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The physical characteristics and spatial location of land are hypothesized to be significant inputs to its valuation. This research evaluates the influence of locational, economic, and physical site variables on the assessed value of real property.

Evaluation of such influences is based on a stratified systematic sample of land parcels in coastal Oregon. Data were collected on 52 variables representing the physical characteristics of the land, economic characteristics, and various spatial measures believed to influence value. Among variables available for analysis of land parcels are percent slope, land use, area, soil type, distance to the Pacific Ocean and distance to several classes to urban places.

Based on a sample of 1078 land parcels, a linear regression equation is developed which explains 78 percent of the variation in the common logarithm of assessed land

value per acre. Seven variables are included in the equation and all are significant at the .001 level. The logarithm of the perimeter of a parcel is by far the dominant term as it accounts for nearly 65 percent of the variation in assessed value.

The data are also analyzed by multivariate methods. The location of a parcel with regard to major Oregon urban centers is dominant among the eight dimensions derived by factor analysis. Factor scores from the eight uncorrelated components are regressed against the assessed value per acre with size of the parcel again accounting for the majority of the variance explained.

Factors Affecting Rural Land Value in the Central Coastal Zone of Oregon

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I. INTRODUCTION

Classic land use theory, supplemented and expanded by recent investigation, has contributed much to the understanding of urban forms and structures. Likewise, many of the factors that influence agricultural land use and land value have been identified. A segment of the land resource which has not been so often investigated are the predominately non-urban, non-agricultural lands. These types, which herein will be referred to as rural, are frequently excluded from empirical and theoretical studies of land use and valuation. Low population densities and the lack of major economic impact of rural land have been sufficient cause to direct research toward the urban and agricultural sectors.

Rural land is characterized by a lack of homogeneity of land use. Although a rural area may contain several settlements and some areas of cropland, the majority of land parcels are typically devoted to pasture and grazing, forest, mineral extraction, recreation, transportation, service areas, natural areas or nonuse. Explanations of property valuation and use are complicated by this heterogeneity. Several attempts at explaining the market value per acre of land constituting a bonafide transaction have achieved moderate success. Most were conducted in areas of high but non-urban population densities and cultivated agriculture. Rural regions west of the 110th meridian are characterized by low population densities and extensive agriculture. Investigations which seek to identify the influences on land value and use are affected by these variations in the cultural and physical landscape. Factors which are found to be important in one region might be insignificant in another. The procedures used to sample parcels for analysis also affect the factors found to be important.

Approaches to Selection of Study Data

Investigations of the value of non-urban land have often been based on a sample of property transactions which are deemed to be bonafide sales. Such exchanges are thought to be the best indicators of the true market value of real property. Although the theoretical premise of the determination of true market value has been fulfilled, the sampling frame may in some instances prove to be inadequate. Data on bonafide transactions are time consuming to obtain, involve a certain judgment about qualification and, in empirical investigations, usually must span a number of years before an adequate number of observations can be collected. In addition, bonafide sales must represent a peculiar sample of the land market. One may conjecture that such sales are not a representative sample of all land parcels, due to the fact that the definition of the sampling frame allows only parcels which have been sold. Although this is an adequate frame for some uses, it could introduce sampling bias with regard to all possible land uses and a definite spatial sampling bias. Unless caution is exercised, it seems that a random sample of bonafide transactions in a typical rural area would select a greater proportion of parcels suited for development and nearer an urban fringe than any other type of parcel. An investigation based on this type of sample might select factors which influence the market value of a distinct minority of all possible land parcels. The stratified systematic sample used in this research insures that parcels are selected from all parts of the study area and that they represent the majority of possible land uses. Parcels of similiar use and location are likely to be appraised at approximately the same time, providing better estimations of market value over the strata and reduction of error in parameter estimation.

Thus sampling methodolgy, the land value proxy employed and the study area differ from most previous investigations. Conclusions regarding the relative importance of factors selected here as influencing land value must therefore be viewed in this light. Sample selection will be done in such a way as to minimize locational bias while insuring all land use types are included for analysis. Land values, as measured by assessed valuation, may differ from the hypothetical true market value in many instances, but should provide an adequate measure when prediction of land value is of secondary importance.

Research Objectives

Several research objectives were formulated in order to investigate the causes of land value on the Orgon coast. On the premise that the latent influences affecting rural land values are inherently similar through space, and have been identified as several different factors by previous investigations due to differing data collection and methodological techniques, the following objectives were formulated: (1) identify the factors which are thought to influence rural land value; (2) obtain information on as many of these factors as is practical; (3) formulate an hypothesis which can be used to judge the validity of the premise; and (4) judge the hypothesis through the analysis of data provide by multivariate methods and linear regression techniques.

Previous investigations of land value by appraisers and economists have naturally stressed the influence of market and cultural factors. The variation in a sample of market values might also be satisfactorily explained in terms of purely spatial factors and site (physical) characteristics.

Rather than employing variables which reflect the reaction of the real estate market to the site and situation of a land parcel, it is hypothesized that an explanation of the variation in land values which is equally successful may be defined exclusively in measures which are generally unaffected by the land market. It is the contention here that a model of assessed values with satisfactory explanatory power can be derived from spatial and site variables. Stated more succinctly, a linear relationship exists between assessed value per acre and the set of spatial, economic, and site variables.

II. LITERATURE REVIEW

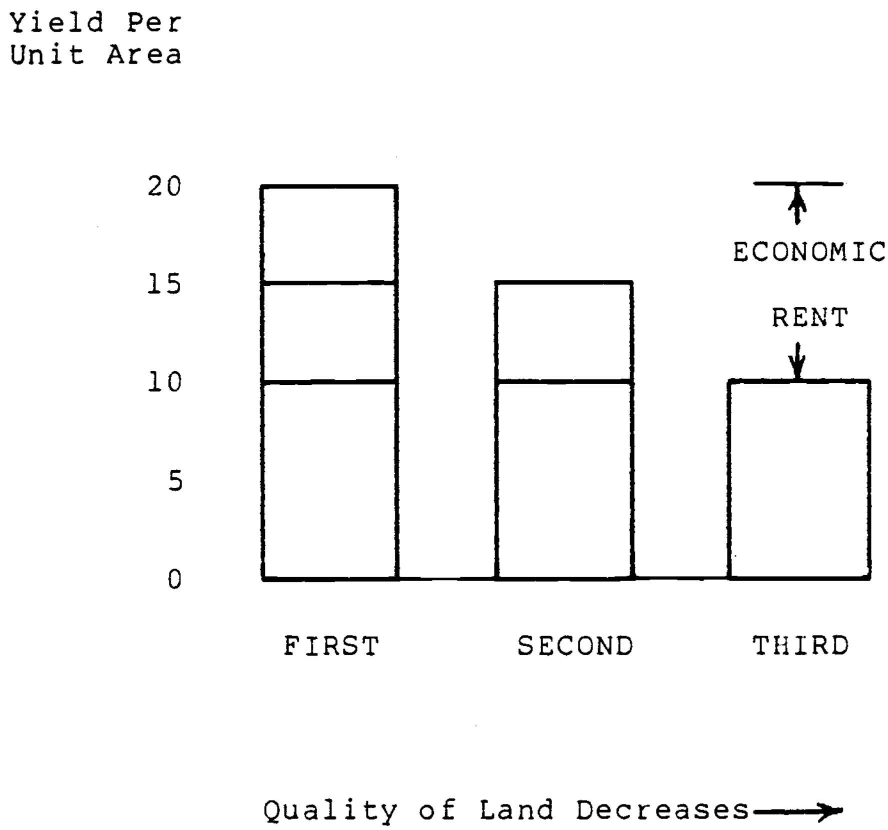
Theoretical

Inquiries as to the nature and spatial differentiation of land value and use began with the works of Ricardo and von Thunen. Land value is discussed by many earlier authors, but most lack the basic ingredient pertinent to a number of variables in the present study: the influence of distance on value. Although Ricardo was not directly concerned with the aerial distribution of value, his concept of economic rent is inherent in the von Thunen method of analysis. It should be noted that while both authors independently developed the idea, Ricardo's exposition preceeded von Thunen by several years.

Ricardo based his definition of economic rent upon inherent differences in soil fertility. If a developing region requires that only a small proportion of the total arable land be cultivated, then it follows that only the most fertile lands will be put to the plow. If an adequate supply of fertile land exists, no competition will exist among cultivators for the land resource and, therefore, no economic rent will accrue to these lands. As the population increases, the total area of best quality lands will be brought into production. Further population increases will cause lower quality land to be put into production, and rent will immediately accrue to the highest or first quality lands (See Figure 1). The amount of rent depends on the difference in fertility between the first and second quality lands. Eventually more land is needed and a third area of even less fertility is cultivated. Rent therefore commences on the second quality lands and increases on the most fertile. The process will continue until the margin of production for the existing conditions is reached. At the extensive margin, returns from labor and capital inputs will just equal the costs of bringing the land into production. The economic rent of a parcel is the return which can be obtained above that which can be obtained from areas at the margin of production. In the long run, it is this economic rent which tends to determine the spatial distribution of land uses and the value of a parcel.

A small modification to the previous argument will, in essence, provide the basis for the von Thunen exposition of the effects of location on rents. Instead of assuming that the land fertility is variable, let us hold that the land is of equal fertility, and let land quality vary only as to distance from the market. Assuming transportation costs increase linearly with distance, lands nearer the market have a rent advantage over more distant lands. This rent advantage is the difference in transport costs of moving a like product to market. As one moves further from the market, conveyance costs will increase until they are just equal to the return from the land. Thus transportation

Figure 1.--Ricardo's Explanation of Economic Rent.

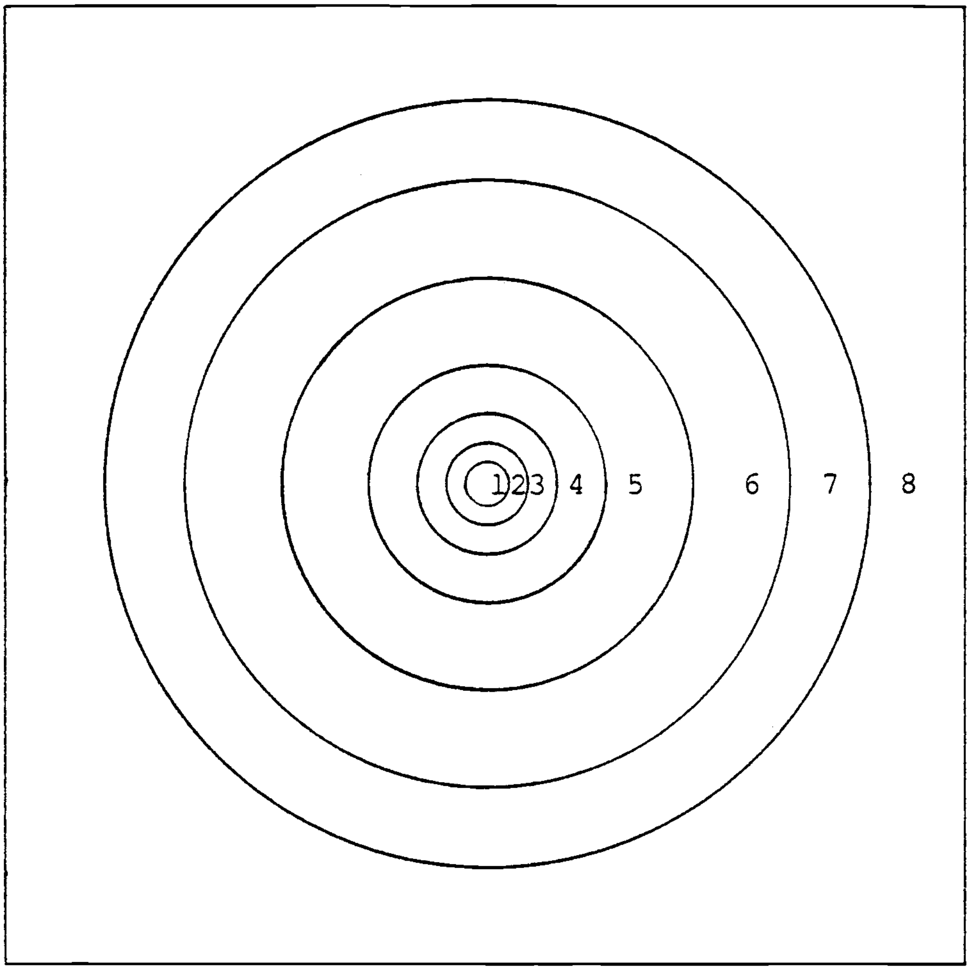


Source: After Chisholm, 1962, p. 23.

costs can also fix a margin beyond which production usually does not occur.

The complete von Thunen analysis of the "Isolated State" initally assumes homogeneity of all factors of land and production, and allows returns per unit of land to vary only with transportation costs. Under these assumptions, a definite pattern of land use will develop around a single market center through the process of competitive bidding among possible land uses for occupancy of a given site. The enterprise which will yield the greatest return per unit of land will make the highest bid for a given parcel. Land uses with a lower yield per unit area will be unsuccessful in their bid for the parcel and will be relegated to other locations, where they will be able to make the highest bid (Dunn, 1954, p. 6-7; Conkling and Yeates, 1976, p. 15). Products which are highly perishable or incur high transportation costs per unit of volume will occupy the innermost of a series of concentric rings (Figure 2). Outer rings will generally, but not always, be occupied by crops with lower transport costs per unit of production (Dunn, 1954, p. 12). For example, crop A is worth $10 per pound at the market and cost $6 per pound to produce, therefore a surplus of $4 per pound is realized by lands near the market (Figure 3). At an average yield of 100 pounds per acre the economic rent is $400 per acre. If the same crop were to be produced at a distance from the market, a transport cost

Figure 2.--Von Thunen's System of Land Use.



1 The Town

2 Horticulture & Dairying

3 Sylviculture

4 Crop Rotation without Fallow

5 Crop Rotation with Fallow

6 Three-Field System

7 Grazing

8 Wilderness

Source: After Chisholm, 1962, p. 29 and Conkling and Yeates, 1976, p. 20.

Figure 3.--Effect of Distance to Market on Net Product Value.

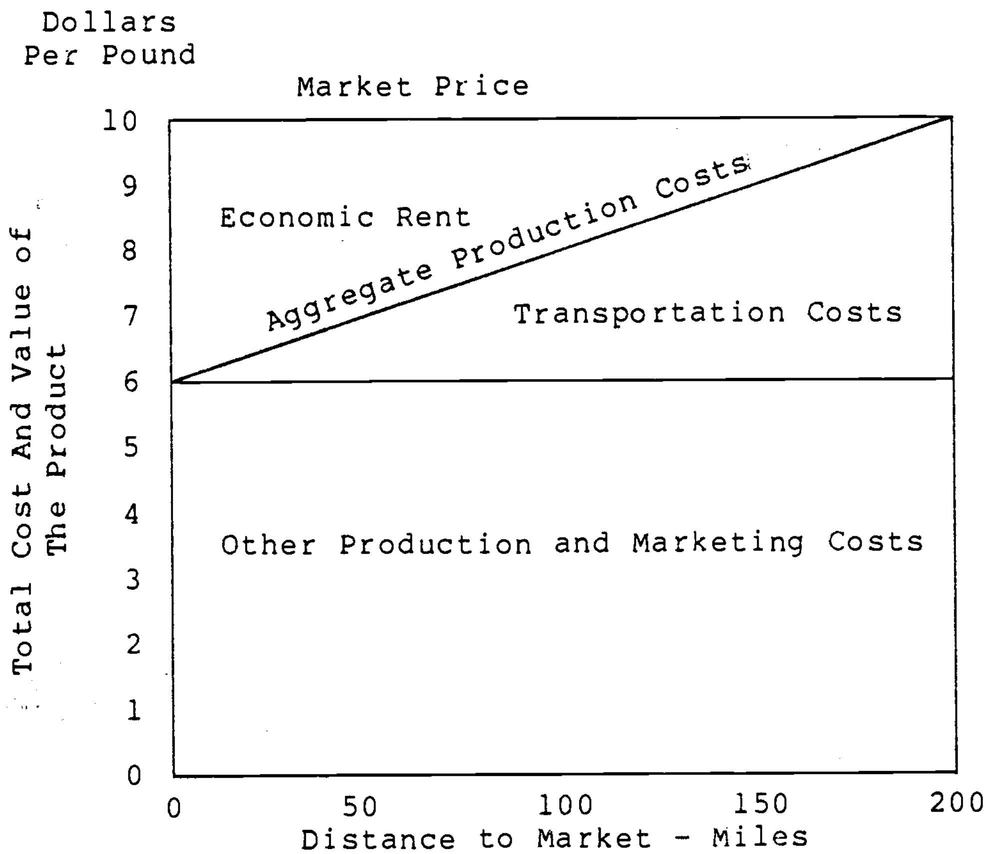
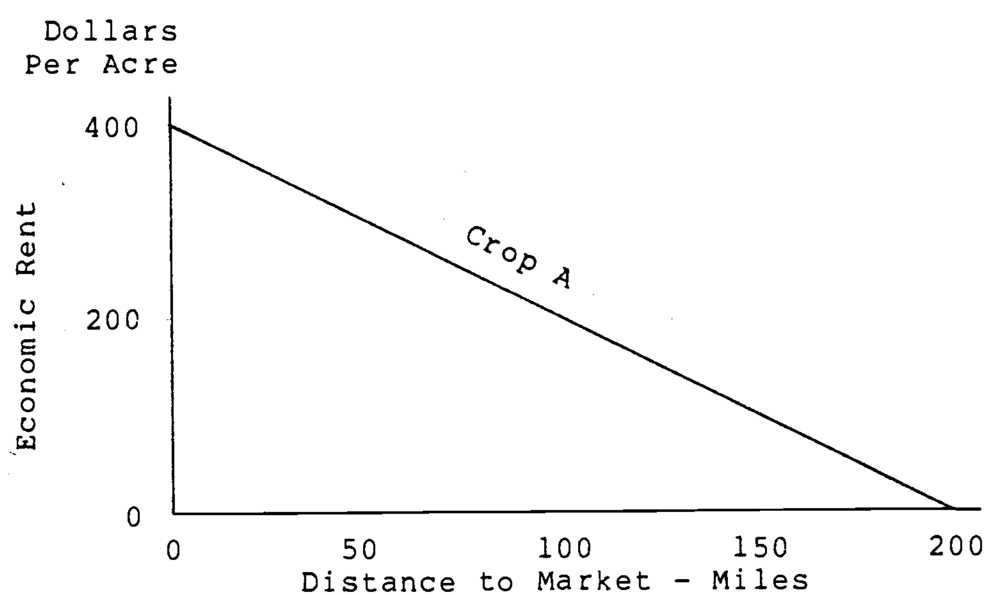


Figure 4.--Economic Rent and Distance to Market.

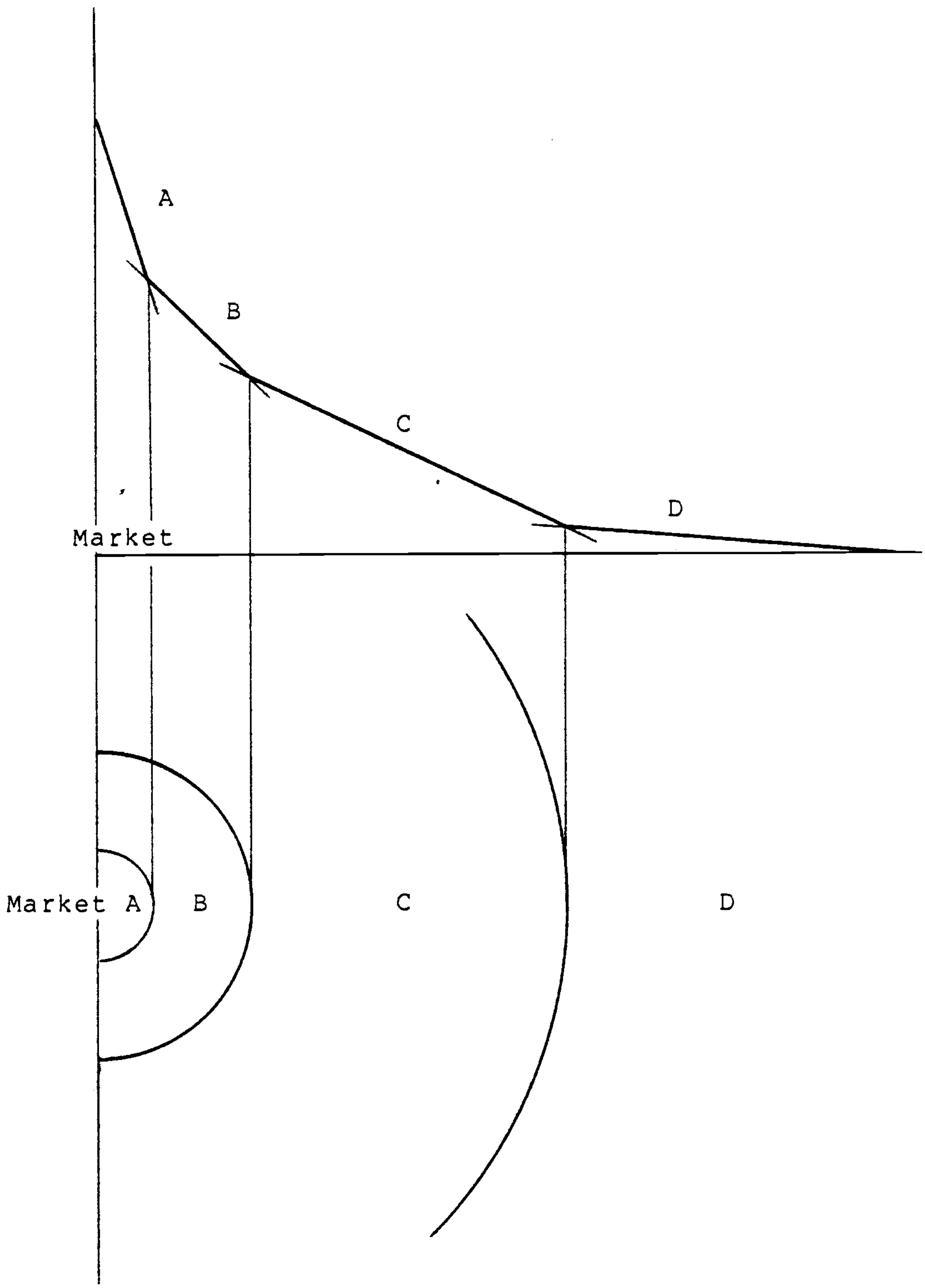


Source: After Barlowe, 1972, p. 168.

would be subtracted from the economic rent. At a rate of \$0.02 per pound per mile, the amount of rent per acre drops at \$2 for each additional mile from the market (Figure 4). At a distance of 200 miles, the crop would not compete for land. If one were to construct a curve for crops B, C and D, and plot them with the curve of crop A, then a composite curve as in Figure 5 would be realized. Rotating the curve about the vertical axis would produce the concentric ring pattern illustrated by von Thunen analysis (Figure 2). Each ring contains the land use that yields the greatest economic rent.

Relaxation of several of the initial simplifying assumptions concerning the nature of the land and production allows observation of the effect of factors other than distance to the market on the distribution of economic rents. Allowing routes of improved transportation would reduce the cost per unit distance for products from lands adjacent to the route, thereby elongating the pattern of land use along the route. Introduction of several other market places would create a series of rings about each place, elongated along the transport links connecting the places. Variable production costs would tend to broaden the rings in areas of lowered costs and narrow the rings in high production cost zones. The areal extent of the zones could be effected by governmental policies. Taxes, subsidies and foreign markets would introduce additional demand and

Figure 5.--Composite Rent Curves and Resulting Land Use.



Source: After Hoover, 1948, p. 95.

competition and cause artifical increases or reductions in production costs. With a reduction in the scale of analysis, one can also expect to find the same pattern of land use and economic rent existing within the holdings of an individual producer (Chisholm, 1962).

The work of von Thunen has been the subject of considerable discussion and some criticism. Conkling and Yeates (1976) and Lloyd and Dicken (1972) touch upon the general areas of concern. Early criticisms of the theory were centered upon the land uses found in the concentric zones, especially the occurrence of the zone of silviculture so near to the market. As Chisholm (1962, p. 30) pointed out, such an arrangement was to be widely encountered in Germany during the early nineteenth century. At this approximate distance from the market, no other agricultural pursuit could return a higher economic rent per unit area. Even in the twentieth century, such an arrangement has been reported in the area surrounding Addis Ababa, Ethiopia (Horvath, 1969).

The formation of the concentric rings of similar land use has been questioned. Of 27 possible combinations of two products, Losch (1954) found that in only 10 cases would rings result. Although Dunn (1954, p. 15) agrees that rings will not always occur in the two-product case, there is a high probability for occurrence in the multiple-product case. The conditions that are necessary and sufficient for ring formation hold that the rent curves for the products must intersect, and intersect above the abscissa of the rent-distance schedule.

Von Thunen has been criticized for his preoccupation with the details of his estate and subsequent failure to define the nature of the boundary between adjacent rings and develop a complete general theory of agricultural location. Further discussions have involved the omission of various factors today recognized as effecting the costs of transportation, the variable costs of inputs to agricultural production, and the assumption that all producers were the rational "economic man" with perfect knowledge of market and innovation (Chisholm, 1969, p. 401). Brinkman (1935) discusses several of these topics and other extensions to the classical model including changing the demand for agricultural products and advances in technology.

Regional studies have shown that the zonation of von Thunen is found surrounding several market centers. Works by Ahmad (1952), Chisholm (1962), Durand (1964), Gottman (1961), Harvey (1963), and Horvath (1969) support the general concepts of zonation as modified by local climate, physiography and culture. The maximization of economic rent has been found to exert a large influence on the patterns of agricultural production around the world.

The concepts of von Thunen are of great value in visualizing the basic causes for the distribution of rural land use. Several more recent investigations have attempted to overcome the limitations of the earlier normative model by including much of the variation found in the real world. Harvey (1966) discusses several approaches including the application of linear programming and the trade theory of comparative advantage to construction of models which maximize profits or minimize costs to explain land use. The simultaneous equations involved may also be used to predict the economic rent returned for each trade region. Other studies have employed stochastic variables in an attempt to introduce the uncertainty of climate, market and human behavior to models of rural land use. The techniques employed by these studies are beyond the scope of the present paper, but serve to illustrate the complexity involved in constructing explanations for real world phenomena.

Empirical Research

The majority of investigations on rural land value are concerned with providing an alternate means of property appraisal. One of the more comprehensive studies involves the estimation of the market value of rural properties in northern Georgia (Wise and Dover, 1974). A random sample of 105 cases was drawn from bonafide farm sales in seven counties. A linear multiple regression model with 23 independent variables was able to account for almost 80 percent of the variation in per acre sale prices. The four variables which accounted for nearly 64 percent of the variance are building value (dollars/acre) 33 percent, residential area (Yes-No) 16 percent, purchase for retirement (Yes-No) 9 percent and parcel size (acres) 5 percent. The original sample of seven counties was partitioned into three sub-samples and separate models developed for each. The two counties deemed to represent mostly mountainous forest land contained 30 sales. Approximately 63 percent of the variation in value per acre was explained by ten factors. Variables which were assumed to be measures of recreational importance accounted for one-half of the variation. For the two farm counties, building value (dollars/acre) 42 percent, size (acres) 10 percent, and purchase to farm (Yes-No) 8 percent accounted for 59 percent out of the total 71 percent of variation explained by 12 variables. The remaining 45 cases occurred in three counties which exhibited trends toward rapid suburbanization. Building value (dollars/acre) 27 percent, dominant city population (thousands) 14 percent, distance to interstate highway (miles) 8 percent and parcel size (acres) 8 percent were deemed to represent the influence of location relative to urban areas. The total variance explained among 12 variables was 68 percent.

One further model was constructed based on the potential land use of a parcel rather than the present use.

Three qualitative binary nominal variables were added to the set of independent variables. The three represented the potential of a parcel to be used as residential, farm or forest land. Each parcel was evaluated as to the most probable future use based on the integration of all available data and the intuitive notions of the researchers. Of the 86 percent of the variation explained by the independent variables, the potential for residential use accounted for 71 percent of the variance in per acre property values. As the variable is qualitative, the professional judgement of an experienced land appraiser in predicting potential use can be interpreted as the most important factor in explaining land prices in northern Georgia.

Another study of property values in Georgia concerned the relationship between Soil Capability Ratings and the sales price per acre of farm land (Schott and White, 1977). The influence of land capability on value was quantified as six variables. Each variable represented the proportion of the total parcel area occupied by a capability class. Two variables for occurence of river frontage and interstate highway access were included to account for possible site influences. The six variables representing the percentage of Land Class occuring on a sale and the locational variables were able to account for 86 percent of the variation in per acre sales price.

While the above studies are informative, one has to question the validity of the models selected. Neither showed whether any of the regression coefficients were significantly different from zero, whether any residual analysis was performed, or whether the effects of multicollinearity were investigated. In addition, Wise and Dover failed to indicate any measures of the efficacy of the grouping of the cases into sub-samples. The studies could be improved somewhat by application of standard tests for linearity and multicollinearity, and the analysis of residuals to validate the assumptions of the least squares model. Two articles by George W. Gipe (1974, 1975) on regression and residual analysis indicate that examples of the application of these test are to be found in the appraisal literature.

In a more rigorous application of regression analysis to predicting market value, Cox (1975) found that this method was a reasonable approach to estimating land value in South Carolina when the motive for purchase was to establish or expand farming operations. The 118 variables available for analysis were grouped into 18 terms for the covariance model. With the dependent variable as the value of land purchased with the intent to farm, the covariance factors accounted for 78.2 percent of the variation in value. The influence of commercial or industrial development, residential development, and the Interstate Highway, when combined with the location of the parcel and the stage of development to produce a single externality factor, was found to be the most important influence on purchase price. When a parcel was purchased to expand farming operations, reason sold was deemed the most important factor, with R squared equal to .682. Models for the three other strata of transactions, Investment in Land, Non-Agricultural Development and Rural Dwellings were not concluded to be significant due to a lack of observations for model fitting and validation. Although several factors which influence rural land prices were identified, no mention was made as to the relative importance of each factor. Cox also found that multiple regression is probably a useful approach to valuation and the motive for purchase is a viable means of stratifying the land parcels for analysis. The major limitation of the methodology seems to be the definition of the sampling frame to include only bonafide sales. While the limitation might result in better estimation of market values, the paucity of observations proved a major hurdle to analysis.

In dealing with rural parcels of at least 40 acres in northern Wisconsin, Munger (1964) found that factors measuring off-site influences were dominant. Such influence probably is due to the demand for land as residential property with little or no regard for agricultural or silvicultural potential. Although the three models developed here were only able to explain approximately 35 percent of the variation in land prices per acre, it is interesting to note that the size of parcel was not found to be important. Also of interest is that neither transformations nor test for linearity were applied to the models. The relative lack of variance explained might be related to a poor fit by the linear model and not the independent variables employed.

Brown (1972), in a time series analysis, found that time period was the most important influence on land value among urban fringe parcels of five to one hundred acres. The common logarithm of the time period was able to explain 51.4 percent of the variation in the common logarithm of land value per acre over a five year period. The logarithm of driving time to the nearest shopping center accounted for 6.5 percent and the logarithm of the percent change in census tract population another 4.3 percent. With all 14 variables in the equation, the amount of explained variation reached 74.2 percent. The optimal model, based on a shorter but more indicative time period, showed that driving time to the nearest expressway interchange was the most important variable, followed by the percent change in population lagged on time period, the existence of road frontage and the parcel size. The validity of the model was adequately verified as was the assumption of the least squares estimators.

While the above studies dealt with market value and therefore in some way should be affected by the von Thunen concepts of economic rent, few found distance to an urban place (or some proxy) to be a major influence. Even in the urban setting, some measure of distance to urban place (market place) should be evident (Isard, 1956). Most such studies mentioned the von Thunen concepts and make at least a cursory attempt at making available several distance variables for possible inclusion in models. Several models are quite successful at explaining market value without the specific inclusion of distance variables. One must therefore deduce that the action of distance on land values is included in the other variables as a latent influence. It is possible that at relatively large distances from points of attraction, the influence of distance to an urban center is weak, or acting in opposition to another place and so becomes masked by more localized influences on land value. Also, the nature of these investigations may have served to direct attention toward the identification of variables which embody the action of distance in market terms, rather than as strictly spatial measures.

The action of distance to market on economic rent was identified in the mid-nineteenth century. Von Thunen showed that in a hypothetical, highly artifical environment, a certain pattern of land values and use would develop. Relaxation of several of the artifical constraints should produce predictable modifications to the initial land use patterns. Indeed, many of the patterns hypothesized by von Thunen have been identified in the real world. In contrast to the normative approach mentioned above, several recent investigators have attempted to develop explanations of land use patterns based on the variability found in nature. Other modern approaches involve modeling of the theories of comparative advantage applied at both regional and global scales. Identification of specific factors affecting rural land value have generally relied on linear models.

In several instances, rural land values were shown to vary in response to market influences generated by urbanization or the value of buildings on a site. Few have attempted to discern the possible influences of site and spatial location on land value. The following chapter describes the analytical techniques utilized to identify the factors that influence rural land value in coastal Oregon.

III. METHODOLOGY

The Sample

Recreational and "second home" development has given the Oregon Coast a widely divergent land use pattern. The flood plain areas are generally devoted to agriculture, the mountainous terrain to timber production, and various beach front and streamside locales have been developed. Land use, parcel size, and property value will vary widely among such areas. To provide a high degree of accuracy concerning conclusions about land parcels in the study area, and to include a variety of land uses, a stratified systematic sample was designed. The sample design and selection of parcels was done for an earlier investigation by Northam, Maresh and Nolan (1975). Four variables used in this research are taken from the 1975 report. Small and large scale aerial photography, county assessor plat maps and field reconnaissance were employed to classify each section (640 acres) of land in the study area as to the predominant land use. Sections were thus identified as one of four classes or strata: Agriculture, Development, Forestry, or Coastal Mix. Considerable latitude was necessary in the classification process due to the size of the unit of stratification and the previously mentioned spatial irregularity of use. Predominance was defined simply as occupying the largest area and thus each section usually was comprised of areas of all land use types (Northam et al, 1975).

The sampling frame was defined as all taxable land parcels occurring within the study area which were on the Lincoln County and Tillamook County Real Property Tax Roll for the Tax Year 1973-74. The number of items in the frame was estimated to be 12,789 (Table 1). Due to the wide variation in stratum size, two sampling frequencies were used. For the Development stratum a 5 percent frequency was chosen, and for the remaining strata, a 50 percent (and in one instance 67 percent) frequency was used. Item selection was done systematically using a random starting item in the Agriculture, Forestry, and Coastal Mix strata. For the Development stratum, the procedure was modified to realize savings in data collection and field time. Rather than selecting every twentieth item throughout the stratum, every fifth was chosen until a total of ten items was drawn. The sampling then proceeded with the next randomly chosen starting point. In all strata, the sample was treated as a systematic sample using random starting points. The number of parcels designated for selection and the number finally accepted for analysis differ slightly due to post-selection sampling frame validation. Several other items representing small parcels of odd shape were also dropped during the analysis process as they were deemed deviate cases. The totals shown in Table 2 indicate the number of cases

TABLE 1.--Estimated Strata Sizes, Sampling Frequency, and Number of Elements to be Drawn: Oregon Central Coastal Zone.

County/Stratum	Estimated Size	Sampling Frequency	Number To Be Drawn
Lincoln			
Agriculture	126	50%	63
Coastal Mix	391	50%	196
Development	7103	5%	355
Forest	101	50%	51
Tillamook			
Agriculture	196	50%	98
Coastal Mix	136	50%	68
Development	4636	5%	232
Forest	100	67%	67
Study Area			
Agriculture	322	-	161
Coastal Mix	527	-	264
Development	11,139	-	587
Forest	201	-	118
Total			
	12,789	-	1130

Source: After Northam et al, 1975, p. 21.

Table 2.--Summary of Sample in the Oregon Central Coastal Zone: Number of Elements Retained, Proportions, and Expansion Factors.

County/ Stratum	Estimated Size	Number of Elements	Actual Sampling Frequencies	Expansion Factors
Lincoln				
Agriculture	126	63	50%	2.000
Coastal Mix	391	189	48%	2.069
Development	7103	326	5%	21.788
Forestry	101	49	49%	2.061
Tillamook				
Agriculture	196	98	50%	2.000
Coastal Mix	136	65	48%	2.092
Development	4636	223	5%	20.789
Forestry	100	65	65%	1.538
Study Area				
Agriculture	322	161	50%	-
Coastal Mix	527	254	48%	-
Development	11,739	549	5%	-
Forestry	201	114	57%	-
Total				
	12,789	1078	8%	-

actually used for analysis. An analysis of variance showed that the means of the strata for parcel size and land value were significantly different at the 0.001 level. Henceforth, all references to values derived from the sample will be estimates of the true population parameters based on the expansion factors shown in Table 2.

Analysis

Analysis of the factors affecting assessed land values was comprised of four steps. Data checking and verification was the first procedure. Second, multivariate analysis was performed to investigate the underlying dimensions of variability among the variables. Regression and the search for the best set of independent variables was the third operation. Finally, residual analysis was performed to verify the assumptions of the model and to suggest additional independent variables.

Data were gathered from a variety of sources and in many formats. To facilitate collection, the majority of the information was taken in a "shorthand" form and entered on optical scanning data sheets. An optical scanner device converted the image patterns to machine readable permanent storage files. An array of computer programs were devised to manipulate and expand the raw data into a usable format. Several other programs inspected the data for values which were beyond predetermined limits or were illogical when evaluated in conjunction with others. The finished files were input to the Statistical Package for the Social Sciences (SPSS) (Nie et al, 1975), and the Statistical Interactive Programming System (SIPS) (Rowe, Brenne, Barnes and Ewert, 1978).

Among the procedures available in SPSS is the Factor Analysis Subprogram. Two of the factoring methods available, principal components and principal factors, were utilized for descriptive purposes. Both methods were employed due to uncertainty as to the existence of common factors. The principal components model is as follows (Nie et al, 1975, p. 470):

$$z_j = a_{j1}F_1 + a_{j2}F_2 + \dots + a_{jK}F_K$$

where: z_j = variable j in standardized form;

a_{jn} = regression coefficients;

F_n = derived uncorrelated components;

$j, K = 1, 2, \dots, n.$

The principal factor model is given below (Nie et al, 1975, p. 471):

$$z_j = a_{j1}F_1 + a_{j2}F_2 + \dots + a_{jm}F_m + d_jU_j$$

where: z_j = variable j in standardized form;

F_i = hypothetical factors;

U_j = unique factor for variable j;

a_{ij} = standardized multiple-regression coefficient of variable j, on factor i (factor loading);

d_j = standardized regression coefficient of variable j on unique factor j;

$j \quad = 1,2, \ldots ,n;$

$m \quad \leq n.$

The following correlations are assumed to hold among the hypothesized variables:

$r(F_i,U_j) = 0, \quad i = 1,2, \ldots ,n; \quad j = 1,2, \ldots ,n;$ and $i \neq j;$

$r(U_i,U_j) = 0, \quad j \neq k.$

Selection of the independent variables which most influence land value was based on regression equations produced by the SPSS Subprogram Regression. The stepwise option causes a series of equations to be constructed which only allow variables of the previous equation to remain if they meet certain minimum levels of explanatory power. In a similiar fashion, the independent variable which contributes most to the reduction in the the remaining variation of the dependent variable is included in the equation. The process continues until none of the remaining variables meet the minimum criteria for inclusion. The best set of independent variables is defined as the point at which the coefficient of determination (R squared) fails to show significant improvement as another variable is added or the point at which the mean square for error fails to decrease or the decrease is insignificant. The form of the general least squares linear model is as follows (Neter and Wasserman, 1974, p. 218):

$$Y_i = B_o + B_1 X_{i1} + B_2 X_{i2} + \ldots + B_p X_{ip} + \varepsilon_i$$

where: $B_0, B_1, \ldots, B_p$ are parameters;

$X_{i1}, X_{i2}, \ldots, X_{ip}$ are known constants;

ε_i are independent errors $N(0,\sigma^2)$;

$i = 1,2, \ldots ,n$.

The above model is an appropriate estimator of coefficient values only when a set of assumptions concerning the variables is verified. The aptness of a model is often determined through a process known as residual analysis.

The residuals are the difference between what is actually observed and what is predicted by the regression equation. Thus residuals are defined as (Draper and Smith, 1966, p. 86):

$$e_i = Y_i - \hat{Y}_i$$

where: Y_i is an observation;

$\hat{Y}_i$ is the corresponding fitted value obtained by use of the fitted regression equation;

$i = 1,2, \ldots ,n$.

Neter and Wasserman (1974, p. 8-9) list several categories of departures from the simple linear model which can be detected through graphical analysis of residuals:

1. The regression function is not linear.
2. The error terms do not have constant variance.
3. The error terms are not independent.
4. The model fits all but one or a few outlier observations.
5. The error terms are not normally distributed.
6. One or several important independent variables have been omitted.

Although graphic analysis is inherently subjective, analysis of several residual plots will generally reveal any departures from the assumptions of the model. The run test, Durbin-Watson and chi-square test are available if a formal test is desired. In addition, inspection of the correlation matrix for the independent variables will expose any violations of the assumptions of uncorrelated independent variables.

The bulk of the effort in regression research is devoted to an iterative process of model contruction, residual analysis, model construction, and so forth. Each round of residual analysis will suggest data transformations on existing variables, or new variables for inclusion in subsequent models. The process continues until there is no reason to believe that any of the assumptions have been violated, or the simple linear model is deemed inappropriate for the task at hand.

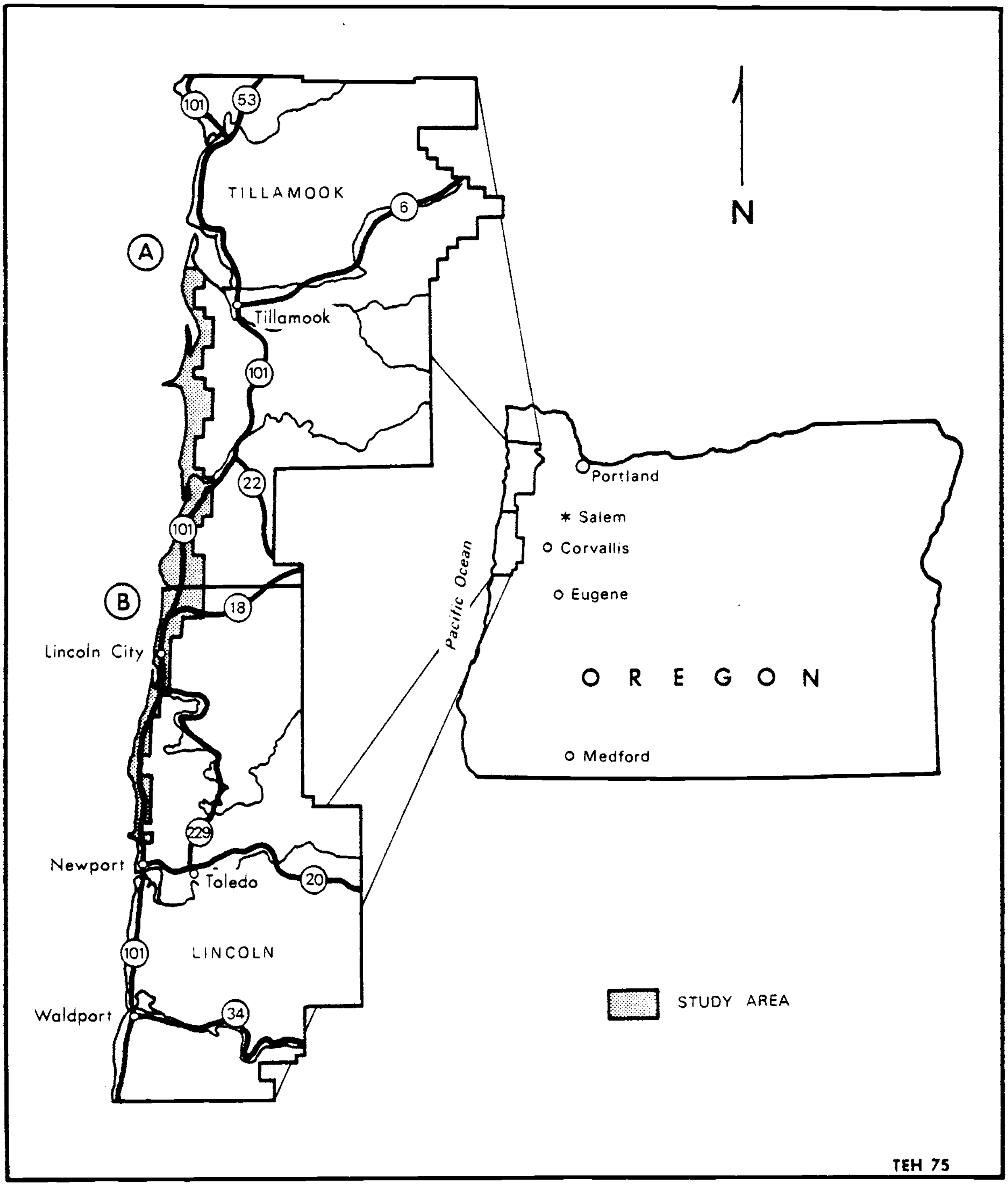
IV. STUDY AREA AND DATA SOURCES

Study Area

The area of investigation is a portion of the central coast of Oregon (Figure 6). Specifically, the area encompasses the land from the City of Newport on the south to Cape Meares on the north. It begins at the Pacific shore on the west and continues eastward to a line approximately one mile east of the paved highway which parallels the coast. Thus the area is approximately 58 miles in length and from 0.8 to 6.3 miles in breadth (Figure 7).

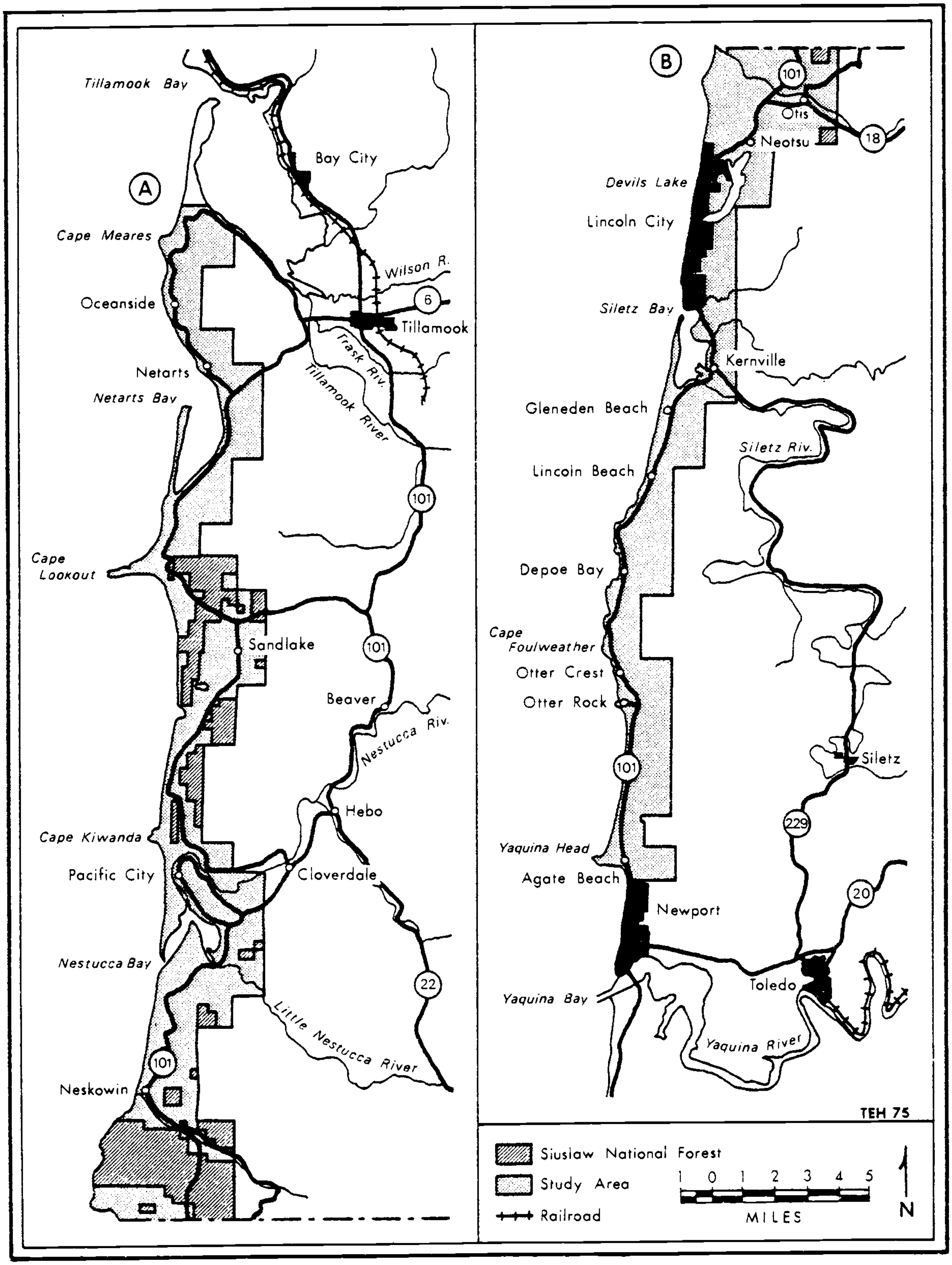
The physiography is typical of an emergent coastline of strong relief. The majority of the generally linear coast consists of marine terraces interrupted by a number of headlands and an occasional embayment. The terraces rise steeply from the narrow beach to elevations generally of 50 to 100 feet and extend inland up to one mile. In the vicinity of the headlands, the cliff face is much more pronounced, extending to near 400 feet, with one vertical rise to 700 feet. In contrast to the majestic headlands are the narrow embayments. These occur in conjunction with two sand spits and at the mouths of the four major streams of the area. Generally less than three square miles in extent, the littoral margin of the bays and the entire coast is of complex form due to a seasonal reversal of longshore currents. These terraces and headlands are actually the

Figure 6.--Location of Study Area.



Source: Northam et al, 1975, p. 15.

Figure 7.--Study Area: Oregon Central Coastal Zone.



Source: Northam et al, 1975, p. 16.

western flank of the Coast Range. Offshore remnants of the headlands are prominently visible as numerous arches and sea stacks.

Thus, the mountains rise almost directly from the sea to coastal elevations of 200 to 300 feet. To the east, the rounded hills give way to steep slopes and narrow ridges with local relief of 500 to 700 feet and elevations of near 1500 feet. Evidence of slides and slumps are visible throughout the area (Schlicker et al, 1972, 1973).

Precipitation ranges in amount from over 70 inches along the coast to more than 180 inches in parts of the Coast Range. Mean annual precipitation for Tillamook is 90.82 inches, Cloverdale 84.53 inches and Newport 70.73 inches (U.S. Weather Bureau, 1973).

The area is under the influence of the numerous Pacific frontal systems during the winter months and the mid-Pacific high pressure regime in the summer. Thus, nearly 80 percent of the precipitation occurs from October through March each year. The mean annual maximum and minimum temperatures for Tillamook are 58.9 and 41.7, Cloverdale 60.3 and 43.0, and Newport 57.3 and 43.2 degrees (U.S. Weather Bureau, 1965). The growing season ranges from 250 days along the coast to 140 days in the inland areas. In the Koppen-Geiger system of climatic classification the study area would be a "Csb" or a "dry summer, subtropical" climate.

Vegetation is dominated by coniferous forest with the major coastal species being Sitka spruce and Western hemlock. Inland the Douglas fir is predominant in conjunction with the hemlock. Over 90 percent of the land area of Lincoln and Tillamook counties is classified as forest land by the U.S. Forest Service (1964, 1965). Grasslands occur along the stream courses and on flood plains, and in widely scattered, but highly visible, hillside and headland locales.

The cultural landscape relects the influence of this physical setting. The bulk of the populace occurs immediately adjacent to the coast. Settlements are widely spaced and are found along the bays, river courses, or confluences of transportation routes. The City of Newport is the largest urban place in this section of the coast, followed by Lincoln City and Tillamook (Figure 7). Newport, with a 1977 population of 6,550, is the county seat and largest place of Lincoln County and is a service center for the logging and maritime industries. Lincoln City, population 4,650, also serves the logging industry but is primarily a recreation and tourist based center. Tillamook, population 4,300, is the seat of county government for Tillamook County and serves the local dairy industry as well as logging and paper concerns. It is also the largest place in the county. With declining timber production, the economic base of the area has shifted somewhat to tertiary activities in support of recreational and tourist activities and the associated "second home" land developments. These developments generally occur outside city corporate boundaries. Because the study area was defined to exclude land within city corporate boundaries, such developments provide the basis for a major portion of the urban land parcels selected for analysis.

The Variables

Identification of the factors or influences which create market value should not be a difficult task. Economic theory states that the value is created by interaction between the supply of a good or land parcel and the demand for the good. The exchange offered by the informed purchaser is determined by the evaluation of a wide variety of tangible and intangible characteristics of the land. Each purchaser may weight a certain characteristic more heavily than another thus producing widely varying estimates of value. In contrast, the procedure followed by experienced appraisers is well defined and considers a large number of factors such as the characteristics of the site and its environs (Barlowe, 1972, p. 313). Although the value derived by an assessor is often less than market value, one can expect more uniformity among estimates of value. Spatial influences, such as those discussed in Chapter II, also contribute to the value of the land. Complications arise when one attempts to define a quantitative representation of certain of the theoretical influences. Intangible factors such as the scenic qualities of the site fall into this category. Certain other easily defined economic and physical factors might prove just as elusive due to the vagaries in data collection and presentation found in all governmental organizations. Soil surveys, for example, often are limited to specific locales and are of limited utility in regional scale inquiries. In practice, data are collected on every factor which is believed to influence the dependent variable and are available with reasonable effort. The set of variables assembled for possible use in analysis and description are given in Table 3. To facilitate manipulation, the variables are grouped into three classes: Economic; Physical; and Spatial. Classification was arbitrary and guided mainly by the source of data and the mode of collection.

Table 3.--Variables Available for Analysis: Central Oregon Coastal Zone.

I. ECONOMIC

1. L1 - Assessed land value (dollars).
2. IMPF - Improvements (binary).
3. TCO - County tax rate (dollars).
4. TPORTS - Port district tax rate (dollars).
5. TROADS - Road district tax rate (dollars).
6. TFIRE - Fire district tax rate (dollars).
7. TH2O - Water district tax rate (dollars).
8. THOSP - Hospital district tax rate (dollars).
9. TSAN - Sanitary district tax rate (dollars).
10. TSCH - School district tax rate (dollars).
11. TTOTAL - Consolidated tax rate (dollars).

12. ZONEC - County land use zone.
13. ZONEUSE - Highest and best land use index.

II. PHYSICAL

14. AREA - Area of parcel (acres).
15. PERIM - Perimeter (feet).
16. CIRC - Circularity index.
17. ELEV - Elevation (feet).
18. SLOPE - Slope (percent).
19. SOIL - Predominant soil series.
20. EROS - Erosion hazard (index).
21. SHRINK - Shrink-swell potential (index).
22. SEPTIC - Limitations on septic tank fields (index).
23. DWOB - Limitations on dwellings without basements (index).
24. DWB - Limitations on dwellings with basements (index).
25. COMMB - Limitations on small commercial buildings (index).
26. RDSTS - Limitations on local roads and streets (index).
27. PASTAUM - Pasture-animal units per month per acre.
28. DFSITE - Douglas fir site index.
29. SCAPRAT - U.S.D.A. Soil Capability Class.
30. FLDHAZ - Flood hazard (binary).
31. HIH2OT - High water table (binary).
32. LNDSLD - Land slide topography (binary).
33. INASLD - Inactive slide area (binary).
34. ACTSLD - Active slide area (binary).
35. LNDUSE - Land use.
36. FOREST - Forest land use (binary).

III. SPATIAL

37. COUNTY - (binary).
38. STRATA - Land use stratum from which parcel was selected.
39. CAMPWOR - State/county park without overnite facilities, highway (miles).
40. CAMPWOA - State/county park without overnite facilities, airline (miles).
41. CAMPWR - State/county park with overnite facilities, highway (miles).
42. CAMPWA - State/county park with overnite facilities, airline (miles).
43. VEGLINA - Pacific shore (miles).
44. HWYR - Highway (miles).
45. MARTR - Major arterial (miles).
46. WATERA - Water body (miles).
47. UP8R - Eighth order urban place, highway (miles).
48. UP8A - Eighth order urban place, airline (miles).
49. UP7R - Seventh order urban place, highway (miles).
50. UP7A - Seventh order urban place, airline (miles).

51. UP6R - Sixth order urban place, highway (miles).
52. UP6A - Sixth order urban place, airline (miles).
53. UP4R - Fourth order urban place, highway (miles).
54. UP4A - Fourth order urban place, airline (miles).
55. UP35R - Third-fourth order urban place, highway (miles).
56. UP35A - Third-fourth order urban place, airline (miles).
57. UP3R - Third order urban place, highway (miles).
58. UP3A - Third order urban place, airline (miles).
59. SUBINDX - Platted subdivision index.

Interpretation of regression coefficients is predicated on the definition of each variable and most important, the units of measurement. The definition, scale of mensuration and source of each variable utilized is given below.

1. Assessed Land Value: This variable, when divided by the area of the parcel, is the dependent (Y) variable. Dollar values for variables one and two were obtained from the 1973-74 Real Propery Tax Roll in the Assessors Office of the respective counties. There is some question as to the relationship of the assessed value of a parcel and its market value. Oregon State law requires that the assessed value of all parcels be within five percent of the market value. In practice, rural parcels are appraised at least every five years (and more recently every three years in urban fringe areas), and seem to be conservative estimates of value.
2. Improvements: The existence of improvements to a

land parcel has a definite influence on the assessed value per acre. Parcels which lacked improvements showed a mean value per acre of approximately $6,000 less than those with improvements. To control for this difference, an indicator variable was created, based upon the existence or absence of improvements.

3. County Tax Rate: Several variables are derived from the disaggregation of the consolidated tax rate for each county. The county tax is the rate in dollars per thousand dollars of total assessed valuation which is levied by county government. In the present study, it merely reduces to an indicator variable for the county from which the parcel was selected. Data for all the tax rate variables were obtained from the county Tax Collectors Office.

4. Port District Tax Rate: The study area encompasses portions of the Port of Newport and the Port of Tillamook assessment districts. The variable is the rate in dollars per thousand dollars of assessed valuation levied by the port district. The actual rate is unimportant and the variable is used as an indicator variable for inclusion in the port district. Since the ports are also the major urban centers, this variable might tend to indicate

the relative proximity of the parcel to a population center and indirectly the Pacific shore.

5. Road District Tax Rate: The rate in dollars per thousand dollars of assessed valuation levied by a local district formed to provide and improve local roads. The variable was included as a measure of services available, i.e., good roads, but such districts are not common and therefore limit their contribution.

6. Fire District Tax Rate: The rate in dollars per thousand dollars of assessed valuation levied by Rural Fire Protection Districts. The existence of fire protection directly influences insurance rates and therefore would seem to influence the value of a parcel through the suitability of the land for development. As mentioned in number two above, the existence of improvements do effect parcel land value.

7. Water District Tax Rate: The rate in dollars per thousand dollars of assessed valuation levied by water supply districts. Here again, the availability of water at a site would seem to influence the property value. Some individuals prefer to provide their own water supply, and tend to look at the tax as an added burden, while other potential buyers would place importance on the

service. Such disparity might tend to reduce the importance of this variable.

8. Hospital District Tax Rate: The rate in dollars per thousand dollars of assessed valuation levied by a hospital district. Although no hospital districts exist in the Tillamook County portion of the study area and all of the Lincoln County portion is in a single taxing district, the variable reduces to an indicator variable for the county.
9. Sanitary District Tax Rate: The rate in dollars per thousand dollars of assessed valuation levied by a sanitary waste disposal district. The existence of sewer facilities seems to be in the same situation as number seven above, water districts. Opinions may differ as to whether the service is an asset or a liability. With existing and increasing Federal and State pressure for improved sewer arrangements, this variable probably indicates the existence of an amenity at a site.
10. School District Tax Rate: The rate in dollars per thousand dollars of assessed valuation levied by all school districts. This variable was envisioned as indicating the level of educational services available to a resident at a site, since all parcels are in at least a high school district.

With a higher tax rate, it was assumed more services would be provided and therefore provide a greater attraction for residential developments and a higher parcel value. In vacation developments, the added taxes might depress land values. Buyers would tend to avoid taxation for unwanted services.

11. Consolidated Tax Rate: The rate in dollars per thousand dollars of assessed valuation levied for all taxing districts. Since it is a linear combination of variables three through ten, it serves only as a general description of the level of public services provided at a site. In some instances, public services are considered an added burden and thereby might lower land values.

12. County Land Use Zone: The land use which is allowed outright on a parcel. In addition, there are requirements for lot size, building height and public utilities associated with each class. Land use zone was included primarily as a general indication of the use the county planning staff feels is appropriate at a particular site. Data were obtained from the County Planning Offices.

13. Highest and Best Use Index: The land use which theoretically produces the greatest return on a site is termed the highest and best use. Zoning use classes defined by variable number twelve are

grouped into general land use classes. Each parcel is given a designation which indicates how the permitted land use ranks as to economic return among all land uses. The general land use classes in rank order are as follows:

1. Industrial (Greatest Return).
2. Commercial.
3. High Density Residential.
4. Medium Density Residential.
5. Low Density Residential.
6. Agriculture.
7. Forestry (Least Return).

14. Area: The area of a sampled parcel expressed in acres. Values were obtained from county real property assessment rolls and from the assessors plat maps. Sample parcel sizes range from 0.01 to 640 acres.

15. Perimeter: The length of the perimeter of a parcel given in feet. Perimeter was included primarily as an input for the circularity index, but also as a proxy for the influence of shape on land values. Perimeters were measured on assessors plat maps and U.S.G.S. quadrangles.

16. Circularity Index: This variable is a measure of the amount of irregularity present in the shape of a parcel. It seems logical that the more irregular

a parcel is in shape, the lower its intrinsic value for purchase or development. The index (R) is derived by the following formula (Gregory and Walling, 1973, p. 51):

$$R = \frac{\text{Area of Parcel (A)}}{\text{Area of Circle of Equal Perimeter}} = \frac{4\pi A}{p^2},$$

where: p = parcel perimeter.

17. Elevation: Approximately fifty percent of the area of a parcel is higher than this vertical distance above mean sea level. Data for elevation and slope were obtained from United States Geological Survey 15 minute quadrangles. In this area, parcels at a low elevation would tend to be prone to flood hazard, or at high elevation, might occur on steep slopes far from the Pacific shore or urban areas. Thus it would tend to exert a negative influence above or below a certain value.

18. Slope: The influence of topography on parcel value is given as percent slope. Approximately fifty percent of the area of a parcel has slopes steeper than this value. The reliability of this variable decreases as parcel area increases due to the averaging process. In general, parcels with steeper slopes would be expected to have lower land values.

19. Predominant Soil Series: Selection of a soil

series is based upon the proportion of a parcel each series occupies. The series that covered the largest portion of a parcel was selected as the dominant series. The variable is shown here for reference only. Data were obtained from annotated soil survey field sheets (aerial photographs), the Soil Survey of the Tillamook Area (Bowlsky and Swanson, 1964), the U.S.D.A. Soil Conservation Service field offices in Newport and Tillamook and field observations. Each soil series is interpreted for a variety of potential applications. The ratings do not preclude the use of the soil for a certain purpose, rather they only point out possible difficulties to be expected. If additional expenditures are required to mitigate such problems, then the value of the parcel for development would tend to diminish. The following ten variables are examples of the most relevant of the soil limitation interpretations.

20. Erosion Hazard: Each soil is rated as to the expected severity of erosion if the ground cover is removed. Parcels with soil erosion problems would tend to have lower land values than those without such difficulties. Additional development costs for grading, slope maintenance and footings would tend to contribute to this reduction in value.

Erosion hazard classes are slight, moderate, high and very high.

21. Shrink-Swell Potential: The expected relative change in the volume of a soil caused by changes in soil moisture content. The value of parcels that occur on a soil with a high shrink-swell potential would tend to be reduced due to added costs of reinforcement and grading. The classes of shrink-swell potential are low, moderate, and high.

22. Limitations on Septic Tank Fields: The ability of a soil to absorb effluent from septic tank drain fields is indexed by this variable. Again, a high rating would indicate added costs if the parcel were developed for residential use. Limitations are indicated as slight, moderate, or severe.

23. Limitations on Dwellings Without Basements: The relative restrictions placed on construction of dwellings of less than four stories by soil properties are indexed by this variable. Elements considered are load bearing capacity, resistance to settling and ease of excavation.

24. Limitations on Dwellings With Basements: This variable measures the same properties as dwellings without basements except with added emphasis on soil properties relative to excavations and subsurface moisture. Possible ratings for both

variables are slight, moderate, and high degree of limitations.

25. Limitations on Small Commercial Buildings: This variable measures the same considerations as for dwellings except that the slope limits for each class are reduced. Each parcel is rated as having slight, moderate, or severe limitations on development of small commercial structures.

26. Limitations on Local Roads And Streets: The limitation on use of a soil as a base for construction of local all-weather roads and streets. The rating is a composite of several engineering considerations such as load bearing capacity, workability and quality of cut and fill material. The classes of limitations on construction of local roads and streets are slight, moderate, and severe.

27. Pasture Animal Units per Month: The predicted average yield per acre of soils used as pasture land under a high level of management. A large value for this variable would tend to indicate the desirability of the land for grazing purposes. The number of animals per month per acre ranges from zero to thirteen units.

28. Douglas fir Site Index: The average total height of the dominant and codominant trees in a stand at

the age of 100 years. Thus the index is an indication of the potential tree growing productivity of a parcel. Average heights for soils which are rated for this index range from 110 to 185 feet.

29. U.S.D.A. Soil Capability Class: The general suitability of soils to be used for most types of field crops. Suitability classes are defined by the limitations a soil series imposes on agriculture, the risk of soil damage if cultivated and the practicality of conservation measures on the soil. Eight classes are defined but classes I and V are not present in the study area. Class II makes up only 8 percent of the unweighted sample, Class III is 33 percent, Class IV is 26 percent, Class VI is 25 percent, Class VII is 3 percent and Class VIII makes up 5 percent. The Capability Classes are defined as follows:

    1. Class I soils have few limitations that restrict their use.

    2. Class II soils have moderate limitations that reduce the choice of plants or require moderate conservation practices.

    3. Class III soils have severe limitations that reduce the choice of plants, require special conservation practices, or both.

    4. Class IV soils have very severe limitations that reduce the choice of plants, require very careful management, or both.

5. Class V soils are not likely to erode but have other limitations, impracticable to remove, that limit their use largely to pasture, range, woodland, or wildlife.

6. Class VI soils have severe limitations that make them generally unsuited to cultivation and limit their use largely to pasture or range, woodland, or wildlife.

7. Class VII soils have very severe limitations that make them unsuited to cultivation and that restrict their use largely to pasture or range, woodland, or wildlife.

8. Class VIII soils and landforms have limitations that preclude their use for commercial plants and restrict their use to recreation, wildlife, water supply, or to [a]esthetic purposes (S.C.S., 1977, p. 1).

30. Flood Hazard: A binary indicator variable signifying the propensity of a parcel to experience stream or ocean flooding. Data were obtained from overprinted U.S.G.S. quadrangles accompanying Schlicker et al (1972, 1973). A parcel is considered to be subject to flooding if a majority of its area was shaded by the symbol for flood hazard. The effect of flooding on property values seems to be directly proportional to the actual occurrence of flooding. Areas which are flooded regularly show lower property values.

31. High Water Table: A binary indicator variable denoting the presence of the ground water table at or near the ground surface for a significant

portion of the year. The predicted presence of this hazard was derived in the same manner as flood hazard.

32. Landslide Topography: This variable is a binary indicator variable for presence or absence of old landslide topography. Irregular hummocky ground showing disrupted drainage but no well-defined headscarps characterize such areas (Schlicker et al, 1972, p. 77). Due to the lack of evidence of historic movement, effects on land values would be minimal and probably represented as added development costs for grading and excavation.

33. Inactive Slide Area: A binary indicator variable based on the occurence of topography characterized by erosion-modified headscarps and a hummocky, poorly drained surface (Schlicker et al, 1972). This variable also probably has little effect on value because these slides lack evidence of recent movement.

34. Active Slide Area: A binary indicator variable which denotes whether a parcel is situated on an active slide (Schlicker et al, 1972). Rock fall, slumps and fresh scarps are indications of continuous or periodic ground movement. Land values should be depressed by the occurence of an active slide, but seafront property along actively

slumping terraces commands premium prices. Only well informed buyers or obvious signs of slope failure would tend to discount values.

35. Land Use: As mentioned in the description of the <u>highest and best use</u> variable, land use has a direct influence on land values. While actual land use may or may not conform to the zoned classification, parcels with uses higher on the use scale should have higher property values. Land uses considered by the present study are as follows:

    1. Single Family Residential.
    2. Multiple Family Residential.
    3. Commercial.
    4. Industrial.
    5. Idle or Vacant.
    6. Agriculture with Residence.
    7. Agriculture without Residence.
    8. Forest Land.
    9. Recreational.
    10. Public Service Facilities.

    Data on land use were obtained by field observation, interpretation of aerial photography and assessors office records (Northam et al, 1975).

36. Forest: A binary indicator variable defined by the presence or absence of a forest land use. Parcels

which are used for silvicultural activities tend to show a very low assessed value per acre due to property tax benefits granted by Oregon Statutes and county zoning ordinances. Forest parcels are taxed for a highest and best use limited to timber production rather than the conventional definition.

37. County: A binary indicator for the county from which the parcel was sampled. Analysis of the unweighted sample shows a significant difference in mean land value and parcel size between the counties.

38. Strata: An indicator variable denoting the sampling stratum from which the parcel was drawn. It is used primarily to isolate a particular stratum for detailed analysis.

39. State/County Park Without Overnight Facilities (highway): The route mileage from the entrance of the nearest day-use-only State or County Park to the most likely point of access to a parcel. In an area where recreational activities are actively promoted, it was surmised that the relative proximity of access to recreational sites would effect land values. Distances for the four State/County Park variables were measured on assessors plat maps and U.S.G.S. topographic quadrangles.

40. State/County Park Without Overnight Facilities (airline): The straight-line mileage from the entrance of the nearest day-use-only State or County Park to the most likely point of access to a parcel. The facility used as the end point in this variable was defined by variable 39 above. A ratio of highway to straight-line distance provides an indication of the perceived accessability of the site.

41. State/County Park With Overnight Facilities (highway): The route mileage from the entrance of the nearest State or County Park with camping facilities to the most likely point of access to a parcel.

42. State/County Park With Overnight Facilities (airline): The straight-line mileage from the entrance of the nearest State or County Park with camping facilities to the most likely point of access to a parcel. The park chosen as the nearest for the straight-line measurement was defined for each parcel by variable 41 above.

43. Pacific Shore: The straight-line mileage from the Pacific littoral to a parcel. The seaward endpoint of measurement is on a Vegetation Line defined by the State of Oregon to be the landward extent of submarine properties which are publicly owned. The

endpoint of measurement on a parcel is the point which is nearest the Vegetation Line. Thus the distance is the minimum mileage between any point on the Vegetation Line and any point on a parcel perimeter. Parcels which are nearer the Pacific shore tend to have higher land values. Data were obtained from Oregon State Highway Department aerial photographs and U.S.G.S. topographic quadrangles.

44. Highway: The route mileage from the nearest intersection on U.S. 101 to the most likely point of access to a parcel. As a measure of accessibility, it was assumed that with decreasing isolation from the major transportation route of the study area, increases in land value would be noted. Data were obtained from assessors plat maps and U.S.G.S. topographic quadrangles.

45. Major Arterial: The route mileage from the nearest intersection with a paved county road to the most likely point of access to a parcel. Data were obtained from assessors plat maps and U.S.G.S. topographic quadrangles.

46. Water Body: The straight-line mileage from the parcel to the nearest water body other than the Pacific Ocean. Land value tends to rise with proximity to aesthetic features of the landscape as

well as recreational features. This variable attempts to quantify the influence on land values caused by the demand for water front property. Data were obtained from assessors plat maps and U.S.G.S. topographic quadrangles.

47. Eighth Order Urban Place (highway): The route mileage between the most likely point of access to a parcel and the centroid of the nearest urban place which provides at least the services characteristic of eighth order urban places. Variables 47 through 58 are attempts to quantify the theoretical aspects of the influence of the "central city" on land values. As one moves farther from an urban place, economic rents should decline.

Discussed somewhat by von Thunen and more fully by those who applied his theories to the urban sphere, a hierarchy of urban places tend to cover the landscape in a uniform pattern. Rank in the hierarchy is determined by the number and type of services provided (Table 4). Large places provide the basic services and specialized services commensurate with the number of inhabitants. Small places are able to support only the basic functions such as post, fuel and food (Table 5). By providing a separate variable for each rank of

Table 4.--Typical Functions Offered by Each Order of Urban Place.

Order of Central Place	CENTRAL FUNCTIONS				
	8th Order	7th Order	6th Order	5th Order	4th Order
4th: City > 2500 Pop.	All 8th	All 7th	All 6th	All 5th	Sheet Metal Works Sporting Goods Store Hospital Regional High School
5th: Town 1000-2500 Pop. 50 Service Units	All 8th	All 7th	All 6th	Jewelry Store Department Store Dentist or Lawyer Bank High School Weekly Newspaper	(None)
6th: Village 150-1000 Pop. 10 Service Units	All 8th	All 7th	Elementary School Physician Hardware Store Auto Dealer or Repair Farm Implement Lumber Yard Churches	(None)	(None)
7th: Hamlet 16- 150 Pop. No Business Core	All 8th	Tavern Gas Station Church Grocery Store Post Office	(None)	(None)	(None)
8th: Roadside	One Multi-Purpose Establishment	(None)	(None)	(None)	(None)

Source: After Abler, Adams, and Gould, 1971, p. 369; Alexander, 1963.

Table 5.--Urban Places In The Study Area by Rank and By Relative Location: Oregon Central Coastal Zone.

Tillamook County		Lincoln County	
Rank	Place	Rank	Place
4th	Tillamook	4th	Lincoln City Newport
6th	Cloverdale Netarts Pacific City	6th	Depoe Bay
7th	Beaver Neskowin Oceanside	7th	Gleneden Beach Neotsu Otis Junction Otter Rock
8th	Sand Lake	8th	Salishan

NORTH			
7th	Oceanside	7th	Otis Junction
4th	Tillamook	7th	Neotsu
6th	Netarts	4th	Lincoln City
7th	Beaver	8th	Salishan
8th	Sandlake	7th	Gleneden Beach
6th	Pacific City	6th	Depoe Bay
6th	Cloverdale	7th	Otter Rock
7th	Neskowin	4th	Newport
SOUTH			

urban place, it should be possible to identify how accessibility and level of services affect land value. Distances were obtained from Oregon State Highway Department Straight Line Maps and route log books, assessor plat maps and U.S.G.S. topographic quadrangles.

48. Eighth Order Urban Place (airline): The straight-line distance from the most likely point of access to a parcel and the urban place identified in variable 47 above. Straight line distance is included as a separate variable due to differences in the manner in which individuals perceive accessibility. Mileages were obtained from U.S.G.S. topographic quadrangles and assessor plat maps.

49. Seventh Order Urban Place (highway): The route mileage between the most likely point of access to a parcel and the centroid of the nearest urban center which provides at least the services characteristic of seventh order places.

50. Seventh Order Urban Place (airline): The straight-line mileage from the most likely point of access to a parcel and the urban place identified in variable 49 above.

51. Sixth Order Urban Place (highway): The route mileage between the most likely point of access to

a parcel and the centroid of the nearest urban center which provides at least the services characteristic of sixth order places.

52. Sixth Order Urban Place (airline): The straight-line mileage from the most likely point of access to a parcel and the urban place identified in variable 51 above.

53. Fourth Order Urban Place (highway): The route mileage between the most likely point of access to a parcel and the centroid of the nearest urban center which provides at least the services characteristic of fourth order places.

54. Fourth Order Urban Place (airline): The straight-line mileage from the most likely point of access to a parcel and the urban place identified in variable 53 above.

55. Third-Fourth Order Urban Place (highway): The route mileage between the most likely point of access to a parcel and the centroid of the nearest urban center which provides the bulk of the services characteristic of third order places. The City of Salem and the Albany-Corvallis metropolitan area do not meet the definition of a third order trade center as described by Abler, Adams and Gould (1971, p. 369). Since they are situated so as to provide an intervening opportunity for nearly all

services however, this classs of urban place was defined.

56. Third-Fourth Order Urban Place (airline): The straight-line mileage from the most likely point of access to a parcel and the centroid of the urban place as defined in variable 55 above.

57. Third Order Urban Place (highway): The route mileage between the most likely point of access to a parcel and the Central Business District of the City of Portland. With nearly 20 percent of the population of the State and as the hub of economic acitivity, it is conceivable that the influence of the urban investor might be felt on land values in the study area.

58. Third Order Urban Place (airline): The straight-line mileage from the most likely point of access to a parcel and the Central Business District of Portland.

59. Platted Subdivision Index: As the number of lots in a subdivision increases, the value of the land per acre might also increase. Though not a general rule, larger subdivisions seem to provide more amenities and are the product of better and more careful planning than smaller developments.

As a measure for this influence, the following index was defined:

Index Value	Number of Lots in Subdivision
0	Sampled parcel is not in a platted subdivision.
1	1 to 3 lots.
2	4 to 20 lots.
3	21 to 50 lots.
4	Greater than 50 lots.

Of the 59 variables, 52 will actually be utilized for analysis. The remainder are mentioned above to give the original scaling and source for several of the transformed variables.

To investigate rural land values on the coastal margin of Oregon, a study area of approximately 120 square miles was defined. After exclusion of publicly owned land and areas within city corporate boundaries, approximately 105 square miles remained from which the sample was drawn. Through random sampling, a set of land parcels was selected to reflect the diverse land use and physiography of the Oregon coast. With so large a sample and the large number of independent variables available for analysis, multivariate methods are in order to simplify the dependence structure and investigate hypotheses concerning the basic underlying factors among the independent variables. The procedures employed to analyze the relationships between land value and the set of variables thought to influence value are described in the following chapter. Factorial analysis will be presented initially followed by multivariate linear regression.

V. ANALYSIS AND RESULTS

Analysis of the variables identified in the preceding chapter begins with multivariate analysis. The dependence structure of the independent variables will be identified and simplified by factorial analysis. The hypothesis of a certain set of latent factors will be tested for validity. Identification of the latent factors derived by factorial analysis that most affect rural land values will be among the results of multiple linear regression. Regression will also be applied to the complete set of independent variables to select untransformed variables that most affect land values.

Principal Components

Preliminary analysis of the variables was done with factorial analysis. Initially it was assumed that the variables available for analysis included the total variation among all economic, spatial, and site characteristics. Thus, a principal components analysis was in order.

The variables were transformed to standard scores and made available for input to the SPSS Factor Analysis Subprogram. The diagonal elements of the computed correlation matrix were unchanged, thus the factors derived are linear transformations of the original variables and contain the sum of the original variance. The first nine factors, which account for 67.5 percent of the variance, are shown as Table 6. The first factor extracted explains the largest portion of the total variation among the variables. With that portion removed from the total variation, the second factor accounts for the largest portion of the remainder. Factors are created in this manner until the total variation is accounted for among as many factors as there are input variables. Factors beyond the first nine were deemed to account for so little non-error variation that they were excluded from interpretation.

The first factor or the principal component explains approximately 15.7 percent of the variation in the original data. Interpretation of the component is hindered by the seeming diversity of variables showing high loadings. Inspection of the original data provides the answer to the quandry. All the variables with high loadings, except the distance measures (UP35R, UP35A, UP3A, HWYR) are binary or three part indicator variables, strongly influenced by the county from which the parcel was selected. Further, due to the nature of the topography of the study area, the distance measures tend to be large for one county and small for the other. Lincoln County is nearer Corvallis or Salem (UP35R, UP35A) and Tillamook is nearer Portland (UP3R, UP3A). The principal component may therefore be interpreted as accounting for the strong differences in soil types, public

Table 6.--Principal Components Analysis of Input Variables: Oregon Central Coastal Zone.

VARIABLE	FACTOR 1	2	3	4	5	6	7	8	9	Adequacy of the solution
ZSIZE	.07209	.03020	.23647	.30134	.48798	.41118	-.23755	-.02557	-.29672	.70516
ZPERIM	.07331	.02909	.28899	.40264	.53068	.40578	-.21057	.03085	-.31369	.84183
ZCIRC	-.05517	.01785	-.15425	-.12714	-.24474	.10018	-.00698	-.01904	.27900	.19151
ZELEV	.28206	.32679	-.02879	.14785	.37136	.29061	-.18338	-.01951	.33528	.57782
ZSLOPE	.32650	.30534	.05677	.21132	.25050	.20041	-.03095	-.12478	.46540	.58376
ZEROS	-.24884	-.47849	.25150	.00879	.24940	-.04259	.31782	-.12004	.34293	.65124
ZSHRINK	.54541	.54105	.14982	.03955	-.13597	-.16782	.14694	.06609	-.14532	.70795
ZSEPTIC	.21891	.37647	-.32580	-.18614	.29445	.12118	-.04152	.26083	.05262	.50435
ZDWOB	.51766	.48861	-.27750	.09476	.22131	.01868	.44696	.19166	-.11161	.89099
ZDWB	.51783	.48428	-.28920	.09183	.22315	.02601	.43602	.19680	-.12633	.89002
ZCOMMB	.38349	.17662	-.20170	.06526	.29883	-.10611	.60460	.08677	-.13864	.71605
ZRDSTS	.19253	.68088	-.36787	-.14218	.10467	.22900	.15346	.27466	-.00790	.81866
ZPASTAUM	-.41721	.37732	.05908	.36126	-.38319	.04085	-.30419	.09291	-.05512	.70315
ZDFSITE	.11602	.67460	.11932	.22372	-.31395	.17671	-.27946	.05812	.13820	.76320
ZSCAPRAT	-.06622	-.62973	-.00453	-.17090	.50154	-.00365	.30882	-.06538	.28226	.86104
ZFLDHAZ	-.13465	-.29619	.00475	.26088	-.14607	.10988	.23347	.04941	.02007	.26471
ZHIH2OT	-.40873	.23171	-.06854	.05996	.06643	-.08704	-.09881	-.07361	-.32339	.36080
ZLNDSLD	.22288	.18812	.23572	.19714	.20416	.24012	-.08417	-.15755	.18552	.34516
ZINASLD	.33361	.13268	.08646	.02924	.19371	.09238	-.15038	-.26390	.22607	.32665
ZACTSLD	.02369	.02019	.02508	.05403	.11593	.09717	-.07030	-.05361	-.06894	.03997
ZFOREST	.07190	.01724	.21836	.24665	.42692	.38914	-.19581	-.04836	-.20790	.53157
ZCOUNTY	-.82356	.46279	-.14407	-.03347	-.00266	.10558	.09655	-.05857	.06592	.94256
ZCAMPWOR	.15261	-.23474	-.15632	.74590	-.26792	.25097	.30001	.02077	.05996	.88800
ZCAMPWOA	.08070	-.28956	-.25737	.77684	-.19864	.15454	.24150	-.01990	.11175	.89462
ZCAMPWR	.24293	-.10402	.17115	-.36644	-.30484	.63077	.04864	.42124	.04924	.90644
ZCAMPWA	.17328	-.17126	.05164	-.31771	-.29347	.57532	-.05939	.49395	.07449	.83314
ZVEGLINA	-.14179	.19774	.26269	.74470	-.16958	-.07028	-.01570	.06157	-.00567	.72055
ZHWYR	.83533	-.04984	.27507	-.16557	-.12676	-.01130	-.00983	-.30786	-.02069	.91484
ZMARTR	-.04358	-.01151	.29041	-.38573	.08867	.18826	.38084	.08658	.10326	.44167
ZWATERA	.37221	.21950	.20159	-.03759	.08426	.16015	-.20827	-.26121	.45070	.57626
ZUP8R	.06877	-.15916	.55680	.17305	.20496	-.43593	-.14621	.54650	.03832	.92359
ZUP8A	.07076	-.13384	.51658	.20989	.22213	-.45600	-.17989	.52893	.02602	.90390
ZUP7R	.18456	-.10079	.35024	-.23556	-.28825	.19961	.06042	-.15868	-.23376	.42879
ZUP7A	.07829	-.19696	.47311	-.05486	.02560	.27030	.23800	-.37491	-.32151	.64606
ZUP6R	-.27710	-.08828	.75143	-.35654	.15015	.04416	.09277	.20712	.04930	.85478
ZUP6A	-.42952	-.03355	.66968	-.34828	.18719	.03991	.05924	.12163	.11736	.82409
ZUP4R	.36148	-.73232	-.34390	.11529	.08643	.21500	-.15791	.07694	-.06227	.88694
ZUP4A	.33061	-.69649	-.40073	.08958	.09609	.19895	-.20244	.11181	-.12037	.87981
ZUP35R	.58605	.25785	.14952	-.63049	-.04799	.00787	-.07178	-.09524	-.07492	.85201
ZUP35A	.74226	.05210	.36184	-.27409	-.29498	.04439	.02924	-.07866	.02997	.85665
ZUP3R	-.43766	-.05701	-.44857	-.54577	.37333	.14779	-.13393	-.05497	-.12363	.89134
ZUP3A	-.76603	.22482	-.36849	-.30996	.20936	.12223	-.03427	.04348	-.01554	.93128
ZSUBINDX	-.41678	-.10498	-.02234	-.43503	-.24291	.12423	.17204	.03268	.07570	.48531
ZIMPF	.02920	-.01548	-.06223	.00898	.06977	-.28834	.02033	-.07308	-.06306	.10278
ZTPORTS	.23084	.29123	-.07466	-.38064	.26724	-.19272	-.09546	-.18642	-.17195	.47055
ZTROADS	-.20078	.17903	-.05360	-.13924	-.14701	.06285	-.32330	.09784	.03769	.23571
ZTFIRE	.18163	-.22769	-.51064	-.14693	.29839	-.34492	-.28815	.10881	.15021	.69261
ZTH2O	.34961	-.25708	-.75038	-.06576	-.00809	.11064	-.14849	.12940	.16307	.83340
ZTHOSP	-.81870	.44696	-.02315	.04680	-.07199	.10174	.14895	-.05418	.12249	.92849
ZTSAN	.55349	.26919	-.04876	.02254	.03847	-.40022	-.07088	-.04333	.16787	.57844
ZTSCH	.91702	-.10131	.21241	-.09616	-.11488	-.11746	-.04358	.07119	-.01890	.93986
ZZONEUSE	-.40686	.17861	.36552	.29589	.31726	.04053	.15911	.06001	.18289	.58326
Eigenvalue	8.16	5.31	4.97	4.67	3.18	2.85	2.31	1.92	1.75	35.12325
% of total variance	15.7	10.2	9.6	9.0	6.1	5.5	4.5	3.7	3.4	
Cumulative %		25.9	35.5	44.4	50.6	56.0	60.5	64.2	67.5	

facilities and spatial location (with regard to transportation and major urban centers) which exist between the counties.

The second component, which accounts for 10.2 percent of the total variation, again seems somewhat related to the differences between the counties. This is evidenced by moderate loadings on two variables which were also important in the first factor, but appear in this factor with sign reversed. Several of the soil interpretation variables again appear, with the addition of two which relate to potential biological productivity. The spatial orientation of a parcel with respect to major county population centers (UP4R, UP4A) appears important with the two most highly loaded variables. With negative signs on the distance variables and the soil capability rating (SCAPRAT), and the positive sign on the potential Douglas fir productivity index, the second factor might be defined as an urban-agricultural suitability dimension.

The third component seems to be most influenced by variables which describe the accessibility to smaller urban places (UP6R, UP6A). High loadings on variables which describe the public services provided by such places reinforce the interpretation. The fourth component shows high loadings on variables which measure access to some recreation opportunities (CAMPWOR, CAMPWOA) and the Pacific shore (VEGLINA). Access to Willamette Valley major urban centers (UP35R, UP3R) appears as negatively correlated to the dimension. The factor thus describes the availability of day use recreation versus the proximity to major urban centers.

The remaining five factors tend to load most highly on a single variable or several closely related variables. Such factors are usually referred to as "specific" factors rather than "basic dimensions" as in the case of the preceeding four. Factor five is the size of the parcel, factor six is the accessibility of recreational opportunities with overnight facilities, factor seven is the soil suitability for commercial development, factor eight is the proximity to the lowest order urban place, and factor nine is the site aspect.

To facilitate interpretation of the factors, orthogonal transformations or rotations are often applied to the factors shown in Table 6. The varimax rotation is most often used due to its aim of simplifying the pattern of loadings on the factors rather than on the variables. The technique attempts to define the factor axes in a unique manner which maximizes the loadings on as few variables as possible and minimizes the loadings on the remainder of the variables for each factor. Since the factors are orthogonal transformations of the input correlation matrix, a non-deterministic orthogonal rotation will maintain this property. The normalized varimax rotation of the factor matrix is given as Table 7. Factors are numbered as they were extracted in the original solution and their order in the rotated solution is given in parenthesis. The percentages of variation explained are not given "because the importance of a factor in a terminal solution often reflects only the number of variables for a given factor included in the data relative to the total number of variables" (Nie et al, 1975, p. 478).

The interpretation of the components is much simplified. The principal component, although by definition remains complex, is more influenced by spatial variables. The component now centers on access to major Willamette Valley population centers (UP35A, UP3A), proximity to the major transportation route (HWYR) and indicators for between county variation. A simplified interpretation of the factor would be a dimension indicating access to major urban places.

The pattern of loadings on the second factor showed the greatest simplification among the factors. After varimax rotation, the variables showing high loadings on the factor remain the soil interpretations, but are now those which index potential agricultural productivity. Evidence of spatial or urban influences have also been diminished.

With accessibility measures for both major and intermediate county urban centers, the third component centers on within county spatial variation. Distance to

TABLE 7.--Principal Components Analysis of Input Variables With Varimax Rotation: Oregon Central Coastal Zone.

FACTOR / VARIABLE	1 (1)	2 (3)	3 (4)	4 (2)	5 (9)	6 (7)	7 (6)	8 (5)	9 (8)
ZSIZE	-.02669	-.01358	.01410	-.02511	.82238	.05401	.00845	.06359	.14174
ZPERIM	-.03439	-.01051	.04162	-.10227	.88524	.04010	.04233	.14726	.14007
ZCIRC	-.07389	-.05043	-.06506	-.02309	-.31229	.17819	-.08160	-.15979	.13141
ZELEV	-.04961	-.06290	-.11363	.06420	.25968	.07790	.22359	.02591	.65590
ZSLOPE	.05835	-.00449	.01125	-.07789	.09973	-.00087	.20678	.00421	.72209
ZEROS	-.11894	.68044	.18747	-.20540	-.06983	-.03446	-.26283	.12116	.08327
ZSHRINK	.45856	-.36987	.21664	.08562	-.04830	-.10570	.52287	.07834	.11648
ZSEPTIC	-.14409	-.09310	-.24194	.32243	.04694	.14957	.49489	.02293	.20594
ZDWOB	.14701	-.05249	-.04281	-.01401	.04446	-.04839	.91830	-.04498	.12239
ZDWB	.14430	-.05830	-.05782	-.00817	.05509	-.04297	.91798	-.04931	.11131
ZCOMMB	.14455	.27339	.01197	-.07854	.02291	-.16687	.76335	-.03152	-.04514
ZRDSTS	-.19392	-.30368	-.04693	.23110	-.03561	.22332	.72756	-.13967	.18226
ZPASTAUM	-.33787	-.67849	.18853	-.22105	-.00512	-.00469	-.20190	.05321	-.02435
ZDFSITE	.01420	-.73090	.19687	-.04505	-.01204	.12423	.11710	-.00001	.39837
ZSCAPRAT	-.08649	.90237	-.13704	-.01829	.01471	.00265	-.11011	.07419	.04819
ZFLDHAZ	-.05042	.15638	.01613	-.44646	-.02373	.08536	-.08376	-.02079	-.15107
ZHIH2OT	-.35987	-.23249	.13921	.11737	.16683	-.22473	-.02858	-.07401	-.24383
ZLNDSLD	.12002	-.02793	.13012	-.06319	.28594	.01897	.04061	-.00250	.47463
ZINASLD	.21512	.02082	-.03267	.10326	.14033	-.08946	.01534	-.07845	.48387
ZACTSLD	-.00525	-.00929	-.01208	.01851	.18917	-.01108	-.00287	-.03162	.04948
ZFOREST	-.01571	.01922	.02355	-.02497	.70312	.07039	-.00738	.03266	.17123
ZCOUNTY	-.83121	-.19984	.37833	.06921	-.11811	-.02039	-.01109	-.21963	-.03271
ZCAMPWOR	.09292	-.02918	-.15301	-.90609	.06892	.03054	.12033	-.11462	.02833
ZCAMPWOA	-.00502	.01386	-.25553	-.89658	.03919	-.08964	.06301	-.09835	.04502
ZCAMPWR	.25644	-.01140	.01477	.03322	-.02159	.91330	.04755	-.03975	-.02850
ZCAMPWA	.15184	-.04046	-.14211	.01475	-.04702	.88412	-.01087	.02586	-.05813
ZVEGLINA	-.08649	-.38909	.25770	-.58883	.15984	-.21808	-.03769	.25670	.09014
ZHWYR	.90203	.04072	.00381	.13272	.03201	-.02179	.06555	-.13216	.24214
ZMARTR	.03018	.36711	.37943	.16004	-.08158	.34068	.11647	-.00905	-.00677
ZWATERA	.26180	-.04317	.05473	.12841	.01447	.04488	-.05843	-.05832	.69089
ZUP8R	.15570	.05646	.11920	-.01654	.08567	-.05121	-.08692	.92743	-.06344
ZUP8A	.13653	.02112	.08424	-.01723	.10443	-.10046	-.07730	.92079	-.05084
ZUP7R	.44302	-.01263	.27298	.06795	.06933	.23668	-.15673	-.19984	-.16704
ZUP7A	.35643	.26418	.43235	-.05920	.37478	.05361	-.15319	-.26799	-.14203
ZUP6R	-.00589	.29572	.60522	.25940	.08377	.32002	-.25612	.39201	-.07080
ZUP6A	-.17934	.28580	.60785	.28085	.05531	.25010	-.30676	.31936	-.01384
ZUP4R	.26544	.32997	-.73582	-.23854	.20648	.16906	-.14789	-.05263	-.11585
ZUP4A	.21715	.27719	-.77583	-.18253	.21860	.16192	-.12744	-.05074	-.16664
ZUP35R	.57933	-.06316	.06925	.62481	-.09120	.17520	.20606	-.13562	.13175
ZUP35A	.84071	-.07068	.13189	.15400	-.11496	.21741	.09347	-.03071	.18326
ZUP3R	-.55163	.25059	-.25339	.56486	.06949	.09044	-.05458	-.29683	-.19202
ZUP3A	-.85643	.00974	.03301	.34154	-.05720	.07114	-.02401	-.21411	-.15878
ZSUBINDX	-.24944	.14956	.19000	.14377	-.33268	.31604	-.18900	-.19936	-.24068
ZIMPF	.03834	.04355	-.04667	.06390	-.06457	-.27939	.03802	.05802	-.07817
ZTPORTS	.14056	-.01572	-.01324	.57527	.06130	-.22904	.22172	-.10547	.05414
ZTROADS	-.19931	-.31377	-.03840	.20015	-.07372	.14780	-.16785	.00622	.02238
ZTFIRE	-.06331	.17000	-.68747	.28083	-.14930	-.23311	.03700	.16430	.05681
ZTH2O	.02597	.06628	-.83870	-.01550	-.18073	.13597	.17214	-.19554	.07481
ZTHOSP	-.77800	-.20021	.47875	-.04517	-.14655	-.00634	-.04754	-.16742	-.00001
ZTSAN	.39282	-.14978	-.14018	.15510	-.19547	-.32363	.29262	.17215	.31589
ZTSCH	.89554	-.00720	-.17860	.07880	-.01924	.07086	.19757	.18170	.14926
ZZONEUSE	-.40494	.11973	.45413	-.18735	.20245	-.07251	-.00717	.27253	.20749

major county urban centers (UP4A, UP4R) are negatively correlated to the dimension, while the measures of intermediate center accessibility (UP6A, UP6R) are positively correlated. With rotation of the axes, it has become a dimension which indicates the relation between accessibility of the major county urban centers, and access to places of intermediate rank. The expected dominance of the county seat over population centers of the next lowest rank is shown by this dimension.

The fourth component remains essentially unchanged except for increased loadings on accessiblity of recreation areas with day use facilities only (CAMPWOR, CAMPWOA) and the emergence of the port tax district (TPORTS) variable. The port tax rate is essentially an indicator variable for proximity to the port facilities, and therefore logically shows a moderate loading on the factor which characterizes the accessibility of recreational opportunities in the Pacific littoral.

The influence of SIZE and PERIM on factor five has increased in the unique solution. In addition, the indicator variable for forest land use (FOREST) shows an expected moderate loading on the dimension. The interpretation of the sixth component is unchanged, if not strengthened, by the increased loadings on CAMPWA and CAMPWR.

The seventh component has been simplified such that it becomes a factor indicating suitability for development. Variables with major loadings on the factor are derived from interpretation of soil information, and thus tend to be grouped here due to the source of data and the scale of measurement. The pattern of loadings on factors eight and nine are modified only to the extent that the magnitude of the coefficients are substantially increased.

Under the assumption that all variation among site, spatial and economic characteristics is included in the variables, principal component analysis was performed. The first nine factors were selected as representing the many general sources of variation found in the original data. After varimax rotation with Kaiser normalization, the factors selected were interpreted as representing the following dimensions:

1. A general component indexing the accessibility of major Willamette Valley population centers.
2. The accessibility of important county population centers.
3. The proximity of the Pacific littoral.
4. A measure of soil and site capability for agricultural production.
5. An index of site slope and elevation (site aspect).
6. A measure of soil suitability for development.
7. The accessibility of recreational areas with overnight facilities.
8. An index of parcel size.
9. The accessibility of the lowest order urban place.

These nine general dimensions accounted for 67.5 percent of the variation in the original data. It is apparent that the variables available for analysis are centered on three major "areas": spatial relation to urban places, proximity of the Pacific littoral and site characteristics. If one can assume that these areas are in fact "common factors" implicit in all the variables, then a second type of factorial analysis is in order.

Factor Analysis

In this procedure, the assumption is that among all the variables there are certain "common factors." The sum of the variation of these common factors is less than the total among all the variables. Variation which is common to all variables is usually defined as the sum of the variation each variable has in common with all other variables. Estimates of common variation for each variable are referred to as "communalities" and are generally defined as the squared multiple-correlation coefficient between a given variable and all others. Thus, the diagonal elements of the input correlation matrix are replaced with the squared multiple-correlation coefficients and extraction of factors proceeds as in principal components analysis.

In view of the aribitrary grouping of input variables and the interpretation of the principal components analysis, the number of underlying common factors should be three.

The Factor Analysis Subprogram replaces the diagonal correlation matrix elements with the communalities and extracts the first three factors. Using an iterative process, the communality estimates are improved by replacing the diagonal elements with the variance accounted for by each factor and again extracting factors. The procedure continues until no significant differences exist between successive iterations (Nie et al, 1975, p. 480). The three factors are then rotated to a unique solution by the varimax method with Kaiser normalization (Table 8).

The pattern of loadings shown here is similiar to those of the three rotated principal components in the solution shown in Table 7. Absence of variables with high loadings makes interpretation somewhat difficult. In addition, several variables show moderate loadings on two or all factors, e.g., HWYR, TH20, and TSCH. This lack of simplification among factors is probably an artifact of the iterative procedure employed to adjust communalities, and would tend to indicate non-independence among factors. Due to the lack of obvious pattern, the small variation explained (35.5 percent), and the above mentioned similarity to a prior solution, one cannot accept the premise of three underlying uncorrelated factors. The nine factors of the rotated principal components solution will be retained as summaries of the many general sources of variation among the input data. The linear functions defined by these factors

TABLE 8.--Factor Analysis of Input Variables: Oregon Central Coastal Zone.

VARIABLE	FACTOR 1	2	3
SIZE	.01152	.04441	.16482
PERIM	.00830	.04130	.20020
CIRC	-.03048	-.01362	-.12354
ELEV	.00637	.38197	-.03175
SLOPE	.03422	.39664	.04985
EROS	.08362	-.49218	.21927
SHRINK	.01132	.74535	.18433
SEPTIC	-.03940	.40414	-.27398
DWOB	.08601	.70592	-.23424
DWB	.09045	.70363	-.24543
COMMB	.17046	.37296	-.14325
RDSTS	-.25761	.63817	-.36141
PASTAUM	-.50400	-.01502	-.05272
DFSITE	-.34655	.53344	.06341
SCAPRAT	.33397	-.47298	.03428
FLDHAZ	.08215	-.27072	-.01737
HIH2OT	-.39593	-.10212	-.13021
LNDSLD	.01250	.24326	.19482
INASLD	.13453	.28370	.10217
ACTSLD	.00327	.02398	.01500
FOREST	.01976	.03722	.15645
COUNTY	-.90718	-.20179	-.29556
CAMPWOR	.26698	-.04771	-.16436
CAMPWOA	.26736	-.12596	-.26239
CAMPWR	.18917	.07952	.20427
CAMPWA	.19823	-.00316	.09157
VEGLINA	-.22817	.02804	.13639
HWYR	.59019	.51414	.41347
MARTR	-.07122	-.04196	.27273
WATERA	.09414	.36282	.21242
UP8R	.07554	-.09263	.49816
UP8A	.06751	-.07212	.45353
UP7R	.13182	.03649	.35143
UP7A	.10442	-.10150	.43873
UP6R	-.25105	-.28891	.72407
UP6A	-.38209	-.34583	.61691
UP4R	.81320	-.29264	-.26363
UP4A	.77033	-.28163	-.32237
UP35R	.20725	.55326	.25621
UP35A	.43083	.52230	.48235
UP3R	-.20918	-.30219	-.42079
UP3A	-.65010	-.33188	-.46162
SUBINDX	-.22239	-.32397	-.02773
IMPF	.03353	.01240	-.04344
TPORTS	-.00889	.33265	-.01864
TROADS	-.22594	-.00829	-.06728
TFIRE	.32811	-.01900	-.40398
TH2O	.52803	.08226	-.66561
THOSP	-.90300	-.21519	-.17346
TSAN	.21550	.54182	.01925
TSCH	.70708	.54451	.36897
ZONEUSE	-.42450	-.15749	.22929
Eigenvalue	7.78	4.83	4.45
% of total variance	45.6	28.3	26.1
Cumulative %		73.9	100.0

will be used to construct component scores for use in regression analysis.

Regression Analysis

In a later section, multivariate linear regression will be applied to factor scores derived from principal components which are by definition uncorrelated summaries of other variables. But first, the analysis will proceed with regression analysis on the "raw" input data. The dependent variable is the assessed land value divided by the size of the parcel. The independent variables are those described in Chapter IV above.

Regression on Variables As Collected

Initial regressions were performed to determine the relative explanatory power of the independent variables. Coefficients of multiple determination (R Square) were found to be in the range of 0.45. Scatter plots of the first several variables selected by the stepwise regression procedure revealed a marked non-linear relationship. Various transformations were applied to the variables including common logarithms and reciprocals of various orders. Regression was performed on the set of transformed and raw independent variables. Inspection of the simple correlation matrix for the input variables contributing a reasonable amount of explanation revealed several instances of non-independence. The problem was corrected by deleting several variables and regression was performed again. The coefficient of multiple determination was increased to approximately 0.68. Analysis of the residuals from regression indicated several problems in confirming the assumptions of the model.

Several instances of error in data collection and coding were revealed and corrected. A number of small parcels, obviously inadequate for development, and with current uses such as driveways or utility easements, were eliminated. More importantly, a distinct spatial bias was detected which was caused by the specific appraiser involved and the year in which the appraisal was conducted. The degree of departure was unexpected and the standardized residuals ranged as high as 1.72 standard deviations from the mean regression line for specific appraisal areas. Little could be done to control for the influence of the personnel except to delete the parcel from the sample, as the identity of specific appaisers for parcels is seldom available.

The time elapsed since a parcel was last appraised had marginal influence. Land parcels are generally appraised every three to five years, and "indexed" in non-appraisal years to maintain the State required assessment ratio. Oregon Revised Statutes section 309.035 require that the difference between the assessed value of all locally assessed property and the true market value of such property be five percent or less. The actual ratio of assessed value to true market value for Lincoln County in 1973 was 97.8 and Tillamook County was 96.0 (Oregon Department of Revenue, 1973, p. 91, 123).

Several items identified by residual analysis as outliers were deleted from the sample. Inspection of the simple correlation matrix (Table 9) computed for the reduced sample shows little multicollinearity among the independent variables. Regression was then performed on the 1078 parcels remaining in the sample using SIPS and SPSS.

The model derived after the above modifications to the input data is given as Table 10. Seven independent variables are included in the equation and together these explain approximately 78 percent of the variation in the common logarithm of per acre assessed land value. The F value is 541.93, which indicates a highly significant linear relationship exists between the logarithm of land value per acre and the seven independent variables. The coefficients of the variables in the equation also are significantly different from zero.

Inspection of the coefficients derived for each variable in the equation shows the overwhelming influence of parcel size on per acre land value. Over four-fifths of the total variation explained by the seven variables is accounted for by the common logarithm of the perimeter of

TABLE 9.--Simple Correlation Matrix for Regression Model: Oregon Central Coastal Zone.

	L1	LPERIM	UP7R	LWATERA	SUBINDX	IMPF	RVEGLINA	FOREST
L1 Log of Assessed Value per Acre.	1.00000							
LPERIM Log of Perimeter of Parcel.	-.80673	1.00000						
UP7R Route Mileage to 7th Order Place.	-.15149	-.04879	1.00000					
LWATERA Log of Distance to Nearest Water.	-.10617	-.06575	.10439	1.00000				
SUBINDX Number of Parcels in Subdivision.	.45481	-.50918	.11467	.00704	1.00000			
IMPF Binary Indicator for Improvements.	.19146	-.02496	-.13575	-.10762	-.09279	1.00000		
RVEGLINA Reciprocal of Dist to Pacific Shore.	.13942	.08960	-.00912	-.13214	.05539	-.01319	1.00000	
FOREST Binary Indicator for Forest Use.	-.49479	.45062	-.00046	.03279	-.20139	-.05726	-.03985	1.00000

TABLE 10.--Multiple Regression On Input Variables: Oregon Central Coastal Zone.

Step	Variable Entered	F Value To Enter	Sign.	Mult R	R Square	R Square Change	Overall F	Sign.
1	LPERIM	1995.47	.000	.8060	.6497	.6497	1995.46	.000
2	RVEGLINA	159.37	.000	.8336	.6949	.0452	1224.47	.000
3	UP7R	144.09	.000	.8550	.7310	.0361	972.86	.000
4	IMPF	96.67	.000	.8679	.7532	.0222	818.80	.000
5	FOREST	62.55	.000	.8759	.7668	.0136	705.13	.000
6	LWATERA	43.27	.000	.8806	.7759	.0091	617.99	.000
7	SUBINDX	19.95	.000	.8832	.7800	.0041	541.93	.000

	Variable	Coefficient	Standard Error of Coefficient	F Value	Sign.
1	Logarithm of Perimeter of Parcel	-1.25794	0.031778	1566.97	.000
2	Reciprocal of Dist. to Pacific Shore	0.00263054	0.00020959	157.53	.000
3	Distance to 7th Order Urban Place	-0.00662322	0.00058661	127.49	.000
4	Indicator for Improvements	0.170779	0.017558	94.61	.000
5	Indicator for Forest Land Use	-0.593431	0.074530	63.39	.000
6	Logarithm of Distance to Nearest Water	-0.0893936	0.013858	41.62	.000
7	Index for Size of Subdivision	0.0261975	0.0058657	19.95	.000
	(constant)	7.26294	0.093302	6059.53	.000

Source	DF	Sum of Squares	Mean Square	F Value
Total	1077	4503.87	4.18187	
Regression	7	3512.99	501.856	541.93
Residual	1070	990.88	0.92605	

the parcel (LPERIM). Interpretation of the coefficient in quantitative terms shows that the antilogarithm of a one unit increase in perimeter (10 feet) would decrease the per acre value of a parcel the antilogarithm of 1.2579 or $18.11 when all other variables are held constant.

The relation between size and value is not unexpected. Smaller parcels tend toward more intensive uses and therefore accrue a larger economic rent. In addition, those parcels in subdivisions show the additional value of development costs in the rent. The six additional variables subsume only 13 percent of the unexplained variation.

The reciprocal of the distance to the Pacific shore (RVEGLINA) accounts for nearly five percent of the variation. The positive sign of the coefficient is expected as parcels near the littoral are more in demand due to aesthetic and recreational amenities. The small value stems from the units of distance measure, namely miles and hundredths. The variable would show large values for parcels near the shore and decrease rapidly as one moves inland, thus encompassing a large range of values.

Route distance to the nearest seventh order urban place (UP7R) shows an inverse relation to value per acre and a small magnitude. The decrease in value with increasing distance from the urban place fits nicely with theories of economic rent discussed earlier. Again, the large range of values influences the size of the coefficient.

IMPF is an indicator variable for presence or absence of improvements to a parcel. Among sample parcels, those with improvements averaged at least $6000 more per acre than those lacking improvements. The sign agrees with the coding scheme with presence coded as one and absence as zero.

The presence of commercial timber on a parcel is indicated by a one value for the indicator variable FOREST. Parcels with timber tend to show a lower value per acre and thus the negative sign on the coefficient. Timber parcels also tend to be large as shown by the correlation coefficient between FOREST and LPERIM.

Land value per acre is also affected by the proximity of water bodies other than the Pacific Ocean. The common logarithm of the airline distance to these sites (LWATERA) again indicates the influences of aesthetic and recreational considerations on economic rents. Demand is higher for those sites which offer the amemity of pleasant landscapes and recreational opportunities. The effect of the topography in areas removed from the coast might also be included in this variable. Gently sloping lands are generally found only as flood plains or river terraces. With increasing distance from such features, the availability of level land would decrease and thus economic rents decrease.

The number of lots in a subdivision (SUBINDX) apparently has some affect on land value. One would expect larger developments to provide a higher level of services and better site planning, thus contributing to an increase in lot value.

Parcel size is unquestionably the dominant influence on per acre land values. Six other independent variables have coefficients significantly different from zero and are included in the model, but provide relatively little additional explanatory power. The proxy for parcel size is the variable LPERIM, which is the common logarithm of the perimeter (in feet) of a sample parcel. Appraisal techniques include evaluation of the benefits or costs of parcel shape and thus perimeter was chosen rather than the size of the parcel in acres, LSIZE. That parcel size is important in determining land value is not questioned; only its dominance over all other factors hypothesized as contributing to value.

Several interpretations of this phenomenon are possible. First, sampling methodology has introduced a bias which is contributing to the size dominance. This is unlikely in the Forest, Agriculture and Coastal Mix strata due to the sampling frequency which selected at least one-half of the elements in the frame. In the Development stratum, the large number of elements selected (549) provides more than adequate protection against the influence of deviate cases. Second, the method of weighting used by SPSS has caused undue influence by a stratum for which size accounts for a large portion of the variance. Percentages of variation explained by LPERIM in each stratum are Development 49 percent, Agriculture 73 percent, Forest 15 percent, and Coastal Mix 64 percent. In the most heavily weighted stratum, Development, size has less of an influence than when the sample is considered as a whole. Third, the selection of the coastal zone of Lincoln and Tillamook counties as the study area provides a unique mixture of topography, spatial organization, market demand, and appraisal practices which cause the size of a land parcel to be the most important factor in determing per acre land values. Non-urban parcels tend to be larger, lack improvements, show similar low value uses and thus have fairly uniform valuation. Agricultural and Forest parcels are generally priced by the acre and vary moderately from site to site. Parcels in the Development stratum are generally priced by the unit or lot. Valuation is predicated on a variety of economic, physical and aesthetic amenities and thus tend to vary widely between parcels. Relatively small differences in valuation will cause large changes in per acre value due to the size of the parcel. Although size is less effective a predictor of land value among development parcels, LPERIM remains the dominant factor in accounting for the variation in value.

Regression On Factor Scores From Principal Components

Composite scales or factor scores which represent the theoretical dimensions of each factor in the rotated components solution (Table 7) were derived for input to regression. Nine uncorrelated independent variables were regressed against the common logarithm of parcel land value per acre (Table 11). Eight factors are significant and together explain 54.6 percent of the variation in land value per acre.

Size of the parcel again accounts for the overwhelming majority of the variation. While it fails to reach the 65 percent level of the preceding model, the proportion accounted for among all variables is higher. Site aspect was selected as explaining the largest portion of the remaining variance. Two of the three major variables of the factor, (ELEVATION) and (SLOPE), were not present in the previous model. The third variable, distance to other water bodies (WATERA) explains less than one percent in the previous model and was the sixth variable to enter the previous stepwise regression. The remainder of the factors explain less than one percent variance each.

Regression on the factors from principal components has failed to provide much improvement over the variables as collected. Principal components analysis is most useful when the set of independent variables is highly correlated. Factor scores derived would satisfy the regression requirement of uncorrelated independent variables. Due to

TABLE 11.--Multiple Regression On Factors From Principal Components: Oregon Central Coastal Zone.

Step	Variable Entered	F Value To Enter	Sign.	Multiple R	R Square	R Square Change	Overall F	Sign.
1	Factor 8	1075.51	.000	.7070	.4999	.4999	1075.51	.000
2	Factor 5	26.90	.000	.7156	.5121	.0122	564.15	.000
3	Factor 3	19.29	.000	.7126	.5207	.0086	388.93	.000
4	Factor 4	17.24	.000	.7268	.5283	.0076	300.42	.000
5	Factor 9	15.45	.000	.7314	.5350	.0067	246.66	.000
6	Factor 6	10.40	.002	.7345	.5395	.0045	209.08	.000
7	Factor 1	10.39	.002	.7375	.5439	.0044	182.27	.000
8	Factor 7	4.83	.029	.7389	.5459	.0020	160.66	.000
9	Factor 2	0.65	.465	.7391	.5462	.0003	142.83	.000

	Variable	Coefficient	Std Error of Coefficient	F Value	Sign.
8	Index of Parcel Size	-0.421326	0.012284	1176.49	.000
5	Index of Site Aspect (Elevation and Slope)	-0.0658448	0.012284	28.73	.000
3	Access to Pacific Shore	0.0552959	0.012284	20.27	.000
4	Index of Potential Agricultural Productivity	0.0518745	0.012284	17.83	.000
9	Access to Lowest Order Urban Place	-0.0487776	0.012284	15.77	.000
6	Index of Soil Suitability For Development	-0.0398446	0.012284	10.52	.001
1	Access to Major Willamette Valley Urban Places	-0.0396363	0.012284	10.41	.002
7	Access to Recreational Facilities	-0.0269929	0.012284	4.83	.029
2	Access to Important County Population Centers	-0.0988525	0.012284	0.65	.466
	(constant)	4.15965	0.012283	144,681.	.000

Source	DF	Sum of Squares	Mean Square	F Value
Total	1077	4541.16	4.21649	
Regression	7	2480.41	275.601	142.83
Residual	1070	2060.75	1.292955	

the dominance of a single variable and the correlation structure of the variables, the main contribution of the multivariate analysis is to provide insights as to the underlying structure of relationships among independent variables.

Summary

Multivariate analysis was used to determine the basic dimensions of the independent variables. Nine factors, accounting for approximately 68 percent of the variation, were derived by principal components analysis. The factors and variation accounted for by each are as follows: (1) Willamette Valley accessibility, 15.7 percent; (2) agricultural suitability, 10.2 percent; (3) accessibility of county population centers, 9.6 percent; (4) Pacific shore accessibility, 9.0 percent; (5) parcel size, 6.1 percent; (6) recreational accessibility, 5.5 percent; (7) development suitability, 4.5 percent; (8) access to nearest roadside, 3.7 percent; and (9) site aspect, 3.4 percent. Varimax rotation was employed to maximize the loadings on as few variables as possible in each factor and thus facilitate interpretation of the factors. Factor scores were derived from the rotated unique solution for later regression analysis.

Factor analysis was used to evaluate the arbitrary grouping of variables into three groups. Factors derived explained only 35.5 percent of the variance and were dissimiliar in interpretation to the imposed theoretical groupings.

The set of independent variables was then regressed against the common logarithm of the assessed land value per acre. After several modifications and transformations to the data set, an equation which accounted for 78 percent of the variation in assessed value was created by stepwise regression. The size of the parcel was the dominant variable and explained approximately 65 percent of the variation in assessed value per acre. The remaining six variables and the variance accounted for by each are as follows: (2) reciprocal of distance to Pacific shore, 4.5 percent; (3) distance to seventh order urban place, 3.6 percent; (4) improvements (Yes-No) 2.2 percent; (5) forest (Yes-No), 1.4 percent; (6) logarithm of distance to nearest water body, 0.9 percent; and (7) subdivision index, 0.4 percent.

Factor scores from the nine uncorrelated principal components were also regressed against the logarithm of land value per acre. Eight factors were significant and accounted for 54.6 percent of the variation. The variables in order of their entry and variance explained are as follows: (1) size, 50.0 percent; (2) site aspect, 1.2 percent; (3) Pacific shore accessibility, 0.9 percent; (4) agricultural suitability, 0.8 percent; (5) access to nearest roadside, 0.7 percent; (6) development suitability, 0.5 percent; (7) Willamette Valley accessibility, 0.4 percent; and (8) recreational accessibility, 0.2 percent.

VI. SUMMARY AND CONCLUSIONS

Most investigations of rural land value have stressed the influence of the real estate market. Empirical research primarily concerned with the affects of factors not couched in market terms has been lacking. Although several studies include some direct spatial measures, emphasis understandably was not placed on pursuing any implications of further "explanatory power" among other spatial variables. Investigation of land value utilizing exclusively site and spatial variables thus has few antecedents for comparison of results. Conclusions concerning the models developed here will generally use the theoretical normative ideas of von Thunen and the associated concepts of Ricardo for a basis of comparison.

Rural property values generally should decrease with increasing distance from various foci of attraction. In the historical model, the center of attraction was the market place. Economic rents are theoretically determined by the distance from the market place to the point of production and the costs of production at that point. Lacking intensive agriculture which would provide a direct basis for analysis using the von Thunen approach, various other points of attraction have been included here to determine if land values respond to these influences in the same manner as agricultural activities do for the market place. Various spatial locations for which a demand for accessibility was assumed to exist were identified. In addition, several variables which are physical measures of a particular site were identified. On the premise that the market value studies were using variables which embodied the reaction of the real estate market to the physical setting, it was surmised that the actual measures would provide the same information. Thus the set of 52 variables include points of attraction such as recreational opportunities, aesthetic considerations and urban attractions as well as measures of area, slope, and land use on a particular site. It is hypothesized that a variable or set of variables from among those mentioned above will contain sufficient "explanatory power" to satisfactorily identify those factors which most influence rural land value on the Oregon coast.

Selection of variables which possibly influence land value is affected by personal inclination, the availability of pertinent reference material, theoretical considerations, and practical limitations. Though the set of independent variables may include every conceivable influence, some will inevitably be overlooked or will not be directly quantifiable. In light of this eventuality, factorial analysis has been employed to seek latent influences among the independent variables and to simplify the many variables into a form which meets the criterion for input to regression analysis. Linear regression has also been applied directly to the variables, in hope that a small number of them directly affect land value. Analysis of the input variables begins with the multivariate methods.

Factorial analysis generally proceeds on one of two paths based upon assumptions concerning the variance contained among the independent variables. Factor analysis assumes that only a portion of the total variance is contained within a few common factors, while the remainder is spread among several specific factors. Thus the procedure is generally employed for investigating the existence of a small number of factors hypothesized to contain a majority of the variation common to the set of independent variables. The alternate procedure, principal components, makes no assumptions concerning underlying factors and attempts to simplify the variance among all variables by creating a new set of variables which contain the sum of the original variance. Thus they are linear transformations of the original set and are uncorrelated. With no assumptions necessary as to the latent structure of the independent variables, principal components analyis was performed on the variables.

Nine factors deemed to be significant were derived from the standardized independent variables (Table 6). With 67.5 percent of the original variance accounted for among the nine, the first component extracted represents approximately 15.7 percent of the variance in the original data. As this factorial method attempts to include the greatest possible variance in the principal component, interpretation of the component is often difficult unless a small number of variables are highly correlated to the principal axis. Unfortunately, no such obvious analysis is possible here. The first component was interpreted as indicating the strong differences in soil types, public facilities and spatial orientation which exist between the two counties. The second component also reflects this differentiation but is based on differences in the physical and urban settings. With approximately 10.2 percent of the original variance explained, these differences were interpreted as an urban use - agricultural suitability dimension. The Lincoln county area is characterized by more extensive urban areas, while Tillamook county has fewer inhabitants and more areas suitable for agriculture. The spatial accessibility hypothesised by von Thunen is evident in the third component. High loadings on access to smaller urban places and the public facilities supported by such places provide the basis for the interpretation.

The fourth component is also comprised of measures of potential spatial interaction. Access to major urban centers is positively correlated to the dimension while access to recreational opportunities shows an inverse relationship. The component thus represents a continuum which relates urban accessibility to the availability of recreational facilities. The remaining specific components were interpreted as representing the influence of parcel size, overnight recreation facilities, soil suitability for commercial development, proximity of the smallest urban place and the site aspect.

Obviously no single component exists which effectively summarizes the variation among the independent variables. The components derived do not facilitate interpretation and seem to be dominated by inter-county differences. Although the affirmation of the expected contrast is noteworthy, it does little to identify specific influences on land value. A further modification of the components is often helpful in arriving at interpretations.

Orthogonal transformations are applied to the components with the goal of simplifying the pattern of loadings on each factor. The varimax transformation attempts to maximize the loadings on as few variables as possible in a factor and minimize the loadings on the remainder. With the most important influences on each factor emphasized, analysis of the factors should be facilitated. The components originally derived were transformed and are shown as Table 7. A considerable simplification of the loadings on the first several components is evident.

The principal component is now more influenced by spatial variables. Inter-county variation remains, but is now overshadowed by spatial influences. The expected influence of major urban centers and the availability of the transportation links that provide access to the urban centers are now dominant. The transformed linear combination of the independent variables that best summarizes the many sources of variation included in the variables is interpreted as delineating the spatial influence of the major urban centers. The large metropolitan areas of the Willamette Valley provide high order functions not available in the study area. Demand for these goods and services tends to increase property value among those parcels nearest the urban areas or along the major highway. While the nature of the many input variables somewhat foreshadows the conclusion, it agrees with the von Thunen model as applied to the urban setting.

The second component has been much simplified. It continues to be influenced by the many variables based on soil interpretations. However, the expected agricultural productivity of the soil is now the dominant theme. The third component continues as a summarization of intra-county spatial variation. Access to day-use recreation has become dominant in the fourth component. Interpretation of the fifth and sixth components are strengthened by increased loadings on the major variables. The pattern of loadings on component seven has simplified such that the interpretation becomes one of a factor indicating suitability for development. Factors eight and nine remain specific factors for accessiblity of the smallest urban place and the site aspect.

From the principal components analysis it is evident that there is no underlying theme among the independent variables. The principal component (Distance to major urban centers) accounts for only about 16 percent of the total variation and the first nine components only 67.5 percent of the variation among all variables. Thus the set of independent variables represent a wide range of inputs and contain little redundant information. Unfortunately, this situation limits the usefulness of the components derived because so large a portion of the total variance is not included among them. Due to their property of zero correlation among the factors, they were retained for further analysis employing multivariate regression. The conclusion drawn from the principal components is the independent variables measure many diverse influences on land value and are generally not repetitive quantifications of several sources. Further factorial analysis entails a differing approach with regard to the number and nature of the factors to be extracted.

Factor analysis generally begins with an hypothesis concerning the structure of basic influences found among independent variables. It was hypothesized that the common sources of variation among the variables would be found in three factors. Further, the factors derived would identify a spatial component, an economic component, and a site component. The factors derived from factor analysis are shown as Table 8. The pattern of loadings are similar to the first three factors derived by the principal components solution. The absence of variables with high loadings and those with moderate loadings on several factors greatly hinders interpretation. Due to the lack of direct interpretation, and the small variation explained by the three factors, the hypothesis of a spatial, economic and a site factor cannot by accepted. The major result of the analysis is the verification of many independent sources of variation among the variables. In such a case, a regression model approach will prove to be a more effective tool.

A linear model of seven terms was derived through the step-wise selection procedure. All the variables shown in Table 10 are significant at the .001 level and together account for approximately 78 percent of the variation in the logarithm of assessed land value per acre. The logarithm of the perimeter of a parcel is by far the most important term is the model. The remaining six variables account for only 13 percent of the total variation. Domination by a single variable is quite unexpected and has little precedence in the literature. The influence of size may be an artifact of the sampling methodology, caused by the measures utilitzed for land value, the nature of local assessment practices or the failure to include other pertinent independent variables. Only the omission of other important elements that might contribute to land value is justified as possible cause for the size dominance. Standard random sampling methodology was employed in conjunction with stratification to reduce sampling bias. The local assessed value is certified by state government as an accurate measure of market value. Other variables might indeed contribute some additional explanation of variance, but most probably would be correlated to size and thus not included in the present model. However other variables would be included in a regression model based on principal components.

Factor scores from the nine principal components were also regressed on the logarithm of assessed value per acre. Eight factors were significant and together explain 54.6 percent of the variation in value (Table 11). Parcel size is again dominant and by a larger margin than in the previous model. The remaining factors provide so little additional information, they could be omitted from the equation. The overall loss in explanatory power might be caused by the large percentage of total variance among independent variables not included among the principal factors. In comparison to the previous regression model, the factors from principal components analysis provide little additional insight as to the influences on land value. Mainly they serve to underscore the dominance of parcel size and indicate that dominance increases in the case of uncorrelated linear combinations of the independent variables.

With approximately 78 percent of the variation in land values accounted for among seven terms, the hypothesis that an adequate explanation of value may be found among spatial and site factors seems to be acceptable. Although the level of explanatory power is acceptable, one must verify that conclusions implicit in the magnitude of variance explained and the ordering of the variables in the final solution is rational and consistent with existing information. Most previous investigations found the parcel size to be a significant factor but with a much lower level of influence. The apparent discrepency might stem from the units employed to measure the dependent variable. Application of regression analysis to land appraisal naturally requires that the predicted values for each observation be computed. If the dependent variable is modified by a logarithmic transformation to improve the regression fit, then the predictive power of the model is in the transformed units of measurement. Therefore, the confidence limits on a predicted value when returned to the original units of measurement rapidly increase with increases in the magnitude of the predicted value. Thus, regression studies as applied to land appraisal have not applied transformations to the dependent variable and generally have avoided transformation of independent variables. In addition, most models were developed for prediction of improvement values or land and improvement value as opposed to land values alone. If such a constraint were placed upon the variables employed here, the results of regression analysis might be quite different. Under the assumptions of the present study, one may conclude that the size of a parcel is far and away the dominant factor affecting land value.

Further investigation of the study area and the variables available for analysis might address the hypothesis under the constraints mentioned above. It is doubtful that size would be so dominant a factor. The scope of investigation most likely would be narrowed to parcels with structures and the value of structures made available as an independent variable. Previous investigations have shown that the value of structures on a parcel easily predicts the combined value of the land and improvements.

A second sample drawn from the study area would provide a better indication of the explanatory power of the model. Since the model was fitted to the present data set, it is likely that the amount of variation explained would differ when the model is applied to a second data set. Although the error for the second sample could be large, one expects little discrepancy when the sample sizes are similar.

The findings of scientific research must always be evaluated in the light of the existing body of knowledge.

Solutions to problems which deal with man and his institutions are by nature rare and tend to be complex when identified. Results which contradict this intuitive prejudice are immediately the subject of some skepticism. In the present investigation, rigorous scrutiny of research methodology and validation of the regression model has failed to detect any uncertainty as to study results. One must therefore conclude that under the constraints of the present investigation, parcel size is the dominant determinant of parcel value.

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