Faculty Working Papers

NEIGHBORHOOD, ZONING, AND THE VALUE OF URBAN LAND

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College of Commerce and Business Administration
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Summary:

This paper is an empirical study of land values in Champaign-Urbana. Land value depends on lot size relative to the typical lot size in the neighborhood. This result supports the notion that minimum lot area zoning can have externality effects. The supply effects of existing zoning appear to dominate any externality effects which might exist. This suggests that the zoning in Champaign-Urbana does more harm than good. Several location variables are introduced to deal with the fact that the value of land would vary across land use zones in the absence of governmental zoning.

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I. 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. In those few studies where disaggregation makes neighborhood variables possible, those which relate specifically to land characteristics are generally primitive and relate only to topographical features. Finally, the tendency to include only a single zoning classification or a small range of classifications has made it impossible to detect the impact of governmental zoning on land value within the empirical model. In contrast, this paper uses micro data, a transcendental function, a new neighborhood variable, and variables to capture the effect of zoning at the two ends of the zoning hierarchy.

Neighborhood variables have been utilized to explain urban property values in a number of studies. Some examples are average assessed value [3]; value of improvements [22]; degree of blight [9]; percent non-white [3, 25]; median income [1, 4, 22]; crowding index [3]; air pollution [2, 19]; and developed area [15]. Focusing on the aspect of land that differentiate neighborhood characteristics, this paper introduces a new variable--lot area relative to the typical or average neighborhood lot area.

Zoning has also been used to explain urban property values in a number of studies [7, 8, 14, 17, 18, 21, 23]. In order to make it possible to detect the impact of governmental zoning on land values, the

sample in this paper includes all zoning classifications. A principal hypothesis of this paper is that governmental zoning has its impact on urban land values primarily through supply rather than externality effects. This hypothesis implies that governmental zoning is allocatively inefficient.

In addition to the neighborhood and zoning variables, it is important to include location variables. The theory of urban land economics tells us that different land use zones would have different values in the absence of governmental zoning so the effect of governmental zoning can only be measured while holding location constant. Location variables have been used in several studies in various forms. Examples are distance to CBD [1, 3, 4, 13, 22]; job access potential [3, 22]; distance to a regional shopping center [25]; and an urban function access index (uses time-distance) [9]. This paper utilizes five location variables: distance to a center of economic activity and dummy variables for cul-de-sac, growth path, corner lot, and busy street.

II. HYPOTHESES

Neighborhood: The primary importance of neighborhood variables (i.e., technological externalities or intra-neighborhood effects) in determining urban land values is undeniable. Those who believe that these effects are trivial have generally not considered the rapid rate at which the effects fall off with distance, and used definitions of neighborhood which are too large. Of course, there are substantial problems involved in measuring the overall ambient quality of a neighborhood or the various components of quality. The obvious solution is to use dummy variables to characterize neighborhoods. But if dummy

variables are used to represent neighborhoods and neighborhoods are small, it is unlikely that a large enough number of sales will be found to provide sufficient degrees of freedom. Thus, for empirical as well as theoretical reasons, it is desirable to attempt to measure the abstract characteristics of neighborhoods. In order to move into this direction, this paper includes a variable that takes into account the impact of one neighborhood characteristic, the relationship of the lot's size or area to the average lot area in the neighborhood. It is hypothesized that the values of larger lots are pulled down while the values of smaller lots are raised according to their positions relative to a typical or average area. At least for residential property, this may be explained by the feeling of spaciousness that one experiences within neighborhoods of typically large lot sizes, and an oppressive-cramped feeling in neighorhoods with small lot sizes.

(1) $$SP_{ij} = ka_{ij}^{\beta_1}(a_{ij}/A_j)^{\beta_2}$$

where $1 > \beta_1 > 0,\ \beta_2 < 0,\ \beta_1 > |\beta_2|$

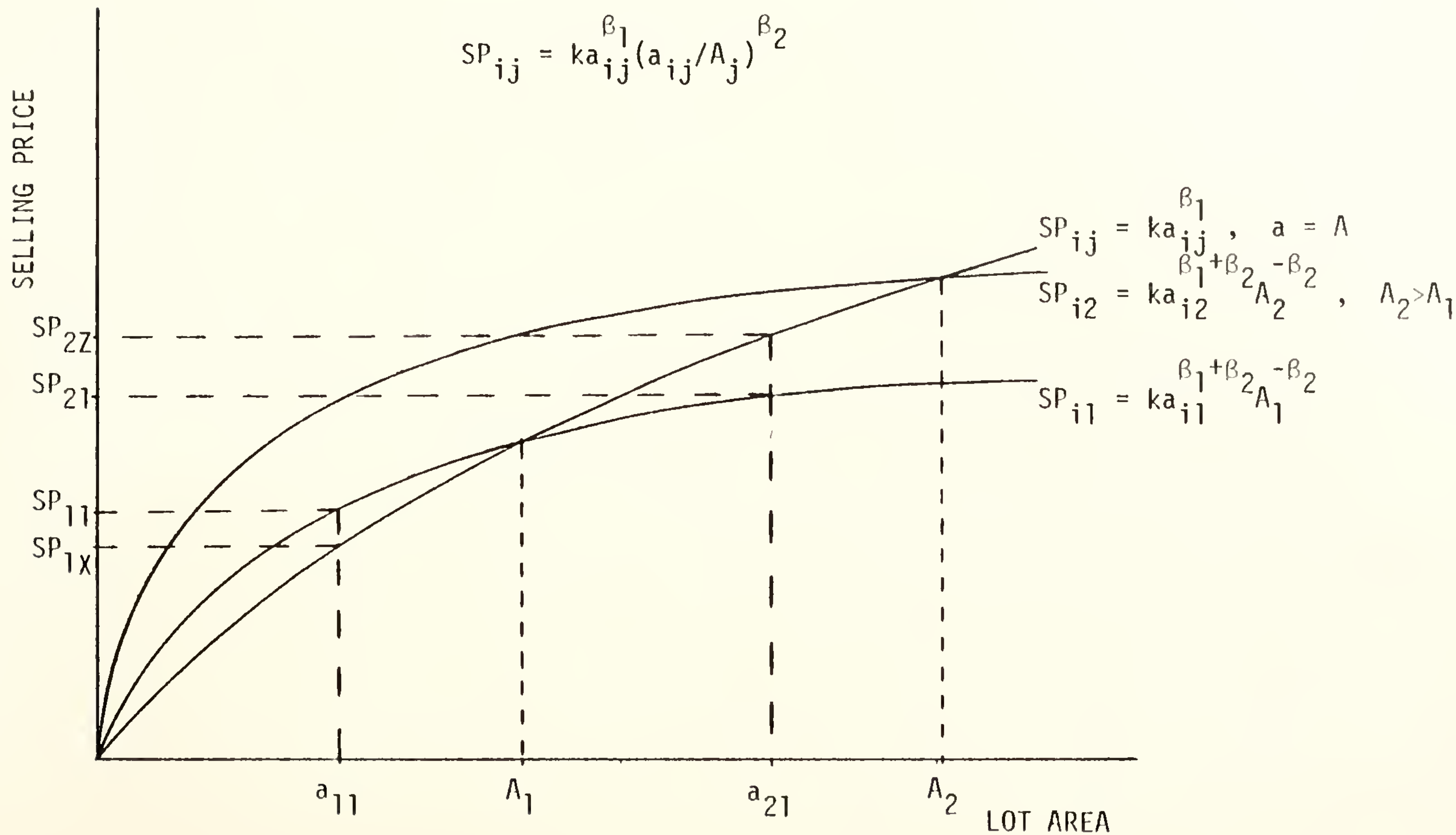
SP_{ij} = the selling price of ith lot in the jth neighborhood,

A_{ij} = the area of lot i in neighborhood j,

A_j = the average lot size or area in jth neighborhood,

and k = everything else.

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



SP_ij = ka_ij^β1 (a_ij/A_j)^β2
SELLING PRICE
SP_2Z
SP_21
SP_11
SP_1X
SP_ij = ka_ij^β1 , a = A
SP_i2 = ka_i2^(β1+β2) A_2^(-β2) , A_2>A_1
SP_i1 = ka_i1^(β1+β2) A_1^(-β2)
a_11
A_1
a_21
A_2
LOT AREA

FIGURE 1

Figure 1 illustrates equation 1. Since lot 1 in neighborhood 1 is smaller than average ($a_{11} < A_1$) as shown in Figure 1, its selling price would be expected to be more than if it were in a neighborhood where it happened to be the average ($SP_{11} > SP_{1x}$ where $a_{1x} = A_x = a_{11}$). Similarly, suppose that lot 2 in neighborhood 1 is larger than average ($a_{21} > A_1$). As in Figure 1, its selling price would be expected to be less than if it were in a neighborhood where it happened to be the average ($SP_{21} < SP_{2z}$ where $a_{2z} = A_z = a_{21}$). Note that as average neighborhood area increases from A_1 to A_2 the function which relates intra-neighborhood lot areas with selling price shifts upward. The selling price-lot area relationship in equation (1) and illustrated in Figure 1 has the same look as Deusenbery's well-known relative income hypothesis or Friedman's permanent income hypothesis without the proportionality assumption. Thus, this relationship will be referred to as the relative land area hypothesis.

Zoning: What is variously known as hierarchical zoning, cumulative zoning, or progressively inclusive zoning operates by allocating a zone to a particular land use or any higher use in the governmentally defined hierarchy. The rationale for hierarchical zoning suggests that it restricts the flow of negative externalities from lower to higher land uses in the hierarchy. If this were the only effect of governmental zoning, the value of the highest uses in the hierarchy would be raised as a result of the protection provided by the zoning ordinance (i.e., ceteris paribus). That is, those who desire to use land for residential purposes, usually the

highest use in the hierarchy, are able to choose from land in any zone, but would be willing to pay more for land in the protected residential zone, holding location and other factors constant. Thus the externality argument, which provides the rationale for the legal application of police powers to governmental zoning, implies that there should be a premium paid for residentially zoned land.

On the other hand, governmental zoning may be put to other purposes. Special interests in and out of government may be able to shape governmental zoning to serve their own ends [11]. A local government may engage in fiscal zoning in order to directly protect its purse and indirectly beggar neighboring governments. Planners may have their biases. "The almost universal preference, as expressed in zoning statutes, for single-family dwellings probably inspires planners to ... overallocate land for single-family use." [14]. If planners are ideologically at odds with the expansion of business activity locally, they will have little trouble finding political allies. "The owners of land currently zoned for (commercial and industrial) use prefer to limit its supply. They may be joined in their efforts to restrict supply by owners of residential land who fear the effects of negative externalities" [14].

Thus, zoning may not only increase efficiency by separating incompatible land uses and reducing the flow of negative externalities. It may also create inefficiency by distorting the supply of land to the various uses. The nature of hierarchical zoning causes such distortions to be asymmetric. It can only overallocate land to the highest uses and underallocate land to the lowest uses. The reverse of underallocating land to the highest and overallocating land to the lowest uses is

impossible. Thus where there are supply effects from governmental zoning, there would be a tendency for residential land values to be depressed and commercial land values to be raised by the zoning. Recall that the externality argument suggests that there would be a premium paid for residential land. Thus, any net effect of residential zoning on land value indicates whether zoning operates primarily to improve the allocation of land or to misallocate land. If the partial effect of commercial zoning is to increase land value, this would be evidence of the misallocation at the low end of the zoning hierarchy.

Location: Five location variables are employed in this study. The first of these variables is distance to the center of activity. For Champaign-Urbana, a typical campus town and the subject of this study, the north end of the University of Illinois 'quad' is the center of activity. The university serves as the principal regional employer, the main night-life 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 measures the impact that cul-de-sac location has on land value. The inclusion of this variable is based on our belief that the cul-de-sac plays 3 main roles. First, it lends itself to flexibility in arrangement and orientation of houses and, thus,

provides for more variety in spatial arrangements. Second, the cul-de-sac reduces pedestrian, bicycle, and automobile traffic and, thus, reduces noise and dirt and increases security. Finally, neighbors around a cul-de-sac may be more socially integrated than those on traditional grid-iron patterns, because the cul-de-sac neighborhood is well defined and small. These factors promote club formation and cohesion as well as the resulting public goods production (e.g., manicured lawns, freshly painted facades, and help when needed). Based on such attributes, being on a cul-de-sac should have a positive impact on selling price.

The third 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.

The fourth location variable is included to capture the effect of corner location on land value. It is expected that corner location increases land value. This is especially so for commercial properties. Corner location enhances the visibility of the property. It provides more access and more exposure due to the double frontage. Corner location provides desireable separation for residential property. Thus, corner location is probably preferred for both residential and commercial land users. The corner location variable used in this study is a dummy indicating whether the lot is a corner lot or not.

The fifth and final location variable is a dummy for high traffic volume streets. It is hypothesized that location on a busy street has

a positive impact on land value. Commercial activity favors location on busy streets because of the visibility and high potential for attracting customers because of the sheer numbers who pass by the property.

Time of Sale: It is hypothesized that during the sample period, 1977 and 1978, land appreciated in value at a rate which was relatively constant and that the sale price of lot i depends on its time of sale in the following manner.

(2) $$SP_i = he^{\beta_{10} t_i}$$

where β_{10} = rate of appreciation,

t_i = time of sale of i^{th} lot, and

h = everything else.

III. THE MODEL

All the hypotheses developed above were brought together into the following equation:

(3) $$SP_i = \beta_0 a_{ij}^{\beta_1} (a_{ij}/A_j)^{\beta_2} \exp[\beta_3 COMM_i + \beta_4 SRES_i + \beta_5 QUAD_i + \beta_6 CdeS_i + \beta_7 GRTH_i + \beta_8 CORN_i + \beta_9 HTRF_i + \beta_{10} MOS_i$$

where SP_i = selling price of lot i,

a_{ij} = area of lot i in neighborhood j in thousands of square feet,

A_j = average area in the jth neighborhood (i.e., block) in thousands of square feet,

$COMM_i$ = a dummy variable assigning 1 if lot i is located in a commercial zone and 0 for all other zones,

$SRES_i$ = a dummy variable assigning 1 if lot i is in a single-family residential zone and 0 for all other zones,

$QUAD_i$ = distance in miles of lot i from the north end of the University of Illinois 'quad'

$CdeS_i$ = a dummy variable assigning 1 if lot i is on a cul-de-sac and 0 if it is not located on a cul-de-sac,

$GRTH_i$ = 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,

$CORN_i$ = a dummy variable assigning 1 if lot i is a corner lot and 0 if it is not.

$HTRF_i$ = a dummy variable assigning 1 if lot i is located on a street with an average-daily traffic volume of 5000 or more and 0 for less than 5000.

MOS_i = the month of sale of lot i.

The sample data consist of all recorded sales in the cities of Champaign and Urbana during the years 1977 and 1978. The Sale Price data was taken from transfer tax and deed records while the lot size data was taken from platbooks. Zoning information for the city of Urbana was taken from the Champaign County Regional Planning Commission while that of Champaign was taken from the Champaign City (Planning) Office.

The model was estimated by taking natural logarithms of both sides of equation (3) and utilizing Ordinary Least Squares. The results of the estimation are as follows:

$$\begin{aligned} \text{(4)} \quad \ln SP_i = {} & \underset{(5.226)}{1.934} + \underset{(3.923)}{0.416} \ln a_{ij} - \underset{(-1.923)}{0.211} \ln(a_{ij}/A_j) + \underset{(1.461)}{0.405}\, COMM_i \\ & - \underset{(-3.871)}{0.702}\, SRES_i - \underset{(-1.643)}{0.150}\, QUAD_i + \underset{(1.737)}{0.266}\, CdeS_i \\ & + \underset{(1.866)}{0.304}\, GRTH_i + \underset{(1.391)}{0.207}\, CORN_i + \underset{(1.535)}{0.428}\, HTRF_i + \underset{(1.087)}{0.013}\, MOS_i \end{aligned}$$

(t ratios in parentheses; d.f. = 114)

The adjusted coefficient of determination is 0.35. (A correlation matrix for the explanatory variables is shown in Table 1.) The coefficients on the ln a_{ij}, ln a_{ij}/A_j, $SRES_i$, $CdeS_i$, $GRTH_i$, are significantly different from zero at the 90% level of confidence. The coefficient on the $QUAD_i$ variable is significantly negative (one-tail) at the 90% level of confidence. The coefficients on the $COMM_i$, $CORN_i$ and $HTRF_i$ dummy variables are significantly positive (one-tail) at the 90% level of confidence.

The magnitude of the annual rate of appreciation is 15.6% this is the same rate estimated by Colwell and Sirmans [5] for the period 1969-1975. However the coefficient here does not differ significantly from zero, whereas it does in the Colwell and Sirmans paper. The main reason for this remarkable difference is that as the urban bid-rent function shifts upward over time, the price of peripheral land in transition from agricultural to urban uses is determined by the agricultural land price and not by the height of the bid-rent curve. Most sales in the 1977-78 period were peripheral. Thus the coefficient on the month of sale variable is more indicative of the experience of agricultural land prices than urban land prices. There is independent evidence which suggests that agricultural land prices were relatively stable over the study period while they increased dramatically over the earlier period.

The relative lot area hypothesis was borne out by the estimation. Figure 2 shows the estimated relations between value and area relative to average neighborhood area over the range of 250-18,000 square feet. In constructing Figure 2, it is assumed that the lot is north of Kirby, 1 mile from the 'quad,' zoned for single-family residential, not located on a cul-de-sac, not on a corner lot, not located on a busy street, and sold just at the end of 1978.

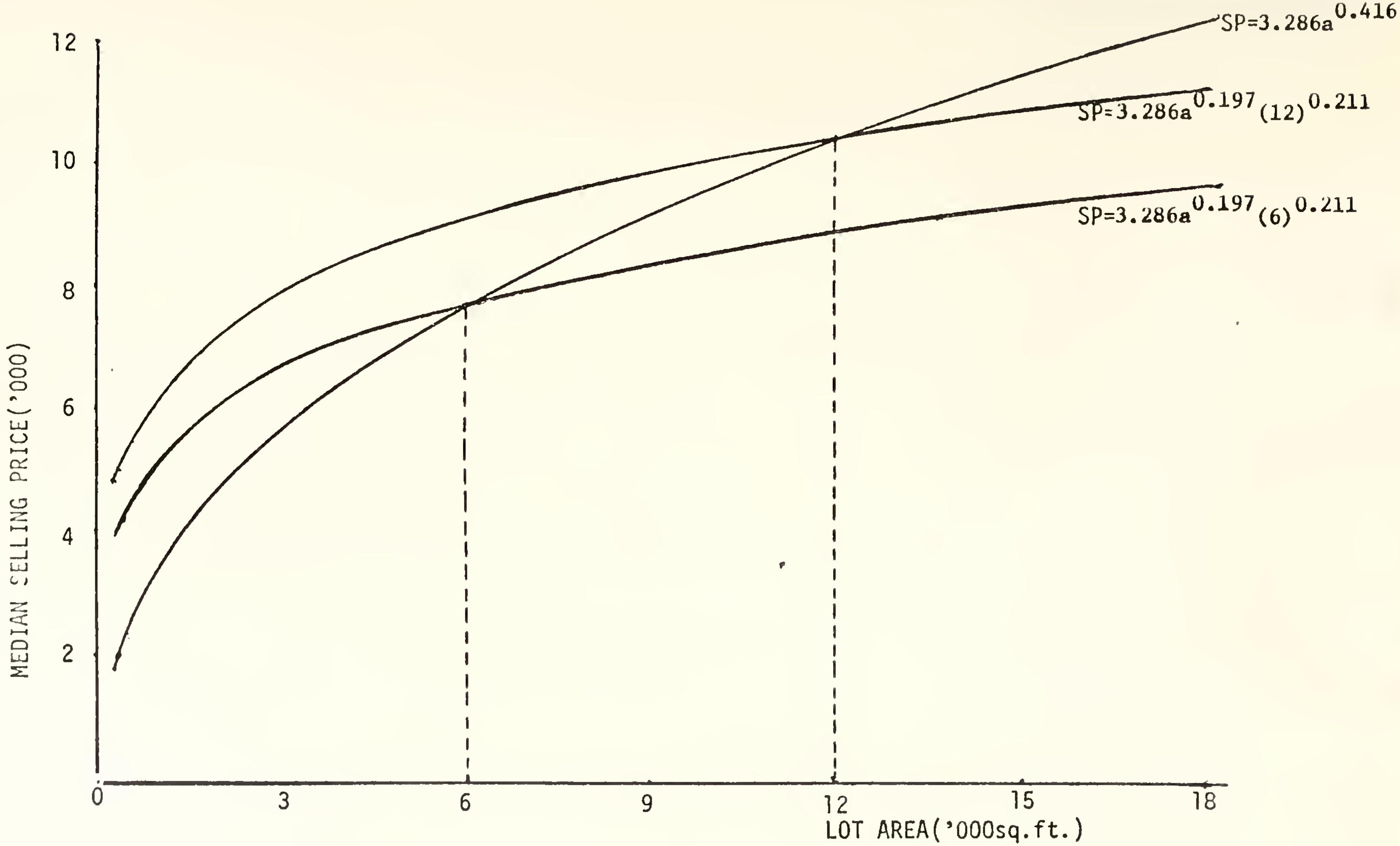

SP=3.286a^0.416
SP=3.286a^0.197 (12)^0.211
SP=3.286a^0.197 (6)^0.211
MEDIAN SELLING PRICE('000)
12
10
8
6
4
2
0
3
6
9
12
15
18
LOT AREA('000sq.ft.)

FIGURE 2

As shown in Figure 2, 3 plots were made: one shows the relationship between value and lot area given that lot area just equals average neighborhood lot area. The other 2 plots assumed that average neighborhood lot equals 6000 square feet and 12,000 square feet, respectively. The results as shown in Figure 2 are consistent with the hypothesis as presented in Figure 1. Land values of larger lots are pulled down while values of smaller lots are raised according to their positions relative to a typical or average area in the neighborhood. Note that as the average increased from 6000 to 12,000 square feet, the function, which related intra-neighborhood lot areas with selling price, shifted upward. The coefficient on a_{ij} is significantly greater than 0 and less than 1 at the 99% level of confidence, while the coefficient on (a_{ij}/A_j) is significantly negative at the 95% level of confidence. The coefficient on a_{ij} is significantly greater than the absolute value of the coefficient on (a_{ij}/A_j) at the 95% level of confidence.

The estimated coefficients on the zoning variables strongly suggest that governmental zoning has done more harm than good. The dummy variable $COMM_i$ (Commercial) proved to have a substantial positive impact on land values. Commercial zoning adds 50% to value. The dummy variable $SRES_i$ (single-family residential), on the other hand, proved to have a substantial negative impact on land value. It appears to cause a 51% decline in value. The commercial dummy variable is significantly positive at 90% level of confidence while the single-family residential dummy variable is significantly negative at 99% level of confidence. The negative impact on land values of single-family residential zoning means that the supply effect has swamped any externality effects which might exist.

An interpretation of these results is that land in Champaign-Urbana has been overallocated to residential uses and underallocated to commercial uses.

The location variables all worked as expected. The land value gradient turned out to be .150. The magnitude of the coefficient on the 'cul-de-sac' dummy variable establishes that, all things being equal, a lot would be expected to gain 30% in value if it were located on a 'cul-de-sac.' The $GRTH_i$ (growth path) dummy variable proved to give positive impacts on land values. Location south of Kirby/Florida Avenue, the growth path, would be expected to lead to a 36% gain over values than north of it. The $CORN_i$ (corner lot) dummy variable establishes that, all things being equal, a lot would be expected to gain 23% in value if it were located on a corner. The $HTRF_i$ (high traffic) dummy variable proved that location on a busy street would be expected to lead to a 53% gain in value over other locations.

IV. SUMMARY AND CONCLUSIONS

This paper has offered some empirical evidence of the hypothesized relationship between urban land values and neighborhood, zoning, location and time.

The model in this paper specifies that selling price of urban land is a function of both lot area and lot area relative to typical neighborhood area. This relative lot-area hypothesis is at least visually akin to Deusenbery's relative income hypothesis. The relative lot-area hypothesis provides empirical support for minimum lot-area zoning as an externality type of zoning. The empirical development of this concept is probably one of the most important contributions of this paper.

Zoning appears to do more harm than good. The coefficient on the commercial zoning dummy variable is significantly positive while the coefficient on the single-family residential dummy is significantly negative. These price effects are indirect evidence of distortions in the allocation of land caused by governmental zoning. It is suggested that land is being overallocated to the highest uses to the extent that any positive impact due to reductions of negative externalities must be swamped by this supply effect. The opposite side of the coin is that land is overallocated to the lowest uses.

Our zoning results are inconsistent with the results of Maser, Ricker and Rosett for Rochester, New York [10]. But their comparisons were only within residential types and within commercial and industrial not across the entire spectrum. So they conclude that zoning did not alter market allocations whereas we not only find that zoning alters market allocations but that is does so in a counter-productive way. A problem with their interpretation is that no effect would have the same look as offsetting effects. That is, the public good effects of externality type of zoning may be offset by supply effects.

An alternative rationale for zoning may provide a weak defense of the supply effects which have been found in this study. If there are distortions in other markets (e.g., credit) which have differential impacts on demand for various land uses, then supply effects of zoning might be used to overcome the defects in these other markets. Whether those who zone have the information, analytical capability, and the legal authority necessary to do this is another question. Certainly, the use of the supply effect zoning to overcome the defects in other

markets is a circuitous approach. One wonders why it would not be superior to attack the problem directly.

There may be yet another rationale for the supply effects of zoning. A stated objective of zoners in the study area is to "conserve the taxable value of land." [26] Suppose that this is taken to mean that governmental zoning ought to produce higher aggregate land values than the market. This can be achieved via the supply effects of zoning if the constrained land use has a higher price elasticity of demand for land [17]. However, this method of increasing aggregate land values is uncertain in its effects, because the relative demand elasticities are far from obvious. When this method works, the government is utilizing the same techniques as a price discriminating monopolist would. Thus, even when the method successfully increases aggregate land value, it reduces the efficiency with which land is allocated.

The problem with the commercial zoning variable is that it may be a proxy for the location factors which attract commercial activity. If governmental zoning merely follows the market, commercial activity would be found on higher priced land having the desirable location factors. But it can never be certain that the right location factors have been identified and included in the regression. Thus, it is possible to complain if commercial zoning shows positive effect that the impact of governmental zoning has not been detected. Rather, commercial is capturing the effect of some omitted locational factors. Therefore, location variables must be selected with care. The location factors which are commonly thought to attract commercial activity ought to be included. Centrality, location in the path of most urban growth, corner location,

and location on a busy street were used in this study. Land values were shown to be a negative exponential function from the University of Illinois quad. Locations in the path of most urban growth, corner location, and location on a busy street proved to give positive impacts on land values. Probably distance from the quad, cul-de-sac, and corner location, and location on a busy street are important for residential uses.

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Table 1

Variable Correlation Matrix

	$CORN_i$	$CdeS_i$	$SKIRBY_i$	MOS_i	$QUAD_i$	ln a	ln(a/A)	$SRES_i$	$COMM_i$
$CdeS_i$	0.11720								
$SKIRBY_i$	-0.07945	-0.14207							
MOS_i	0.00973	0.12142	0.15706						
$QUAD_i$	-0.29716	-0.01769	0.32423	0.06040					
ln a	0.04246	-0.02681	-0.15561	-0.02365	0.12471				
ln(a/A)	-0.11605	-0.08100	-0.07827	0.05262	0.06085	0.58676			
$SRES_i$	0.02910	0.00252	-0.01922	-0.15380	0.15061	0.00516	-0.00421		
$COMM_i$	0.08342	0.20572	-0.02177	0.08494	-0.17934	-0.02250	-0.07904	-0.53313	
$HTRF_i$	0.023104	0.02278	-0.10477	-0.17913	-0.31527	-0.06082	-0.07502	-0.03839	0.11935