The Relative Lot Size Hypothesis: An Empirical Note

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Introduction

Various models have been used to explain urban land values. These models have exhibited differences in functional forms, levels of aggregation, and the explanatory variables selected. Most often linear functions and aggregate data are employed. Neighborhood variables have been utilized to explain urban property values in a number of studies. Some examples are average assessed value (Brigham, 1964); value of improvements (Wendt and Goldner, 1966); degree of blight (Stanislaw, 1971); per cent non-white (Brigham, 1964; Wingo, 1961); median income (Alonso, 1964; Brodsky 1970; Wendt and Goldner, 1966); crowding index (Brigham, 1964); air pollution (Anderson and Crocker, 1971; Ridker and Henning, 1967); and developed area (Mohring, 1961).

This paper focuses on a neighborhood variable that specifically relates to land: individual lot area relative to the typical or average neighborhood lot area. The relative lot size hypothesis says that a lot's value is affected by its size in relation to average lot sizes in its immediate neighborhood. Micro data are used to test this hypothesis. The data include all lot sales from an urban region over a two-year period.

Relative and Absolute Lot Size Hypotheses

The relative lot size hypothesis suggests that the values of larger lots are reduced while the values of smaller lots are raised according to their positions relative to the average lot size. This may be explained by the feeling of spaciousness that one experiences within neighborhoods of typically large lot sizes, and a crowded feeling in neighborhoods with small lot sizes. Technically, a neighborhood's average lot size may provide technological external benefits to the owners of individual lots within the neighborhood.

Holding relative lot area constant, selling price probably increases at a decreasing rate as absolute lot area increases. This means that the unit price of land decreases as lot area increases. At first blush, one might think that this kind of price pattern cannot persist, because arbitrage, consisting of further subdivision of lots, would eliminate the unit price differentials. However, this pattern might persist because it reflects unit cost differentials. That is, the total costs of providing a lot with street access, and utilities, as well as surveying and platting costs, increase at a decreasing rate as lot size increases. So while there is an increment to value as a result of subdividing land over a wide range of lot areas, this increment, called plattage, is equal to the increment in subdivision costs in equilibrium (Colwell and Sirmans, 1978). Lot value increasing at a decreasing rate with lot size will be called the absolute lot size hypothesis.

Both the relative lot size hypothesis and the absolute lot size hypothesis are represented by Equation (1).

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$$SP_{ij} = \beta_0 a_{ij}^{\beta 1}(a_{ij}/A_j)^{\beta 2} \quad (1)$$

where SP_{ij} = the selling price of the ith vacant lot in the jth neighborhood,
a_{ij} = the area of vacant lot i in neighborhood j,
A_j = the average lot size in jth neighborhood,
and $1 > \beta_1 > 0$; $\beta_2 < 0$; $\beta_1 > -\beta_2$; $\beta_0 > 0$

Equation (1) could be rewritten so that the arguments of the selling price function are lot area and average lot area rather than lot area and the ratio of lot area to average lot area. While this second form is mathematically equivalent to the first, it is not econometrically equivalent. This is because the ratio has lower colinearity than average lot area has with lot area.

Other Variables

Three explanatory variables were included in this study in addition to the relative and absolute lot size variables. The other variables include two location variables and a time of sale variable.

The two location variables employed in this study are distance to the center of urban activity and location in the path of growth. For Champaign-Urbana, the north end of the University of Illinois 'quad' is the center of activity. The University serves as the principal regional employer, the main nightlife rendezvous, and campus town at the north end of the quad serves some commercial functions. The downtowns (CBDs) for Champaign and Urbana are not explicitly used as proxies for the centers of activity because of their relative decline in importance in recent years along with the development of peripheral shopping centers. However, it should be noted that the north end of the 'quad' is approximately on a line halfway between the two CBDs and thus may act as the centroid of the activity which remains.

The second location variable is intended to pick up the impact of being in the path of rapid growth. Most developments south of Kirby/Florida Avenue appear to be post-1960, and most post-1960 developments appear to be south of Kirby/Florida Avenue. Thus the growth path variable is a dummy indicating whether the lot is north or south of this street.

During the sample period (i.e. 1977 and 1978), land may have appreciated in value, but anecdotal evidence suggests that the rate could not have been very rapid and may have been in decline. The specification for time of sale in the regression equation is designed to detect a positive but declining rate of appreciation.

The Regression Equation, the Data, and the Estimation Results

The regression equation is as follows:

$$SP_i = \beta_0 a_{ij}^{\beta_1}(a_{ij}/A_j)^{\beta_2}(1+mos_i)^{\beta_3}e[\beta_4 QUAD_i + \beta_5 GRTH_i] \quad (2)$$

where SP_i = selling price of vacant lot i;
a_{ij} = area of vacant lot i in neighborhood j in thousands of square feet;
A_j = average area in the jth neighborhood (i.e. defined in terms of blocks) in thousands of square feet;
$QUAD_i$ = distance in miles of lot i from the north end of the University of Illinois 'quad';
$GRTH_i$ = A dummy variable assigning 1 if lot i is located in the growth path-south of Kirby/Florida Avenue and 0 if it is located north of it;
MOS_i = the month of sale of lot i. Fractions are based on 30-day months. Sales extend from MOS = 0.06667 to 22.5 or from January 1977 to December 1978.

The sample data for our empirical analysis consist of all recorded sales (i.e. a total of 125) of vacant lots in the twin cities of Champaign and Urbana during the years 1977 and 1978. The data (which are 82 per cent residential) were taken from transfer tax and deed records while the lot size data were taken from plat books. Observations were excluded from the data where we had reason to believe that the transfers were not arm's-length or were transactions with no recorded pecuniary exchange.

Equation (2) was estimated by taking natural logarithms on both sides and utilizing ordinary least squares. The results of the estimation are as follows:

$$\begin{aligned} \ln SP_i = {} & \underset{(4.045)}{1.7439} + \underset{(4.095)}{0.4557} \ln a_{ij} \\ & \underset{(-1.9975)}{-0.2482} \ln(a_{ij}/A_j) \end{aligned}$$

$$
\begin{aligned}
&-0.3269\mathrm{QUAD}_i + 0.4129\mathrm{GRTH}_i \\
&\quad(-3.4209) \qquad\quad (2.2149) \\
&\quad + 0.1362\ \ln(1+\mathrm{MOS}_i) \\
&\qquad (1.1750) \qquad\qquad\qquad\qquad (3)
\end{aligned}
$$

t-ratios in parentheses; d.f. = 119.

The adjusted coefficient of determination is 0.18. Other variables for location, zoning, etc. were included in earlier estimations but all proved to be rather ineffective. The coefficients on the $\ln(a_{ij})$, $\ln(a_{ij}/A_j)$, QUAD_i, and GRTH_i, are significantly different from zero at the 90 per cent level of confidence. The coefficient on the month of sale variable, however, does not differ significantly from zero. Various other specifications for time were tested but all proved insignificant at conventional levels. The coefficient on a_{ij} is significantly greater than zero and less than unity at the 95 per cent level of confidence, while the coefficient on (a_{ij}/A_j) is significantly negative at the 95 per cent level of confidence.

Based on Equation (3) the sale price of a 10,000 square foot lot would be equal to \$11,788 if the average neighborhood lot size is also 10,000 square feet [i.e. $\mathrm{SP}_i = 4.125(10)^{0.456}$]. If the average neighborhood lot size was 6,000 square feet, the sale price of a 10,000 square foot lot would be only \$10,385 [i.e. $\mathrm{SP}_i = 4.125(10)^{0.208}(6)^{0.248}$]. If the average neighborhood lot size is 12,000 square feet, the price of a 10,000 square foot lot would be \$12,333 [i.e. $\mathrm{SP}_i = 4.125(10)^{0.208}(12)^{0.248}$]. Note that as the average increases from 6,000 to 12,000 square feet, the function which relates intra-neighborhood lot sizes with selling price shifts upward. In making the above calculations, it is assumed that the lot is located north of Kirby Avenue, one mile from the quad, and sold just at the beginning of 1977 (i.e. MOS = 0).

These results are consistent with the relative lot size hypothesis: the values of larger lots are reduced while values of smaller lots are raised according to their positions relative to the lot size in the neighborhood.

Summary

Both the relative and absolute lot size hypotheses were confirmed by the regression estimates. The results in Equation (3) show that the value of a lot is pulled up or down depending on whether it is smaller or larger than the average lot size in the neighborhood. Furthermore, the selling price of land increases at a decreasing rate as absolute lot area increases.

Our location variable (QUAD_i) for distance to University of Illinois worked as expected. Land values decay away from the center of the campus in a negative exponential manner. Location in the path of most urban growth had positive impacts on value. In fact, location on the growth path (south of Kirby Street) would lead to as much as 51 per cent premium relative to location north of it. Finally, there was apparently no appreciation or depreciation of lot values over the study period.

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