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Residential Land-Use Controls and Land Values: Zoning and Covenant Interactions

Carolyn A. Dehring and Melissa S. Lind

ABSTRACT. *Residential land use in urban areas can be constrained by zoning or restrictive covenants. When covenants and zoning exist simultaneously, covenants can facilitate an efficient allocation of high-restriction and low-restriction residential land. However, covenants cannot remedy deadweight loss resulting from zoning that over-allocates land to high restriction use. We examine subdivided, vacant residential lot sales from two residential zones which differ in both minimum lot size and the minimum square feet of house. Our findings of a negative price effect from covenant use in the more restricted zone suggest that private restrictions are over-supplied in that zone.* (JEL R14, R52)

I. INTRODUCTION

A covenant is a legal device that restricts the use of real property. Because covenants, or deed restrictions, "run with the land," the deed and the property are inseparable once the covenant is recorded, thereby subjecting successive landowners to the original restrictions. Restrictive covenants commonly address property use, and the type, character, and location of houses or other improvements within residential subdivisions.

Covenants have long been in use in the United States. In the nineteenth century, covenants regulated land use by restricting the types of animals allowed in residential areas. Thought of as legitimate nuisance regulations, the covenants barred landowners who used the land for their livelihood from residential areas. Later, in the early twentieth century, restrictive covenants emerged in response to the City Beautiful movement, progressive-era reforms, and American garden city planning.[1] Covenants evolved into exclusionary mechanisms, enabling the "conspicuous consumption" described by Thorstein Veblen in his 1899 *Theory of the Leisure Class.* Covenants were also used to shape the physical and social character of the suburbs along the dimension of race. By 1917, deeds with prohibitions against land sale to non-Caucasian buyers were in effect. In 1934, the Federal Housing Administration's *Underwriting Manual* recommended the use of subdivision regulations and restrictive covenants to segregate the "social and racial classes" in order to maintain neighborhood stability. When the Supreme Court finally struck down racial covenants in 1948, suburbs with restrictive covenants were ubiquitous in the United States.

Because covenants apply to properties within private developments, they can not protect against negative externalities arising from incompatible land uses locating at the development's border. Zoning, which separates property uses broadly while controlling density, forestalls the threat of lower uses, such as commercial and industrial, from locating on adjacent parcels. Thus, zoning complements covenants by protecting the borders of covenanted land while at the same time

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[1] For example, Jesse Clyde Nichols' planned Country Club District in Kansas City, started in the 1920s, required every landowner to join the homeowners association.

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protecting the municipal tax base (Fischel 2004).[2] Zoning is enforced by the police power of the local government, and thus differs from private deed restrictions that are subject to civil contract law. Hughes and Turnbull (1996) suggest covenants are more efficient than zoning at resolving intra-neighborhood effects, because directly affected landowners are responsible for the design, monitoring, and enforcement of covenants.

Covenants affect land prices when they provide either net benefits or costs to consumers. The costs of covenants may include increased future housing expenditures and/or expenditures related to subdivision governance and covenant enforcement. Benefits may include value from the promotion of intra-neighborhood conformity. Hughes and Turnbull's (1996a) credible commitment theory suggests that covenants reduce future intra-neighborhood externality risks by effectively locking-in both existing and future neighbor behavior. They suggest higher house prices result from stricter covenants and stricter enforcement mechanisms, both of which lower consumption risk.

Previous empirical studies of covenants and property values generally find net benefits from covenant use. Cannaday (1994) tests the extent to which condominium prices in North Chicago are affected by pet covenants, and finds price is enhanced by covenants restricting dogs and in favor of cats. Hughes and Turnbull (1996b) examine the effect of covenants on house prices from 37 neighborhoods in Baton Rouge, Louisiana. They develop a strictness index reflecting representation of categories within the deed restrictions of each neighborhood. They find covenant strictness has a net positive effect on house prices, but that this effect diminishes with subdivision age. Spreyer (1989) examines un-zoned properties in Houston, and properties in two municipal "islands" within Houston having zoning. She finds an increased willingness to pay for houses with zoning and covenants, with similar premiums between the two land-use control mechanisms across municipalities. She suggests, but does not test for, potential interaction effects between zoning and covenants.

Several papers in the zoning literature examine the effects of varying levels of strictness across zoning classifications. Netusil (2005) investigates two levels of environmental zoning restrictiveness in Portland, Oregon. She finds amenities enhance property values, yet does not find any differential effects for lot size across zoning or city quadrants. In a study of lakefront property in Wisconsin, Spalatro and Provencher (2001) report an overall economic gain for restrictive municipal zoning while accounting for environmental amenities. They include an index of soil quality representing the potential for improvements as well as control for type (public, tribal, private) of land ownership.

When covenants and zoning are used together, both the benefits and costs of covenants may relate to the level of restrictiveness in the underlying zoning. We develop a model of an urban area in which households demand high and low-restriction land. We show that covenants facilitate an efficient allocation of high and low-restriction land in the absence of zoning, or when the underlying zoning is in itself not sufficiently restrictive. However, covenants cannot remedy deadweight loss from a zoning policy that over-allocates land to high restriction use. A hedonic model tests the effect of covenants on residential land prices while controlling for the level of zoning restrictiveness. Using a small data set of subdivided, vacant residential lot sales from two residential zones within a Dallas-Fort Worth community, we find no price effect from covenant use in the zone having lower restrictions, but a negative price effect from covenant use in the zone with higher restrictions. Because we find no evidence

[2] A number of studies have examined the effect of zoning on property values, including Crecine, Davis, and Jackson (1985), Rueter (1973), Sagalyn and Sternlieb (1973), Ohls, Weisberg, and White (1974), Stull (1975), Orr (1975), Maser, Riker, and Rosett (1977), Jud (1980), Mark and Goldberg (1986), McMillen and McDonald (1991).

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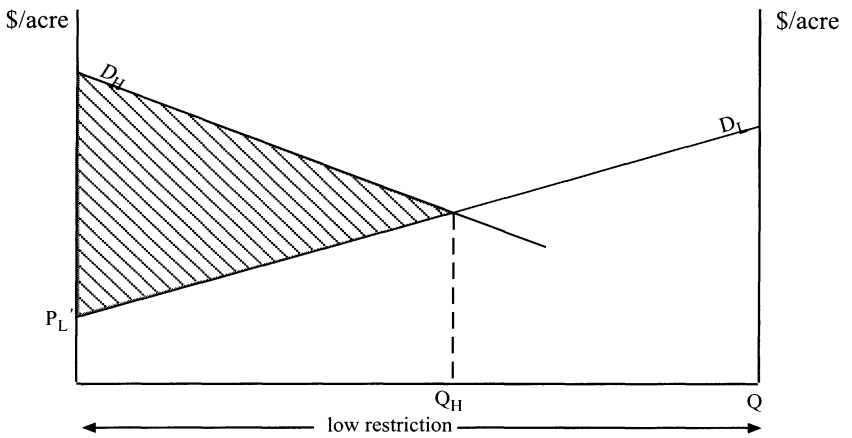

FIGURE 1
DEADWEIGHT LOSS: NO COVENANTS

that zoning policy over-allocates land to the low-restriction zone, the results suggest that private land-use restrictions are oversupplied in the zone having higher restrictions. This paper adds to the sparse literature on the effects of private land-use controls on real property prices. It is the first empirical study to reveal zoning and covenant interaction effects on land prices.

II. ZONING, COVENANTS, AND LAND PRICES

The following diagrammatic analysis illustrates how the price effects of covenants relate to the level of restrictiveness in the underlying zoning. Imagine a submarket in which households demand two possible residential land uses: high-restriction land and low-restriction land. Assume that there are no locational advantages within the submarket, but that there are locational differences between this submarket and competing submarkets, such that the demand curves for both types of residential land are downward sloping.[3] Assume that higher levels of restrictions are more effective in promoting conformity and/or in reducing uncertainty about future development outcomes, such that the willingness to pay for high-restriction land exceeds that for low-restriction land. The graphical analysis that follows assumes that any spatial externalities flowing between low-restriction land and high-restriction land do not cause price effects on the boundary.

The willingness to pay for high-restriction land decreases as more land in the submarket is allocated to this use. The willingness to pay per acre of high-restriction land is shown in Figure 1 as D_H, and the willingness to pay per acre of low-restriction land is D_L. The horizontal axis measures the quantity of restricted residential land in the submarket, Q, and the vertical axes measure price per acre. Assume there is no zoning policy, and that covenants do not exist. Restrictions on land are not supplied because the costs of private negotiation, contracting, and enforcement between neighbors would exceed the benefits of conformity and credible commitment. Without covenants, the price of land is P_L', and there is no high-restriction land in the submarket. The shaded triangle in Figure 1 is the resulting deadweight loss if covenants cannot supply restrictions.

If covenants are available as a legal mechanism, restrictions are privately supplied such that the optimal allocation

[3] See Colwell and Trefzger (1994) for a similar diagrammatic framework applied to residential and office property. Colwell and Dehring (1999) also use a similar framework to illustrate the value of zoning.

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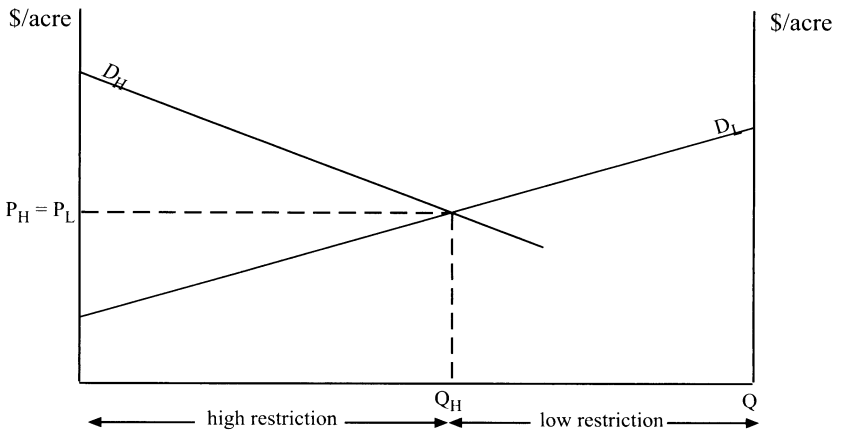

FIGURE 2
MARKET ALLOCATION OF LAND-USE TYPES

of restricted residential land results. In Figure 1, this is the allocation of Q_H to high-restriction land and $Q–Q_H$ to low-restriction land. This allocation maximizes the sum of land value and consumer surplus in the submarket. At the market allocation, the price per acre of high-restriction land, P_H, is the same as the price per acre of low-restriction land, P_L. This is depicted in Figure 2.

Now consider that there is zoning in the submarket, and the zoning hierarchy features just one residential zoning classification for the submarket. Covenants and zoning together can bring about an optimal allocation of restricted residential land.[4] If the level of restrictiveness set forth in the zoning classification is sufficient for low-restriction land, then we would observe covenants used to create high-restriction land. If zoning is not sufficiently restrictive to supply low-restriction land, then there will be two types of covenants used. Those covenants used for high-restriction land will be more restrictive than the covenants applied to low-restriction land. Here, higher restrictions are achieved though a wider range of covenant coverage and/or a higher level of restrictiveness along a given dimension. For example, relative to a sole restriction of minimum lot size requirement of one-quarter acre, higher restrictions would result from the addition of a minimum square foot of house requirement, or an increase in the minimum lot size requirement to, say, one-third acre.

The demand for restricted land may change over time (Hughes and Turnbull 1996a). A change in the demand for one type of restricted land changes relative prices in the short run. Consider an increase in the demand for high-restriction land in the submarket due to changes in household real income. This is depicted in Figure 3 as a shift in the demand for high-restriction land to D_H'. In the short run, the price of high-restriction land increases to P_H'. An optimal allocation of restricted land may be restored if stricter covenants are adopted on some low-restriction land, effectively increasing the supply of high-restriction land. However, this can only occur if the total costs to transfer from low-restriction use to high-restriction use are not greater than the total benefits of transferring. Otherwise, the price difference between low- and high-restriction land will persist. An increase in the demand for low-restriction land in the submarket would have the reverse effect, with the price of high-restriction land selling

[4] Zoning has value when there are negative externalities. Optimal zoning constrains the lower use such that the price of land on the interior of the zones is equalized.

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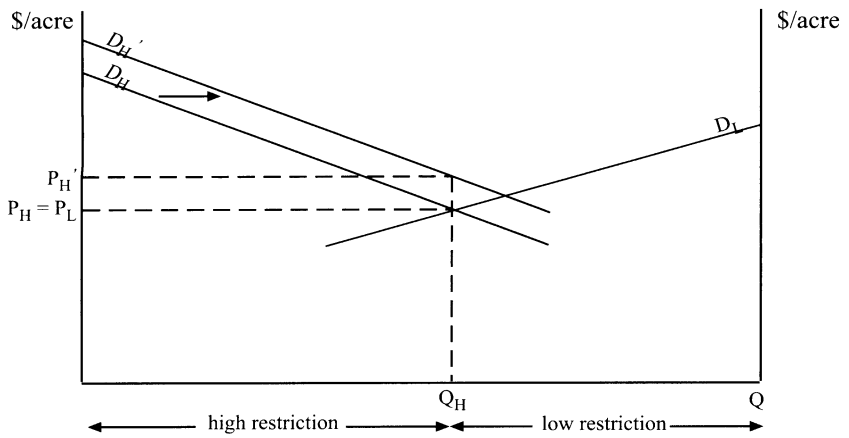

FIGURE 3
A CHANGE IN THE DEMAND FOR HIGH-RESTRICTION LAND

for less than the price of low-restriction land. Here a new equilibrium is possible only through the elimination or expiration of existing covenants, which would equate to an increase in the supply of low-restriction land. The costs of transition from high-restriction use to low-restriction use are potentially great, because covenants cannot relax zoning.

It is not uncommon for municipalities to have multiple residential zoning classifications. Restrictions by which residential zoning classifications might vary include minimum lot size or minimum square feet of structure. As a mechanism for supplying restrictions, covenants can achieve an optimal allocation of restricted land when land in the submarket is not zoned in an optimal matter. That is, covenants can eliminate any dead weight loss resulting from zoning that too tightly constrains land available for high-restriction residential development. This is illustrated in Figure 4. The submarket features two residential zoning classifications: high restriction and low restriction. We consider a case where zoning policy is sub-optimal due to changes in demand for high-restriction land after a municipal comprehensive zoning plan is enacted. Assume zoning constrains high-restriction land use to Q_{ZH}, resulting in an over-allocation to low-restriction land in the submarket. The resulting price per acre is P_H' for high-restriction land and P_L' for low-restriction land. The societal dead weight loss resulting from this zoning policy is represented by the shaded triangle in Figure 4. Now consider that Q_H–Q_{ZH} of the land in the low-restriction residential zone is covenanted with restrictions that, together with the underlying zoning, match the level of restrictiveness in the high-restriction zone. A simple example of this would be a covenant in the low-restriction zone that restricts lot size to be not less than one acre, where zoning policy requires minimum lot dimensions in the low and high zones of one-quarter acre and one acre, respectively. Covenants restore the amount of high-restriction land to the market allocation that equalizes the prices in the two land markets, Q_H, and the deadweight loss from suboptimal zoning is eliminated.

Note the price of both covenanted and non-covenanted land in the low-restriction zone increases when covenants are applied to Q_H–Q_{ZH} of land. If less than Q_H–Q_{ZH} is covenanted, the covenanted low-restriction land will sell for more than the non-covenanted low-restriction land. This market situation would persist only if additional covenants could not be imposed. At the same time, we would expect to see high-restriction land supplied only to Q_H, as beyond this point additional supply would reduce the price of such land to less than the

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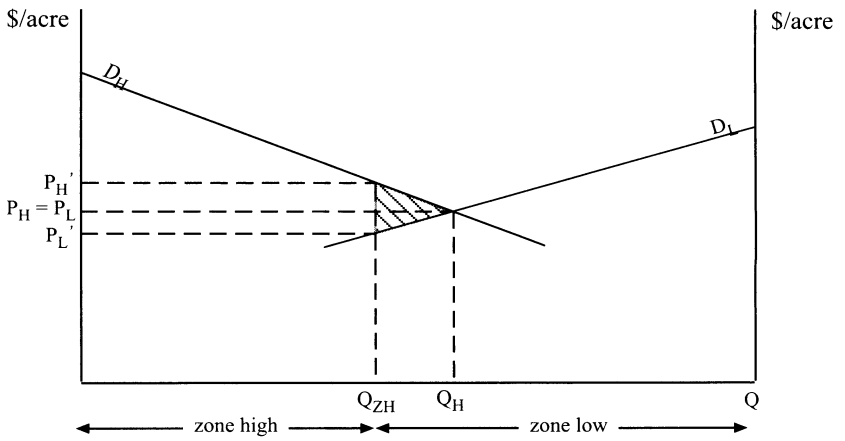

FIGURE 4
DEADWEIGHT LOSS FROM A ZONING POLICY THAT OVER-ALLOCATES LAND TO LOW-RESTRICTION USE

market equilibrium price, P_L. That is, covenants applied to more than Q_H–Q_{ZH} of land in the low-restriction zone would result in all high-restriction land selling for less than non-covenanted land in the low-restriction zone. Thus, in the low-restriction zone, the use of covenants would be associated with a price discount.

What if zoning is of an exclusionary nature, such that zoning policy over-allocates land to high-restriction use? Holding demand constant, the optimum allocation could only be restored through an increase in the supply of low-restriction land. Because covenants cannot relax, but can only tighten, the restrictions put in place by the underlying zoning, low-restriction land would command a higher price than high-restriction land. A reduction of the deadweight loss resulting from an exclusionary zoning regime could only be brought about over time by a change in the demand for restricted (or unrestricted) land or through the expiration or abandonment of covenants. Thus, in a functioning land market, the abandonment or expiration of covenants over time suggests a change in demand for restricted land, an exclusionary zoning regime, or an oversupply of private restrictions on the part of residential developers.

III. METHODOLOGY

We use a hedonic housing price model to explore the effects of private land-use controls on the value of undeveloped subdivided residential lots while controlling for zoning. Using vacant rather than improved land sales results in a small sample size, but eliminates any bias introduced by the inclusion of housing improvements (Thorsnes 2002). The pricing model is

$$price = area^{\alpha_1} \exp\begin{pmatrix} \beta_0 + \beta_1 dist + \beta_2 time + \beta_3 \text{interior} \\ + \beta_4 culdesac + \beta_5 corps + \\ \beta_6 nonconform + \beta_7 agesub + \\ \phi_1 zonehigh + \\ \text{covenant}(\mu_1 zonelow + \mu_2 zonehigh) \end{pmatrix} \quad [1]$$

The model is a device to explain the dependent variable, price, which is the sale price of the subdivided land parcel in \$1994.[5] The variable *area* is total square feet of the lot. We expect $0 < \alpha_1 < 1$, revealing a concave lot value–parcel-size

[5] The CPI-U for Dallas-Fort Worth is from the U.S. Bureau of Labor Statistics (CPU-U xxxx).

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function. The variable *dist* is distance from the Southlake city center in miles. We expect to find $\beta_1 < 0$, or that prices decline with increased distance from the city center. To control for date of sale we use *time*, which is a continuous variable equal to years since the beginning of the sample period. The coefficient on *time*, β_2, reveals the annual real rate of appreciation throughout the sample period. The variables *interior* and *culdesac* describe placement of the lot within the subdivision. The variable *interior* indicates lots which are located on the interior of a subdivision, rather than on the external border of a subdivision. We expect the $\beta_3 > 0$ since interior lots are less exposed to negative externalities arising from factors outside the neighborhood. The variable *culdesac* indicates whether the lot is located in the radius of a cul-de-sac.[6] We expect that $\beta_4 > 0$ revealing both the benefits of reduced traffic and the increased development costs associated with cul-de-sacs. The variable *corps* indicates a lot bordering undeveloped land surrounding a reservoir maintained by the Army Corps of Engineers. We expect that $\beta_5 > 0$, indicating a premium for those properties which back up to Army Corp of Engineers property. The variable *nonconform* indicates whether the lot is nonconforming with the existing zoning (having a lot size smaller than that specified in the zoning policy). We would expect $\beta_6 < 0$ if the lot size difference is so severe the lot is contextually "odd" relative to surrounding lots. On the other hand, the relative lot size hypothesis says that a lot's value is affected by its size relative to the subdivision average, such that the value of a smaller (larger) than average lot is pulled up (down) (Asabere and Colwell 1985). The variable *agesub* is subdivision age in years. Subdivision age is calculated from the date of the deed restriction or, if not available, the earliest date of sale from the subdivision listed on the tax rolls. Land prices will decrease with subdivision age, if older subdivisions have functional obsolescence associated with dated house designs, lot configurations, and street patterns, and hence do not suit current market preferences.[7]

To test the paper's main hypothesis we use covenant and zoning dummy variables. The variable *zonehigh* is a dummy variable indicating whether or not the sale took place in the zone having higher restrictions. The coefficient ϕ_1 is the percentage change in price associated with a location in this zone, relative to a location in the lower restriction zone. If $\phi_1 < 0$, then residential zoning is of an exclusionary nature, while $\phi_1 > 0$ would suggest an under-allocation to land in the zone with higher restrictions. The *zonelow* variable, which indicates whether or not the sale is in the zone with low restrictions, and the *zonehigh* variable are both interacted with *covenant*. The variable *covenant* is equal to one if the lot is located in a subdivision having restrictive covenants. This variable does not control for the nature of covenants, but rather indicates merely that covenants of some kind are recorded at the county courthouse. Accordingly, the coefficient μ_1 is the percentage change in price from covenant use in the low restriction zone relative to a lot in this zone without covenants. If $\mu_1 > 0$, then the marginal benefits of covenant use exceed the marginal costs in this zone. Similarly, μ_2 is the percentage change in price from covenant use in the high restriction zone. If $\mu_2 > 0$, then the marginal benefits of covenant use in the zone with higher restrictions exceed the marginal costs. We expect that private restrictions are optimally supplied, such that $\mu_1 = 0$, and $\mu_2 = 0$. Relative to not having covenants in the lower restriction zone, the total price effect of covenant use in the zone

[6] We chose this definition for cul-de-sac in order to avoid all lots in the subdivision deemed cul-de-sac in the case when every street in the subdivision ends in a cul-de-sac.

[7] The regression was run with elementary and high school district dummy variables to reveal price level differences across Southlake. None were significant. We also used dummy variables for year of sale to reveal significant differences in price level over time. None were significant.

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with high restrictions is the sum of μ_2 and ϕ_1.

IV. DATA

The sample data consists of vacant residential parcels sales from Southlake, Texas, sold between 1994 through the middle of 2002.[8] Sale price and date of sale are obtained from the Arlington Board of Realtors MLS.[9] Lot area is obtained from Tarrant County Appraisal District tax files. Other lot characteristics are compiled using maps from both the Tarrant County Appraisal District and the City of Southlake.

All sales are within designated residential subdivisions. Accordingly, the sample does not include sales of survey tracts. In total there were 44 separate subdivisions represented in the sample. Covenants are recorded at the Tarrant County Courthouse for 34 of the 44 subdivisions. The remaining subdivisions do not have restrictive covenants.[10] We eliminate sales from subdivisions not having interior streets, as we did not consider these to be subdivisions in the traditional urban context.

There are four residential classifications in the city zoning hierarchy. Estate zoning, with a minimum of five acres, is not represented in our sample. A second zoning category is a Planned Unit Development (PUD). The PUD zone provides allowances for smaller lots due to developer maintenance of green areas along major streets as well as in common areas. We eliminate sales from the Planned Unit Development zone because all sales within the PUD are in the same subdivision and are identically covenanted. The two remaining residential zones are single family zoning SF-1 and single family zoning SF-20. Zone SF-1 features higher restrictions, with a minimum lot size of one acre and a 2,000SF minimum house size. Zone SF-20 restricts lot size to 20,000SF (.459 acre) and requires a 1,500SF to 1,800SF minimum house size.

Table 1 provides descriptive statistics for the sample data. The average sale price (in real dollars) for the sample is $95,189. It is $99,877 for lots in SF-1, and is $62,376 for lots in SF-20. The average lot area in the sample is 57,505 SF, or 1.32 acres. Approximately 49% of sales are interior lots within the subdivision, while about 26% of sales are located on a cul-de-sac. The average age of a subdivision is 13 years, with subdivision age ranging from 2 to 50 years. The average distance to the town center is 2.25 miles. The sample includes 3 non-conforming lots.

Most of the sales in the sample have covenants. Although 80% of sales in both SF-1 and SF-20 have covenants, these covenants appear to differ across zones. Table 2 provides descriptive statistics on the nature of covenants restrictions across zones. Typical features of covenants include architectural and landscaping restrictions, as well as specification of a minimum house size, house height, and garage size. Additional restrictions include whether homeowner association membership is mandatory, and the restriction of certain types of activity deemed offensive (for example, driving all terrain vehicles in the subdivision). We find that, in general, covenants are more restrictive in the high restriction zone. Table 2 shows a higher incidence of architectural restrictions, building material restrictions, restrictions on parking and offensive activity, and mandatory membership in a homeowner association within the high restriction zone. In addition, there are stricter requirements on the size and height of a house in the high restriction zone.

Besides the scope of restrictions, another way to classify the strictness of covenants is through subdivision governance mechanisms. We assume covenants are not strict when there is no designated governing body referenced within the covenants. Moderate strictness is assumed when there is an

[8] We lost access to the MLS in 2002, which is why the dataset terminates at that time.

[9] Sample selection bias may be present in the data because in our study we use only those sales occurring through MLS. However, from discussions with local builders and developers we have no reason to suspect there is any material difference in the nature of lots regarding the central issues of this paper.

[10] Texas law requires that all deed restrictions be recorded.

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TABLE 1
DESCRIPTIVE STATISTICS

Variable	Minimum	Maximum	Mean	Std. Dev.
Full Sample (n=80)				
Price	$19,718	$244,335	$95,189	$43.605
Area	12,465	168,839	57,505	29,045
Zonehigh	0.00	1.00	0.8750	0.3328
Zonelow	0.00	1.00	0.1250	0.3328
Interior	0.00	1.00	0.4875	0.5030
Distance	0.00	3.90	2.2475	0.9232
Cul-de-sac	0.00	1.00	0.2625	0.4428
Covenants	0.00	1.00	0.8000	0.4025
Covenants × Zonehigh	0.00	1.00	0.7000	0.4612
Subage	2.80	50.73	13.7166	10.8084
Nonconforming	0.00	1.00	0.0375	0.19118
Zonehigh =1 (n=70)				
Price	$32,264	$244,335	$99,877	$44,194
Area	40,000	168,839	59,778	29,042
Interior	0.00	1.00	0.5143	0.5034
Distance	0.00	3.90	2.2289	0.9430
Cul-de-sac	0.00	1.00	0.2714	0.4479
Covenants	0.00	1.00	0.8000	0.4029
Age of subdivision	2.80	28.90	11.4644	6.4560
Nonconforming	0.00	1.00	0.0286	0.1678
Zonelow =1 (n=10)				
Price	$19,718	$85,732	$62,376	$18,693
Lot size	12,465	98,010	41,600	24,850
Interior	0.00	1.00	0.3000	0.4831
Distance	0.65	3.54	2.3780	0.8009
Cul-de-sac	0.00	1.00	0.2000	0.4216
Covenants	0.00	1.00	0.8000	0.4216
Age of subdivision	6.15	50.73	29.4820	19.7553
Nonconforming	0.00	1.00	0.1000	0.3162

architectural control committee, but not a homeowner's association. High strictness is assumed when there is both an architectural control committee and a homeowners association.[11] The majority of covenanted sales in Zone SF-20, 60%, have neither an architectural control committee nor a homeowners association. Of the remaining 40%, half classify as moderate strictness and half as high strictness. This is in contrast to Zone SF-1, for which 50% of sales are high strictness, having both an architectural control committee and a homeowners association. Only 34% of sales in Zone SF-1 are low strictness. Thus, both in terms of subdivision governance and the scope of restrictions, it appears that developers place stricter private restrictions on land in SF-1, the zone having higher restrictions.

[11] All sales with homeowner associations also had an architectural control committee.

V. ESTIMATION AND RESULTS

The regression model is a logarithmic transformation of Equation 1. Results are presented in Table 3, column 1. We do not find significant results with regard to zoning, or covenant use in SF-20. Admittedly, because we have only ten observations in SF-20 (eight with covenants, two without covenants), the lack of significance on *ZonelowCovenant* and *Zonehigh* should perhaps be interpreted with caution. We do, however, find a negative price effect associated with covenant use in SF-1, the zone having higher restrictions. Specifically, covenanted land in SF-1 sells for 21% less than non-covenanted land in this zone. The findings suggest that land market

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TABLE 2
FREQUENCY OF SALE WITH RESTRICTIONS

Description	Full Sample	Low Restriction Zone (SF-20)	High Restriction Zone (SF-1)
Architectural	0.78	0.50	0.82
Building materials	0.75	0.38	0.80
Landscaping	0.36	0.38	0.36
Parking	0.83	0.38	0.89
Offensive activity	0.77	0.25	0.84
Mandatory homeowners association membership	0.58	0.25	0.63
House size	0.75	0.75	0.75
Building height	0.56	0.25	0.60
Garage spaces	0.19	0.00	0.21
Architectural control committee (ACC)	0.63	0.40	0.66
Homeowners association (HOA).	0.46	0.20	0.50

participants perceive that the additional cost of covenants in SF-1 outweigh the additional benefits.

The model's other variables are significant. The area elasticity of value is 0.57, which adds to the growing support for a concave land value- parcel size function. Real prices in the sample area are appreciating at 11% annually during the sample period. We find that land prices decrease by 1% with each additional year of subdivision age. Interior lots and lots on a cul-de-sac sell at premiums of around 15% and 20%, respectively, while properties backing on to Army Corp of Engineer land command an 18% premium. Prices decrease approximately 12% with each additional mile from the city center.[12]

Alterative Specifications

In January of 1998, the City of Southlake updated its Land Use Plan. Two fundamental changes from the 1993 Land Use Plan were the removal of any type of commercial activity from low-density residential classifications, including SF-1, and the restriction of residential activity to single-family dwellings in the medium-density residential classifications, including SF-20. To see to what extent this regulatory change affected residential land prices in the two zones, we run the model with *zonehigh* and *zonelow* each interacted with *post1998LUP*, which is equal to 1 if the sale took place after January 1998. The results of this regression are presented in Table 3, Column 2. There is no price effect in either SF-1 or SF-20 from the adoption of the 1998 Land Use Plan, nor are the earlier findings changed by the inclusion of these variables.

Because covenants appear to vary systematically across zones, we test whether price effects within zones are a function of strictness, as measured by governance mechanism. This specification utilizes the variables *ACC* and *HOA*, which indicate whether the subdivision has an architectural control committee and a homeowner's association, respectively. Because all covenants with a homeowners association also have an architectural control committee, the governance variables are hierarchical. These variables are each interacted with *zonehigh* and *zonelow*. The results of this regression are presented in Table 3, Column 3. The coefficient on *zonehighcovenant* is relatively unchanged, suggesting a negative price effect from having covenants in zone SF-1 of around 21%. However, the effect of additional levels of governance is not significant in this zone. Moreover, there are no significant price effects associated with covenants and covenant governance in Zone SF-20. Thus, in both zones, relative to having covenants for which there is no

[12] The Breusch-Pagan chi-squared test for heteroscedasticity can be rejected, with $p = 0.361$. Variance inflation factors ranging between 1.3 and 5.4 indicate that collinearity is not a problem.

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TABLE 3
ESTIMATION RESULTS

	R^2: 0.876 Adj R^2: 0.729	R^2: 0.882 Adj R^2: 0.733	R^2: 0.880 Adj R^2: 0.720	R^2: 0.881 Adj R^2: 0.737	R^2: 0.872 Adj R^2: 0.726
Variable	(1) Parameter Estimate (*t*-Value)	(2) Parameter Estimate (*t*-Value)	(3) Parameter Estimate (*t*-Value)	(4) Parameter Estimate (*t*-Value)	(5) Parameter Estimate (*t*-Value)
Constant	4.947	5.100	5.018	5.679	5.497
	(4.51)***	(4.71)***	(4.43)***	(4.88)***	(5.35)***
Distance	−0.132	−0.131	−0.142	−0.132	0.126
	(−3.77)***	(−3.78)***	(−3.76)***	(−3.80)***	(−3.59)***
lnArea	0.569	0.577	0.588	0.555	0.532
	(5.76)***	(5.87)***	(5.75)***	(5.67)***	(5.56)***
Time	0.109	0.100	0.103	0.109	0.110
	(7.90)***	(4.16)***	(6.75)***	(7.96)***	(7.91)***
Corps	0.164	0.171	0.133	0.171	0.176
	(1.93)*	(2.01)**	(1.35)	(2.03)**	(2.07)**
Culdesac	0.180	0.170	0.183	0.163	0.180
	(2.05)**	(1.89)*	(2.04)**	(1.87)*	(2.03)**
Interior	0.140	0.152	0.165	0.142	0.131
	(1.89)*	(2.04)**	(2.03)**	(1.94)*	(1.76)*
Agesub	−0.010	−0.011	−0.018	−0.012	−0.009
	(−2.53)**	(−2.85)***	(−2.41)**	(−3.02)***	(−2.30)**
Nonconform	−0.140	−0.098	−0.113	−0.074	−0.157
	(−0.82)	(−0.57)	(−0.63)	(−0.43)	(−0.92)
Zonehigh	0.223	−0.036	0.128	−0.303	0.019
	(1.18)	(−0.16)	(0.62)	(−0.84)	(0.16)
ZonehighCovenant	−0.242	−0.247	−0.240	−0.262	—
	(−2.64)**	(−2.70)***	(−2.19)**	(−2.88)***	—
ZonelowCovenant	0.057	0.087	0.303	0.081	—
	(0.27)	(0.42)	(1.07)	(0.40)	—
ZonehighPost98LUP	—	0.062	—	—	—
	-	(0.54)	-	-	-
ZonelowPost98LUP	-	−0.243	-	-	-
	-	(−1.40)	-	-	-
ZonelowACC	-	-	−0.455	-	-
	-	-	(−1.23)	-	-
ZonelowHOA	-	-	0.024	-	-
	-	-	(0.10)	-	-
ZonehighACC	-	-	−0.065	-	-
	-	-	(−0.54)	-	-
ZonehighHOA	-	-	−0.009	-	-
	-	-	(−0.09)	-	-
ZonelowTime	-	-	-	−0.105	-
	-	-	-	(−1.71)*	-
Covenant	-	-	-	-	−0.201
	-	-	-	-	(−2.30)**

*, **, *** indicates two-tailed significance at the 0.10, 0.05, and 0.01 levels.

intra-subdivision governing or enforcement body, the marginal costs of additional governance are just equal to the marginal benefits.

To test whether growth in the demand for land zoned with high and low restrictions, respectively, differs throughout the sample period, we interact *time* with *zonelow*. The coefficient on *timezonelow* reveals any difference in the annual rate of appreciation between SF-1 and SF-20 land. The results of this regression are presented in Table 3, Column 4. The results suggest that appreciation in SF-20 land was nearly flat during the sample period. That is, SF-20 land appreciated by 10% less than SF-1 land, for

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which the annual rate of appreciation is 11% over the sample period.

Finally, what are the consequences ignoring zoning and covenant interactions when testing for the effects of covenants? To answer this, we run the base regression again, including *covenant* but ignoring any zoning interaction effects. The results, presented in column 5 of Table 2, erroneously suggest that covenant use reduces land prices by 22% across all zones. Thus, the inter-zone differences in covenant price effects are masked by a specification which ignores interaction effects.

VI. DISCUSSION

The results of this paper suggest that the net price effects of private land-use restrictions are zero or negative when controlling for zoning. We find that relative to not having covenants, the marginal benefits of covenants just equal the marginal costs within a zoning classification with relatively low-land-use restrictions. However, the net effect of covenant use is negative within the high restriction zone. Here, any benefits of conformity and reduced uncertainty are less than the present value of any costs the covenant imposes on the future homeowner. However, in both types of zoning classifications, we find that relative to covenants which feature no intra-subdivision governing or enforcement body, the marginal costs of additional governance are just equal to the marginal benefits.

We do not suggest that our results—namely, negative price effects associated with covenants—speak to any general understanding about private land-use restrictions. For example, both Turnbull and Hughes and Speyer find net benefits from covenant use. Rather, this study argues that when covenants and zoning are used together, interaction effects must be handled when measuring the net benefits/costs of private land-use controls

Do the empirical results suggest that local developers in the submarket studied are not profit maximizers? Developers may use exclusive developments as a signal to other municipalities to increase their future development opportunities. In supplying restrictions, developers may have other incentives that affect the level of restrictions imposed. A prestigious development may result in membership in more exclusive clubs, may facilitate political connections, or may alleviate potential conflicts with local regulators. Of course, the results may suggest that developers make mistakes. With multiple developments occurring simultaneously in an urban area, it is reasonable to assume that developers may be unaware of other high-restriction developments in the area. On the other hand, developers may have simply overestimated the demand for high-restriction land.

This paper motivates additional work on private land-use controls. While a small study, it reveals the importance of controlling for differences in restrictive covenants across zoning classifications. This is necessary both because residential zones vary in the level of land-use restrictions, and because covenants vary in restrictiveness across zones. Both issues could be explored more fully with a larger sample. An additional opportunity for future work in the area is to determine whether the value of restrictions is a function of housing density. Similarly, future work could investigate the value of covenants as a function of subdivision size, since both costs and benefits of covenants may be a function of the scale of governance.

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