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The Effect of Land-Use Restrictions on Market Values of Single-Family Homes in Houston

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Abstract

This paper analyzes the effects of zoning and restrictive covenants on single-family housing prices in and around Houston, Texas. The calculation of a hedonic price index reveals that higher prices are paid for homes in neighborhoods with either type of land-use control than for comparable houses in neighborhoods without these controls. The premiums paid for these restrictions are not statistically distinguishable, but institutional constraints on these controls may explain why both forms continue to exist and to command market premiums.

Housing is a location-specific commodity whose investment value depends critically upon both structural characteristics under the owner's control and neighborhood characteristics outside this direct control. Land-use restrictions can therefore benefit even risk-neutral people by improving their predictions of future neighborhood characteristics, but considerably burden owners by restricting the development possibilities of their individual properties.

This paper examines the consumer's willingness to pay for two such instruments of land-use control, zoning and restrictive covenants, in the Houston area in 1978. The study concludes that substantial premiums are paid for both zoning and covenants. Although these premiums are not statistically distinguishable from each other, a public-choice discussion of the origins of these controls explains why both continue to exist in the Houston area.

The paper is organized as follows. The first section summarizes some property-value studies that examine the existence and importance of interactions in land use. It also highlights problems with the techniques and conclusions of the earlier studies and details improvements offered by the present work. The second section develops a model of the consumer's housing choice which highlights the role of uncertainty about future neighborhood quality in this decision. This uncertainty motivates the demand for land-use restrictions. A bid function for land-use controls is derived from this model and then examined graphically. After describing the data used in the analysis, the third section estimates a hedonic price index capturing the reduced form of this bid and the supply or offer function of each land-use control. The fourth section presents conclusions.

1. Critical review of the literature

The most common justification for land-use restrictions is the protection they provide property owners from various kinds of spatial externalities like noise and air pollution from commercial and industrial uses. Several studies have constructed hedonic price indices for housing, including variables on nonconforming uses, to examine the effects of these noxious land-use interactions on housing values. Some examples are those of Crecine, Davis, and Jackson (1967) and Reuter (1973) for Pittsburgh, Kain and Quigley (1970) and Grether and Mieszkowski (1980) for New Haven, and Stull (1975) for the Boston SMSA. The results of these and other similar studies are mixed: some find important land-use interactions, others none at all, and still others only for heavy industrial uses.

The following factors can, however, explain such apparent inconsistencies. Because all the areas studied were *entirely* zoned, the studies indicate not whether spatial externalities would exist in the absence of zoning, but rather whether or not zoning eliminates them. The studies may additionally be flawed by excessive aggregation. Tideman's (1969) study of a Chicago suburb found that the probability of residents' testifying at zoning hearings was reduced by 50% when their homes were only 80 feet away from a nonconforming use, and therefore suggests that land-use interactions are quite localized. Peterson (1973) pointed out that an overly aggregative view of the market for housing can yield the erroneous conclusion that zoning has little or no effect on property values, when in fact the sizable individual effects cancel one another out. Another problem, observed by Mills (1979), is that although some nonresidential uses generate negative externalities, these undesirable impacts can be offset by spillover benefits such as increased accessibility to employment and consumer services.

Nonresidential uses may therefore on balance actually increase neighboring property values, even though the negative aspects are important. Moreover, as Thornton (1978) points out, property values may not be the correct measure of whether or not spatial externalities exist. When people have different tastes with respect to the "disamentity," moving costs and losses of location-specific surpluses would more effectively measure the costs of the externalities. Finally, mixed results can reasonably continue to exist because the coefficient of each attribute in the hedonic price equation represents the interaction of both supply and demand factors, and the supply conditions may vary substantially in different metropolitan areas, even if the demand functions are quite comparable.

The present study has been designed to address the empirical difficulties in establishing the existence of land-use interactions. The study extends the examination of land-use interactions to an area, Houston, where the existence of significant amounts of both zoned and unzoned property enables one to use a different approach to determine whether or not externalities are important. The Houston area also uses covenants[1] as a form of land-use control, providing the opportunity to compare them directly with zoning. Restricting the sample of property values to homes too small to make convertibility to other uses viable additionally averts much of the Peterson problem of excessive aggregation and accompanying "wash out."

This analysis simply asks whether or not people will pay a premium for general land-use restrictions, instead of exactly how much or for what, thus circumventing by a change of inquiry the remaining problems encountered in attempts to identify property-value effects of nonconforming uses of the land. This study infers the importance of land-use interactions *indirectly* from the discovery of premiums or discounts for homes in restricted neighborhoods, and can do so only because of the existence in Houston of unrestricted property.

2. The model

The consumer is assumed to solve a constrained optimization problem with a stochastic element introduced by the uncertainty about changes in the neighborhood over time. Land-use controls enter the problem by affecting the probability distribution of future neighborhood characteristics.[2] Other assumptions closely resemble those made by Tiebout (1956): consumers have unrestricted mobility, full information about tax and services packages and land-use restrictions, and can choose to live in any one of a large number of neighborhoods without being restricted by job opportunities. Specific assumptions about risk preference and exactly how restrictions affect the mean and variance of the distribution of future characteristics of the neighborhood are not necessary.

The consumer's expected utility function is:

$$V(H, N, R, Z) = \int v(H, N, N^f, Z)\psi(N^f; N, R)dN^f \tag{1}$$

where

$v(H, N, N^f, Z)$ = the consumer's utility function in the absence of uncertainty
H = services derived from housing characteristics
N = services derived from present neighborhood characteristics
N^f = services derived from future neighborhood characteristics
Z = a composite commodity representing all other goods and services
$\psi(N^f; N, R)$ = the probability distribution of N^f conditional upon N, the present neighborhood, and R, the land-use controls on the neighborhood

Accordingly, the optimization problem for each level of land-use restriction R becomes:

$$\max_{H, N, Z} V(H, N, R, Z) \tag{2}$$

subject to $Y = P(H, N, R) + T(u(N)) + P_Z Z,$ (3)

where

Y = consumer's total (earned and unearned) annual income

$P(H, N, R)$ = annual expenditure on housing and neighborhood services, including the annualized opportunity cost of development options precluded by land-use controls, R

$T(u(N))$ = the annual transportation cost of living at a distance u from the central business district[2]

$P_Z Z$ = the consumer's annual expenditure on other goods and services

The solution to this expected utility maximization problem yields conditional demand functions for housing services, $H(R)$, neighborhood characteristics, $N(R)$, and other goods and services, $Z(R)$, given the level of land-use controls, R.

Substituting these demand functions into V yields the constrained maximum of the consumer's expected utility function for any R. Notationally, this is given by:

$$V^*(R) = V(H(R), N(R), R, Z(R)). \tag{4}$$

The difficulty in this approach lies in presenting this theory in a testable form. To do so requires, first, deriving, in an approach similar to that of Wheaton (1977), a bid function for R from the original constrained optimization problem; and, second, setting up a hedonic price index for housing.

Assume that the expenditure for land-use controls is separable from the expenditure on housing and neighborhood services. Then the total housing price, P, which was previously written $P(H, N, R)$, becomes $P(H, N) + P(R)$ for a minimization problem that calculates for any R the minimum expenditure, E, necessary to obtain any level of utility. Formally:

$$E(R, \mu) = \min_{H, N, Z} [P(H, N) + T(u(N) + P_Z Z] \tag{5}$$

subject to:

$$V(H, N, R, Z) = \mu, \tag{6}$$

where

$E(R, \mu)$ = the level of expenditure necessary to achieve the level of utility μ with any given level of restrictions on land use[3]

Let R_0 represent the situation when there are no land-use restrictions on the property and define $V^*(R_0)$ as the maximum utility the consumer can achieve with

R_0. The bid function for land-use restriction, $\theta(R_0, R)$, can then be computed from the problem above. This bid function is the gap or difference between the minimum expenditure necessary to achieve $V^*(R_0)$ when the consumer is constrained to restriction level R_0 and the expenditure necessary to obtain this same level of utility when R is a choice variable. Notationally:

$$\theta(R_0, R) = E(R_0, V^*(R_0)) - E(R, V^*(R_0)). \tag{7}$$

Interpreted differently, the bid function is the maximum amount the consumer would pay for any R other than R_0 in order to attain the level of utility given by $V^*(R_0)$.

This bid function for land-use restriction is expressed graphically in Figure 1. A movement from left to right on the horizontal axis represents an increase in the level of restrictiveness of land-use controls, R. Q represents the value of all other goods and services that the consumer buys, and utility increases with upward vertical movement. The indifference curve is "U-shaped" because of the nature of restrictions on land use. Up to R^*, increases in R augment utility by reducing uncertainty about future neighborhood characteristics. Beyond R^*, increases in R decrease utility by imposing constraints on the consumer's development of his/her own property that outweigh the benefits of increased control over the uses of neighboring properties. For some people, the curve may be immediately positive in slope.

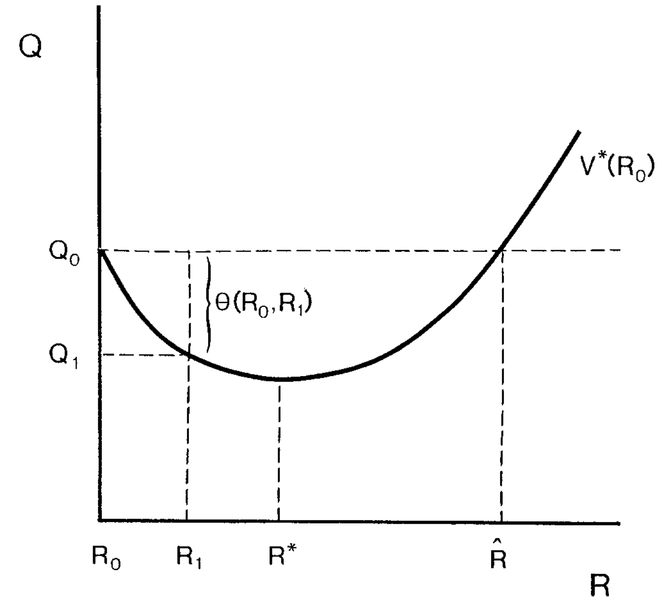

Fig. 1. The bid function for land-use restrictions.

The height of the indifference curve labeled $V^*(R_0)$ tells how much must be spent on other goods and services to achieve the level of utility $V^*(R_0)$. Assuming away administrative costs of land-use controls,[4] this height is precisely $E(R, V^*(R_0))$ for each R. Therefore, $Q_0 = E(R_0, V^*(R_0))$, which is exactly the consumer's income, Y. For the level of restrictions given by R_1, $E(R_1\ V^*(R_0))$ is represented by Q_1. The bid for R_1, $\theta(R_0, R_1)$ is equal to the difference between $E(R_0, V^*(R_0))$ and $E(R_1, V^*(R_0))$, or exactly the vertical difference between Q_0 and Q_1 in Figure 1. In this case, θ is greater than zero, so the consumer would offer a premium to live in an area with R_1 instead of R_0. Similarly, for all R to the left of $\hat{R}$ this bid is positive. However, the consumer will be willing only to locate in areas with restrictions depicted by points to the right of $\hat{R}$ if the property there is sold at a discount.

3. Empirical specification and results

Unfortunately, the "market" for land-use restrictions cannot be examined directly to determine whether or not the bid function specified above has a positive value for any R. Housing is a composite commodity, only one of whose characteristics involves restriction of land use, and the only explicit prices available in this market are those at which houses have been bought and sold. The technique used to circumvent this apparent impasse is to construct a hedonic price index for housing, the index being a function of characteristics involving the house and its neighborhood both as its exists today and as it may exist in the future. The hedonic price approach is used to isolate the effects of any particular characteristic. The semi-log form of the hedonic price index has been chosen because it enables each characteristic to contribute more to higher-valued homes than to less expensive ones, restricting as it does only the percentage contribution to be constant. This technique therefore automatically adjusts for predictable quality differences in physical attributes.

The results reported below were obtained by estimating regression equations of the following general form:[5]

$$\ln P = \beta_0 + \beta_1 H + \beta_2 N + \beta_3 Q_2 + \beta_4 Q_3 + \beta_5 Q_4 + \beta_6 Z + \beta_7 C + \varepsilon \qquad (8)$$

where

P = the price at which the property actually sold[6]
H = a vector of characteristics of the house
N = a vector of characteristics of the neighborhood
Q = dummy variables ($i = 2, 3, 4$) that are 1, if the property was sold in quarter i; 0 if not
Z = a dummy variable that is 1, if the property is zoned; 0 if not
C = a dummy variable that is 1, if the property is restricted by covenants; 0 if not

The vector H includes physical characteristics such as number of baths and half-baths, lot size, parking facilities, and other amenities such as swimming pools and fireplaces. Also included in H is a value representing the relative underassessment of the house for property tax purposes. the vector N has components representing the quality of schools, racial mix of the neighborhood, and estimated radial distance from the center of Houston. The dummy variables Q_i for the quarters of the year 1978 are used to correct for the differences in the selling prices of the homes due to variations in market conditions (such as interest rates and moving costs) and inflation over the year.

3.1. The data

The data for 230 individual house sales come from the Multiple Listing Service (MLS) *Comparable Book* compiled by the Houston Board of Realtors. The sample is composed of sales during 1978 in the Southwest Houston area, which includes the zoned cities of Bellaire and West University Place, as well as unzoned areas within Houston. The entire area of study can be contained within a radius of approximately three miles.

This sample was chosen to make the houses reasonably homogeneous, even before correcting for other attributes with the hedonic price technique, and to minimize variation in the terms of the instruments of land-use control. Accordingly, these instruments can reasonably be entered as dummy variables in the hedonic price index estimation. The characteristics of zoned or covenanted neighborhoods are then essentially separable in the sense that alternative houses quite similar in all the other attributes are available. In addition, the problem of quantity-dependent implicit prices is less pressing. Available information on the probable supply of restrictions is also sufficient to assert with some authority that this schedule is not perfectly elastic.

Zoning information was obtained from city hall offices. For Bellaire, copies of a zoning map and a subdivision map were studied together to yield the required information about zoning by subdivision. Under Bellaire's zoning ordinance, single-family detached homes fall into four classes. I chose those two with restrictions resembling those of the zoning of West University Place and the covenants for the Houston subdivisions that surround these two municipalities. One restricts the lot's minimum size to 5,000 square feet, while the other sets a minimum of 7,400 feet for the lot. A zoning ordinance in West University Place restricts all residential lots to a minimum size of 5,000 square feet. Individual areas are further restricted with respect to the structures' minimum square footages, which range from 800 to 1,600 square feet.

Covenant information was obtained by consulting the records of the Harris County Courthouse and searching for deed restrictions (covenants) in the neighborhoods of Houston surrounding the cities of Bellaire and West University Place. Areas with active restrictions similar to the zoning ordinances described above were added to the sample of neighborhoods with covenants, while those that had covenants at one time but later canceled all restrictions were included in the sample as areas with no restrictions on land use. (These neighborhoods are, however, restrained by basic city ordinances regulating the setback of buildings, off-street parking, trailers, nuisances, and the location of certain facilities.)

MLS information about available elementary and secondary schools was combined with data from the Houston Independent School District's *Elementary School Profiles* and *Second School Profiles* to determine the school-quality and racial-mix variables. Data from the *Houston Tax and Water Guide, 1978* for tax rates and assessment ratios were combined with MLS information about actual property taxes to calculate the relative-tax-advantage variable.

Table 1 defines the tested variables and reports means and standard deviations of the data for each variable.

Table 1. Explanations of variables and means and standard deviations of observations

Variable Name	Explanation	Mean	Standard Deviation
PRICE	Price at which single-family home sold	67893.96	28025.54
BATH	Number of bathrooms	1.470	.57
HFBATH	Number of half-bathrooms	.217	.41
LOT	Size of lot (in hundreds of square feet)	73.377	23.61
ROOMS	Number of rooms	6.426	1.23
CAIR	Dummy variable = 1, if house has central air; 0, otherwise	.630	.48
GARAGE	Dummy variable =1, if property has a garage; 0, otherwise	.887	.32
CARPORT	Dummy variable = 1, if property has a carport; 0 otherwise	.135	.34
POOL	Dummy variable = 1, if property has a swimming pool; 0, otherwise	.026	.16
FIREPLACE	Dummy variable = 1, if house has a fireplace; 0, otherwise	.187	.39
RACE	Nonwhite percentage of enrollment in area elementary school	24.024	15.34
ELSCORE	Average score above expected grade placement on Iowa Test for grades one through six in spring 1978	.847	.26
JRSCORE	Average ranking of ninth graders on Stanford Test in September, 1978	51.775	6.98
SRSCORE	Average ranking of eleventh graders on Stanford Test in September, 1978	57.917	9.80
DISTANCE	Radial distance in miles from Houston CBD	6.72	2.02
RELTAX	(Tax rate times assessment ratio times price less actual annual property taxes) divided by price in thousands of $	16.934	3.97
ZONING	Dummy variable = 1, if property protected by zoning as described in text; 0, otherwise	.561	.50
COVENANT	Dummy variable = 1, if property protected by covenants as described in text; 0, otherwise	.348	.48
QUAR 2	Dummy variable = 1, if property was sold in 2nd quarter of the year; 0, otherwise	.283	.45
QUAR 3	Dummy variable = 1, if property was sold in 3rd quarter of the year; 0, otherwise	.265	.44
QUAR 4	Dummy variable = 1, if property was sold in 4th quarter of the year; 0, otherwise	.087	.28
NONRES	Fraction of the property tax base that is nonresidential	.350	.13

3.2. Findings

The regression results are summarized in Table 2. The adjusted R^2 is .837, and the coefficients of the dummy variables representing land-use restrictions are positive and highly significant. The coefficient for zoning (β_6) is .0702 and the coefficient for covenants (β_7) is .0867. These percentages translate into approximately $4,800 and $5,900 for the mean-valued home. These coefficients show that otherwise equal property in either type of restricted neighborhood commanded a premium which increased with the value of the house. The low-valued F-statistic [$F_{1,208} = 1.3$] supports the null hypothesis that $\beta_6 = \beta_7$; so these estimation procedures do not show a statistically significant difference between the coefficients for zoning and covenants.

The following results for the other coefficients are of note. The positive sign and significance of the coefficient for relative tax advantages indicate that underassessment of property is capitalized into housing values. Oates (1969) finding of a negative relationship between the effective tax rate and local property values suggests that this interpretation is reasonable.

The dummy variable for the second quarter of the year is positive and significant at the 1% level. Not only a rise in the general price level from the first quarter,

Table 2. Hedonic price equation estimation

Independent variable	Coefficient	t-Statistic
INTERCEPT	4.2452**	38.830
BATH	.0717**	8.298
HFBATH	.0697**	6.724
LOT	.0013**	6.231
ROOMS	.0267**	7.226
CAIR	.0374**	4.411
CARPORT	.0006	.054
GARAGE	.0061	.497
POOL	.0487*	1.807
FIREPLACE	.0169	1.562
RACE	.0009	1.432
DISTANCE	− .0448**	− 7.761
RELTAX	.0081**	3.957
ZONING	.0702**	3.211
COVENANT	.0867**	3.310
QUARTER 2	.0399**	4.248
QUARTER 3	.0167*	1.720
QUARTER 4	.0253*	1.740
ELSCORE	.0439	1.419
JRSCORE	.0036**	3.143
SRSCORE	− .0007	− .675
NONRES	.0375	.483

$R^2 = .852$; adjusted $R^2 = .837$; $n = 230$
*significance at the 10% level; **significance at the 1% level

but also better conditions in the real estate market explain these findings. The latter, basically the seasonal nature of this market, involve such considerations as minimizing the disruption of children's education as occasioned by any move. The coefficients of the dummy variables for the third and fourth quarters are also positive, possibly due to inflation during the year, and are significant at the 10% level.

Also of some interest is the coefficient for the variable measuring the distance from the center of Houston. It suggests that property values decline by 4.5% per-mile as this distance increases. The coefficient is highly significant and well within the range of estimates one would calculate by considering the effect on commuting costs of increased distance from the center of the city.

Although most of the coefficients have the theoretically appropriate signs and magnitudes and are significant, others cannot be interpreted so favorably. Many of these problems can be explained by correlation among the independent variables.

The coefficients of the parking facility variables (carport and garage) are of mixed signs and insignificant. It is quite likely that these results are due to correlation among independent variables. For example, most high-quality homes have garages, and a carport might be thought of as an inferior substitute for a garage.

The coefficient of the school-quality variables are mixed in sign, but only the positive junior high school coefficient is highly significant. The elementary school variable is highly correlated with race. The variable for the quality of senior high schools has much less variation than the other indicators of educational quality, and this small variation may explain the unexpected sign and its insignificance.

The coefficient of the nonresidential variable is positive and insignificant. Because of its high correlation with price in the partial correlation matrix (−.284), this result is unexpected. However, its correlation with the relative-tax-advantage variable is high, and when these two variables are entered separately in the regression, their separate effects on price cannot be distinguished.

4. Concluding remarks

This study finds that homeowners paid significant premiums for land-use controls in the Houston area. This important finding prevails in spite of the fact that the data should cause this result to be understated. Nonrestricted neighborhoods in the study are those where covenants were allowed to expire.[7]

The positive sign of the coefficients of the land-use restriction variables suggests that land-use interactions do exist and that consumers in this area consider the protection from these externalities more valuable than the foregone opportunities for development of their own property. However, empirical work of a different sort is required to distinguish between two possible explanations for this finding. First, consumers may pay premiums to avoid offensive and widespread nonconforming uses that already exist in the unrestricted neighborhood precisely *because* it previously had no restrictions on land use. Second, even if present uses of the land may not adversely affect the desirability of the property for residential use, uncertainty about future changes in the composition and character of the neighborhood may warrant some payment for land-use controls.

Perhaps it seems odd for so high a premium for land-use controls to persist. Economists generally expect entrepreneurs to expand production of a commodity that commands a quasi-rent, thereby eliminating this rent over time. However, institutional constraints in Houston make it difficult to change land-use restrictions. An unrestricted neighborhood in Houston *cannot* be zoned, and new covenants are hard to institute because of the difficulty in achieving unanimous agreement in the appropriate provisions.

Another major finding of the empirical analysis is that premiums paid for zoning and restrictive covenants do not differ significantly. Three explanations for this finding are plausible. First, perhaps the supplies of homes with the two types of restrictions have perfectly adjusted to the number demanded by consumers even though many homeowners may prefer one type of restriction. Second, consumers at the margin, who determine the market "price," may view the two types of controls as equivalent. Third, even if consumers at the margin are not indifferent in choosing between the controls, their bids may look the same because of indeterminacy in the U-shaped indifference curve. When this curve is almost flat, actual differences may also be too small to be identified statistically.

The first of these explanations seems unlikely. It may be true that neighborhoods with zoning and others with restrictive covenants were developed over time to satisfy consumers' demands for housing with the two types of restrictions. However, institutional constraints in Houston are sufficiently binding so that in order for this perfect adjustment of supply to demand to obtain, the demand for these restrictions must have remained relatively stable in a time of rapid growth in the area.

Some data on the merits of covenants and zoning can arguably corroborate either the second or the third explanation. Because Texas law supports deed restrictions (see Olson (1967)), enforceability is not a problem for covenants in the area studied, and while they may be quite inflexible over time, they permit the owners to participate in the decision-making process concerning the management of the restrictions on their property and to be quite specific in their provisions. Zoning, on the other hand, may be more flexible, but requires the delegation of authority for the management of restrictions and makes only fairly general restrictions on land use because of its centralized origin and management. Taken together, if these similarities and differences between zoning and covenants balance one another out, they lend credibility to indifference at the margin due to equivalence of the controls. If they do not, the different restrictiveness has been disguised by the indeterminacy problem of the U-shaped indifference curves. Future research may achieve a better understanding of consumers' perceptions of these instruments of land-use control in order to distinguish between these two possible interpretations of the empirical findings.

If the most likely explanation is indeed valid, and indifference prevails at the margin, further puzzles remain. Why were both instruments used historically for land-use control? Why do both mechanisms persist? Is it inefficient for local government authorities to bear the costs of information and organization for controlling land use in urban areas if zoning and covenants accomplish the same thing?

I suggest that both zoning and restrictive covenants exist due to original differences in the sizes of single owners' tracts of land. In areas with many owners of small tracts of land, zoning is preferable because it uses a public-choice mechanism of majority rule to avoid the possibility of single owners' holding out for personal gain. However, in areas with single developers of large tracts of land, as originally obtained in much of Houston, covenants are preferable because they can be developed to satisfy potential buyers and maximize the original owners' profit. The hold-out problem is averted because potential owners choose whether or not to move into the area and abide by the developer's restrictions. Covenants therefore minimized the cost of land-use control in this particular case. The historically different set-up costs provided the original rationale for both forms of restrictions; costs of changing these forms explain their persistence.

It is also possible that some people on the inframargin have a strong preference for one type of land-use restriction, but that the supply of homes with that type of restriction is sufficient to satisfy them. Those buyers at the margin, who determine the shadow price for restrictions, may be indifferent in choosing between zoning and covenants for the reasons described above.

A premium for land-use controls indicates the existence of land-use interactions. But even if inefficiencies in land use are quite important, several facts about land-use restrictions make a net gain in efficiency improbable for most situations. Zoning decisions are accomplished as a police power of the state, require an untenable amount of information in order to maximize the welfare consequence of land use for entire urban areas, and are likely to be distorted by the political decision-making process. Covenants are inflexible, fail to consider spillovers to adjacent neighborhoods, and are difficult to institute in most cases. In brief, premiums paid for land-use restrictions by buyers of non-convertible single-family homes do not imply that such restrictions are optimal from a social welfare standpoint. In fact, these gains may be small compared with the losses incurred by excluded groups like poor minorities, tenants, the elderly, and vacant landowners.

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Notes

1. Restrictive covenants are private agreements among property owners to constrain the uses of land in a community. As private agreements, they vary substantially in origin, form, amendment procedures, enforceability, and scope. In Houston, covenants are used in the form of deed restrictions without accompanying zoning regulation. They typically have limited terms of twenty to thirty years and are then automatically renewed every ten years unless a simple majority of the residents vote to allow expiration. Except at the expiration/renewal intervals designated in the covenants, a unanimous vote of the residents is required to change any or all of the provisions in the agreement. Unanimity therefore creates the potential for personal gain by any property owner who "holds out" against a generally desired change. See Furman (1982) for further discussion of covenants in Houston.

2. This theoretical model is general enough to encompass the literature on fiscal zoning. The future characteristics of the neighborhood, N_f, could include, for example, the jurisdiction's future tax structure. The empirical section focuses attention on the spatial externality question by including restricted (by covenants) and unrestricted properties within the same jurisdiction.

3. This expenditure also depends on prices and $\psi(N^f; N, R)$, but I have suppressed these in the notation.

4. This assumption is probably quite reasonable: the budget allocations for zoning in the municipalities included in my study are quite low, and the developers' costs of drawing up the legal documents that spell out deed restrictions are also small. (Indeed, most such documents follow a set pattern with changes in specific provisions where appropriate.)

5. Linear forms of the regression equations were also tested, and other variables, including one representing the provision of local services, were added to both regression forms. The major results were qualitatively similar to those reported, but less satisfactory either theoretically or with respect to overall fit. Some physical characteristics were also omitted from the empirical analysis to reduce multicollinarity among the independent variables.

6. The literature on capitalization of property taxes would suggest that the present value of these taxes should be added to price on the left-hand side. Unfortunately, this value is hard to pin down. First, I added γT to price, where T was the current annual tax and γ ranged from 1 to 30, indicating unrealistically high (infinite) and low discount rates, respectively. The overall results of these regressions were quite similar and, more critically, the coefficients on zoning and covenants remained positive and significant for all γ's. Indeed, for the best of the parameter trials, $\gamma = 20$, the magnitudes also held up well.

Because the effects on which this study focuses proved so robust, maximum likelihood techniques to get the globally best estimate of γ did not seem necessary, and T and P are so highly correlated that the explanatory value of all other variables is swamped with γT is entered in the right-hand side for estimation purposes.

7. This may help reconcile the findings of this study with those of Siegan (1972), who observed sections in Houston *only* where covenants *had* expired and then concluded that property values in general did not decline and may, in fact, have increased upon this expiration. If agents are optimizers, one would explain this result first and foremost by sample selection bias. Moreover, Siegan aggregated houses on major thoroughfares, where convertibility to nonresidential uses would surely be attractive, with those in the neighborhood interior, where it could not, thereby falling prey to errors of aggregation as developed by Peterson.

References

Crecine, J.P.; Davis, O.A.; and Jackson, J.E. "Urban Property Markets: Some Empirical Results and Their Implications for Municipal Zoning." *J. Law Econ.* 10 (1967), 79–99.

Furman (Speyrer), J.L. "Responses to Uncertainty in the Market for Neighborhood Characteristics." Ph.D. dissertation, the Johns Hopkins University, 1982.

Grether, D.M. and Mieszkowski, P. "The Effects of Nonresidential Land Uses on the Prices of Adjacent Housing: Some Estimates of Proximity Effects." *J. Urban Econ.* 8 (1980), 1-15.

Kain, J.F. and Quigley, J.M. "Measuring the Value of Housing Quality." *J. Amer. Statist. Assoc.* 65 (1970), 532-548.

Mills, E.S. "Economic Analysis of Urban Land-use Controls." In: P. Mieszkowski and M. Straszheim, eds., *Current Issues in Urban Economics.* Baltimore: The Johns Hopkins University Press, 1979.

Oates, W.E. "The Effects of Property Taxes and Local Public Spending on Property Values: An Empirical Study of Tax Capitalization and Tiebout Hypothesis." *J. Pol. Econ.* 77 (1969), 957-971.

Olson W.A. "City Participation in the Enforcement of Private Deed Restrictions." Paper presented at the Annual National Planning Conference of the American Society of Planning Officials, April 1967, Houston, Texas.

Peterson, G.E. "The Effect of Zoning Regulations on Suburban Property Values." Urban Institute Working Paper No. 1207-24. Washington, D.C., March 1973.

Reuter, F.H. "Externalities in Urban Property Markets: An Empirical Test of the Zoning Ordinance of Pittsburgh." *J. Law Econ.* 16 (1973), 313-350.

Siegan, B.H. *Land Use without Zoning.* Lexington, Mass.: D.C. Heath and Company, 1972.

Stull, W.J. "Community Environment, Zoning, and the Market Value of Single Family Homes." *J. Law Econ.* 18 (1975), 535-558.

Thornton, C. "Zoning, Apartments, and Land Use Interactions." Ph.D. dissertation, The John Hopkins University, 1978.

Tideman, T.N. "Three Approaches to Improving Urban Land Use." Ph.D. dissertation, University of Chicago, 1969.

Tiebout, C.M. "A Pure Theory of Local Expenditures." *J. Pol. Econ.* 64 (1956), 416-424.

Wheaton, W.C. "A Bid Rent Approach to Housing Demand." *J. Urban Econ.* 4 (1977), 200-217.