

Spatial Aspects of Property Value Appreciation

by

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## SPATIAL ASPECTS OF PROPERTY VALUE APPRECIATION

ABSTRACT. An attempt is made to determine whether or not property value appreciation on land adjacent to an expanding urban center is related to distance from the city and to identify the temporal variation in this relationship. The results of simple linear regression strongly suggest that property value appreciation and distance from the city are not spatially related.

### INTRODUCTION

One important economic characteristic of an expanding urban center is the demand which it displays for developable land. The nature and strength of this demand are strongly related to the anticipated direction and spatial extent of future urban development and to the rate of conversion of rural land to urban use. Among the many direct results of the demand, the one to be dealt with here is the increase in the market value of the rural properties nearby. It is a common observation that agricultural land close to an urban center has value added to it because of its potential for urban development. The effect is that the market price of such land rises above its agricultural value.

It is useful to think of the rural area about an urban center as a zone of influence, where property appreciates in value as a result of the demand for developable land. The conversion of rural land to urban use results from a push-pull effect wherein the demand increases the market price, making agriculture less profitable, and

the higher market price encourages the release of the land for the development of more competitive space uses.

The research project related here was pursued within this framework. A zone of property value appreciation surrounding an urban center was postulated. Appreciation was defined to mean the increase occurring in property values over a given period of time. This project is concerned with relationships between rate of appreciation and distance from the urban settlement, and with temporal variation in the appreciation-distance pattern.

## REVIEW OF THE LITERATURE

To understand the importance of property value appreciation, it is necessary to briefly review the nature of the urban land market. A good statement of the theory of the land market has been prepared by William Alonso.<sup>1</sup> In his paper, Alonso first states that all land uses possess bid rent curves such as those shown in Figure 1. This curve shows the amount of rent a proprietor will be willing to pay for land at various distances from the market or the center of the city. On any one curve, profits are everywhere equal. The space uses with the steepest curves will be those whose products have the highest value at the market. These will concentrate close to the market, forcing less competitive activity to the periphery. The land appreciates in value due to increased demand for it and the urban land uses expand outward from the center, displacing agriculture.

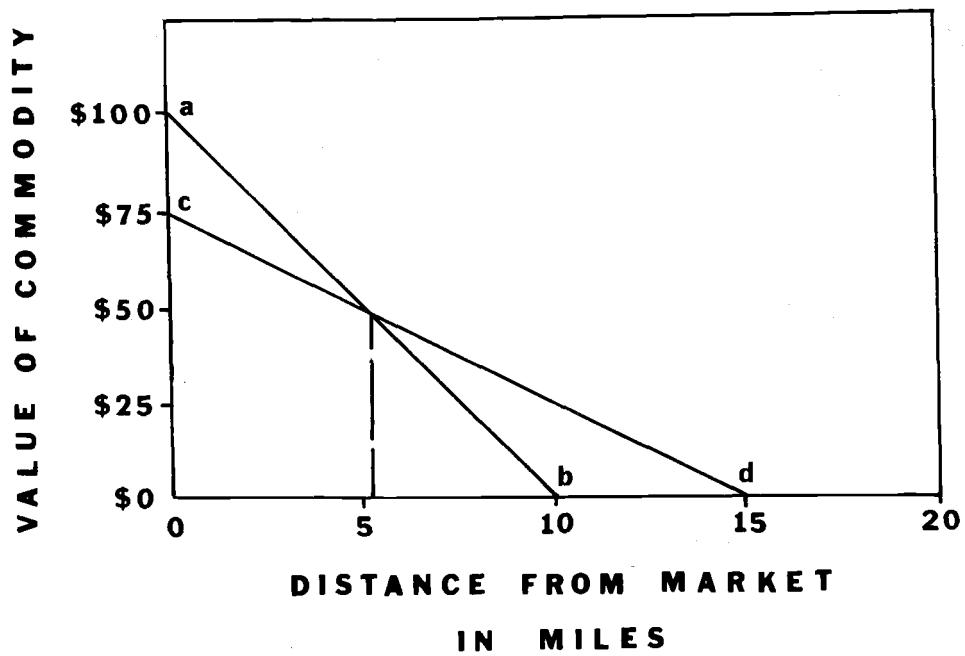
This framework provides the theoretical context for a discussion of property value appreciation. Appreciation is the result of increased demand for developable land, and it also is an important factor encouraging the release of land for development.

Empirical studies complementing the theoretical discussion are

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<sup>1</sup>William Alonso, "A Theory of the Urban Land Market," Papers and Proceedings of the Regional Science Association, Volume 6 (1960), pp. 149-157.





THE AGRICULTURAL LAND MARKET.

FIGURE 1.

mainly descriptive statements of the conversion process.<sup>2</sup> No material is available in the literature on the spatial characteristics of property value appreciation around an expanding urban center. The most useful work done in the field has been in the theory of location. Thorough discussions are found in Location and Space Economy, by Walter Isard, and The Location of Agricultural Production, by Edgar S. Dunn.<sup>3</sup>

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<sup>2</sup>See, for example, Marvin Kottke, "Changes in Farm Density in Areas of Urban Expansion," Journal of Farm Economics, Volume 48 (December, 1966), pp. 1290-1296, and David J. Allee, "Changing Use of Rural Resources," Journal of Farm Economics, Volume 48 (December, 1966), pp. 1297-1305.

<sup>3</sup>Walter Isard, Location and Space Economy (Cambridge, Massachusetts: Massachusetts Institute of Technology Press, 1956), and Edgar S. Dunn, The Location of Agricultural Production (Gainesville, Florida: The University of Florida Press, 1954).

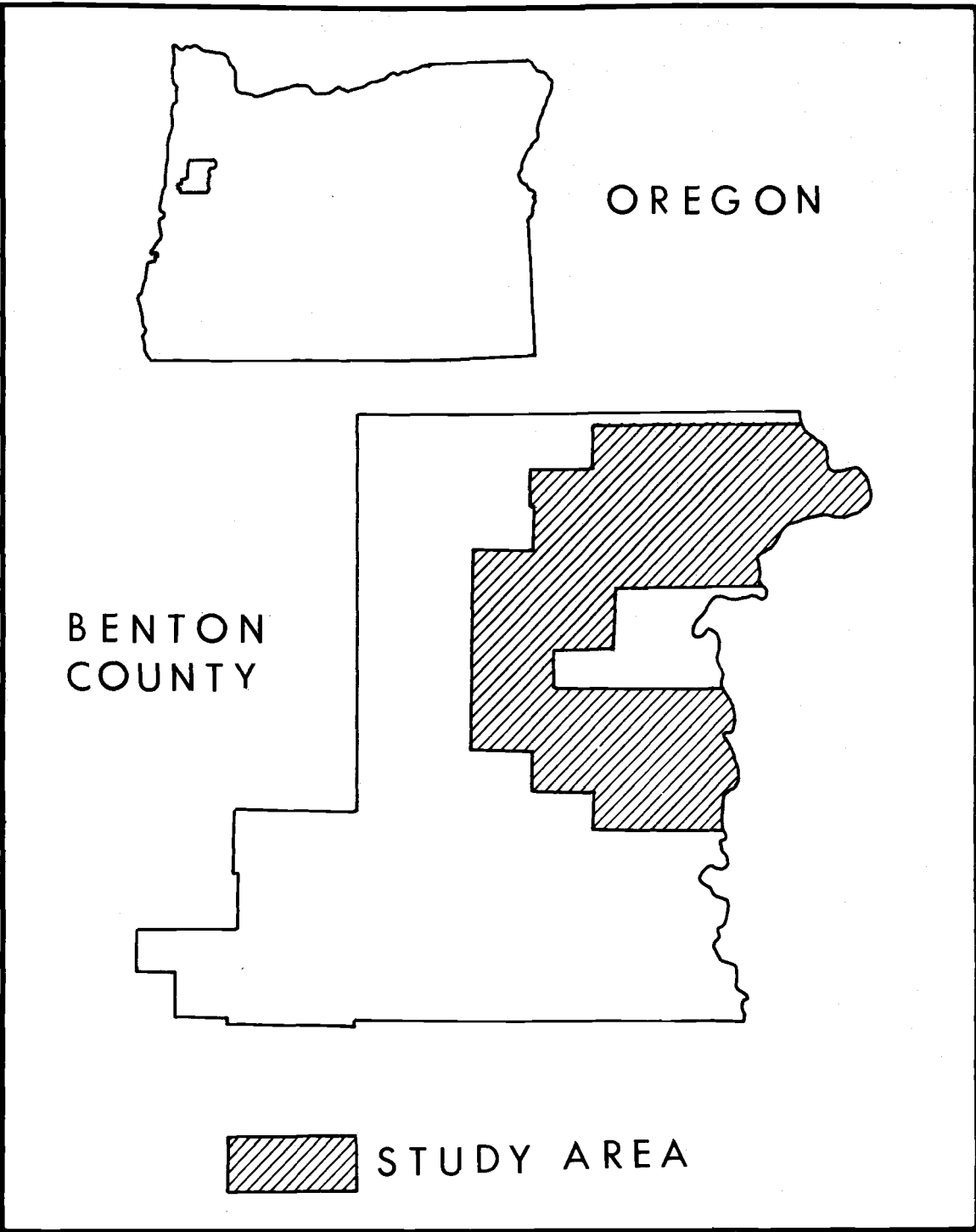
## PROCEDURE FOR INVESTIGATING THE PROBLEM

### Goals of Investigation

Assuming that there exists a zone of property value appreciation on non-urban land surrounding an urban center, it is proposed that a relationship can be demonstrated between the rate at which the value of property appreciates and distance from the center. If it is possible to demonstrate such a relationship, it should also be possible to show the manner in which the pattern of property value appreciation varies from one time period to another. These are the goals of the investigation.

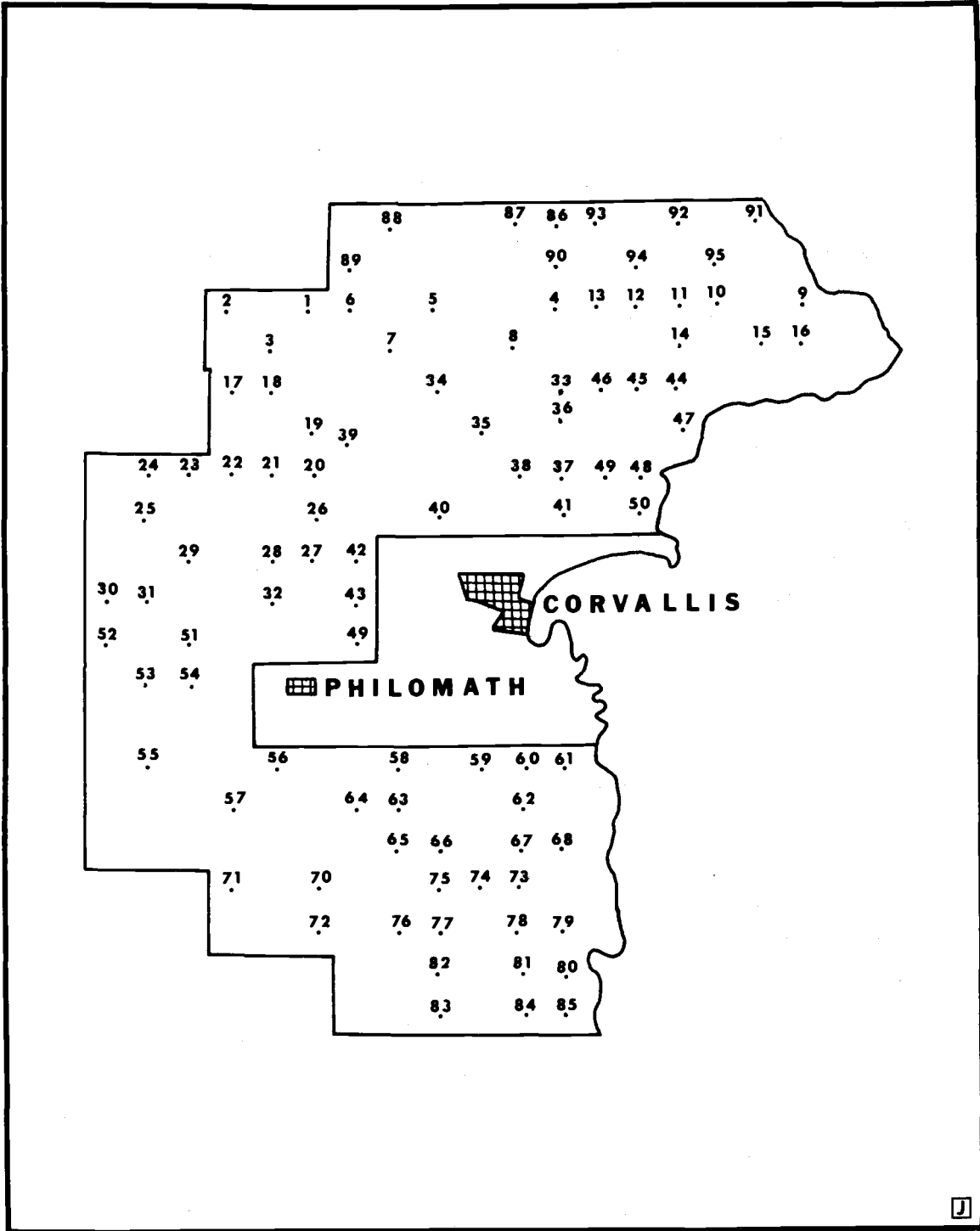
### Selection of a Study Location

At the start of this research project, an expanding urban center was selected, and a study area was delimited surrounding it. The site chosen was Corvallis, Oregon. The study area surrounding Corvallis was designed to include the anticipated zone of appreciation. On the basis of field research and interviews with local officials, it was defined as shown in Figures 2 and 3. It extends five miles from the center of Corvallis on the North, West, and South. The Willamette River separates it from Linn County on the East. It was decided to confine the study to Benton County to simplify problems of data gathering and comparability. The cities of Corvallis and Philomath



BENTON COUNTY, OREGON.

FIGURE II.



SAMPLE POINTS IN THE STUDY AREA.

FIGURE III.

are separated from the study area by the inner boundary, which is the approximate limit of urban land use at the end of 1968.

### Sample of the Study Area

The study area was divided into divisions of six township sections each on the basis of maps furnished by the County Assessor. Four sections were randomly selected from each division, and the parcels of land occupying the midpoints of the sections selected were identified. In this manner, 125 sample points were selected.<sup>4</sup>

### Selection of a Measure of Property Value Appreciation and Gathering of the Data

Appraised values for the parcels selected were obtained from the County Assessor. A value per acre was noted for the years 1948, 1958, and 1968.

It was recognized that property tax data have serious limitations, of which the following were deemed most important at the time of

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<sup>4</sup>This form of stratified random areal sample presented two problems. The first was the possibility that repeated sampling of the section midpoints would produce values unrepresentative of the section as a whole. It was decided that if this problem developed, each section would be randomly sampled, but the problem did not arise.

A second, and related potential difficulty would be the sampling of a small plot whose value per acre would be considerably larger than those for other larger plots in the section. This occurred in three cases, which will be commented upon subsequently.

data collection:

1) Properties are reappraised in Benton County on a six year cycle. Therefore, the time between the year of the sample and the most recent previous appraisal could be as much as six years. It was decided to use appraisals only if they were between 1945-1948, 1955-1958, and 1965-1968.

2) Tax appraisal data do not accurately reflect market value. Nevertheless, the critical element, the relative relationship among the values, should be preserved.

As the data collection proceeded, an additional difficulty of major importance was discovered. The rural area to the north and west of Corvallis is predominantly timberland, for which tax appraisal policies have changed during the past twenty years. Most important is the practice, begun in 1960 by the Oregon State Tax Commission, of appraising timber and land separately. Prior to 1960, according to authorities, the timber was not taxed. In several cases, however, the 1958 appraisal was, in fact, lower than the 1948 appraisal, suggesting that the removal of timber was taken into consideration. It was not possible to verify this through field checking.

As a result of the problems encountered, thirty of the 125 sample points originally selected were eliminated from the study. The final number of useable observations was ninety-five (Table 1).

TABLE 1. -- THE VARIABLES

Observation Number	Distance from Corvallis (miles)	Rate of Property Value Appreciation (%)	
		1948-1958	1958-1968
1	4.4	134.9	72.1
2	5.1	137.0	77.0
3	4.0	253.9	80.0
4	3.6	12.2	179.0
5	3.8	253.6	48.0
6	4.2	252.2	111.5
7	3.5	253.4	43.0
8	3.1	457.0	74.9
9	4.9	59.7	150.9
10	4.4	154.8	1446.1
11	4.1	234.6	282.0
12	3.9	158.6	21.5
13	3.8	149.8	275.6
14	3.4	93.8	36.0
15	4.3	156.5	29.3
16	4.6	154.8	98.4
17	4.0	269.2	61.5
18	4.4	135.3	82.4
19	3.3	252.4	16.8
20	3.0	252.9	44.5
21	3.4	255.3	65.5
22	3.9	94.1	50.1
23	4.3	20.8	108.9
24	4.8	60.3	12.2
25	4.6	71.4	17.9
26	2.7	53.6	24.1
27	2.6	127.4	53.4
28	3.1	41.0	201.3
29	4.1	191.5	268.3
30	5.0	253.2	65.9
31	4.5	63.3	140.0
32	3.0	52.7	84.3
33	2.6	156.3	128.6
34	2.8	159.4	79.9
35	2.2	155.9	102.3
36	2.2	156.3	112.2
37	1.7	157.7	74.5
38	1.7	156.1	56.8
39	2.6	156.4	34.5
40	1.6	148.0	2420.0



TABLE 1. -- (Continued)

Observation Number	Distance from Corvallis (miles)	Rate of Property Value Appreciation (%)	
		1948-1958	1958-1968
41	1.2	157.4	33.1
42	2.1	22.4	1026.9
43	2.0	125.9	46.3
44	3.3	157.6	279.2
45	3.0	139.3	26.5
46	2.8	133.9	18.9
47	2.9	181.1	51.3
48	2.2	157.0	218.5
49	1.9	189.1	86.8
50	1.9	216.8	130.4
51	4.0	120.4	29.4
52	5.0	53.3	58.5
53	4.6		88.7
54	4.1	148.8	52.4
55	4.9	56.1	129.4
56	2.5	100.4	43.8
57	4.2	121.0	20.3
58	2.3	168.2	38.9
59	1.9	161.5	42.1
60	1.8	157.5	43.1
61	1.9	156.5	111.1
62	2.3	297.1	68.0
63	2.8	160.1	45.7
64	3.1	108.2	24.3
65	3.2	157.2	79.1
66	3.0	157.4	56.0
67	2.8	157.2	20.5
68	2.9	313.7	194.1
69	2.0	156.3	110.9
70	4.1	137.1	80.7
71	4.8	84.1	94.3
72	4.6	143.3	28.4
73	3.4	186.4	36.8
74	3.4	209.0	47.1
75	3.4	171.2	28.9
76	4.1	187.4	25.6
77	3.9	157.7	31.8
78	3.8	157.6	26.2
79	3.8	157.5	107.8

TABLE 1. -- (Continued)

Observation Number	Distance from Corvallis (miles)	Rate of Property Value Appreciation (%)	
		1948-1958	1958-1968
80	4.3	175.9	92.7
81	4.3	177.1	62.9
82	4.4	184.9	71.0
83	4.9	262.5	8.8
84	4.8	157.4	25.0
85	4.8	190.6	72.1
86	4.6	242.8	32.0
87	4.6	208.8	32.9
88	4.9	57.1	57.3
89	4.6	12.3	105.0
90	4.1	94.7	150.9
91	5.4	158.0	88.2
92	5.0	174.7	64.2
93	4.7	157.4	40.6
94	4.3	118.1	60.6
95	4.8	157.5	42.8

### Computation and Mapping of the Rates of Change

For each observation, in each time period, a rate of property value change was computed on the basis of value per acre. The following form was used:

$$\frac{1958 \text{ property value} - 1948 \text{ property value}}{1948 \text{ property value}}$$

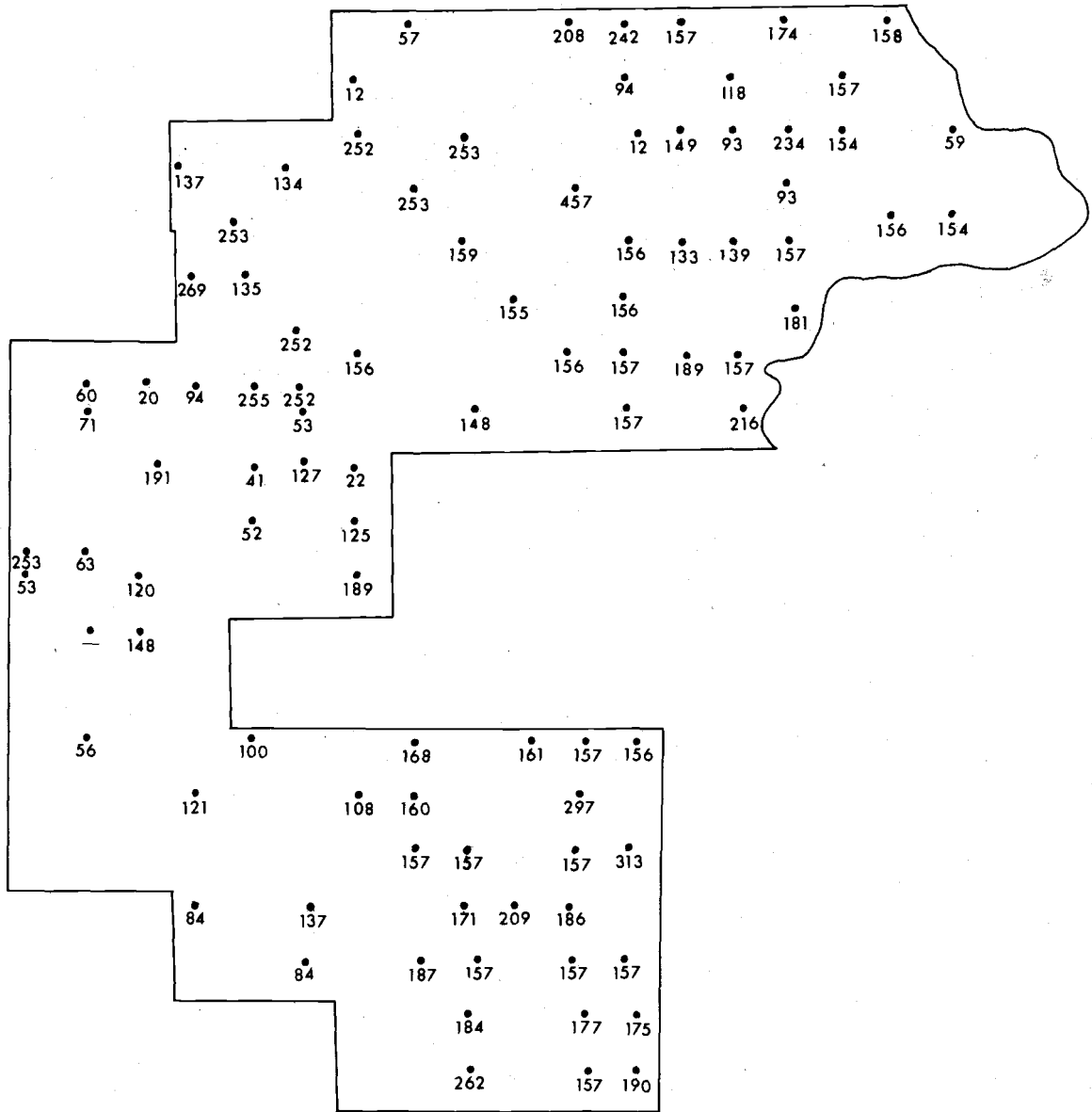
The values thus obtained were used first in the preparation of two maps of property value change, one for each time period. These are shown in Figures 4 and 5.

### The Character of the Variables

Basic statistical characteristics were computed for each variable, and visual comparison was made by means of scatter diagrams. This information appears in Table 2 and in Figures 6, 7, and 8.

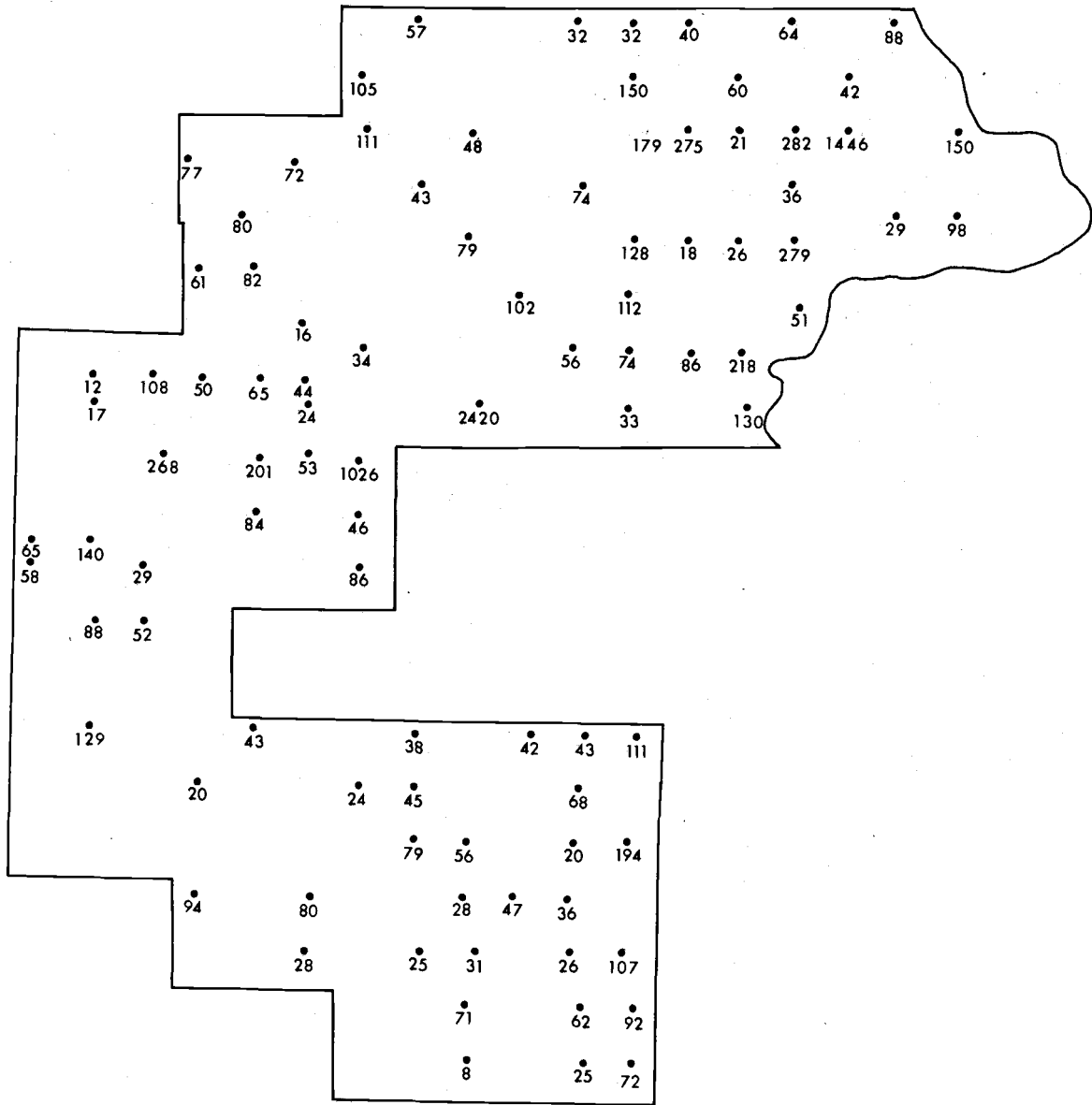
This preliminary analysis indicated that the variables did not have statistically normal distributions. In particular, the rate of property value change in the second period, 1958 to 1968, was skewed to the right by three values which were above 1000%, while the remaining values were below 400%.

The scatter diagrams display the relationship between rate of property value change and distance from the city for both periods, and rate of change in the first period as related to rate of change in



MAP OF RATES OF PROPERTY VALUE  
APPRECIATION, 1948-58

FIGURE IV.

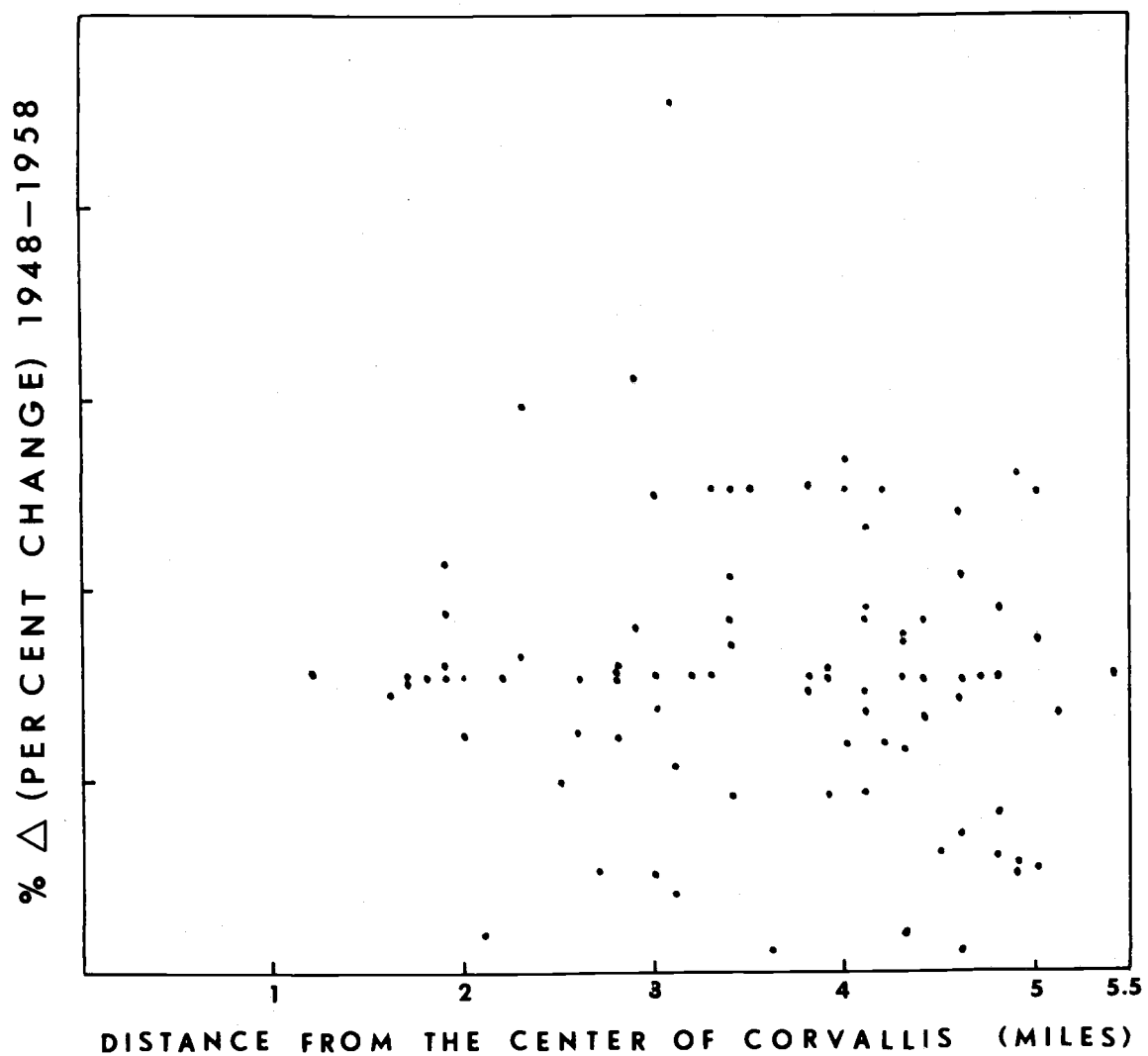


MAP OF RATES OF PROPERTY VALUE APPRECIATION, 1958-1968

FIGURE V.

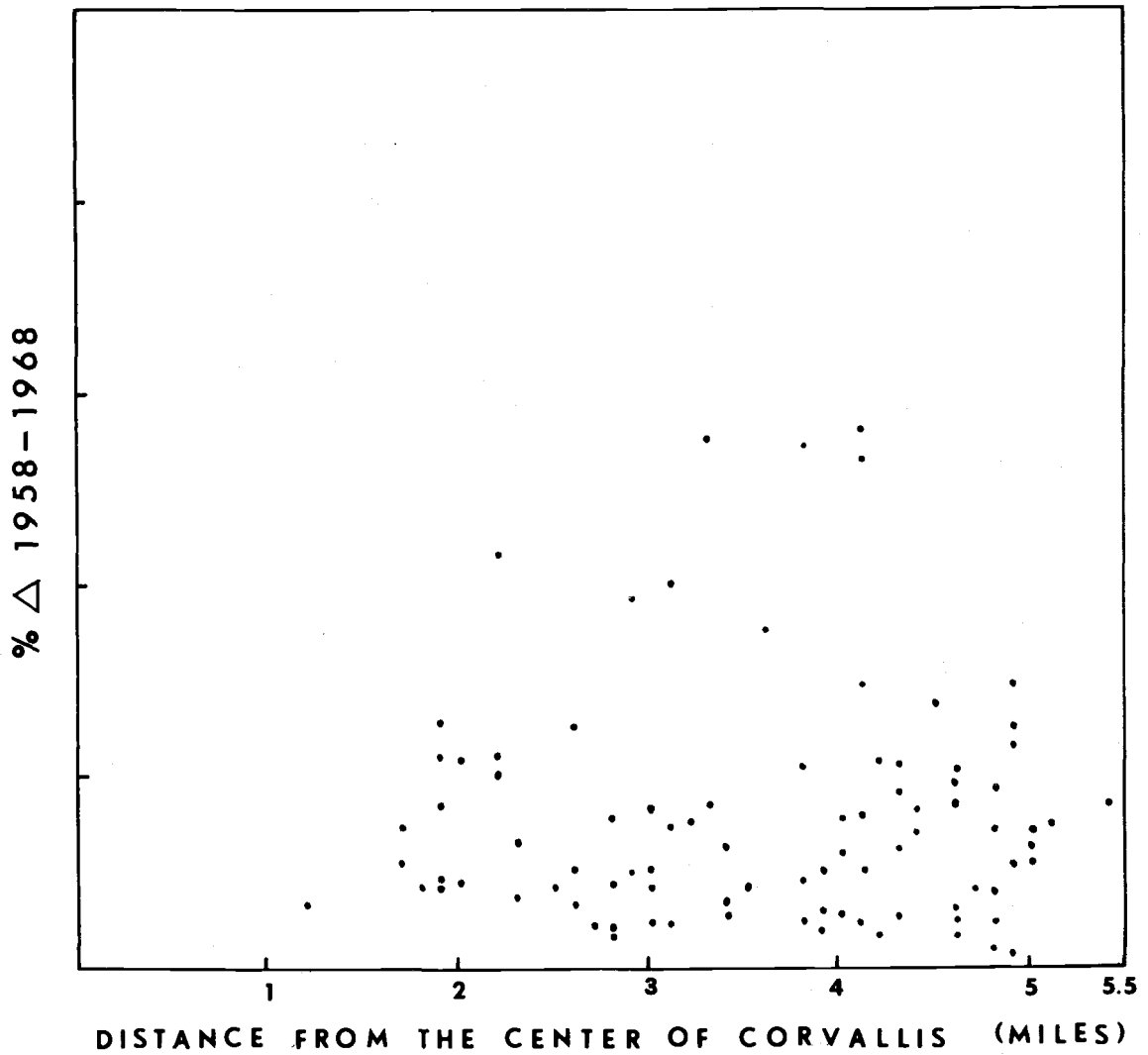
TABLE 2. -- CHARACTERISTICS OF THE VARIABLES

Variable		Mean	Standard Deviation	Mean (Logged)	Standard Deviation (Logged)
Distance from Corvallis	95 obs.	3.57	1.04	0.53	0.14
	92 obs.	3.60	1.02	0.54	0.14
Rate of Property Value Appreciation, 1948-1958	95 obs.	154.84	72.39	2.11	0.35
	92 obs.	156.35	72.24	2.12	0.35
Rate of Property Value Appreciation, 1958-1968	95 obs.	126.53	296.83	1.82	0.40
	92 obs.	77.47	60.53	1.77	0.31



PROPERTY VALUE APPRECIATION AS DISTANCE INCREASES FROM  
THE CENTER OF CORVALLIS, 1948-1958.

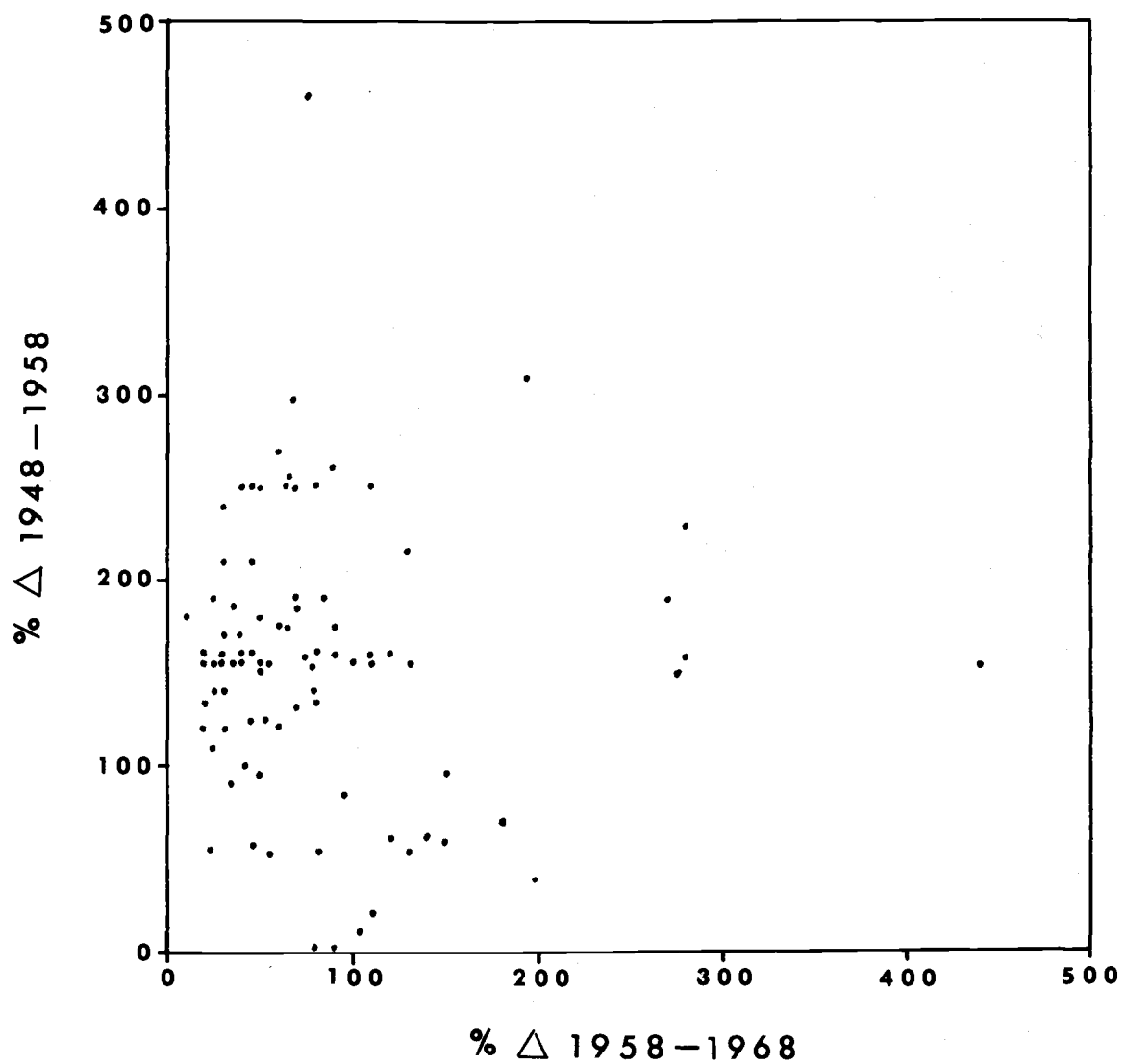
FIGURE VI.



PROPERTY VALUE APPRECIATION AS DISTANCE INCREASES FROM  
THE CENTER OF CORVALLIS, 1958-1968.

FIGURE VII.





COMPARISON OF RATES OF PROPERTY VALUE APPRECIATION  
IN THE PERIODS 1948-1958, AND 1958-1968.

FIGURE VIII.

the second period. No patterns could be ascertained from examination of these diagrams.

### Statistical Comparison of the Variables

The scatter diagrams were then analyzed through simple regression analysis. In the case where distance was plotted against rate of property value change, the distance variable was considered to be independent and the rate of change dependent. In comparing the rates of change in the two time periods, the dependent-independent distinction was not made.

Due to the non-normality problem, the regression analyses were run first with the data as computed and second with the common logarithms of the variables in an attempt to normalize the distributions. Also, each regression was performed with and without the three observations in the second period which were above 1000%. The results are seen in Tables 3 and 4.

Regression analysis was intended to describe each relationship by means of trend lines. Hypothetical examples are depicted in Figure 9. Depending on the distributions in Figure 9a, the distribution in Figure 9b could take a number of different forms. Three are presented here.

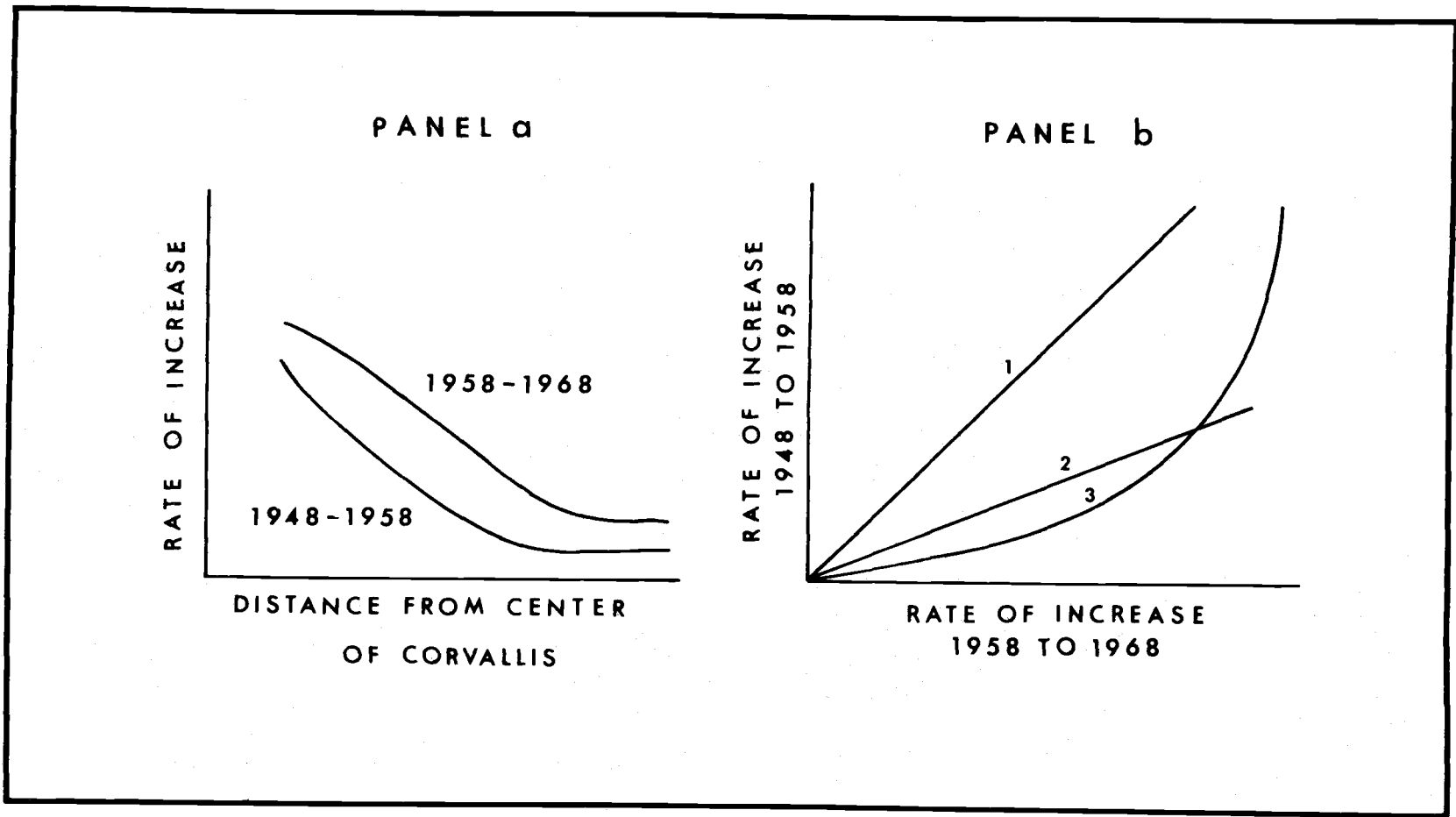
- 1) If the values followed a 45 degree line, all rates of change would be the same in the first period as in the second.

TABLE 3. -- CORRELATION COEFFICIENTS

Relationship	95 Observations		92 Observations	
	Unlogged	Logged	Unlogged	Logged
Distance from Center of Corvallis and Rate of Change, 1948-1958	-.13	-.15	-.16	-.19
Distance from Center of Corvallis and Rate of Change, 1958-1968	-.17	-.15	-.02	-.04
Rate of Change 1948-1958 and Rate of Change 1958-1968	-.08	-.16	-.05	-.14

TABLE 4. -- REGRESSION EQUATIONS

Relationship	95 Observations		92 Observations	
Distance from Center of Corvallis and Rate of Change, 1948-1958	Unlogged	$y = 186.05 - 8.73x$	$y = 198.12 - 11.59x$	
	Logged	$y = 2.30 - 0.36x$	$y = 2.37 - .47x$	
Distance from Center of Corvallis and Rate of Change, 1958-1968	Unlogged	$y = 301.55 - 48.96x$	$y = 81.41 - 1.09x$	
	Logged	$y = 2.04 - 41x$	$y = 1.83 - .099x$	
Rate of Change 1948-1958 and Rate of Change 1958-1968	Unlogged	$y = 177.02 - 0.33x$	$y = 84.15 - .04x$	
	Logged	$y = 2.22 - 0.19x$	$y = 2.05 - .13x$	



POSSIBLE PATTERNS OF PROPERTY VALUE APPRECIATION.

FIGURE IX.

2) In this linear relationship, property values would in each case increase faster in the second period than in the first, but the relationship would be constant.

3) In this curvilinear relationship, values would increase faster in the second period than in the first until the slope of a tangent to the curve equaled 45 degrees. After that, they would increase faster in the first period.

## RESULTS OF INVESTIGATION

### The Variables

As shown in Table 2, the data for each variable were distributed non-normally. When the variables were logged the results indicated a distribution considerably closer to normality. The means and standard deviations for the logged values are also found in Table 2.

### The Relationships Among the Variables

#### Distance from the Urban Center and Rate of Property Value Appreciation

Simple regression analysis yielded a correlation coefficient and an equation of the form  $y = a + bx$  describing the distributions. These results are presented in Tables 3 and 4. The correlation coefficients are negative and extremely low. Furthermore, the slopes of the regression equations indicate that there is no relationship between distance from the city and rate of property value appreciation.

As a backup, tests of statistical significance were applied to both the correlation coefficients and the regression results for the normalized and non-normalized data. In no case could the null hypothesis be rejected at the ninety-five percent confidence level. None of the regression or correlation results could be considered statistically significant.

Two changes which could affect the results are expanding the present study area and increasing the size of the sample within the present study area. Regarding the first of these, it is felt that since the entire range of values appears throughout the study area for both time periods, the present outer boundary would have to be greatly extended. Because of the proximity of other urban centers, such an extension would only complicate the picture. In addition, it is not likely that the results would be changed if the inner boundary were moved inward to the limit of urban land use in 1948. The outward expansion of urban land use from 1948 to 1968 has not been great enough to make a difference at the scale in which this research project was carried out.

In this connection, the prospect for changing the results by a larger sample of the present study area is not promising, since there is no evidence of a relationship. Moreover, there would be serious data collection problems.

#### Temporal Variation of the Appreciation Pattern

A comparison of property value appreciation for the two time periods, 1948 to 1958 and 1958 and 1968, also produced non-significant statistical results. It could not be demonstrated that a relationship exists.

Interpretation. The existence of a relationship between the two time

periods, such as depicted in Figure 9b, is contingent upon the existence of a relationship between appreciation and distance in each of the periods. Therefore, no relationship could be demonstrated. It can only be noted that most properties appreciated faster in the first period than in the second.

In summary, the regression analysis indicates that no relationships exist among the variables. The values obtained were found to be statistically non-significant at the ninety-five percent confidence level.



## RESERVATIONS

Although the results of this study do not support the contention of a relationship between property value change and distance from an urban center, it is possible that the relationship exists. It is felt that the non-significance of the values obtained may be partially the result of peculiarities in the data, influence of other urban centers, and the short time span of the study.

The quality of the data available comprises an important reservation. Although tax appraisal data should preserve the relationships among property values, there are at least two reasons for believing that this is not the case. First, because of the large turnover of personnel in the Benton County Assessor's Office from 1948 to 1968, it may be questioned if appraisal practices or the competence of appraisers have been uniform. Hence the appraised values of the land for 1948, 1958, and 1968 are not strictly comparable. Second, as previously stated, sharp decreases in the value of timberland from 1948 to 1958 suggest that timber removal resulted in a lowered appraisal. This possibility brings into question the quality of all timberland appraisal figures prior to 1960. Since the area to the north and west of Corvallis is predominantly timberland, this is a major weakness in drawing conclusions from the study.

Another reservation concerns the possible influence of other urban centers. Albany, Oregon, for example, undoubtedly has a strong

influence on the land in northeastern Benton County. In addition the expansion of the Portland area has caused land in the Willamette Valley to appreciate in value. These factors obviously have a significant impact, but there is no way to isolate this impact and study the influence of Corvallis alone.

A final reservation concerns the time period of the study. If the data had been available and it had been possible to perform the same study from 1920 to 1960, it is quite possible that a pattern would have emerged in which property value appreciation varied with distance from the city.

## SUMMARY

In a case study of Corvallis, Oregon, it has been attempted to determine if a relationship exists between rate of property value appreciation and distance from an urban center. The results indicate that a relationship does not exist, but they should be accepted with reservations. These reservations, regarding the quality of the data, the influence of other urban centers, and the short time period of the study, are offered in partial explanation of the non-significant statistical results.

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