to identify the factors that exert significant influence on agricultural grazing land sale prices in two Eastern Oregon counties and to assess the impact of changes in these factors on the selling price of grazing land.

A single equation linear regression model is used to identify the

factors that have a significant impact on the price of grazing land. The variables determined to be postively correlated to the price of grazing land are the productivity of the land, the price of feeder cattle, inflation, and the assessed value of real property included in the land sales. The price of hay is negatively correlated with the price of grazing land.

The inclusion of public land (USFS and BLM) grazing privileges in the sale was found to have no significant effect on the price of grazing land. In addition, purchases for the purpose of ranch enlargement are occuring at lower prices than purchases for ranch establishment.

The major limitations of this study are the restrictions placed on the sales that are analyzed and the problem of standardizing a measure of land productivity. The first limitation is defensible given the stated objectives of the study and the need to limit the analysis to a roughly homogeneous class of land sales. The latter limitation prohibits generalization of the results to other areas without appropriate standardization of the measure of land productivity.

An Economic Analysis of Land Prices of Mountainous Grazing Land in Eastern Oregon

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TABLE OF CONTENTS

		Page
I.	Introduction	1
	The Problem and Its Setting	4
II.	Theoretical Considerations Relating to the Market Price of Capital Assets	7
	Present Value Approach to Capital Asset Valuation	7
	Modification of the Valuation Theory	8
III.	Application of Theoretical Considerations to Mountainous Grazing Land	11
	Price of Beef and a Measure of the Productivity of Grazing Land	11
	Other Factors Affecting the Profitability of Beef Production	13
	Other Variables	17
	Expected Capital Gains	18
IV.	Discussion of the Data and Empirical Results	21
	Brief Profile of the Data	21
	Empirical Results	22
	Discussion of Omitted Variables	27
	Grazing Rights on Public Land	27
	Discount Rate	30
	Distance Variables	30
	Size of Sale	31
V.	Summary and Conclusions	32
	Limitations of the Study	33
	Implications of the Study and Suggestions for Further Research	33

TABLE OF CONTENTS (continued)

	Page
Bibliography	35
Appendix I	39
Appendix II	43

LIST OF FIGURES

Figure		Page
1	Relationship Between Index of Real Estate Values Per Acre and Index of Net Income Per Acre, 1959-1977(U.S.). . . .	2
2	Relative Importance of Capital Gains and Realized Net Income as Percentage of Real Estate Values, 1959-1977(U.S.) .	19

LIST OF TABLES

Table		Page
1	Factors for Converting Land Classes to AUM's Per Month. . .	41
AII-1	Selected Regressions Results: Linear Functional Form . . .	46
AII-2	Selected Regressions Results: Double Log Functional Form .	47

AN ECONOMIC ANALYSIS OF LAND PRICES OF MOUNTAINOUS GRAZING LAND IN EASTERN OREGON

I. INTRODUCTION

During the time period of 1910 to the early 1950's, variations in farm real estate prices could largely be explained by fluctuations in net farm income per acre [20]. The period of the early 1950's to the early 1970's was characterized by steadily increasing real estate prices despite stable and sometimes decreasing net farm income per acre. From the early 1970's to present, land values have continued to increase steadily while net farm income per acre has fluctuated widely (see Figure 1). The unusual behavior of farm land prices in recent years has attracted the interest of various researchers and is the object of this research. The primary purpose of this research is to investigate the factors that have been important in influencing the price of mountainous grazing land in Eastern Oregon.

The fact that land prices have been rising steadily in recent years can easily be verified by studying reports addressing the topic of agricultural land prices, interviewing persons close to the land market, or examining actual transactions recorded as public record in county assessors' and recorders' offices. However, it is much more difficult to identify the factors responsible for this trend. The determinants of the price of agricultural land have received and continue to receive a great deal of study. This attention is warranted by the interest of various groups including present and prospective land owners, assessors, credit institutions, and local governments largely dependent upon real estate taxes as a base for earning revenue. These groups, as well as others, desire an understanding of the factors and forces underlying the land

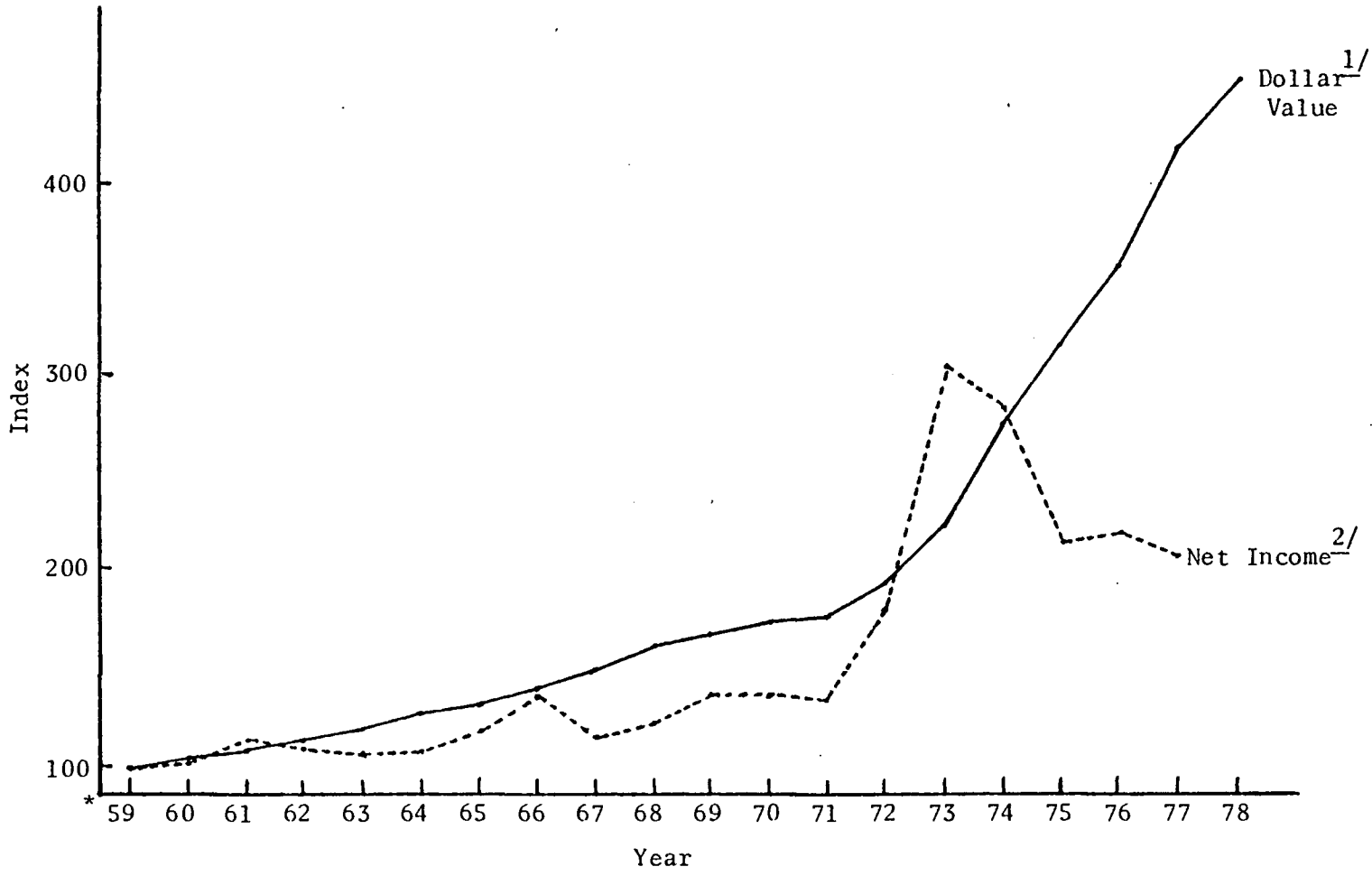

Figure 1.* Relationship Between Index of Real Estate Values Per Acre and Index of Net Income Per Acre, 1959-1977 (U.S.).

*1959 = 100

1/ SOURCE: Farm Real Estate Market Development [43]. 2/ SOURCE: Agricultural Statistics [42].

market. Land is not a homogeneous factor and the fixity aspect of land serves to effectively separate land markets. The price of land in different land markets will be affected by different factors. Barlowe [1] has emphasized the concept of land as location. This concept involves location with respect to markets, geographic features, and other resources. The concept is important because the use and value of most land is largely determined by its location and accessibility and because of the strategic importance of the location factor in modern economic affairs. For instance, two parcels of land with the same productive capacity, one located near a major metropolitan area and the other located in a sparsely populated region will likely command very different prices. The prices of different parcels will be affected by different characteristics as determined in each land market.

This research is undertaken to provide some insights into the determinants of the sale prices of mountainous grazing land in two Eastern Oregon counties. In order to separate the sales to be analyzed into transactions of a similar nature, the land types analyzed have been restricted to largely mountainous grazing land (as determined by a preponderance of Class VII land in the sale) and the size of the sale has been restricted to a minimum of 100 acres.[1] Also, only sales of land in which 100 percent of the acreage have farm use-value assessments are analyzed in this study. These restrictions are intended to minimize the influence of purchases made for the purpose of subdivision and development or for small mountain acreage retirement homesites. These latter types of

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[1]Class VII refers to the land capability rating of the Soil Conservation Service. The ratings are based on all physical features of the land. Class I is the highest rating and Class VIII is the lowest. Class VII land is primarily suited for continuous pasture, recreational use, and timber production.

land sales are influenced by factors not expected to be important in grazing land sales for agricultural production and the analysis of factors affecting their prices is outside the scope and objectives of this research. It is recognized that the restrictions placed on the types of land sales to be analyzed will limit the applicability of the research results; however, it is believed that there is enough land of similar nature to that analyzed in this study throughout Eastern Oregon and surrounding states, notably Idaho, Montana, Wyoming, Utah, Arizona, and Nevada, to warrant the narrowed focus of the study.

The Problem and Its Setting

Land prices have a direct effect on farmers' ability to begin, operate, and expand their enterprises. Several studies suggest that agricultural land prices have been increasing at rates and to levels not totally warranted by net farm income [27, 32, 38]. This opinion is lent a great deal of support by movements toward various types of farm use-value assessments in many states.[2] The farm use-value assessment assesses the qualifying farm land for tax purposes at its value in agriculture rather than at the land's market value, and farm use-value assessments are considerably below the observed sale prices of the land [25]. There has been a considerable amount of investigation into the factors responsible for the market price of land being above the capitalized value of expected future net income streams. Factors that are often cited in these investigations include expected capital gains, technological advance, farm enlargement pressures, government farm programs and pressures from in-

[2]Forty-two states, including Oregon, had adopted some form of use-value assessment as of February 1978 [25].

creasing population [4, 28, 32, 35, 46]. Scofield [36] postulates that the belief that land offers safety and protection from inflation has resulted in substantial amounts of non-farm capital being directed towards farmland markets. Also, the lower tax rate applicable to capital gains than to current income contributes to the premium that buyers in high tax brackets are willing to pay for future capital gains from anticipated increases in land prices [39]. Martin and Jeffries [27] argue that it is unrealistic to attempt to explain the price of an asset such as agricultural land on the basis of only its agricultural output. They suggest "ranch fundamentalism" and "conspicuous consumption" as additional outputs that should be considered when addressing the topic of agricultural land prices [27]. These views are supported by Chryst [3] who also emphasizes the importance of the location factor in affecting land prices. Murray [29] distinguishes between the sale value and income value of the land. The income value of land is based on expected net income streams from the land discounted at the appropriate interest rate. The sale value includes all value factors of which the expected net income stream is only one.

Individuals purchasing land are obtaining a consumptive as well as a productive good. However, it is difficult to quantify many of the factors influencing the demand for land as a consumptive good. The analysis of these factors is as much a psychological or sociological problem as an economic problem. Recognition of the existence of these influences may aid in accounting for the seeming disparity between the farm use-value of agricultural land and the market price of land.

This study is based on actual land sales that have occurred since 1970 in Umatilla and Grant counties, Oregon. These counties were selected on the basis of availability and completeness of ranch sales data through

the nine-year period of 1970-1978. The beginning year of 1970 was determined by the availability of accurate data. Umatilla and Grant counties are located in Eastern Oregon and have average annual precipitation between ten and fifteen inches. The major industries in these counties are agriculture and lumbering. The primary objective of this research is to identify the factors that have been important in influencing the sale prices of mountainous grazing land in these two Eastern Oregon counties.

II. THEORETICAL CONSIDERATIONS RELATING TO THE MARKET PRICE OF CAPITAL ASSETS

The theoretical framework for this study is a modification of the present value approach to capital asset valuation. The present value approach to capital asset valuation is modified to allow for the various unusual aspects of land as an asset or investment. Scofield [36] has commented on the strong traditional beliefs concerning the intrinsic "goodness" of owning land. These types of social beliefs and traditions have an effect on the land market so that the market value of land may not entirely be determined by its income producing capacity. Therefore, this study will attempt to incorporate factors other than those that directly affect the net income producing capacity of the land.

Present Value Approach to Capital Asset Valuation

According to the present value approach of asset valuation, the market value of a capital asset is the discounted value of the net income stream produced by the asset [10]. This relationship is expressed in equation 1.

$$V_o = \frac{A_1}{(1+r_1)} + \frac{A_2}{(1+r_2)^2} + \ldots + \frac{A_n}{(1+r_n)^n} \qquad (1)$$

where V_o is the present market value of the capital asset, A_i ($i = 1, 2, \ldots, n$) is the net income produced during time period i, and r_i ($i = 1, 2, \ldots, n$) is the relevant discount rate during time period i. If A_i and r_i are assumed to be constant through time, the formula for the present value of a capital asset reduces to equation 2 as n approaches

infinity.[3]

$$V_o = A/r \qquad (2)$$

Modification of the Valuation Theory

Application of the valuation theory to a projection of current net income levels results in "warranted" market values that have become increasingly inconsistent with observed market prices of agricultural land. Several hypotheses have been forwarded to explain the apparent disparity between warranted market values and actual market prices [20, 28, 32, 38]. Among factors often cited are pressures from increasing population and urbanization, government program payments, farm enlargement pressures to gain economies of size, technological advance, and expected capital gains. Government program payments, technological advance, and farm enlargement purchases to obtain economies of size each directly influence the net income relationship of farm land. These factors merely suggest that projecting current net income levels may not accurately reflect expected future net income streams. Appropriately adjusting the level of future expected net incomes should adequately account for the effects of these factors. The other two factors, pressure from increasing population and urbanization and expected capital gains, suggest a structural change in

[3]The derivation of equation 2 from equation 1 as n approaches infinity can be demonstrated by various methods. Perhaps the simplest derivation is through the use of what economists have termed a "Koyck transformation." Letting A_i and r_i be constants, A and r respectively, and assuming $r > 0$, multiply equation 1 by $(1+r)$ to obtain equation 1*.

$$V_o(1+r) = A + A/(1+r) + A/(1+r)^2 + \ldots + A/(1+r)^{n-1}. \qquad (1)^*$$

Subtract 1 from 1* to obtain 2*.

$$V_o(1+r) - V_o = A - A/(1+r) + A/(1+r) - \ldots - A/(1+r)^{n-1} + A/(1+r)^{n-1} - A/(1+r)^n, \text{ which reduces to}$$

$$V_o(1+r-1) = A - A/(1+r)^n \qquad (2)^*$$

Divide 2* by r to obtain 3*.

$$V_o = A/r - A/r(1+r)^n \to A/r \text{ as } n \to \infty. \qquad (3)^*$$

the land market. Expanding urbanization and population change the underlying conditions of the local land market. To a large extent, this factor may be considered as affecting the potential net income producing capacity of the land.

The opportunity cost (or highest valued alternative) of keeping the land in agricultural production is increased by expanding urbanization. This occurs because the price of land in proximity of metropolitan areas may reflect expectations of increased net income as a result of non-farm uses in the future. However, unless the present landowner undertakes the development himself, he will not experience the increased net income stream resulting from non-farm development. Thus, the increased present value as a result of the developer's anticipated future net income possibilities may be considered a windfall gain to the present owner as a consequence of being in the proximity of a metropolitan area, i.e., the present owner experiences a capital gain if he sells the land to the developer. This then leads to the final factor often suggested as an explanatory factor in regards to the apparent disparity between present net farm income levels and the market price of agricultural land, expected capital gains.

It is not an uncommon error to treat capital gains as income. If capital gains are defined as an increase in the market value of a capital asset, it is clear that capital gains are the result of changes in underlying conditions rather than the cause [8]. Unexpected capital gains are windfall gains to present owners. Furthermore, capital gains do not alter present net income streams, but <u>expected</u> capital gains are capitalized into the present market value of capital assets, thereby increasing the wealth of the owner of the capital asset. However, the capital gains

are not realized unless the asset is sold.

Past capital gains create expectations that such gains will continue. These expectations contribute to the demand for land, thus compounding the effect of expected capital gains on the market price of the asset [44].

The preceding analysis explains how expected capital gains affect the market price of an asset without directly affecting the net income producing capabilities of the asset. Therefore, some measure of expected capital gains should be included in a model explaining the market price of a capital good.

The final factor considered in this chapter is the discount rate. Changes in the discount rate may cause substantial changes in the present values of a capital asset. The discount rate may be interpreted as the opportunity cost of land investment and, therefore, affects both the supply of farmland and the demand for farmland [16]. An increase in the discount rate as a result of an increase in the rate of return on alternative investments provides incentive for non-farmer investors (landlords) to sell their land and invest in the alternative investments, leading to an increase in the quantity of land offered for sale and hence lower farmland prices [20].

An important factor shifting the demand for land is change in the present value of expected net income streams. An increase in the discount rate decreases the present value of future net income streams, ceteris paribus, implying a decrease in the demand for land. Again, the discount rate and price of land are expected to be negatively correlated as a result of the effect of changes on the discount rate on the demand for land. Due to the effects of the discount rate on both the quantity of farmland offered for sale and the demand for farmland, the discount rate is expected to be negatively correlated with the price of land.

III. APPLICATION OF THEORETICAL CONSIDERATIONS TO MOUNTAINOUS GRAZING LAND

The preceding chapter addressed the valuation of a capital asset in general. This chapter will address the specific factors hypothesized to be significant in affecting the market price of mountainous grazing land in particular. After identifying the specific factors deemed to be important in explaining the variations of mountainous grazing land prices, variables used to represent these factors in the subsequent analysis will be presented and the expected relationships between the variables and the price of mountainous grazing land will be expounded.

In the preceding chapter, it was shown that the sale price is largely determined by those factors that, directly or indirectly, affect the net income producing capacity of the asset. It is also hypothesized that expectations of future capital gains and the discount rate may affect the present sale price of an asset. It is the purpose of this chapter to identify the specific factors felt to influence the net income producing capacity of mountainous grazing land and to suggest appropriate observable variables to represent these factors as well as to suggest a variable hypothesized to be an appropriate measure of the expectations of future capital gains for mountainous grazing land.

Price of Beef and a Measure of the Productivity of Grazing Land

The major output of mountainous grazing land is beef. The net income potential of an acre of mountainous grazing land then depends on the price of beef, the quantity of beef produced, and the cost of producing the beef.

Measuring the price of beef is quite straightforward. Complete time

series data are available from the Livestock Market News Service, USDA. For Eastern Oregon mountainous grazing land, it is hypothesized that the relevant beef price is that of feeder steers since the major type of beef production in the area of study is cow-calf ranching, and the major product is feeder calves. Although a composite measure of feeder calves (heifers and steers) is appropriate, the price of feeder steers would likely be highly correlated with a composite measure and, in addition, the feeder steer price is more readily available. The Portland, Oregon price is likely the most relevant price to the region of study and is used in the subsequent analysis as the relevant measure of the price of beef.

The quantity of beef produced per acre is also directly correlated with the net ranch income per acre. The number of animal-unit-months (AUMs) of forage production per acre per year is used as a variable to quantify the productive capacity of the acreage analyzed in this research. An AUM is defined as the amount of natural or cultivated feed necessary for the sustenance of one cow or its equivalent for the period of one month [11]. Kearl [23] has suggested that problems of standardization of AUM's among diverse areas or ranching types exist. Although the general ranching enterprises in the study region are fairly homogeneous, the problems created by differing land classes within sales and differing precipitation patterns in Umatilla County must be addressed in deriving a standardized measure of AUMs per acre. The derivation of the AUM measure utilized in this research is based upon information provided by the assessor's office, Umatilla County, Oregon. In converting acreage to a standardized measure of AUMs per acre, two factors are of particular importance in Umatilla County. First, the land class of the acreage directly reflects the productivity of the land. For the purpose of this

research, all acreage was converted to Class VII equivalents using conversion factors that are used by the Umatilla County Assessor's Office for the purpose of tax assessment. In addition to the land class, precipitation patterns directly influence the forage producing capacity of the land. Using guidelines suggested by the assessor's office, Umatilla County was divided into three regions on the basis of average annual precipitation. The acreages in the various regions were weighted to account for the difference in productive capacity as a consequence of the different levels of average annual precipitation. The weights were assigned to adjust acreages so that acreage in Umatilla County, regardless of location, is directly comparable to acreage in Grant County, assuming same land classification. The same factors used in Umatilla County to adjust for the different land classes were used in Grant County following the adjustments made for differing precipitation patterns in Umatilla County. (See Appendix I for greater detail of the process whereby this standardization of acreages is made.) As suggested by the preceding analysis, the measure of land productivity is expected to be positively correlated with the price of land.

Other Factors Affecting the Profitability of Beef Production

Kearl [23] postulates that hay (or winter pasture) is required for livestock maintenance in some fixed proportion to summer pasture, i.e., hay and summer pasture are complementary inputs in beef production. An increase in the price of hay results in a reduction of the quantity of hay demanded. If hay and grazing land are used in fixed proportion, the demand for grazing land is reduced by an increase in the price of hay. Under the assumption of fixed input proportions, the price of hay and

the price of grazing land are expected to be negatively correlated.

The variable used to represent the price of hay in this analysis is the Portland, Oregon price of alfalfa hay reported by the Oregon Hay Growers Association. The price of alfalfa hay is reported more consistently than that of other hays, and the prices of various types of hay are expected to be highly correlated within a relatively small region so that the price of alfalfa hay is a reasonable indicator of conditions in the hay market. In addition, the quality of alfalfa hay is reasonably constant over time so that reported price variations may be considered as the result of supply and demand conditions rather than variations in the quality of the hay.

Another factor often considered important in affecting the price of farm land is the demand for land for the purpose of farm enlargement [16, 32, 35, 41, 43]. The demand for land for farm enlargement stems from the possibility of spreading fixed overhead costs over more acres thereby reducing per unit costs [32]. Heady and Tweeten [16] concluded that the major source of real estate price increases (between 1953 and 1963) was farm consolidation and associated scale economies from larger acreages. Farm technological advances and increased pressures for farm enlargement are highly related, and the price of land is positively correlated with these effects. However, in the analysis of mountainous grazing land, one would expect that these effects are much less important than they are for tillable cropland. Nevertheless, this research investigates the effect of pressure for farm enlargement on the price of mountainous grazing land. A binary variable is used to represent those sales bought to enlarge a presently owned ranching operation. In keeping with the hypotheses suggested by other researchers, this variable is expected to be positively

related with the sale price of land.

The analysis of the effects of increasing demand of agricultural land for non-agricultural uses as a result of pressures from an increasing population is not of particular interest in this study. It is believed that these effects have been largely eliminated by the restrictions placed on the sales to be analyzed; each land sale must contain a minimum of 100 acres and only sales with farm-use assessments are analyzed.

Somewhat related to effects of increasing population is the distance of sale tracts from business centers and paved roads [13]. These factors have a direct effect on the profitability of cattle ranching. The closer a ranch is to a marketing center, the lower the costs of operations as reflected in lower transportation costs. As this distance increases, it is hypothesized that the sale price per acre will decrease to reflect the effect of higher operating costs. In addition to the effect of location on operating costs, land parcels nearer to business centers would be expected to command a higher price due to population pressures and increased demand of land for non-agricultural uses. As stated by Ely and Wehrwein [7], farm land near cities may sell on the basis of anticipated urban uses rather than on capitalized agricultural net incomes. Although several restrictions were enforced in an attempt to eliminate the influence of non-agricultural land demand, the variable for distance to a business center will account for any influence not eliminated by the restrictions on land sales.

The two effects of distance from a business center are complementary, so the hypothesized relationship between distance to a business center and the sale price of land is negative; i.e., as the distance increases the per acre selling price of land is expected to decrease.

Several researchers have analysed the effects of various government programs and activities on agricultural land prices [6, 15, 17, 26]. The importance of particular government programs depends on the type of agriculture in the region of study.

The importance of publicly-owned lands for supplemental forage for private ranches in the West has long been recognized and the level of user fees for the privilege of private use of public grazing lands has received a great deal of attention in the past [2, 10, 12, 21, 5, 24]. Caton, et al. [2] state that federal range is normally used in conjunction with private pasture, cropland, and water resources. The profit-producing capacity of the entire unit is capitalized into the private part of the ranch. Roberts [33] has outlined the relationship between grazing fees and ranch prices and addresses the processes whereby public grazing privileges may accumulate a sale value (or "permit" value) for private holders. Various researchers have attempted to estimate the value of public grazing privileges to private ranch owners. A 1966 Arizona study by Martin and Jeffries [27] estimated the capitalized value of each AUM of U.S. Forest Service grazing privileges to be about $23 and each AUM of Federal Bureau of Land Management (BLM) grazing privileges to have a capitalized value of approximately $13. Their estimates were based on regression analysis developed to explain total sale prices of ranches. However, their final model did not include any prices of inputs or outputs from ranching and is incorrectly specified on this account. Gardner [11] estimated the market values to be $16 and $10 per AUM of FS and BLM grazing privileges, respectively, in his 1959 study of Colorado sale prices. The values reported by Gardner [11] were estimated directly by a rancher involved in the transfer. This method of analysis seems highly

susceptible to biased results since ranchers may wish to conceal or at least distort permit values on the assumption that grazing fees may be increased to eliminate positive permit values. Therefore, these results must be interpreted carefully. Nonetheless, the results of these studies indicate that a positive relationship may exist between the inclusion of public land grazing privileges and private land sale prices. An investigation of the relationship between public land grazing privileges and private land sale prices in Eastern Oregon is pursued in this research.

The inclusion of public grazing privileges is measured in two alternative methods in this study. The total number of AUM's provided by public grazing lease(s) was supplied by the administering agency (Forest Service or Bureau of Land Management). One formulation of the amount of public grazing relative to private grazing in a sale is the AUM's of public grazing per acre of deeded land. The alternative measure is the percentage of the total AUM's of the sale (private plus public) provided by the public grazing lease(s).

Other Variables

Other variables may affect the sale price of land without having any affect on agricultural production. One such factor is whether or not the buyer(s) and seller(s) are related. Sale agreements that occur between relatives may not accurately reflect market conditions due to favoritism, etc. A test is desired to investigate whether sale prices differ for sales in which the parties are related as opposed to sales in which the parties are not related. This test is accomplished by the inclusion of a binary variable to identify sales in which the parties are related.

Another factor which may affect the sale price without any influence on agricultural production is the inclusion of an occupied household on

the sale tract. The influence of this factor is also tested through the use of a binary variable.

Somewhat related to the inclusion of an occupied household in a sale is the inclusion of other types of buildings (barns, work shops, etc.) in a land sale. Oregon law requires that buildings be assessed for tax purposes at 100 percent of their fair market value. On the assumption that assessed values accurately reflect market values, one might merely subtract the assessed value of any buildings included in a sale to compute the sale price for the land itself. On the other hand, one may wish to test whether or not the addition of one dollar of assessed building value per acre actually increases the sale price per acre by one dollar. This latter approach is taken in this research. The null hypothesis to be tested in the case of the coefficient for the assessed dollar value of buidlings included in the sale is $H_o: \beta=1$ versus the alternative that the coefficient is not equal to one. The size of the estimated coefficient will provide some indication as to whether assessed values are higher or lower than the true market value.

Data for the assessed value of any buildings included in a sale are available as public record in the county courthouses. However, building assessment are not updated each year so the assessed values were updated by the percentage change in the Consumer Price Index in cases where assessments had not occurred during the year of the land sale.

Expected Capital Gains

Expected capital gains reflect the value of land as an investment or hedge against inflation. Past increases in capital values contribute to expectations of continued increases in the future and expectations of

future capital gains are capitalized into the present value of a capital asset [14]. The importance of capital gains since 1959 relative to net farm income is illustrated in Figure 2. In nearly half of the years from 1959-1970, capital gains were a larger percentage of farm real estate values than realized net farm income.[4] Scofield [37] suggested that returns to land ownership may be fully as important as returns from production in determining forces behind rising land prices. In the past, farmland has been a relatively effective hedge against inflation and expectations that this relationship will continue to hold have a direct effect on the price of farmland. As the general price level increases, the price of farmland is also expected to increase. This relationship is tested by inclusion of the Consumer Price Index (CPI) as a measure of the general price level. CPI and price of land are expected to be positively correlated.

The final topic to be discussed in this chapter is the appropriate discount rate. The selection of the appropriate discount rate is important because small changes in the rate have large effects on the capitalized value. However, there is no widespread agreement among economist and appraisers on the appropriate discount rate. Scofield [39] says that, ideally, the rate should represent the prevailing opportunity cost of capital as determined by that rate of return that could be realized from other investments having the same liquidity and risk characteristics as farmland. In this regard, he suggests non-farm real estate and common stocks. However, a substantial number of farmland buyers are not likely to consider these as alternative investments. Nonetheless, several

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[4]Capital gains are computed as the percentage change from the previous year of the index of farm real estate values.

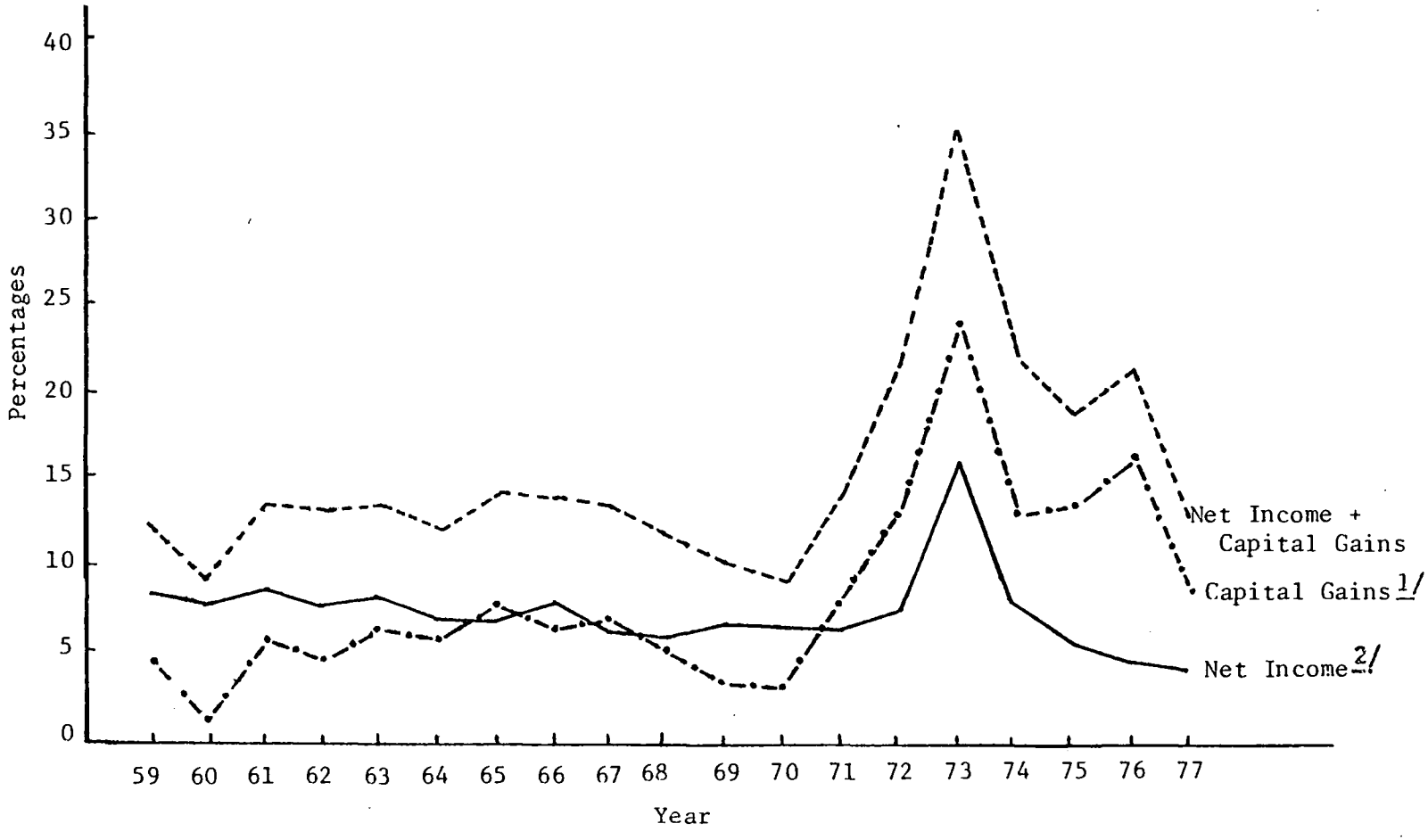

Figure 2. Relative Importance of Capital Gains and Realized Net Income as Percentage of Real Estate Values, 1959-1977 (U.S.).

1/ SOURCE: Farm Real Estate Market Developments [43].

2/ SOURCE: Agricultural Statistics [42].

studies (notably, Herdt and Cochrane [20]; Tweeten and Martin [41]) have used the rate of return on high-grade bonds or common stock as the appropriate discount rate.

For many farmland investors, the primary investment alternatives that they might consider are other agricultural inputs (machinery, fertilizer, etc.) Therefore, the internal earning rate is suggested by Reynolds and Timmons [32] as the appropriate discount rate. However, they also indicate that a "subjective discount" may be made from this rate to reflect preferences for farming as an occupation or some other preference attached to owning land.

Another common capitalization rate is the average rate of interest on farm mortgages, a measure of the cost of capital to land purchasers. Hurlburt [22] claims that this interest rate serves the purpose for general application, as an indicator of what the average farm operator might be willing to accept as a rate of return on money invested in land. For this reason, the average interest rate on farm mortgages as reported by the Chicago District of the Federal Land Bank is used as the discount rate in this study.

IV. DISCUSSION OF THE DATA AND EMPIRICAL RESULTS

The data on date of sale, deeded acreage in the sale, total sale price, assessed value of buildings in sale, and acreage of the sale falling into each land class were obtained from county records. Personal telephone interviews with the buyer or seller (or both) were used to obtain data on location factors, farm expansion sales, existence of occupied households on the sale tract, and information pertaining to any blood relationship between buyer(s) and seller(s). The district offices of the Federal Bureau of Land Management, Department of the Interior, and the United States Forest Service, Department of Agriculture, verified and qunatified the inclusion of public land grazing privileges associated with the private land sales.

Brief Profile of the Data

Fifty-two bona fide ranch sales satisfying the restrictions on sale size and land quality as outlined in Chapter I are analyzed in this study. Of these sales, thirty-eight are from Umatilla County and fourteen are from Grant County. Nine of the sales had Federal Bureau of Land Management (BLM) grazing privileges included and eight of the sales had U.S. Forest Service (FS) grazing privileges attached (four of the sales included both BLM and FS grazing privileges).

The average size of the land sales is 769.7 acres with a mean price per acre of $131.24. The average sale included buildings assessed at $8.07 per acre. However, thirty-four of the sales had no buildings. Twenty-eight of the sales were additions to presently owned ranch land in the county of the purchase and only five of these sales had buildings included.

Empirical Results

The final model [5/] estimated in this research is specified as:

1) Price = f(AUM, AVB, CPI, CATTLE, HAY)

or

2) Price = f(AUM, AVB, CPI, CATTLE, HAY, ADD)

where;

Price = sale price in dollars per acre,

AUM = animal-unit-months of forage provided annually per acre,

AVB = assessed value of buildings per acre in dollars,

CPI = level of the consumers' price index during the month of the land sale,

CATTLE = Portland, Oregon price of good-choice feeder steers during month of land sale in dollars per hundredweight,

HAY = Portland, Oregon price of alfalfa hay in dollars per ton,

ADD = binary variable denoting purchases for ranch enlargement (= 1, if the purchase was for ranch enlargement; = 0 otherwise).

Equations (1) and (2) were estimated in the linear functional form using ordinary least squares (OLS) regression.[6] The results of OLS estimation of the parameters of equation (1) are given in equation (3).

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[5]As in most empirical work, several alternative models were studied in an attempt to identify the "best" model. The models presented above were selected on the basis of high statistical significance of the independent vairables and goodness of fit. Results of some of the alternative models studied in this research are presented in Appendix II.

[6]A double-log functional form was also studied, but could not explain as much of the variation in sale prices as the linear functional form. For a discussion of the theoretical considerations and the regression results of the double log functional form, see Appendix II.

3) PRICE = -467.68 + 55.45 AUM + 4.76 AVB + 3.53 CPI + 3.04 CATTLE
(121.89) (20.92) (.63) (.99) (1.41)
-3.38 HAY; R^2 = .6574.
(1.48)

The numbers in parentheses are the standard errors of the coefficients. Each of the coefficients in equation (3) has the anticipated sign and is significant at the five percent probability level.

One of the assumptions of ordinary least squares regression is homoskedasticity, that is, the variance of the error terms is constant across observations. Violation of this assumption (heteroskedasticity) results in estimated parameters that are unbiased and consistent, but inefficient, i.e., the estimated parameters do not have the minimum variance of the class of linear unbiased estimators. For this reason, a test of the model for the presence of heteroskedasticity was made.

One method of checking for the presence of heteroskedasticity is through visual examination to ascertain whether the variance of the error terms varies with different levels of independent variables. The independent variables most likely to be related to the variance of the error terms are AVB, AUM, and CPI. To test for the presence of heteroskedasticity, the residuals from equation (3) were plotted against these variables, individually. No pattern between the residuals and each of these variables could be detected; it is concluded that the homoskedasticity assumption is not violated so that the parameter estimates are efficient.

The coefficient for AUM (animal-unit-month) implies that an additional AUM per acre adds $55.45 (V) to the per acre sale price. Using this estimate and estimates of private AUM lease rates (A), implied discount rates (r) can be determined from the present value formula, V = A/r. Algebraic manipulation of this formula yields r = A/V. If one assumes

perfect competition in the private rental market so that the lease rates accurately reflect the marginal value of the AUM of grazing, private AUM lease rates may be used as an appropriate estimate of A, the annual return from an AUM of forage.

Wood, et al. [48] found the average private AUM rental rate in Malheur County, Oregon to be $3.46 in 1974. In a 1976 data set for the Malheur National Wildlife Refuge area of Harney County, Oregon, Schmisseur [34] found the average lease rate to be $4.43. The average lease rate for Oregon during 1977 as reported by the Statistical Reporting Service in Farm Real Estate Market Developments [44] was $5.30. These estimates yield implied discount rates of 6.24, 7.99, and 9.56 percent respectively. The average farm mortgage rate of the Chicago office Federal Land Bank on new loans was 8.44 percent during the 1970-1978 time period. These findings substantiate the argument by Hurlburt [22] that the average farm mortgage rate is the relevant discount rate considered by prospective purchasers of grazing land.

The estimated coefficient for assessed value of buildings per acre (AVB) implies that an increase in the assessed value of $1.00 per acre increase the per acre sale price by $4.76. Oregon law requires building assessments to be 100 percent of market value, so one would anticipate an increase in the assessed value of buildings of $1.00 per acre to cause an increase in the per acre sale price of $1.00. The size of the coefficient for AVB suggests that the assessed values are not accurately reflecting the value of the buildings to the purchasers. The assessor is faced with considerable difficulty in placing an assessed value on outbuildings (barns, sheds, etc.) of little value in their own right. Purchasers may consider the cost of replacement in determining the value of

existing buildings. In view of escalating construction costs, replacement costs are much greater than the value of the existing buildings. By purchasing existing buildings, ranchers are able to avoid the cost of construction for new buildings, and hence, existing buildings as a part of a ranch unit may command prices greater than their assessed value.

The price of hay and the price of cattle have a direct effect on the profitability of beef production. Through their effect on the profitability of beef production, these prices affect the demand for grazing land as hypothesized in Chapter III. According to the estimated coefficients in equation (3), a $1.00 increase in the price of feeder calves induces a $3.04 increase in the price of grazing land. A $1.00 increase in the price per ton of alfalfa hay results in a $3.38 decrease in the price of an acre of grazing land.

The CPI index is introduced in this study as a measure of inflationary pressures. It is a widely held belief that land has been (and is) a good hedge against inflation. The estimated coefficient for CPI seems to support this belief. An increase of a point in the CPI results in an increase of $3.53 in the price of land. The elasticity of the price of land with respect to the CPI, calculated at the means is 4.09. Thus, a one percent increase in the CPI is accompanied by a 4.09 percent increase in the price of land. These results suggest that during the period 1970-1978, increases in the general price level, as measured by the CPI, have been accompanied by even greater increases in the price of grazing land.

The OLS estimates of the parameters of equation (2) are presented below.

4) PRICE = -436.55 + 56.95 AUM + 4.49 AVB + 3.48 CPI + 2.77 CATTLE
(122.19) (20.68) (.65) (.98) (1.40)
-3.31 HAY - 33.47 ADD; R^2 = .6732
(1.46) (22.69)

All of the coefficients in equation (4) are significant at one percent except CATTLE, HAY, and ADD. The significance probability for the HAY coefficient is 2.8 percent, 5.5 percent for the CATTLE coefficient, and 14.7 percent for the ADD coefficient.[7] The estimated coefficients for the variables in equation (3) are of the same magnitude as those for equation (4) and may be interpreted in a similar fashion.

The sign of the coefficient for ADD is negative, contrary to expectations based on the assumption that ranch-enlargement purchases are basically made for the purpose of spreading fixed costs over more units. However, the coefficient is not significant at the ten percent level of significance. Nonetheless, one may wish to consider alternative hypotheses that may explain the negative sign of the ADD coefficient.

The fact that agricultural grazing land is a consumptive good as well as a productive good may account for the higher prices being paid for those purchases that are not ranch enlargements. Additional acreage may not significantly increase the utility obtained for "conspicuous consumption" and "ranch fundamentalism." People who already own ranchland may consider the purchase of additional acreage primarily on the basis of its productive capacity since they are already enjoying the consumptive "outputs" from the land they own. Purchasers who do not own any ranchland may attach more importance to the consumptive aspects of owning

[7] The significance probability is the minimum level of significance at which the null hypothesis may be rejected. In this case, the null hypothesis is $H_o: \beta_i = 0$.

land and may be willing to pay higher prices for the land because they are obtaining additional outputs when they buy the land.

Another factor that may explain the negative coefficient attached to the variable representing farm enlargement purchases is the value of information. Ranchers who presently own land may have a better idea of the economic value of land than people who do not already own ranchland. On the basis of the additional information held by present land owners, they may be willing to pay less for grazing land than those people who do not have the information.

Discussion of Omitted Variables

Economic theory suggests that several variables not found in equations (3) or (4) should affect the price of agricultural grazing land. The theory underlying the impact of these variables is outlined in Chapter III. Possible reasons why these variables were not important in their effect on the sale price in the region of analysis are presented below.

Grazing Rights on Public Land

The most complete and current publication addressing the issue of public grazing fees is the 1977 joint report of the Secretary of the Interior and the Secretary of Agriculture entitled Study of Fees For Grazing Livestock on Federal Lands [5]. This publication presents a concise and comprehensive history of the public grazing fee issue from the time user fees were first administered in 1906 to the present. Determination of the "fair" user fee has been a topic of intense controversy since imposition of these fees. Ranchers who had become accustomed to free and unrestricted use of Federal rangelands became increasingly discontent in the face of increasing user fees demanded by several members of Congress

and the public at large who felt that the government should receive renumeration equal to the value of the grazing. The very issue of the "fair market value" of the forage provided by the Federal rangeland has been a topic of much concern. Numerous studies have been conducted to investigate this issue and various suggestions for procedures to determine the "fair market value" have been made as the result of these studies [12, 19, 27, 30, 33].

Prior to 1969, various economic studies were undertaken to investigate the level of user fees and the impact of the level of user fees on the economic stability and structure of ranches affected by the Federal rangeland issue [2, 11, 12, 18, 24, 27, 33]. By and large, these studies concluded that public grazing leases were under-priced relative to private grazing leases and, as a result, the public grazing privileges had accrued substantial capital values.[8] Purchasers of private grazing land were willing to pay a premium to a seller in cases where the seller had a public grazing permit [12, 27]. The premium was the result of a differential between the fee paid to graze public lands and the true economic value of the grazing use; the capitalized value of this differential is known as the permit value.

Since permit values accrue as a result of underpricing of public grazing leases relative to the true economic value of the grazing, permit values will diminish as the level of user fees is increased to reflect the "fair market value" of the grazing use. Indeed, one of the pro-

[8]When comparing lease rates between public and private grazing leases, one must consider more than just the AUM rental charges. Arguments have been made to the effect that the public grazing lands are lower quality in general than the private grazing lands because homesteaders settled in the choicest locations. The Grazing Fee Technical Committee [40] reported that substantial nonfee costs accompany public grazing leases over and above similar costs for private leases (greater transportation costs,

claimed objectives of the agencies administering the Federal rangelands is to escalate the user fees to accurately reflect the "fair market value" of the grazing. When this level of the user fee is achieved, the permit value should be zero. As a result of this stated objective and on the basis of recommendations made in the report, "Review of Public Land Grazing Fees" [40], Forest Service grazing fees have increased from $.51 per AUM in 1966 to $1.60 per AUM in 1977 and BLM grazing fees have increased from $.33 per AUM in 1966 to $1.51 per AUM in 1977. The objective of the fee escalation is to achieve "fair market value" by 1980.

While it is possible that permit values have occurred in the past due to under-pricing of grazing fees on public lands relative to the true value of the forage, the results of this study indicate that purchasers of private grazing lands have not been paying a premium for the public grazing permits. (See equations 1.5, 1.6, 2.4, and 2.5 in Appendix II.)

From an economic standpoint, public grazing leases would be expected to carry a permit value until the user fee accurately reflects the fair market value of the grazing. Therefore, the permit value should decrease as the user fees are increased to reflect the diminishing differential between user fees and the fair market value of the grazing. However, Schmisseur [34] found that very few ranchers had a thorough understanding of the policies and procedures regulating and determining the level of user fees. If ranchers are generally unaware of the policies and goals of the grazing fee system, observed increases in user fees may have a greater effect on the ranchers' reactions than is warranted from

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8 (continued)
water development, fence repair, and general damage resulting from other users of the public lands). The term "user fees" is used throughout this study and is intended to reflect these differences between public and private grazing leases.

an economic viewpoint. That is, limited knowledge about future fee increases may result in overly cautious behavior as a result of past fee increases.

Another factor that may have caused an accelerated reaction to fee increases is the psychological and/or sociological effects of grazing public lands. There are several non-monetary costs associated with grazing the public range. Among these is some loss of choice in the ranching operation as various regulations and policies must be upheld while grazing public ranges. Costs of this nature may compound the effect of increased user fees and expedite the reduction of permit values.

Discount Rate

The importance of the discount rate is evident from the present valuation formula, since small changes in the discount rate result in large changes in the present value of an asset. The discount rate is not linearly related to the present value of a capital asset but rather enters into the model in a multiplicative form. However, when the discount rate is included in the model in a manner consistent with economic theory, the statistical significance of the independent variables declines markedly (see Appendix II).

This result is likely due to a high degree of multicollinearity. The simple corrleation coefficient between R and CPI is .944 which is not too surprising since R is a nominal interest rate which is expected to be influenced by expected inflation. The high degree of multicollinarity results in imprecise estimates of the regression coefficients, i.e., the least squares estimators have large variances [48]. Due to the problem of multicollinearity, the discount rate is omitted from the final model. While omitting the discount rate from the model results in the introduc-

tion of specification error into the model, a tradeoff is made in the gains of efficiency increasing the statistical significance of the remaining variables.

Distance Variables

Several distance variables were used in an attempt to identify the importance of the location factor in affecting sale prices of agricultural grazing land. Variables tested included distance to nearest county seat (assumed to be the major marketing center in the area), distance to the nearest paved road, and distance to other owned property in the county. None of the distances proved to have a significant effect on the price of grazing land. Possible reasons for this result are that transportation costs are a minor factor in ranching and that the towns in the region are not large enough to exert a significant influence on sale prices from increasing urbanization.

Size of Sale

Several researchers [4,45] have discovered a negative relationship between the size of a sale and the sale price per acre. Presumably this relationship exists as a result of spreading relatively fixed transactions costs over more units. In this study, the size of the sale as measured by total number of deeded acres did not have a significant effect on the per acre sale price. Likely, the restriction limiting sales to be analyzed to 100 acres or more results in the transactions cost becoming a relatively minor factor in the total sale price and nullifies the effect of sale size on per acre sale price.

Another aspect that may be related to the influence of the size of the sale and the sale price per acre is the existence of different land

markets for different size sale tracts. Again, the restriction on sale size has likely eliminated the influence of the demand for small tracts of land for second homes, etc.

V. SUMMARY AND CONCLUSIONS

The major objective of this study was to identify the factors that exert a significant influence on the price of mountainous grazing land in Eastern Oregon. Linear regression analysis was utilized to investigate the impact and importance of the independent variables on the per acre sale price of private grazing land in Umatilla and Grant Counties.

The variables determined to have a substantial effect on the price of grazing land include the quality of the land (AUM), the assessed value of buildings per acre included in the sale (AVB), the price of feeder steers (CATTLE), the price of alfalfa hay (HAY), expected capital gains (CPI), and farm enlargement pressures (ADD). As hypothesized, the estimated coefficients for AUM, AVB, CATTLE, and CPI were positive and the coefficient for HAY was negative. Contrary to expectations, the coefficient for ADD was negative, but the coefficient for this variable was not statistically significant at the ten percent level.

The coefficient for AUM was used to determine implied discount rates in the range of 6.24 to 9.56 percent on the basis of various estimates of private AUM lease rates. The average Federal Land Bank mortgage rate is included in this range of values and it is concluded that the farm mortgage rate is an appropriate measure of the discount rate considered by purchases of mountainous grazing land.

The inclusion of public grazing privileges was found to have no significant impact on the level of private grazing land sale prices. This result does not support earlier studies done by Martin and Jeffries [27] (in Arizona) and Gardner [11] (in Colorado). Both of these studies found that substantial permit values had accrued as a result of user fees plus nonfee user costs for grazing Federal rangelands being substantially below

the fair market value of the forage. However, these two studies were undertaken prior to 1969 when a new policy was enacted with the explicit objective of escalating user fees to reflect the fair market value of the forage grazed while the present study analyzes only sales that have occurred after 1969. The results of this study support the conclusion that permit values did not exert a significant effect on private sale prices within the time period and region analyzed.

Limitations of the Study

Throughout this paper, the problem of standardizing the AUM measure has been recognized. This problem is the main obstacle to direct application of the model to other areas since the AUM measure in this study has been converted to a quite specific measure. Generalization of the estimate of the AUM coefficient to regions outside the study area could give misleading results since the estimated coefficient relates to the standardized AUM measure in this study. However, the general procedures used in this study should be easily adaptable to other regions that are similar in nature to the study region of this research.

Implications of the Study and Suggestions for Further Research

This study provides some insights into the determination of agricultural grazing land prices. As much as two-thirds of the variation in sale prices could be explained by the variables in the land price model. This compares quite favorably with other studies of similar nature. Crowley [4] obtained R^2 ranging from a low of .1140 in an urban-influenced land market to .6284 in an agricultural land market. Vollink [45] obtained R^2's ranging from .50 to .62 in four regions in North Carolina.

The estimated model is likely not suitable for the purpose of property

assessment since approximately one-third of the price variation is unexplained. However, the model may be useful for determining whether or not assessed values reasonably reflect market values and further development of the model may be able to account for more of the price variations in grazing land sales.

The results of this study indicate that the inclusion of public grazing privileges does not have a significant effect on the sale price of private grazing land. However, studies in Arizona and Colorado prior to the implementation of a fee escalation policy in 1969 found that substantial permit values had occurred to holders of public grazing permits. Further research is needed in these areas to determine the effect of the fee escalation on the permit values. Economic theory suggests that the permit values should decrease as the user fees are increased to reflect the true market value of the forage. Changes in user fee policies affect both operating costs of ranching and the wealth position of permit holders and the effects of these policy changes on the structure and nature of the ranching industry merit further research.

This study indicates that the assessed value of buildings in the study area is not accurately reflecting the prices land purchasers are paying for the buildings. Whether or not this situation should be altered by increasing assessed values is a normative, policy question. Nonetheless, the economic impact of increasing building assessments on the social welfare of the region is another area of possible research that could provide useful information to state and county officials.

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Appendix I

Procedure for Standardizing Acreage

Chapter III explained the need for standardizing acreages of land sales from different areas of the region of analysis. The purpose of this appendix is to demonstrate the methods used in this study to standardize the acreages.

The study area was divided into three distinct regions on the basis of productivity differences arising from variations in precipitation patterns. The divisions of Umatilla County were based upon guidelines suggested by the Umatilla County data analyst in a personal interview. Region 1 consisted of Townships 4N, 5N, and 6N, all in Umatilla County. Region 2 consisted of Townships 1N, 2N, and 3N, all in Umatilla County. Region 3 consisted of Townships 1S through 6S in Umatilla County and all of Grant County (see map).

All acreages were converted to Region 3 equivalent acreages. In order to accomplish this, acreages of each land class in Region 1 were multiplied by 2.266 and acreages in Region 2 were multiplied by 1.185. These conversion factors were based on the number of acres required to support one animal unit for a month as suggested by the Umatilla County Assessor's office.

These transformed acreages were next converted to AUM's produced per month of grazing. To convert to AUM's, the transformed acreages of each land class were multiplied by the factors in Table 1. This transformation accounts for differences in productivity among the various land classes.

Finally, differences in the grazing seasons in the different regions were taken into account. Region 1 has a six month grazing season, but Regions 2 and 3 have seven month grazing seasons. As a consequence, the AUM's per month were multiplied by six for sales in Region 1 and by seven

for sales in Regions 2 and 3.

TABLE 1. FACTORS FOR CONVERTING LAND CLASSES TO AUM'S PER MONTH

Land Class	Factor
I	.394
II	.335
III	.292
IV	.247
V	.216
VI	.199
VII	.175
VIII	.140

The result of this multiplication is a standardized measure of AUM's of grazing provided per year by the entire sale acreage. This measure is divided by the actual number of acres in the sale to achieve a standardized measure of AUM per acre per year.

Numerical Example

For simplicity, assume a sale that occurred in Region 1 consisted of one acre in each of the eight land classes. Since the sale occurs in Region 1, each of the acreages is multiplied by 2.266 to convert to Region 3 equivalent acreages. We now have 2.266 (transformed) acres in each land class. The number of (transformed) acres of each land class are now multiplied by the factors in Table 1 and summed to derive the number of AUM's provided per month of grazing.

$$\text{AUM/Month} = 2.266(.394+.335+.292+.247+.216+.199+.175+.140)$$

$$= 2.266(1.998)$$

$$= 4.527$$

The number of AUM's per month (4.543) is multiplied by six to account for the length of the grazing season in Region 1 to yield 27.162 (=4.527x6) total AUM's in the sale. This is divided by the total acreage of the sale, eight acres, to find 3.39525 (=27.162/8) AUM's per acre per year for this particular example.

Appendix II

Selected Regression Results

In Chapter IV the final estimated models of this research were presented and the variables that did not significantly affect mountainous grazing land prices were discussed. This appendix provides a brief presentation of some of the regression results not presented in Chapter IV.

The results are presented in Table AII-1 and Table AII-2. Table AII-1 contains linear regression models and Table AII-2 displays the results of OLS coefficient estimates of a double-logarithmic functional form. The variable definitions and discussion are presented below.

Variable Definitions

PRICE = actual per acre sale prices in dollars,

AUM = standardized measure of animal-unit-months of forage produced per acre per year,

AVB = assessed value of buildings per acre included in the sale, in dollars,

CPI = level of consumer price index during month of sale,

CATTLE = price of choice feeder steers at Portland, Oregon during month of sale, in dollars per hundredweight,

HAY = price of alfalfa hay at Portland, Oregon during month of sale, in dollars per ton,

ADD = binary variable indicating purchases for ranch enlargement (=1 if purchaser owned other ranch property in county at time of sale; =0 otherwise),

R = average farm mortgage rate on new loans of Chicago District Federal Land Bank,

TACRES = size of sale, in acres,

FSPACRE = AUM's of Forest Service (FS) grazing privileges per acre of deeded land,

BLMPACRE = AUM's of Bureau of Land Management (BLM) grazing privileges per acre of deeded land,

DFS = binary variable indicating inclusion of FS grazing privileges (=1 if privileges included; =0 otherwise),

DBLM = binary variable indicating inclusion of BLM grazing privileges (=1 if privileges included; =0 otherwise),

PERFS = percentage of total AUM's of sale provided by FS grazing privileges,

PERBLM = percentage of total AUM's of sale provided by BLM grazing privileges,

TOWN = distance from sale tract to nearest county seat, in miles,

PROP = distance from sale tract to other owned property in county, in miles,

ROAD = distance from sale tract to nearest paved road, in miles,

C = binary variable for county of sale (=1 if Grant County; =0 if Umatilla County),

HH = binary variable for occupied household included in sale (=1 if house included; =0 otherwise),

REL = binary variable to indicate if buyer and seller were related (=1 if related; =0 otherwise),

LNPRICE = natural logarithm of price, ln(PRICE),

LNAUM = ln(AUM)

LNAVB = ln(AVB+1)

LNCPI = ln(CPI)

LNCATTLE = ln(CATTLE)

LNHAY = ln(HAY)

LNR = ln(R)

LNPERFS = ln(PERFS+1)

LNPERBLM = ln(PERBLM+1)

LNFSPACRE = ln(FSPACRE+1)

LNBLMPACRE= ln(BLMPACRE+1)

Discussion of the Variables

The expected signs of most of the estimated coefficients follow from the discussion in Chapter III. Two different procedures were used to in-

TABLE AII-1. SELECTED REGRESSIONS RESULTS: LINEAR FUNCTIONAL FORM.[1,2]

Variable \ Equa. No.	1.1	1.2	1.3	1.4	1.5
AUM	55.45	56.95	45.88	54.70	52.73
	(20.92)	(20.68)	(23.37)	(21.60)	(22.54)
AVB	4.76	4.49	4.70	4.78	4.74
	(.63)	(.65)	(.84)	(.65)	(.67)
CPI	3.53	3.48	3.76	3.59	4.74
	(.99)	(.98)	(1.06)	(1.03)	(1.06)
CATTLE	3.04	2.77	2.32	3.18	3.19
	(1.41	(1.40)	(1.67)	(1.49)	(1.53)
HAY	-3.38	-3.31	-3.79	-3.47	-3.45
	(1.48)	(1.46)	(1.57)	(1.53)	(1.56)
ADD		-33.47	-40.85		
		(22.69)	(29.74)		
TACRES			-.012		
			(.015)		
FSPACRE					-9.38
					(115.18)
BLMPACRE					74.95
					(210.16)
DFS					-4.65
					(55.39)
DBLM					-16.42
					(38.45)
PERFS				-.48	
				(1.35)	
PERBLM					.61
				(3.43)	
TOWN			-.17		
			(1.12)		
PROP					
ROAD			-5.13		
			(4.49)		
C			4.21		
			(37.92)		
HH			-37.03		
			(40.74)		
REL			12.88		
			(38.38)		
PAST			.023		
			(.56)		
R^2	.6574	.6732	.6976	.6586	.6604

[1]Dependent variable is PRICE.

[2]Numbers in parentheses are standard errors.

TABLE AII-2. SELECTED REGRESSION RESULTS: DOUBLE LOG FUNCTIONAL FORM.[1, 2]

Equa. No.	LN AUM	LN AVB	LN CPI	LN CATTLE	LN HAY	LN R	LN PERFS	LN PERBLM	LNFS PACRE	LNBLM PACRE	DFS	DBLM	ADD	R^2
2.1	.61	.28	2.70	.57	-.34									.5301
	(.24)	(.06)	(1.17)	(.40)	(.56)									
2.2	.62	.24	2.70	.47	-.36								-.28	.5574
	(.24)	(.06)	(1.15)	(.40)	(.55)								(.17)	
2.3	.62	.28	2.20	.68	-.34	1.43								.5308
	(.25)	(.06)	(2.28)	(.61)	(.56)	(5.58)								
2.4	.59	.29	2.86	.66	-.42		-.08	.05						.5384
	(.25)	(.06)	(1.20)	(.42)	(.57)		(.09)	(.15)						
2.5	.55	.29	2.72	.62	-.40				.74	.48	-.47	-.02		.5477
	(.26)	(.06)	(1.23)	(.44)	(.58)				(1.10)	(1.75)	(.42)	(.27)		

[1] Dependent variable is LNPRICE.

[2] Numbers in parentheses are standard errors.

corporate the public grazing privileges into the model. The first method introduced the four variables DFS, DBLM, FSPACRE, and BLMPACRE. The binary variables (DFS, DBLM) determine the effect of inclusion of public grazing privileges without reference to the size of the sale or the number of public AUM's in the sale. The other two variables (FSPACRE, BLMPACRE) provide a measure of the number of AUM's of public grazing privileges included in the sale per acre of deeded land.

As discussed in Appendix I, the number of acres is not an accurate measure of the grazing potential of a particular tract of land. For this reason, a second procedure for incorporating public grazing permits was introduced to take account of the relative number of AUM's provided by public grazing privileges. This procedure was accomplished by constructing the variables, PERFS and PERBLM. These variables may be an improved measure of the importance of the public grazing privileges to the sale package.

The integer one (1) was added to several of the variables before taking logs. This was done since some of the values of these variables were zero (0) and the natural log of zero is negative infinity. Choosing one (1) to add to these variables is somewhat arbitrary but has the appeal that those observations that are zero (0) before transformation are also zero (0) after transformation.

Equations 1.1 and 1.2 are identical to the final models presented in Chapter IV. Equation 1.3 has the population-distance variables included as well as total sale acreage and the binary variables for county of sale (C), occupied household in sale (HH), and relationship between buyer and seller (REL). None of the added variables are significant at the ten percent level of significance. TACRES, TOWN and ROAD each had the expected

negative coefficients, but the signs of the coefficients for HH, REL, and PAST did not agree with a priori expectations. There was no a priori expectation for the C coefficient.

Equations 1.4 and 1.5 show the addition of the public grazing formulation to equation 1. In both cases, the standard errors are quite large relative to the size of the coefficients indicating that public grazing privileges do not exert a significant effect on the sale price of mountainous grazing land in the study area during the time period 1970 to 1978. Including the ADD variable in these two equations does not significantly alter the estimates so the results are not presented.

The coefficients of the variables in equation 1.1 remain fairly stable when other variables are added which indicates that equation 1.1 (or 1.2) may be a fairly accurate specification of the land price model. The R^2 is also quite stable (which is to be expected since the added variables are not significant) and indicates that about two-thirds of the variation in sale prices is explained by the model.

The present value formula, V = A/r, clearly demonstrates that the discount rate, r, is not expected to affect the present value of a capital asset in a simple linear fashion. For this reason, CATTLE, HAY, CPI, and an interaction term CATTLE x AUM were discounted by R and these variables were used in formulating a linear land price model. The results of estimation are presented in equation 1.

$$\begin{aligned} \text{PRICE} = {} & -735.40 + 4.61\ \text{AVB} + 162.74\ \text{AUM} - .24\ (\text{CATTLExAUM})/R \qquad (1) \\ & \quad (207.45)\ (.65) \qquad\quad (85.50) \qquad\quad (.18) \\ & +.54\ \text{CATTLE}/R - .20\ \text{HAY}/R + .35\ \text{CPI}/R \qquad R^2 = .6460 \\ & \quad (.33) \qquad\quad (.13) \qquad\quad (.11) \end{aligned}$$

As before, the numbers in parentheses are standard errors. None of the discounted variables are significant at 5 percent. All of the variables

have the expected signs except for the interaction variable. Although the R^2 is comparable to those of the other models, this model is rejected on the basis of insignificant explanatory variables.

The double-logarithmic functional form implicitly assumes a multiplicative model. The underlying multiplicative form of the model when estimated in the double-log functional form is consistent with the effect of the discount rate on the price of land. For this reason, the double-log functional form may be preferred to a simple linar model. The estimated coefficients in a double-log equation are elasticities of the dependent variable with respect to the respective independent variables. In some research, estimating elasticities is one of the primary goals and a good case can be made for use of the double-logarithmic functional form. However, elasticities are not necessarily of primary concern in this research. Nonetheless, several model formulations were estimated in the double-log functional form and the results are presented in Table

Equations 2.1 and 2.2 are the double-logarithmic counterparts of equations 1.1 and 1.2. All of the coefficients of equation 2.1 have the expected signs and LNAUM, LNAVB, and LNCPI are significant at 5 percent. LNHAY and LNCATTLE are not significant at ten percent.

Equation 2.3 is identical to equation 2.1 except for the addition of LNR. The sign of the LNR coefficient is contrary to a priori expectations and only two of the independent variables (LNAVB and LNAUM) are significant at the 5 percent level.

Equations 2.4 and 2.5 show the addition of the two public grazing formulations to the double-log model. As in the linear case, none of the public land variables are significant as evidenced by the size of the standard errors relative to the size of estimated coefficients.

As an example of interpretation of the coefficients of a double-log function, consider LNAUM in equation 2.1. The coefficient of .61 indicates that a 10 percent increase in the AUM's per acre induces a 6.1 percent increase in the price per acre. The other coefficients are interpreted in a similar manner.