The Effect of a Forest Conservation Regulation on the Value of Subdivisions in Maryland

by

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Abstract

Profit-maximizing land developers are hypothesized to configure subdivisions to minimize the effects of a conservation regulation on developed land values, subject to their expectations about the demand for developed building lots. This hypothesis allows development of a hedonic price model that takes account of production adjustments. The model is applied to the Maryland Forest Conservation Act, which requires developers to retain or plant trees on part of the developed land. Being exempt from the Act allows developers to gain more for the subdivisions they develop: the cost to regulated developers is about six percent of the per-acre price of developed land. The Act has significantly lowered per-acre developed land values in subdivisions with a mixture of townhouses and single-family dwellings. Costs of the Act are reduced by provisions that allow developers to plant trees offsite or to pay fees in lieu of planting.

Keywords: Land Hedonic Price Regulation Spatial Econometrics Forest Conservation Open Space

Introduction

Most metropolitan areas of the United States have local regulations that control the development of suburban land. These regulations work in conjunction with other government programs, the land market and an area's natural geography to determine the suburban landscape. They typically are implemented through county or municipal planning agencies that have the power to withhold approval, validate compliance with existing laws, administer fees, and negotiate changes in subdivision development plans. Some regulations, such as an agricultural zoning restriction that limits residential development to one house per twenty acres, work primarily to affect the timing and density of development. Others, including clustering regulations and floodplain building requirements, serve primarily to determine the configuration of subdivisions once their development is initiated.

The Maryland State government put a regulation of this second type into place in 1991 when they enacted the Forest Conservation Act (FCA). This Act, the first of its type in the United States, requires subdivision developers to leave or plant forest on a certain proportion of the land being developed. As Hilsenrath et al. (7) note, "The primary objective of the Act is to ensure that as much forest as possible is retained during the land development process. If forest clearing is unavoidable, the Act requires reforestation at mandated ratios. On sites with limited or no forest resources, new forest stands (afforestation) must be established at minimum levels." (p. 1). Enforcement of this Act is placed with local government planning agencies, which determine required reforestation and afforestation levels. Planting or retention requirements depend on land use (zoning) categories, but can be adjusted through wide ranges (e.g. 15 to 50 percent). They also can be affected by agency desires to maintain forest in environmentally sensitive areas, in areas that adjoin forest on other properties, along wildlife corridors, next to streams, etc. While local authorities are granted discretion in administering the Act, developers also are granted discretion in compliance, for they may meet the regulation by planting or retaining forest on-site, planting off-site, or by paying a fee in lieu of compliance.

This paper presents a hedonic price analysis developed to determine how developed land values are being affected by this novel and flexible regulation. Such an analysis should be timely, as concern about "sprawl" and desire for "smart growth" is increasing interest in the provision of forested area and other open space within the suburban landscape. It may also contribute to the hedonic property value literature (reviewed by Palmquist in Braden and Kolstad, (13) and by Freeman (4)). This literature currently is being extended to allow for exogenous (to the homebuyer) changes in the supply of open space over time (Smith et al. (15); Irwin and Bockstael (9)). But, as is also true for the more traditional property value studies (see, in particular, Tyrväinen and Miettinen (16)), these analyses are concerned with the demand for open space and forest that is located outside of a developed building lot. We are concerned with the supply of open space that is retained or provided within a property that is being developed.

We have not found any previous hedonic studies that analyze how regulations affect the way a subdivision is produced. Some previous conceptual work exists that treats the land developer as a producer (Büttler (1); Colwell and Scheu (2)). Holway and Burby (8) use a production model of land development to derive a hedonic derived demand equation for an undeveloped parcel. But they do not investigate how developed land values are affected by production controls. Consequently, we introduce a theoretical model in the paper's next section that can be used to analyze the Forest Conservation Act.

While the theory includes both the decision of when to develop (the optimal timing decision) and how to develop (the production decision), the empirical analysis is confined to the production decision. Separation from the timing decision is accomplished by the way data are obtained: we determine a universe of properties that have been developed into residential subdivisions in a given time period and a given region, and then draw a representative sample from that universe. The separation depends on a revealed timing argument. If sufficient information exists, and if rational owners develop property when it is most profitable to do so, then seeing a tract develop at time *t* reveals that *t* is the optimal time to develop. Thus our data is drawn from the set of properties for which *t* has arrived.

The next section reviews and slightly extends part of a theoretical model developed by Fujita (5). The section following that describes the formulation of the hedonic model. It introduces the data we assembled and reviews how we formulated the models used in the empirical analysis. Results obtained from the estimated models are presented in the subsequent section. Findings about the effects of the Forest Conservation Act on subdivision values are emphasized, but this section also reports other results obtained from the model. The final section summarizes the study and presents its main conclusions.

Conceptual Framework

Pogodinski and Sass (14, p. 598) report in their 1991 survey that “By far the most common way to analyze the effect of zoning regulations is to estimate a hedonic housing price model.” The model we develop is formulated for the price of a subdivision instead of a house. Development of a subdivision is defined as the process of converting a rural property into a set of building lots and parcels. Parcels are composed of open space, streets, parking areas, swimming pools, playing fields and other land units without houses. Homebuyers do not directly purchase parcels, but their presence affects the value that buyers are willing to pay for building lots.

Since a subdivision is a set of lots and parcels of different sizes and values, averaging or indexing is required to obtain a single price. In our data, we aggregate values for each building lot and parcel into an average price per acre for the subdivision. If subdivisions were homogeneous goods, returns to scale could be analyzed by observing how this average price varies for subdivisions of different sizes. But subdivisions of the same size may have different configurations and exhibit different prices. For this reason, we define the subdivision price as a hedonic price function, which for any given size of subdivision, may vary according to the composition and attributes of lots and parcels.

Our subdivision price model is a modification of a specification Fujita developed as part of his urban growth model.[1] Fujita makes lot size endogenous, a necessary feature to describe a situation where developers can choose to develop lots for single family, townhouse or multiple family housing units. We extend Fujita's model to incorporate parcels without houses, as well as heterogeneous land attributes. For simplicity, the following discussion is restricted to the case of a single size of building lot and a single parcel size. Multiple lot and parcel sizes can be incorporated into the model, but doing so adds complexity without insight.

Adoption of an existing model implies adoption of a preexisting set of assumptions and conditions. The adopted formulation models timing of development as a single switch in land use. Rents derived from agricultural use are obtained continuously until the date of development, development is instantaneous, and housing rents are obtained continuously

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[1] The urban growth model has been developed by Anas, Arnott, Breuckner, Capozza and Helsley, Fujita, Mills, Wheaton and other economists. For a review of urban growth theory, see Fujita (6).

thereafter. Housing does not depreciate and is not replaced over time, and uncertainty and risk are set aside by assuming that the developer can perfectly anticipate future housing rents.

Given this conceptual framework, the price of an acre of land can be specified as:

$$v(m,s,p,t,h;z) =$$
$$\int_0^t e^{-r\tau} A(\tau;m,z)d\tau + \frac{e^{-rt}}{s}\left[\int_t^\infty e^{-r(\tau-t)} R(s,p,\tau,h;m,z)d\tau - C^s(s,h;z)\right] - \frac{e^{-rt}}{p} C^p(p,h;z) \tag{1}$$

where

m = distance in miles from the subdivision to a central business district (CBD)

s = size of the building lot expressed in acres

p = size of the parcel expressed in acres

t = date of development

h= vector of mutable characteristics including capital improvements

z = vector of immutable characteristics including flood plain, topography, etc.

r = discount rate for future revenues and costs

and

A = rental value of an acre of undeveloped land at time τ and at distance m from a central business district

R = rent of a developed lot of size s at distance m in time τ with improvements h in a subdivision with a parcel of size p and immutable characteristics z

C^s = costs of developing a building lot of size s at time t in a subdivision with improvements h and immutable characteristics z

C^p = costs of developing a parcel of size p at time t in a subdivision with improvements h and immutable characteristics z.

This price is the net present value of an acre of the subdivision discounted to time 0, with development occurring at time $t \geq 0$. Developed land rents depend on the size of the lot, the size of the parcel, and other mutable characteristics (e.g., houses, walking paths, etc.) supplied by the developer.[2] Rents also vary with distance from a CBD, with time, and with a vector z of immutable characteristics (e.g., presence of streams and wetlands). The parcel receives no direct rent payments, but the consumer's willingness to pay for a developed lot is affected by the presence, size and characteristics of the parcel. Rents are assumed to increase with p, making the parcel a desired characteristic of the subdivision. The developer is assumed to take rents accruing to undeveloped land as exogenous. This is consistent with a situation in which the developer does not control management of the land prior to time t.

For equation (1) to be a hedonic price model, developers must maximize v by choosing optimal values of $t, s, p,$ and h for any distance m, undeveloped land rent $A(\tau; m, z)$, and characteristics z. The rent $R(s, p, t, h; m, z)$ must be the consumers' maximum willingness to pay or "bid rent" for a developed lot at time t and distance m, with lot size s and housing characteristics h in a subdivision with parcel p and characteristics z.[3] When this type of bid rent function exists and is included in equation (1), then $v(m, s, p ,t, h; z)$ is a function both of the costs of supplying the developed lots and parcels and of the consumers' willingness to pay for them. Incorporation of the bid rent in v adds the rational expectations hypothesis that the developer knows and uses the consumers' demand for developed lots in

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[2] Model (1) is based on the assumption that the developer supplies both subdivision infrastructure and housing units. This simplification ignores the fact that many subdivision developers sell building lots to homeowners who build custom houses or to commercial firms that construct houses and then sell the house and lot to homebuyers. Developers and builders will be treated as separate entities in our empirical model.

[3] Derivations of this type of bid rent from homebuyer utility maximization models are available in Fujita, or in Wheaton (18).

his or her production decisions.[4] Under these conditions, the value *v* can be interpreted as an equilibrium price and the hedonic model can be estimated using observed market data.

The equilibrium condition inherent in equation (1) is most easily seen by noting that the price of a building lot

$$v^L(t,h;m,z) = \int_t^{\infty} e^{-r(\tau-t)} R(s,p,t,h;m,z)\,d\tau$$

is modeled as the present value of the stream of future rents obtained from the developed use. If bid rents rise faster than agricultural rents over time, the optimal time to develop and to sell a building lot is when the bid rent has increased enough to cover the opportunity costs and direct costs of development. At that date:

$$R(s,p,t,h;m,z) = sA(t;m,z) + rC^s(s,h;z) + r\frac{s}{p}C^p(p,h;z)\,. \tag{2}$$

Thus when development is at the optimal time *t*,

$$v^L(t,h;m,z) = \int_t^{\infty} e^{-r(\tau-t)} \left(sA(t;m,z) + rC^s(s,h;z) + r\frac{s}{p}C^p(p,h;z) \right) d\tau$$

and

$$v^L(t,h;m,z) - \frac{sA(t;m,z)}{r} = C^s(s,h;z) + \frac{s}{p}C^p(p,h;z)\,. \tag{3}$$

Thus the model incorporates the competitive equilibrium condition that the value added by development just equals the cost of developing it.[5]

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[4] Rational expectations are a bit of a misnomer here. While actual lots have to be developed before they are sold and the developer has to employ an expected price function, development is instantaneous in the model. In it, the expected price would be the sales price and the developer would observe the price function.

[5] Condition (2) is a first order condition that translates the costs of development to a per-lot basis. If, for example, a subdivision is one acre in size and is configured to have two ¼ acre building lots and a ½ acre parcel, then s = ¼ and p/s = ½. One fourth of the foregone undeveloped land rent *A*, all of the cost of the capital needed to develop a lot, and one-half of the cost of the capital needed to develop the parcel are included as costs of development. The requirement that developed lot rents rise at a faster rate over time than agricultural land rents is a second order condition (Fujita (5)).

The conditional model we are using in our empirical analysis can be obtained by setting $t = 0$ in equation (1). Then the per-acre price of the subdivision becomes:

$$v(m,s,p,h;z,t=0)=\frac{1}{s}\left[\int_{0}^{\infty} e^{-r\tau}R(s,p,\tau,h;m,z)d\tau - C^{s}(s,h;z)\right]-\frac{1}{p}C^{p}(p,h;z)$$

An interior solution to the problem of maximizing v, with s, p and h all greater than zero, would satisfy the following conditions:

For lot size

$$\overline{R}(s,p,t,h;m,z)-rC^{s}(s,h;z)=s\left[\overline{R}_{s}(s,p,t,h;m,z)-rC^{s}_{s}(s,h;z)\right] \tag{4}$$

For parcel size

$$\overline{R}(s,p,t,h;m,z)-r\frac{s}{p}C^{p}(p,h;z)=\frac{s}{p}\left[\overline{R}_{p}(s,p,t,h;m,z)-rC^{p}_{p}(p,h;z)\right] \tag{5}$$

For mutable characteristic i

$$\overline{R}_{i}(s,t,h;m.,z)=rC^{s}_{i}(s,h;z)+r\frac{s}{p}C^{p}_{i}(p,h;z) \qquad i\in h. \tag{6}$$

Here $\overline{R}(s,p,t,h;m,z)=r\int_{0}^{\infty} e^{-r(\tau-t)}R(s,p,t,h;m,z)d\tau$ is the average future rent from the developed lot, and $\overline{R}_{x}$ is the partial derivative of that rent with respect to $x = s, p,$ and i.[6]

Conditions (4) and (5) establish the optimum size of lot and parcel. They can be pictured as net return curves in a two-dimensional mapping of value against size. If the average net return defined by the left side of the optimization condition (5) is smooth, continuous and convex, and has a positive unique maximum at a positive p, then the marginal net return defined by the right side of the condition will be equal to the average at that optimum size. A zoning condition such as the Forest Conservation Act may force the

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[6] These optimization conditions also apply to model (1) if t replaces 0 as the lower limit of integration.

developer to provide a larger than optimum-sized parcel. This will cause this optimization condition to be violated: marginal net returns will be less than average net returns at the imposed *p*, and the equality in condition (5) will become a “greater than” inequality. Average net returns will be lower than those obtained at an optimum-sized parcel, and because these net returns appear in the subdivision price equation (1), *v* will be decreased by the imposition of the exogenous parcel size constraint. Thus, in an empirical model with subdivision price as a dependent variable, a negative and significant coefficient on a variable measuring parcel size would be consistent with the presence of a regulation that makes parcel size “too big” and lowers the value of a subdivision development.[7]

Conditions (6) are the first order conditions for mutable attributes. They state that the optimum amount of attribute to produce equates the marginal cost of providing the attribute to the marginal increase in rent obtained from it. We follow Palmquist (12) in putting mutable characteristics into the hedonic function, and consequently take a similar risk that mutable attribute quantities will be simultaneously determined with subdivision price. This will not happen if the developer treats the marginal increase in rent as parametric when satisfying condition (6). Palmquist develops a rationale for interpreting marginal rents in this way. The heuristic argument in our case is that the developer actually uses an expected bid rent function since the lot is developed before it is sold. When the market is in equilibrium, only homebuyers willing to pay $\overline{R}_i(s,t,h;m,z)$ will be in the market. Successful developers will use this marginal market bid rent function to develop the lot: in equilibrium developers who do not do so will not be in the market. Thus the assumption that R in equation (1) is an

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[7] An analogous argument applies to the optimum lot size condition (4). A negative estimated coefficient would be expected for a lot size variable if a local jurisdiction imposes a binding minimum lot zoning regulation on a developer. To develop this argument more formally, one could add constraints to equation (1) and obtain an

equilibrium rent function allows mutable attributes to be incorporated into the hedonic model. Condition (3) serves to verify that this can be an internally consistent assumption for the model.

Hedonic Analysis

Our empirical study is restricted to subdivisions that have all single-family dwellings, all townhouses, or mixtures of single family and townhouse dwellings. Subdivisions with commercial or industrial sites or with lots developed for apartment buildings are eliminated from the study: we did not want to include cases where price could depend on the value of lots not developed for homeownership. We also have limited the study to subdivisions with five or more building lots and to subdivisions for which plans were approved between 1991 and 1997.

Data for the analysis were collected from county planning agencies and from State-maintained GIS databases. The initial work, done in the counties, identified all of the subdivisions that fit our residential use criteria. Then a random sample of data was collected from each county planning agency for at least 40 percent of these qualifying subdivisions. These data were matched to lots and parcels in the Maryland Property View county databases developed and maintained by the Maryland State Department of Planning. The Property View dataset provided access to tax assessment, sales and "CAMA" data files (which contain attributes of existing dwelling units), and to GIS data on roads, streams, and other geographical features.

The study area is made up of five Maryland counties in the DC-Baltimore metropolitan area. Two, Montgomery and Prince Georges, have densely populated urban

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expanded set of optimization conditions. Then the difference between the average and marginal values would be the sum of the shadow prices associated with the constraints.

areas that adjoin Washington D.C. The average commuting distance from the sample subdivisions in these counties to the Washington D.C. CBD is 16.3 miles. Subdivisions in Carroll and Charles, the most rural counties included in the study, are dispersed throughout the countryside or clustered around a county town center. The average commute from these subdivisions to the nearest major CBD is 45.2 miles. The average commute to the center of Baltimore (the nearest CBD) from the sample subdivisions in Howard County is 15.8 miles. But this fifth county has many homeowners who work in and commute to the Washington D.C. metropolitan area. Howard is one of the fastest growing counties in the State, and its location between two metropolitan areas adds to the spectrum of subdivision development situations included in the analysis.

Data

The hedonic model is formulated to predict the average per-acre assessed land value of the subdivisions. This variable (ACRLNDVL) is calculated by first dividing the assessed values for each lot and parcel in a subdivision by the acreage of that lot or parcel. The resulting per-acre values are then averaged over the lots and parcels within the subdivision. Since parcels are included in this average, the effect of leaving open space and providing amenities in the subdivision is in the computation. So also are the effects of variation in floodplain and other natural features of the subdivided property. Table 1 provides descriptive statistics for the available observations for this variable and for the other variables described below.

Assessed value is used instead of sales value because the output of the developer is defined to be developed lots and parcels. In many cases in our data, the lot is developed but not yet sold. Thus considerable adjustment of the recorded sales data would be necessary to create comparable sales values for the sample lots. Assessors in all five counties are mandated to provide full market value assessments of both lots and improvements, and we proceed under the assumption that their lot assessments will be a more accurate proxy of relative sales value than our adjustments. Assessed values are available for all lots and parcels: thus suitable subdivision values can be computed. Assessments used in the analysis occurred in 1997, 1998, 1999 and 2000, and we use dummy variables (ASSESSD__) to adjust for any systematic change over time in these values.

Subdivision developers will configure subdivisions to fit the type of housing they expect to be built, and a variable measuring the value of building improvements is needed to explain this aspect of land development. Among the variables listed in Table 1 is an instrument for the value of housing, BLDINSTR, which is a proxy for the developer's estimate of how much revenue the planned set of houses will produce when they are sold. We observe higher lot values for lots of similar size when housing values are higher, and if the quality of house placed on a lot affects the lot's assessed value, then differences in observed house sales prices or assessed values of improvements will be correlated with the hedonic model's error term. The instrument is developed to eliminate this correlation.

BLDINSTR is constructed by dividing a predicted value for improvements on each building lot by the acreage in the lot and then averaging these per-acre values for each subdivision. Predicted values are obtained from a random effects panel model. Coefficients for the panel model coefficients were estimated using the 6,000 plus building lot observations for which CAMA data are available. Variables included in the panel model measure the square feet of the houses' foundation, the quality of construction, and the exterior material (brick, vinyl siding). The model also includes variables that measure the number of stories, the type of house (townhouse, split level), the year built, and the presence or absence of a public sewer hookup. Model fit is good, with 92 percent of the total variation in the assessments of improvements explained. BLDINSTR cannot be constructed for eleven subdivisions that have no CAMA data and for 27 subdivisions that have no houses built in them. Because this variable represents developer expectations about housing values, these observations are dropped when the hedonic model parameters are estimated.

Lot size is a fundamental element in the configuration of subdivisions, and the average acreage of building lots is included in the subdivision dataset. This lot acreage is conditional on the type of housing being developed: townhouses will have small lots relative to the square footage of the house foundation and the deviation in the size of lot provided with a given townhouse will be small. Bigger lots will be provided with single-family detached dwellings and there will be a greater range of lot sizes for a given size of house. To recognize these design differences, and to allow for dwelling unit zoning restrictions that control the type of housing that can be supplied, we develop dummy variables indicating subdivisions approved to have all townhouses (TYPE1), all single-family dwellings (TYPE2), and a mixture of townhouse and single-family dwellings (TYPE3). We then create three lot size measures (LOTSIZE1, LOTSIZE2, and LOTSIZE3) by multiplying the average of the building lot acreages in each subdivision by these dummy variables. These variables are our empirical measures for s, the size of building lot variable included in the conceptual model.

All five counties include minimum lot sizes as part of their zoning codes. But not all of the sample subdivisions are constrained by this restriction: 141 of the 261 sample subdivision developments have minimum lot sizes that are smaller than the zoning code minimum and 13 have minimum lot sizes that are larger. To model this situation, we subtract the zoning code minimum from the observed minimum lot size (LOTMIN – MINLOT) and then create two variables. LOTEXCPN takes the value of this difference when the observed values are lower than the code values and takes a zero value otherwise. LOTZONE takes the value of this difference when the observed minimum lot size is larger than the code size and takes a zero otherwise. Thus by construction, both variables take zero values when subdivisions have minimum lot sizes that satisfy the zoning code restrictions (107 cases). Inclusion of these minimum lot variables in a hedonic model will produce an estimate of the value of being able to produce lots smaller than the code size and an estimate of the value gained from providing minimum lots that are larger than the minimum zoning size. These estimated values will be relative to the value of subdivisions for which the lot size constraint is satisfied, since the effect of the zoning code will be subsumed into the model's intercept.[8]

Parcel size (defined as p in the conceptual model) is represented in the data by PCTOPEN, the percentage of total acreage that is designated as open space parcels in the subdivision plans. Designated or planned open space omits area devoted to streets, parking lots and similar land uses. While these areas are necessary to the production of developed lots, they are not necessarily viewed as amenities by homebuyers. To allow for the possibility that provision of open space is dependent on the type of subdivision, PCTOPEN is multiplied by TYPE1, TYPE2 and TYPE3. This creates the variables PCTOPN1, PCTOPN2 and PCTOPN3.

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[8] We assume that an observed minimum lot size that deviates from code by one tenth of an acre or less meets the zoning regulation. This allows for measurement error and for the likelihood that county planning agencies tolerate some small topographically driven deviations from code specifications. Changing this deviation to 0.05 acre causes less than a one percent change in the hedonic model estimates.

Variables measuring other subdivision characteristics under the control of the developer include AMENITY1 – AMENITY4, dummy variables that indicate the presence or absence of constructed amenities such as walking paths, pools or golf courses. Mutable characteristics also are measured by lot configuration variables giving the percentage of building lots that adjoin floodplain (PCTFLDLT), forest (PCTFORLT), open space (PCTONPLT), water bodies other than storm water management ponds (PCTWATLT), and storm water management ponds (PCTSWMLT). These type-of-lot variables are obtained by counts from maps, and they do not account for any tradeoff in value between large lots that contain forest and open space within lot boundaries and smaller lots that are located next to areas that do not have houses.

Several variables are developed to measure differences in buyer bid rents caused by factors outside of the control of the developer. Among these are a measure of commuting distance to the nearest CBD (CMMILE) and measures of the quality of the schools serving the subdivision (MSPAP_E and MSPAP_H). Characteristics of the countryside surrounding the subdivision are represented by OPENURBN (area in public parks, outdoor recreation facilities, historic sites, etc), NATURAL (area in brush, forest, wet or bare land) and FARMLAND (area in agricultural use). These variables are computed as percentages of land in the designated uses within a one-mile radius of the subdivision center. All three can represent amenity values to homebuyers. NATURAL and FARMLAND can also proxy for the costs of buying land for development. In this role, these variables can indicate the supply of nearby land potentially available for development.[9]

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[9] They are not an exact indicator because farm and natural land that is preserved will not be available for development.

Geographic factors that affect how the developer can configure the subdivision are measured by VTAREA, the total acreage of the property under development, PCTWET, the percentage of total acreage that is floodplain or wetland, and PCTTREE, the percentage of total acreage that is in forest before development. Since size of subdivision is exogenous in this conditional analysis, omission of VTAREA would impose a constant-returns-to-scale assumption on the production of developed lots and associated amenities. Acreage that is in designated floodplain or wetland cannot be used for building lots; thus its presence increases the area configured as parcels and reduces the area available for the production of building lots. Acreage in forest can either be cleared and developed or kept in open space parcels. This developer choice is introduced by PCTKEPT, which measures the percentage of forested land that is retained after the subdivision is developed.

We do not have a "clean" before-after comparison of the Forest Conservation Act's effect. We would have liked to provide such a measure, but the GIS data available to us for the analysis begins in 1993 and the while the Act was initiated in 1991. But we do have data that captures effects of the Act. Trees planted to satisfy the Forest Conservation Act may be placed on open space or floodplain parcels or on open areas within large building lots. Developers of subdivisions with enough area in these parcels or building lots can plant onsite. Developers of subdivisions without such suitable areas will have to plant offsite or to pay fees in lieu of planting. Variables measuring the effects of the Act include the percentage of the subdivision site required to be planted to forest (PLANT), the percentage developers choose to plant onsite (PLANTON), to plant offsite (PLANTOFF), and a dummy variable (TREEFEE) that indicates if a fee was paid in lieu of planting. We also construct a variable (OFFPLANT) by converting the fees to equivalent acreages, adding these acreages to those planted offsite, and then converting the result into a percentage of site measure. Subdivisions exempt from the Forest Conservation Act are indicated by the dummy variable EXEMPT.

Models

Initial exploration of hedonic price models using linear and semi-log specifications showed parameter estimates to be dependent on functional form. Accordingly, we adopted a Box-Cox form that includes both of these specifications as special cases. The Box-Cox transformation of the model's dependent variable is $ACRLNDVL^{(\lambda)} = (ACRLNDVL^{\lambda} - 1) / \lambda$. We tested whether this Box-Cox transformation produced significantly different estimates by fitting models in which λ is restricted to 0.0 (the semi-log model) or to 1.0 (the linear model). Likelihood ratio tests support the hypothesis that the Box-Cox specification is significantly different from the linear and semi-log formulations. Consequently only Box-Cox model results are reported here.

We also used Box-Cox transformations to test if the subdivision size and commuting distance variables should be nonlinear variables. We found that substituting LOGAREA = log(VTAREA) and LOGMILE = log(CMMILE) for VTAREA and CMMILE in the Box-Cox model resulted in virtually the same parameter estimates as a model with Box-Cox transformations for VTAREA and CMMILE. Results presented in this paper are from Box-Cox models with LOGAREA and LOGMILE included as explanatory variables.[10]

The other explanatory variables chosen to be in the estimated models are listed in the first column of Table 2. This table presents results from two alternative models: one that does not distinguish whether trees are planted onsite or offsite and one that does. Both of the estimated models reported in Table 2 were tested for the presence of spatial autocorrelation

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[10] Cropper, Deck and McConnell (3) found a linear Box-Cox model to be a preferable form in a simulation of housing prices in the Baltimore region. We do not know if their findings extend to developed lot prices.

using Moran and Lagrange multiplier tests and a variety of distance measures. None of the test statistics were larger than the critical values at any of the usual confidence levels, and we consequently did not attempt to adjust the models for spatial autocorrelation.

Model 1 is formulated to test the hypothesis that the Forest Conservation Act does not have different effects on the price of different types of subdivisions. We estimated two variants of this model. One includes the variables PLANT1, PLANT2 and PLANT3, which are formed by multiplying PLANT by TYPE1, TYPE2 and TYPE3. The other variant replaces PLANT1 and PLANT2 with PLANTH, which is the sum of PLANT1 and PLANT2. The first variant allows the effects of the tree planting requirements to differ between townhouse, single-family and mixed dwelling unit subdivisions. The second allows these planting requirement effects to differ between subdivisions with homogeneous types of housing and "planned unit subdivisions" (PUD's). The second distinction is relevant because subdivisions with all townhouses or all single-family dwellings are subject to a more abbreviated planning and approval process than are PUD's. Table 2 presents the second variant, but these tabled parameter estimates for the significant coefficients differ by 4 percent or less from those of the first variant.

Model 2 is developed to test the hypothesis that developers comply with the Act in the same way when they produce different types of subdivisions. To test this, PLANTH is decomposed into PLANTONH, the acreage of trees planted onsite in the townhouse and single-family subdivisions, and OFFPLNTH, the equivalent acreage planted offsite. PLANT3 is decomposed into PLANTON3 and OFFPLNT3. As in the case of model 1, both variants were estimated, and as in the case of Model 1, similar results were obtained.

We have modified the first variant of Model 1 to test the hypothesis that counties administer the Forest Conservation Act similarly. That was done by multiplying PLANT by the dummy variables CARROLL, CHARLES, HOWARD, MONTGMRY and PRINCGEO, incorporating these five interaction terms into the model and omitting PLANTH to avoid singularity. None of the parameters estimated for the added variables were significantly different from zero, and model fit was not affected by the modification. Nor were the estimated parameters for other variables substantially different. Based on this evidence, we accepted the hypothesis that the counties were administering the Act similarly and adopted the models presented in Table 2.

Results

Forest Conservation Act

The 45 subdivisions that are exempt from the Forest Conservation Act have significantly higher per-acre developed land values than the 216 subdivisions that are regulated. This difference is estimated to be $13,200 per acre using the coefficient from Model 1 and $13,300 per acre using the coefficient from Model 2. It amounts to approximately 5.5 percent of the $242,000 per acre average value of the developed land. Exempt subdivisions include subdivisions with application dates that precede implementation of the Act and subdivisions that qualified for exemption because of provisions within the Act. Thus we can only conclude that, regardless of reason, having an exemption allows developers to gain a modestly higher per-acre price for the subdivisions they develop.

Model 1 is formulated to measure the effect of the Forest Conservation Act on the values of different types of subdivisions. Results from this model (see the estimated coefficient for PLANTH) indicate that, once other factors are controlled, the Act is not lowering the average per-acre value of homogeneous dwelling (single family and townhouse) subdivisions beyond the general effect of being subject to the regulation. But the significant coefficient on PLANT3 indicates that implementation of the Act is having an additional negative effect on the price of "type 3" subdivisions. These subdivisions contain both single-family and townhouse dwellings and, as the estimated coefficient for LOTSIZE3 indicates, they obtain a higher per-acre value from having more flexibility to determine lot sizes.

The magnitude of these effects can be seen by comparing elasticities. Seventeen of the subdivisions in the random sample are mixed-dwelling nonexempt subdivisions (TYPE3 =1 and EXEMPT = 0). For these subdivisions, Model 1 provides an estimated mean elasticity of -0.092 for the change in per-acre subdivision price that would result from a one percent change in the acreage required to be planted by the FCA. The corresponding elasticity of per-acre subdivision price for a one percent increase in average lot size is 0.083. Thus a marginal increase in the acreage required to be planted to trees would decrease the average per-acre price of $561,800 for these 17 subdivisions by an estimated $51,700. A small increase in the size of lots provided would raise that average price by $46,600. These results suggest that while per-acre values of type 3 subdivisions are higher, they could be increased by supplying less forested area and larger lots.

On average, developers of the type 3 subdivisions have been required to plant approximately 10.8 percent of their total site acreage into trees, about the same as the 9.3 percent average required to be planted in the homogeneous dwelling unit (type1 and type2) subdivisions. Three developers have been able to retain enough forested acreage to avoid having to plant any trees. Five have had to plant between 20 to 29 percent of the acreage being developed. When compared to the other nonexempt subdivisions in the sample, the type 3 developments are located closer to an urban center (16 miles versus 24 miles), are surrounded by about the same amount of residential development (41% versus 37%) and are generally larger in size (66 acres versus 42 acres). Average lot size is small when compared to the single-family dwelling subdivisions (0.15 acre versus 1.22 acres) due to the townhouse dwellings in these subdivisions. Sixty-five percent of the type 3 developments include walking paths and tot lots as compared to 14% of the homogeneous unit subdivisions, and 35 percent provide ball fields, swimming pools or tennis courts as compared to 3% of the type1 and type2 subdivisions. Thus these developers may have more competing uses for the un-built parcels retained in the subdivision and that may help explain why the forest regulation has a greater effect on their value.

Model 1 imposes the same estimated coefficient on acreage that is planted on or off of the subdivision site. Model 2 introduces the developer's decision to plant onsite or offsite. This is done by replacing PLANTH and PLANT3 with corresponding PLANTON and OFFPLANT variables. Acreage equivalents paid for by fees in lieu of planting are incorporated into the offsite variables so that all of the acreage required by the Act is included. Exclusion of these acreage equivalents results in insignificant coefficients for all offsite variables.

Model 2 reveals that developers of type3 subdivisions are significantly affected by the Forest Conservation Act regardless of whether they plant trees onsite or offsite. Sample summary statistics indicate that, on average, developers of these subdivisions supply about 7.6 of the 10.8 percent acreage requirement onsite and about 3.2 percent offsite. The mean elasticity of price with respect to a change in the percentage of acres planted onsite is -0.053 and the elasticity of price with respect to a change in the percentage planted offsite is -0.038.

These elasticity estimates indicate that the choice to plant onsite or offsite has lowered the cost to the developers: a marginal increase in planted acreage would decrease subdivision price by an average $27,300 instead of the $51,700 indicated by Model 1. Thus the opportunity to plant either onsite or offsite is reducing the costs of compliance to the Forest Conservation Act.

Developers of seventeen of the 216 nonexempt subdivisions chose to pay a fee in lieu of planting trees. The estimated coefficients for TREEFEE in models 1 and 2 indicate that this choice increased the per-acre price of these subdivisions by $40,300 (Model 1) and $50,600 (Model 2). We could not detect anything in the data that would suggest why these developers chose to pay fees instead of planting trees offsite. When compared to subdivisions for which trees were planted offsite, the subdivisions for which fees were paid contain similar-sized lots (0.52 versus 0.68 acres) and have roughly similar per-acre prices ($364,700 versus $319,150). They have a greater percentage of their area in planned open space (29% versus 17%), but more of them provide walking paths and tot lots (41% versus 20%). It may be that these subdivisions provide a different type of open space amenity, or it may simply be that the cost of planting and ensuring survival of new trees is higher for these developers.

Other Results

Figure 1 shows how commuting distance affects the predicted subdivision price once other model factors are held constant. This gradient is obtained from Model 1 and is based on an average per-acre subdivision price of $242,000, the approximate mean for the sample of 261 subdivisions. As the figure shows, this average price occurs at about 23 miles of commuting distance, which is beyond the steeply declining part of the gradient. For close-in subdivisions, the price change per mile is greater than the change in the costs of commuting. Thus the gradient should not be interpreted as a cost of transportation function.

The estimated coefficients for LOGAREA in Table 2 indicate that the per-acre price of larger subdivisions is lower than the price of smaller subdivisions. Signs and significance have been stable enough across alternate models that we believe that this basic negative relationship exists. But collinearity between LOGAREA and FARMLAND is strong enough that we are not willing to use the coefficient estimates to quantify this relationship. Omitting LOGAREA from model 2, for example, alters the coefficient estimates on FARMLAND by 26% and omitting FARMLAND alters the estimates for LOGAREA by 66%. With this sort of variation, it is imprudent to estimate elasticities or to say how much lower or higher will be the subdivision price. The estimated coefficients for FARMLAND do remain negative and significant, regardless of whether LOGAREA is included or omitted from the model. Thus the models do indicate that a lower subdivision price is associated with an increased supply of farmland in the vicinity of the development.[11]

As expected, the sign and significance of BLDINSTR indicates subdivision prices are higher when house values are higher. The estimated coefficients for LOTSIZE2 indicate that per-acre prices are approximately $19,000 less for subdivisions with no townhouses. This also is expected, since the per-acre costs of producing single family dwellings are smaller. Less expected is the finding that subdivisions with minimum lot sizes that match zoning code regulations have similar per-acre prices to subdivisions with minimum lot sizes that are less than zoning code specifications. Higher values would be expected for subdivisions with

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[11] . Using data from the same general study region, Irwin (10) found that surrounding farmland increased land values relative to residential development, but that the effect became insignificant when the vicinity was increased from a 0.06 mile radius around each parcel to about 0.4 mile. Our observations are defined

smaller than code lots if minimum lot size is a binding constraint on the production of developed lots. Insignificant price differences may be consistent with the hypothesis that zoning "follows the market" (McMillan and McDonald (11); Wallace (17)). But exemptions from codes may also play a role, since the average minimum lot size for the 141 subdivisions with sizes less than code is 0.6 acres, substantially less than the average zoning code restriction of 3.3 acres. There is a market for the transfer of development rights in three of the five sample counties, but only a few of the developers of the 141 subdivisions participated in this market.

Per-acre prices are predicted to be higher for the thirteen subdivisions where developers are observed to provide larger than prescribed minimum lot sizes. Models 1 and 2 provide similar mean elasticity estimates of approximately 0.32 for these subdivisions. This translates into a marginal price increase of about $26,000 for subdivisions that have an average assessed value of $81,400 per acre. These are large-lot subdivisions, with an average lot size of 3.3 acres.

Table 2 indicates that school qualities, as measured by MSPAP_E and MSPAP_H, are related to subdivision prices. When other factors affecting subdivision value (including MSPAP_H) are held constant, predicted prices for subdivisions with MSPAP_E scores of 14 (the lowest observed score) are approximately equal to the average per-acre price of $208,000. But predicted prices are approximately $68,000 higher than this average for subdivisions with MSPAP_E scores of 81 (the highest observed score). When MSPAP_E is held constant at its mean, subdivisions with the highest observed MSPAP_H score of 106 have predicted prices that are about $42,000 higher than the average $242,000 price, and

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differently from Irwin's (whose data consists of residential parcels with houses that sold between 1995 and 1999), and we are concerned with the supply of lots rather than the demand for houses.

subdivisions with MSPAP_H scores of 90 (the lowest observed score) have predicted prices that are about $78,000 lower. These estimates suggest that counties can reasonably expect some of the costs of providing better schools to be offset by consequent higher property tax revenues.

We were mildly surprised to find that PCTWET and PCTTREE do not significantly affect the predicted subdivision price, since we thought these variables would represent natural constraints on the production of subdivisions. It may be that the timing of development adjusts for observable natural features, and that development is delayed or moved forward until prices are in equilibrium. We know that PCTKEPT is correlated with PCTTREE; nevertheless, omitting either of these variables does not make the other's estimated coefficient significant. Apparently developers can successfully adjust for differences in initial site conditions, and also determine the right amount of forest to retain.

The models indicate that subdivision values would increase if developers would produce a greater amount of open space in townhouse subdivisions. Signs of the estimated coefficients for PCTOPN1 are important because they suggest that the planning agencies are not forcing these developers to supply more open space than would be demanded by homebuyers. If that were so, we would expect a lower subdivision value and a negative sign. Developers appear to be making the right trade-offs between open space parcels and building lot size in single-family and mixed-dwelling type subdivisions, since the estimated coefficients for PCTOPN2 and PCTOPN3 are insignificant. This is an interesting outcome, for the data indicate substantial heterogeneity in the configuration of single-family subdivisions. The sample of type 2 subdivisions can be decomposed into 90 single-family subdivisions with less than one percent open space and an average lot size of 2.06 acres, and

126 single-family subdivisions with an average 33.1 percent open space and an average lot size of 0.77 acre. Yet estimated coefficients remain insignificant when PCTOPN2 is decomposed into two variables, one representing the 90 subdivisions and the other representing the 126. This suggests that developers are producing the right amounts of large-lot-no-open-space and smaller-lot-open-space single-family subdivision configurations.

Per-acre subdivision prices are found to be higher if the developer provides walking paths, tot lots, or sitting areas (AMENITY1) or ball fields, tennis courts or swimming pools (AMENITY3). Positive coefficients make sense for these variables, since these constructed amenities are costly to provide. In equilibrium, the increase in subdivision price, net of differences due to other characteristics, should just cover the costs of constructing these amenities. Except for subdivisions with lots adjoining water bodies (PCTWATLT > 0), the provision of lots with location amenities does not significantly change per-acre subdivision values. The 73 subdivisions with lots adjoining water bodies other than storm water management ponds have an average 23 percent of their lots adjoining water. These subdivisions have more floodplain and wetland than the other sample subdivisions (14.6 percent of total acreage versus 5.3 percent), and they have less access to public sewer service (55 percent with access versus 76 percent of the other sample subdivisions). Homeowners are sometimes thought to value access to water, but from a developer's perspective, this preference is not translating into higher subdivision prices.

Summary and Conclusions

The main purpose of this study is to investigate whether a regulation governing the provision of forest on lands undergoing subdivision development affects developed land values. The regulation is viewed as a policy that can cause a land developer to change the configuration of building lots, constructed amenities and open space parcels that are supplied in a subdivision. Accordingly, our hedonic price model is derived from a production model instead of a homebuyer bid rent model. This hedonic model is consistent with a competitive market that is in equilibrium, and we interpret our results within that framework. Most of the estimated parameters are consistent with this viewpoint. In particular, results for lot location amenities, constructed amenities, and provision of open space are robust across the models we have tried, and they provide support for the hypothesis that subdivision developers are mostly able to equate the values of mutable characteristics across subdivisions.

Using data on properties undergoing subdivision in five Maryland counties and our hedonic models, we find that the Forest Conservation Act (FCA) is lowering the per-acre values of residential subdivisions by about 5.5 percent relative to exempt subdivisions. The Act's effect also effect depends on the type of subdivision that is constructed. Our results suggest that the FCA planting requirements have had more of an effect on the developed land prices of subdivisions that contain a mix of single family and townhouse dwellings. Per acre prices are not decreased for subdivisions containing a homogenous type of housing (all single family or all townhouse developments) beyond the general 5 to 6 percent decrease. These findings hold regardless of whether developers meet the planting requirements by planting trees onsite or offsite. We also find that giving developers the options to plant offsite or to pay fees in lieu of planting reduce the mixed-dwelling subdivision price decrease. Developers who pay fees have higher-priced subdivisions than developers who choose to plant trees.

Data used for the analysis were obtained for residential subdivisions with five or more building lots, which were approved for development in the six years after the FCA was enacted. Data limitations prevented us from including observations prior to the Act. Because of this, we are not able to evaluate how the Act may have affected the optimal timing of subdivision development. We note that developers concerned about the regulations' potential to reduce profits may have sought development plan approval before the Act's provisions became mandatory. Our finding that planting requirements have no differential effects on the price of single family or townhouse developments may result from landowners reacting to the FCA by changing the time at which properties are developed. In equilibrium, timing of development should adjust to account for any value differences resulting from the enactment of the FCA, and that effect would be in our data.

Maryland has been a strong advocate of 'smart growth' measures that seek to conserve rural lands, consolidate developed land uses, and encourage mixed-use development. This study suggests that existing regulations may achieve some smart growth goals at the expense of others. At least the FCA is found to retain or provide forest at some potential cost to the development of the mixed-use residential housing favored by some smart growth measures. For the most part, however, developers appear to be able to alter the configuration of subdivisions to take account of buyers' preferences for forestland, and to meet the Forest Conservation Act requirements without substantially lowering the per-acre value of the developed land.

Figure 1: Price and Distance

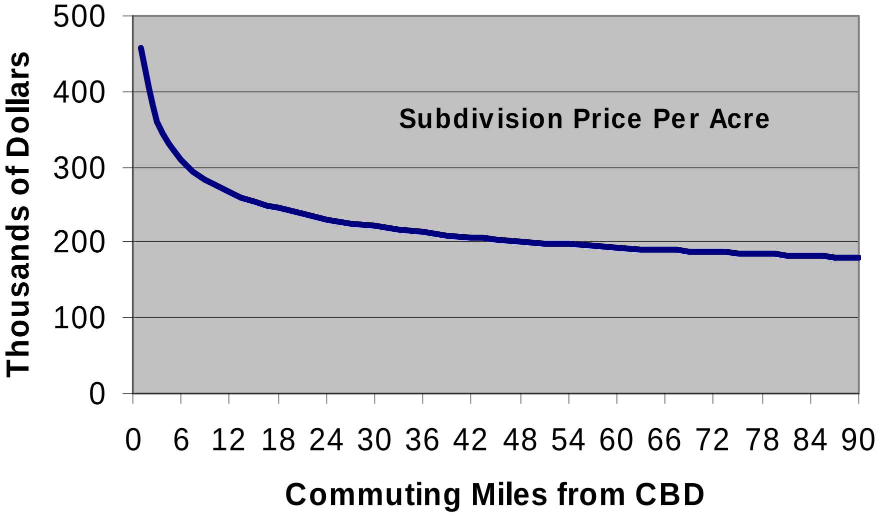

Table 1: Descriptive Statistics for Variables developed for Study

Variable Name	*Descriptive Label*	*Num Obs.*	*Mean*	*Std. Dev.*	*Min*	*Max*
ACRLNDVL	Average per-acre land value ($1,000 units)	261	242.014	359.250	701	1777
AMENITY1	1 if walking paths, tot lots, sitting areas	261	0.169	0.375	0	1
AMENITY2	1 if clubhouse or community center	261	0.015	0.123	0	1
AMENITY3	1 if ball fields, tennis courts, swimming pool	261	0.057	0.233	0	1
AMENITY4	1 if subdivision has a golf course	261	0.015	0.123	0	1
ASSESSD97	1 if assessed in 1997	261	0.226	0.419	0	1
ASSESD98	1 if assessed in 1998	261	0.360	0.481	0	1
ASSESD00	1 if assessed in 2000	261	0.065	0.247	0	1
BLDINSTR	Avg. predict. improvement value ($1,000/acre)	223	734.87	834.67	13.00	4456.33
CARROLL	1 if subdivision in Carroll County	261	0.111	0.315	0	1
CHARLES	1 if subdivision in Charles County	261	0.130	0.337	0	1
CMMILE	Commuting miles to nearest CBD	261	23.2	17.4	5.0	92.9
EXEMPT	1 if subdivision exempt from FCA	261	0.172	0.378	0	1
FARMLAND	Percent of surrounding area in farmland	261	19.6	19.1	0	77.4
HOWARD	1 if subdivision in Howard County	261	0.226	0.419	0	1
LOTMIN	Minimum lot size in subdivision (acres)	261	0.727	1.032	0.021	9.550
MINLOT	Minimum lot size in zoning code (acres)	261	2.135	4.385	0.021	25.000
MONTGMRY	1 if subdivision in Montgomery County	261	0.249	0.433	0	1
MSPAP_E	Elementary school MSPAP test score	261	49.43	16.20	14.13	80.77
MSPAP_H	High school MSPAP test score	261	101.35	3.176	91.93	105.71
NATURAL	Pct. adj. area bare or in forest, wetland, water	261	33.26	16.71	2.0	84.9
OPENURBN	Pct. adj. area in parks, other public use	261	2.242	4.093	0	26.4
OFFPLANT	Pct. acres forest planted offsite, including fee	261	3.191	9.652	0	95.6
PCTFLDLT	Percentage of lots adjacent to floodplain	260	6.17	13.17	0	78.6
PCTFORLT	Percentage of lots adjacent to forest	259	29.09	29.01	0	100.0
PCTKEPT	Percentage of forest retained in subdivision	261	22.50	18.15	0	84.6
PCTOPEN	Percentage of acres designated as open space	261	24.06	23.78	0	81.3
PCTOPNLT[1]	Percentage of lots adjacent to open space	261	37.63	32.88	0	100.0
PCTSWMLT	Pct. of lots adj. to storm water mgmt. Pond	260	4.16	8.65	0	71.4
PCTTREE	Pct. of acres in forest in undeveloped site	261	47.30	34.85	0	100.0
PCTWATLT [2]	Percentage of lots adjacent to water body	260	6.47	14.76	0	83.3
PCTWET	Percentage of acres in floodplain or wetland	260	7.92	13.24	0	88.2
PLANT	Pct. Acres required to be planted to forest	261	7.81	11.23	0	95.6
PLANTOFF	Pct. Acres of forest planted offsite	261	2.62	9.34	0	95.6
PLANTON	Pct. Acres of forest planted onsite	261	4.62	7.28	0	37.3
PRINCGEO	1 if subdivision in Prince Georges County	261	0.284	0.452	0	1
TREEFEE	1 if fee paid in lieu of planting forest	261	0.065	0.247	0	1
TYPE1	1 if subdivision has townhouses only	261	0.103	0.305	0	1
TYPE2	1 if subdivision has single family houses only	261	0.828	0.378	0	1
TYPE3	1 if sub. has single, town, multfmly dwellings	261	0.069	0.254	0	1
VTAREA	Total acreage in subdivision development	261	39.86	57.52	1.0	367.7

[1] excludes areas in streets and parking lots

[2] excludes storm water management ponds

Table 2: Box-Cox Hedonic Price Models (Dependent Variable = ACRLNDVL)

Variable	**Model 1**			**Model 2**		
	Coefficient	*Standard Error*	*Asymptotic t - Statistic*	*Coefficient*	*Standard Error*	*Asymptotic t – Statistic*
Intercept	-4.6010	3.2240	-1.43	-4.6222	3.2442	-1.43
ASSESD97	-0.01207	0.1573	-0.08	0.0002586	0.1577	0.00
ASSESD99	0.07627	0.1358	0.56	0.08125	0.1363	0.60
ASSESD00	0.4422	0.2493	1.77	0.4624	0.2536	1.82
LOGAREA	-0.1547	0.07219	-2.14*	-0.1604	0.07291	-2.20*
LOGMILE	-0.7580	0.1886	-4.02*	-0.7603	0.1886	-4.03*
NATURAL	-0.005898	0.004358	-1.35	-0.006004	0.004376	-1.37
FARMLAND	-0.01865	0.006158	-3.03*	-0.01877	0.006167	-3.04*
OPENURBN	0.02007	0.01547	1.30	0.02045	0.01551	1.32
BLDINSTR	0.001480	0.0004173	3.55*	0.001478	0.0004165	3.55*
LOTEXCPN	0.004908	0.01722	0.29	0.005787	0.01738	0.33
LOTZONE	0.4963	0.1758	2.82*	0.4932	0.1756	2.81*
MSPAP_E	0.01625	0.006717	2.42*	0.01597	0.006717	2.38*
MSPAP_H	0.1346	0.03969	3.39*	0.1352	0.03987	3.39*
PCTWET	0.006129	0.004920	1.25	0.005942	0.004916	1.21
PCTTREE	-0.002543	0.002701	-0.94	-0.002610	0.002730	-0.96
PCTKEPT	0.0007261	0.005468	0.13	0.0009511	0.005479	0.17
LOTSIZE1	-11.6473	7.1339	-1.63	-11.7894	7.1814	-1.64
LOTSIZE2	-0.3562	0.06802	-5.24*	-0.03548	0.06791	-5.23*
LOTSIZE3	5.9074	2.3992	2.46*	5.4237	2.3866	2.27*
PCTOPN1	0.03495	0.01079	3.24*	0.03524	0.01086	3.25*
PCTOPN2	0.004159	0.003478	1.20	0.004122	0.003492	1.18
PCTOPN3	0.01263	0.008458	1.49	0.01465	0.008760	1.67
AMENITY1	1.1579	0.2905	3.99*	1.1498	0.2888	3.98*
AMENITY2	-0.3394	0.5031	-0.68	-0.2957	0.5045	-0.59
AMENITY3	1.2161	0.3822	3.18*	1.1597	0.3781	3.07*
AMENITY4	-0.1074	0.4901	-0.22	-0.1303	0.4911	-0.27
PCTFLDLT	-0.001276	0.004408	-0.29	-0.001351	0.004410	-0.31
PCTFORLT	-0.0009157	0.002287	-0.40	-0.0009735	0.002296	-0.42
PCTOPNLT	-0.0003450	0.002257	-0.15	-0.00000886	0.002273	-0.00
PCTWATLT	-0.01432	0.004764	-3.01*	-0.01441	0.004768	-3.02*
PCTSWMLT	0.00007791	0.006279	0.01	0.0001869	0.006293	0.03
PLANTH	0.002628	0.006955	0.38			
PLANT3	-0.09715	0.02936	-3.31*			
PLANTONH				0.002373	0.008988	0.26
PLANTON3				-0.08148	0.03222	-2.53*
OFFPLNTH				0.002311	0.008337	0.28
OFFPLNT3				-0.1306	0.04740	-2.76*
TREEFEE	0.5356	0.2288	2.34*	0.5802	0.2384	2.43*
EXEMPT	0.4256	0.1715	2.48*	0.4268	0.1727	2.47*
Transformation Parameters and Variances						
LAMBDA	0.1701	0.04283	3.97*	0.1707	0.04272	3.99*
SIGMA-SQRD.	0.5454	0.2336	2.34*	0.5450	0.2329	2.34*

220 observations	220 observations
Log–likelihood = -245.5	Log–likelihood = -245.4
Restricted Log–likelihood = -1571.3	Restricted Log–likelihood = -1571.3
Adjusted Log–likelihood = -1135.7	Adjusted Log-likelihood = -1135.0

* Five percent significance level.

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