A Methodological Inquiry into the Determination of the Rural-Urban Interface

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The Löschian "Economic Landscape" model has been used in explaining growth patterns around the cities of Dallas, Indianapolis and Toledo [Davidson, pp. 14-24 and Lösch, p. 125]. Lösch states that the area around a metropolis is composed of market areas and competing locations which comprise a concentric pattern, and he implies that the boundary of the first concentric zone is marked by towns which are located nearest the metropolitan center [Losch, pp. 129-130]. The second concentric zone of population growth extends to the outer limit of the rural-urban fringe.

Although much of the body of location theory may be applied to populational and developmental aspects of the rural- urban fringe, few precise studies have been made of the extent of fringe areas. In those few studies, emphasis has been placed on changes within suburban towns without considering aspects of change of the nearby non-urban population. This research is, however, devoted to the investigation of growth determinants, patterns and limits of the entire rural-urban fringe around a metropolitan center. The limits, or extent, of the rural-urban fringe around a center represent a particular problem to urban and regional planners and developers. As yet, no method has been devised for accurately measuring the fringe area under the dominance of a metropolitan center [Parr, p. 188]. The Lubbock study area represents a fringe region which is physically similar to the basic assumptions of classical central place theory. After establishing the high- and low-growth sectors as discussed by Lösch, p. 129] (figure 1), the Lubbock area is investigated in terms of concentric growth zones. Methods developed through this research may be used generally in the investigation of other areas.

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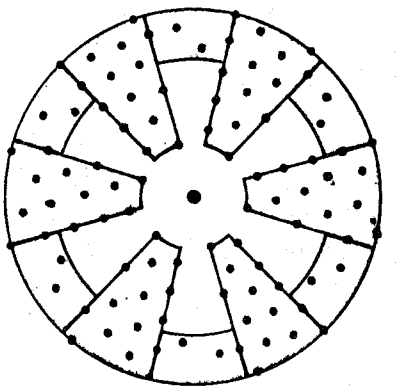
Fig. 1. Löschian 'Economic Landscape'



Study Area

The complete study area includes Lubbock County and seven surrounding counties (figure2). The sample data include all towns and areas within the Lubbock rural-urban fringe. Basal data used in this particular analysis apply to 1960 and 1970, dates which define the time period under consideration. Data were obtained from the United States Census of Population and from local agencies.

Determination of the Extent of the Lubbock Rural-Urban Fringe

Initially, a location model is utilized in determining the extent of the Lubbock rural-urban fringe. The model is an application of the Loschian "Economic Landscape" to the area (figure 1).

After Lubbock's rural-urban fringe was identified, patterns of population growth within the area were investigated through the use of central place theory.

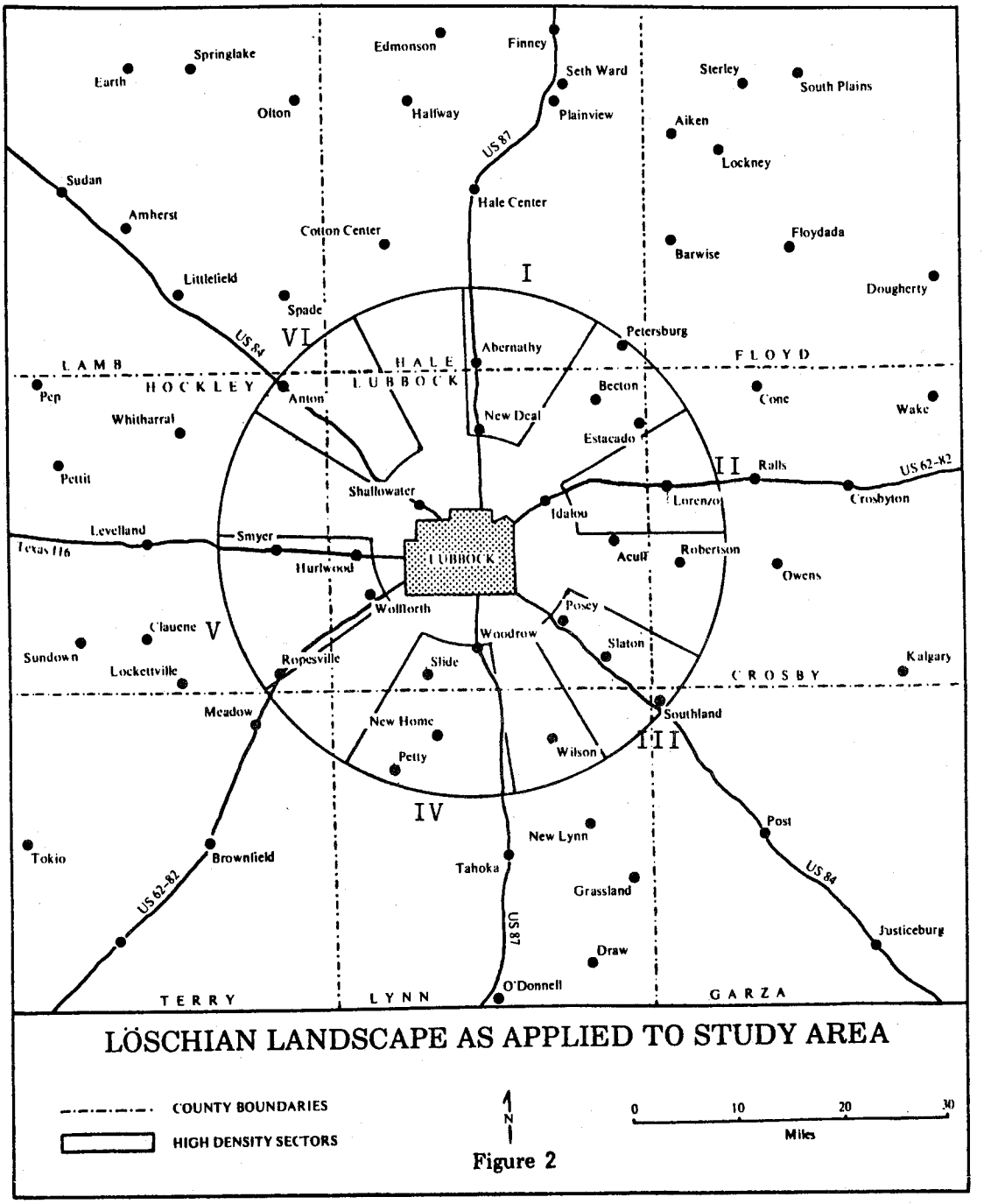


Figure 2

Growth Determinants

In an effort to identify causes of population change (1960-1970) within Lubbock's rural--urban fringe, four variables were incorporated into a model of population growth. For this model, the dependent variable was population change. Independent variables were: 1) Distance from Lubbock; 2) Size of town in 1960; 3) Distance to the nearest town of equal or larger size; and 4) The number of links of highway connectivity serving the town.

Hypotheses related to the growth model developed for the Lubbock area were tested through the use of a multiple-regression technique. Through the investigation and application of these growth patterns and determinants, areas of future population expansion within the area may be predicted. These bases for prediction should aid local governments, planners and developers in planning for the location and the residential, commercial and open-space needs of the changing population and land-use structure within Lubbock's rural-urban fringe.

General Data

The distance to Lubbock is the actual highway distance, which, because of an excellent system of highways, represents the economic distance in the area. The distance to a comparable city is calculated by the actual highway mileage from the sample town to another town of equal or greater size in the study area. The number of highway links is the number of major (U.S.) highways which enter the town.

Löschian Landscape

The Löschian Landscape is graphically represented (figure 1). According to Lösch the distance between urban places of the same kind is equal to the distance between the settlements supplied times the square root of the number of settlements. The formula, as derived from the K = 4 principle, is: $b = a\sqrt{n}$ where: b = the diameter of the landscape; a = distance separating the original settlements $\frac{13+11+11+12+8+11}{6}$; and n = the number of settlements completely supplied, including the point of supply $(1 + \frac{6}{2})$. When the appropriate values from this area are placed in the equation, it reads: $b = 11\sqrt{4} = 22$ miles. Therefore, the inner zone directly related to Lubbock's urban influence has a diameter of twenty-two miles (or a radius of eleven miles).

The outer zone of the landscape is identified using a mapping method based on the growth of each incorporated town in the study area from 1960 to 1970. This zone is tentatively determined by the decline in population of towns farther from Lubbock as compared to the increase in population of towns closer to Lubbock. The outer zone tentatively consists of the area within a twenty-two mile radius of Lubbock.

The six growth zones as indicated (figure 2) are adjusted to include towns with positive growth on major links of connectivity extending from Lubbock. The adjusted zones are zone IV and zone V. Zone IV is adjusted to 40 degrees to include U.S. Highway 87 and the towns of New Home and Slide which experienced positive growth. Zone V is adjusted to 38 degrees to include U.S. Highway 82 and State Highway 116.

Regression Analysis of the Entire Study Area

In an effort to identify causes of rural town growth, four determinants are used in the regression equation. The equation is:

$$Y = f(X_1, X_2, X_3, X_4)$$

where: Y = the growth of the town from 1960 to 1970; X_1 = the size of the town in 1960; X_2 = distance in terms of highway miles to Lubbock; X_3 = distance in terms of highway miles from the town to a town of equal or greater size; and X_4 = number of highway links to the town in 1960.

Regression analysis using ordinary least squares was first run on the entire study area with the following results:

$$Y = 113.38 + 0.09X_1 - 2.80\,X_2 - 0.47\,X_3 - 33.53\,X_4$$

The coefficient of determination (R^2) for the equation is .502, indicating that the four variables explain approximately 50 percent of the growth variation of the towns during the 1960 to 1970 study period. The standard error of estimate for the equation is 262.10, resulting in a large deviation.

All of the coefficients with the exception of X_4 have the expected relationship with the dependent variable as indicated by their sign. Consequently, the regression analysis was rerun deleting the X_4 variable from the equation. The resulting equation was:

$$Y = 46.76 + 0.08X_1 - 2.88X_2 - 0.66\,X_3$$

Standard Errors: (.01119) (1.96) (1.83)

The coefficient of determination for the new regression equation is .4903, and the standard error of estimate is 262.99. Therefore, the number of highway links is not of significant value to the regression analysis.

The F-value for the regression equation is significant at the 99% probability level. Although all

coefficients have the expected signs, X_1 is the only variable which statistically differs from zero at the 95% probability level.

Further analysis is accomplished by looking at the "Unit Normal Deviates" as calculated by the formula U.N.D. = $\frac{Y - \bar{Y}}{s_y}$.
Since 95% of a normal distribution lies between the limits of -1.96 and +1.96 one might expect approximately 95% of the U.N.D.'s to fall within these limits. Those U.N.D.'s that exceed ±1.96 are called "outliers", because they are peculiarities and are data points not typical of the body of the data. The residuals indicate three outliers; they are the towns of Plainview, Littlefield, and Brownfield. Simple regression analysis indicate that these towns influence growth in their respective areas. Consequently, it appears that the Löschian landscape will not extend this far.

Regression Analysis of the Löschian Landscape

A similar anlaysis is now concentrated on the Löschian landscape application. The resulting equation obtained by the twenty-one observations of the landscape is:

$$Y = 74.10 + 0.09\,X_1 - 6.31\,X_2 + 0.74\,X_3 + 38.42\,X_4$$

Standard Errors: (.02) (4.91) (1.12) (30.89)

The coefficient of determination for the new regression equation is .635, indicating that the independent variables explain approximately 64% of the variations of the dependent variable of the new equation. The standard error of estimate is 142.17, indicating a lesser average deviation than predictions made from the previous set of equations.

The coefficients of the variables of the equation all have the predictable sign. The sign of the coefficient of variable X_3 is different from its sign in the previous regression analysis. This difference can be expected since within the Löschian Landscape increased distance to a town of comparable size would have a positive effect on growth. The coefficient of variable X_4 (number of highway links) has the expected sign because population is now in an area where accessability to Lubbock is a vital factor for growth.

The U.N.D.'s indicate that only one "outlier" exists for the regression on this landscape. The town of Lorenzo falls outside the 95% significance level. Lorenzo serves as a residential suburb and its population is much larger than predicted from the regression equation. On the basis of growth, the outer zone of the Löschian Landscape is well defined by the regression analysis and the mapping precedures.

Summary

The objectives of this study were to determine the inner and outer zone of the fringe area for the Lubbock, Texas, SMSA and to ascertain and identify distinguishing characteristics of population distribution within the zones of transition. The inner zone was determined to extend eleven miles from the central city. Using regression models of suburban growth, the outer zone was determined as extending 22 miles from the city. Other urban influence areas were also determined from this procedure.

The Löschian Landscape as developed by this study suggests some interesting results for the growth patterns and growth influence of Lubbock: 1) The outer zone of the landscape can be defined approximately as the Lubbock County Line with growth zones extending along the major highways from the city; and 2) The study also indicates that the smaller towns of Plainview, Brownfield, and Littlefield have a measureable influence on growth of their respective trade areas in the High Plains region.

References

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