Alternative Housing Development Strategies in Georgia's Coastal Marshlands

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abstract

Coastal Georgia continues to experience extremely high population growth rates. People are attracted by coastal amenities, including pleasant views of the saltwater marshes. The real estate market has responded to population growth with a pattern of development that exhibits varying degrees of compatibility with the nearby marshland ecosystem. Among community leaders there is a need for information on development alternatives. Information has been generated from a hedonic price analysis that contains proximity to amenities and development design variables. We conclude that real estate developers have, under certain circumstances, an economic incentive to incorporate more open space in their design of residential subdivisions in marshland environments.

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Introduction

The population of the United States recently passed 300 million, with population levels for coastal counties projected to rise 20 percent between 1998 and 2015 (Beach, 2002). These population increases have been accommodated by expanding urban areas, particularly for residential use, in both coastal and non-coastal regions.

The rapid conversion of land to residential neighborhoods has led to concerns about the negative effects of urban sprawl (Bergstedt, Deyo, and Youngwirth, 1999). Of particular concern are the expansion of impervious surfaces and the concomitant loss of private and public open space. The 1996 National Water Quality Inventory, for example, estimates urban runoff is the cause for 55 percent of environmentally degraded ocean shorelines, 46 percent of degraded estuary miles, and 21 percent of degraded lake-miles (USEPA, 1998). Urban runoff is exacerbated by impervious surfaces and the loss of natural land cover. Nonetheless, current development patterns suggest little attention is being paid either to these negative effects or to the potential amenity value of undeveloped land.

In most jurisdictions of the United States, land use decisions are made at the local level within the context of existing federal and state regulations. County and city government officials scrutinize developers' requests for zoning variations and building permits. Local officials make their decisions under two potentially conflicting objectives. First, they are concerned with providing adequate financing for their jurisdiction, and this can be accomplished through improving their real estate tax base. Second, they are charged with meeting local environmental quality goals. The conflict comes about when environmentally sensitive lands are also desirable, high value places to build. However, there is growing empirical evidence that undeveloped land generates environmental amenities for the larger community and, simultaneously, enhances property values of nearby homes (Correll, Lillydahl, and Singell, 1978; Bolitzer and Netusil, 2000; Lutzenhiser and Netusil, 2001; Geoghagen, 2002; Irwin, 2002, Ready and Abdalla, 2003).

Enhanced property values could translate into higher revenues for developers as well as local governments. Moreover, developers may realize reduced maintenance and construction costs by establishing fewer paved road-miles, and clustering homes in designated areas of a subdivision (Mohamed, 2006). Similarly, local governments and service agencies may realize lower costs associated lower infrastructure requirements. Incorporating open space into the design of residential areas may well represent a win-win-win-win situation for developers, local governments, home owners, and the community at large, allowing a new balance to be struck between residential land and open space.

The principle objective of this study is to examine the role of open space in a saltwater marshland community. The role of open space in this environment is of particular interest because it can exist as land set aside by the community developer, and it can exist as marshland. If homebuyers do not place a high value on additional open space in the form of set-aside land, then developers may lack incentives for employing this design feature. Using data from Chatham County, GA we fit a hedonic model of home sales to estimate the marginal effects of variables that capture these two effects.

A secondary objective is to examine the value of a home's orientation to marshland. The orientation variables of interest include whether the home has water access, a view of the marsh, and the distance of the home from the marsh. Finally, we use the results of the hedonic model to illustrate how the tradeoff between impervious surface and open space is likely to affect gross revenues to developers for a representative subdivision.

Previous Research

Empirical studies of the value of open space in the United States date back to the 1960s. Kitchen and Hendon (1967) examined the correlation between a parcel's proximity to open space and both its assessed land value and sale price. That study found a small, negative correlation between a parcel's distance from a neighborhood park in Lubbock, TX, and its assessed land value. The study's failure to account for house characteristics likely explains the lack of correlation between distance from the park and house prices.

In 1973, Weicher and Zerbst conducted a hedonic analysis of single-family homes adjacent to parks in Columbus, OH. They distinguished between homes that faced the park, homes that backed up to the park, and homes that faced areas of heavy recreational use or park buildings. Their results suggested homes facing parks realized a price premium, while those in the other two categories did not.

Rather than distinguish house orientation to open space, Bolitzer and Netusil (2000) differentiated between types of open space: public parks, private parks, cemeteries and golf courses. Their initial model, estimated with data from Portland, OR, included a dummy variable representing homes within 1500 feet of any type of open space and found a positive price premium associated with these homes. When they included separate dummy variables for the four types of open space they found a statistically significant premium associated with public parks and golf courses, but not with cemeteries and private parks.

Lutzehiser and Netusil (2001) extended the Bolitzer and Netusil study by further distinguishing between urban parks, where more than 50% of the area is developed for recreation, and natural parks, where more than 50% of the area is preserved in native vegetation. They found natural area parks generated a higher price premium than urban parks. They also incorporated a series of dummy variables representing discrete distances from open space. Their results indicate houses closest to natural parks realized the largest price premium.

In suburban Washington, DC, and Baltimore, MD, Geoghegan (2002) estimated a hedonic model that distinguished between permanent open space (parks and conservation easements) and developable open space (private forest and agricultural land). She found that houses near permanent open space sold for significantly more than those near developable open space.

Irwin (2002), also in the DC-Baltimore metropolitan area, broke open space into finer categories. The estimated hedonic model revealed that privately owned conservation land offered the highest price premium, followed by publicly owned, non-military land, then pasture land, and finally private forested land.

Thorsnes (2002), also found a significant premium associated with a home's proximity to permanently preserved forested land in Grand Rapids, MI. And a number of studies have shown that open space in the form of wetlands has a significant and positive impact on housing prices (Lupi, Graham-Tomasi, and Taff, 1991; Doss and Taff, 1996; Mahan, Polasky, and Adams, 2000).

Empirical Specification of the Hedonic Model

Our study area is Chatham County, Georgia, and the City of Savannah. This area is a good case study because it contains a wide variety of neighborhoods built in the marshland environment. Residential subdivisions were first constructed following World War Two, and new ones are being built today. These subdivisions contain wide variability in the key design indicators important to this study. The housing data used for this analysis were obtained from the Savannah Area Geographical Information System and the Chatham County Tax Assessor's Office.

The dependent variable is the most recent sale price for a property. All prices were converted to constant 1994 dollars, using the housing price index for the Savannah metropolitan area from the Office of Federal Housing Enterprise Oversight. As displayed in Table 1, the average price was $109,677 (or $253,661 in 2006 dollars). Table 1 also summarizes the 19 independent variables.

Of the 105,338 parcels in the county, 6,225 met the criteria for inclusion in the analysis and they had complete sets of data. The criteria included: a) parcels within 500 meters of a marsh, lake or river, b) parcels with single family residences, and c) parcel prices within 40 percent of their assessed values. Prices higher than 140 percent of the assessment probably had major improvements that would not be reflected in the model's independent variables. Prices lower than 60 percent of the assessment probably represent transfers between family members, or were made on other special terms.

The variables that describe the parcels' structural characteristics, such as *Size*, *Age*, *Bedrooms*, etc. were obtained from the county's Tax Assessor. All 12 of these variables are hypothesized to have a positive effect on the sale price. Of the two neighborhood variables, *Income* is expected to have a positive effect while *Race* should have a negative effect. Both of these variables are from the 2000 US Census, and they are measured at the census block group level.

The remaining variables represent environmental considerations. In this marshland environment, a property's proximity to wetlands is an important consideration. Proximity is measured as the meters from a property to the closest marsh, lake or river. These three hydrological features are not differentiated because the tidal environment makes them difficult to distinguish, e.g., marshlands become lakes at high tide. GIS software was employed to measure these distances. It is expected that as the distance increases, property prices decrease. Of course, the marshland may have disamenity elements associated with it, i.e. bothersome insects. This possibility is examined in the results section.

Among those with close proximity, properties have differing degrees of access to the wetlands. The tax assessor data indicate which properties have a water or marsh view, which ones have deep water access, and which ones have a boat dock. Each of these three effects is represented with a mutually exclusive dummy variable. From Table 1, 4.1% of houses had a marsh view alone, 1.8% had water access and 5% had a boat dock. The total percent with a marsh view is the sum of these percents, 10.9%, and the total percent with water access is 6.8 percent.

This tidal environment is subject to flooding from the storm surge that can accompany a hurricane. The last hurricane that caused property damage was Dora in 1964. A GIS overlay for the 'A' flood zones was obtained, and it indicated that large areas of this low-lying county are in a special flood hazard area. Using GIS software, a dummy variable was created which indicates whether a property lies inside a SFHA. About 50 percent of properties are flood-prone. The effect of this dummy variable is uncertain because of varying subsidies for flood insurance premiums, and the degree of loss coverage. Speyrer and Regas (1994) found that if homebuyers feel that (a) they are paying an actuarial-based premium and (b) they would not be fully compensated for flood losses, then location inside a flood zone would have a negative effect. Otherwise, the effect becomes ambiguous.

For the houses inside the flood zones, those constructed since publication of the community's Flood Insurance Rating Map (FIRM) have had to meet a special, damage-reducing building code. These properties have a '1' for the *Postfirm* variable, and this variable should have a positive effect.

There are two subdivision design variables of interest. The variable *Commons* is defined as the percentage of a neighborhood's area designated with a special tax status in the tax assessor's records. These parcels are owned by a public body, including neighborhood associations, and represent land that is open space or communal land. Most of these parcels are small parks with playgrounds, ponds or other special landscaping, while others are tennis courts or swimming pools. A park and a swimming pool probably have an equal impact on the prices of surrounding properties. If one wishes to actually swim in the pool, then one would have to pay for a club membership.

Therefore, the amenity of the swimming pool would not be capitalized in sale prices, and the remaining value which the hedonic would capture is the open space amenity. *Commons* should have a positive effect on prices if buyers value this type of land in addition to the open space represented by the marshland. From Table 1, the average property is located in a subdivision which has 5.304 percent of its area as common space.

The *Impervious Surface* variable is the percentage of land in a neighborhood that is covered by asphalt, roofing, or other material that prevents water infiltration into the soil. Rain runoff from roads and parking lots is responsible for transporting oil and other pollutants into the sensitive saltwater marsh environment. Real estate developers have some control over this because they can plan for more or less roads, drive ways and open space. Data for this variable came from a GIS layer developed by the School of Ecology at the University of Georgia.

Empirical Results

Table 2 contains the results of the hedonic regression. Several functional forms were compared and the log-log functional form was found most appropriate for this data set, i.e. all continuous variables were transformed by their natural logarithms. The White test for heteroscedasticity indicated that the model was subject to this problem. Therefore, the t-ratios reported in Table 2 are computed from White's consistent variance estimates (Greene, 2003).

The hedonic model performs well, with an R^2 of 78.5 percent. All of the variables have their predicted influence except for the dummy variable for *Brick*. The negative sign is probably due to the fact that homes with a brick or masonry finish cannot be retrofitted to withstand floods, i.e. they cannot be raised above the base flood elevation. All of the variables have a statistically significant effect except for two, *Impervious Surface* and *Floodzone.* The insignificance of *Floodzone* is no surprise, given the indeterminate nature of its effect.

One of the strengths of hedonic analysis is the ability to examine how marginal changes in individual characteristics of a property affect the value of the property. The value of a unit increase in a given characteristic, c_i, can be measured by the first derivative of the hedonic function with respect to the characteristic, i.e. $\partial r(c)/ \partial c_i$. This is typically referred to as the characteristic's "marginal implicit price".

Table 2 also reports these marginal implicit prices for each variable in the model. The price of an additional square meter of a house is $1,402, while an additional square meter of a parcel is $15.88. Concerning the *Commons* variable, each percentage increase in this type of open space within a subdivision increases price by $3,351. The other design variable, *Impervious*, indicates that as the percentage of permeable surface increases, price decreases by $165.61. However, this variable is not statistically significant so the variable's confidence interval around its implicit price would be wide.

Proximity to the marshland is important, as the results for the *Distmarsh* variable indicate a property would be worth an additional $47 if it were located 1 meter closer to the marsh. The variables that reflect access to the marshlands are described by three mutually exclusive dummy variables, i.e., if a property had a boatdock, then the *Boatdock* variable would take on a value of '1', while the other two access variables would be zero. Therefore, the marginal implicit price of a boatdock in Table 2 represents the cumulative effect of all three marshland access considerations. The average parcel having *Waterview* is valued about $11,700 above a comparable property without a water view. A property with deep water access is valued about $81,000 more than one having water view only, for a total of $92,600 above a comparable property. It is somewhat surprising that a boat dock adds a net $24,000 to property value. Popular wisdom in this real estate market suggests that the effect of a boat dock is much larger. However, these findings suggest that mere water access accounts for the bulk of the price difference. Furthermore, this $92,600 probably represents the option price that buyers are paying for the prospect of building a boat dock in the future.

The finding that both *Commons* and *Distmarsh* are significant, positive contributors to property prices is surprising. An initial suspicion was that homebuyers in this real estate market would regard these variables as substitutes, since they both represent open space, with the result that one or the other would be insignificant. However, buyers apparently view these as sufficiently dissimilar amenities.

Which type of open space is more important? It is difficult to say from these results, since *Commons* and *Distmarsh* are measured differently. However, the beta coefficients in Table 2 represent elasticities, since this is a log-log functional form. A one percent increase in *Commons* causes price to change by 0.059 percent. The same increase in *Distmarsh* changes price by almost half, 0.036 percent. For properties at the marsh's edge, the three dummy variables come into play and this probably brings the marsh's total impact up to par with *Commons*. Over all, the results suggest that real estate developers can plan for more commons in their subdivision, even in this environment where nature is already providing open space, and they can please homebuyers by doing so. Whether or not developers have an effective market-based incentive to provide more eco-friendly designs is the subject of the next section.

Simulations of Development Scenarios

Another advantage of the hedonic price method is that the regression can be used to generate predictions of property prices. By plugging in different values of the independent variables, including the development design, the resulting prices simulate how developer's revenues might change. Simulation results for three development scenarios are presented in Table 3.

The base case from which comparisons are made is the average house in the Savannah housing market, in a neighborhood with 20 hectares, containing 100 homes, with an average lot size of a 0.176 hectare (roughly 0.43 acres). If each house can be sold for \$300,000, then the developer's gross revenue would be \$30 million. Of the 20 hectares, 5 percent (1 hectare) is initially set aside for common areas. Each house is assumed to be a single story with 160 m^2 of roof space, all of which constitutes impervious surface. An additional 1.4 hectares of impervious surface is assumed for the subdivision's infrastructure requirements. The end result is the subdivision is made up of 100 homes, 5% common areas, and 15% impervious surface – 8% from rooftops and 7% from infrastructure. The developer can adjust the subdivision in a variety of ways, but here we focus on two alternative designs.

With the total area of the subdivision fixed, the first design incorporates 5 percent more common area, i.e., an additional hectare of commons. To achieve the increase in the commons one hectare worth of private land is converted to a park or other common area with permeable surface. Because the size of the lots is not changed, the developer has to forgo construction on 6 lots, or $1.8 million. However, reducing the number of lots has two effects: the commons areas are enlarged, and the amount of impervious surface in the subdivision is reduced due to the loss of roof space. The loss of roof space from 6 homes means impervious surface drops from 15% to 14.52% of the subdivision. Both the increase in common area and the reduction in impervious surface increase the value of the remaining homes. In this scenario, each house sells for a little more, i.e. $17,777, but the loss of saleable lots means that the developer's gross revenue would decrease by $128,981.

The second scenario is similar, with the commons area expanding to 15% (through the loss of 12 lots) and impervious surface falling to 14.04%. Again the gain in sales price is small compared with the loss of salable lots, and gross revenue is nearly $500,000 lower than the base case. Under these scenarios there is no incentive for the developer to change for the standard practice.

The final scenario assumes the developer "buys into" the green growth strategy fully, and the increase in commons area is achieved through a reduction in lot size. Lot size falls from 0.176 hectare to 0.166 hectare (or 5.68%). This enables the number of saleable lots to remain constant. Here, the increase in the commons area has a positive effect on sale price, but smaller lot size has a negative effect. The loss of 100 meters per lot, however, is small relative to the gain from the commons area, so the overall impact in this scenario is an increase sale price of about $16,000 per house. Since the number of lots does not decrease from its base, the scenario produces about $1,600,000 more gross revenue.

Summary and Conclusions

This research has attempted to shed light on an important question in environmentally sensitive ecosystems: Are there market incentives for real estate developers to adopt more eco-friendly design elements? This question is addressed by a hedonic price analysis of the Chatham County, Georgia real estate markets in areas bordering on the saltwater marsh. Previous research has shown that homebuyers have a positive willingness to pay for open space, which also acts to limit the runoff of pollutants. Previous research has also shown buyers' preference for proximity to wetlands. A complicating factor is that buyers may regard the marshland as a substitute for the open space that a developer has set aside. To our knowledge, this study is the first to study whether existing marshland has any "crowding out" effect on open space.

Results indicate that there is probably no crowding out effect. Homebuyers in this market pay more for houses with proximity to the marshland, and they pay more for houses located in subdivisions that have higher percentages of commons area. A set of simulations indicate that when the developer can vary the size of housing lots, she can enjoy higher gross revenue from home sales. This suggests the real estate market presents incentives for incorporating eco-friendly design features in future housing developments.

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Table 1: Variable Definitions and Summary Statistics, Variables Used in Hedonic Price Model of Marshland Area Properties in Chatham County, Georgia, 2006.

Variable	Definition	Mean	Standard Deviation
Price	Most recent property sale price, constant 1994 dollars, the dependent variable	109667.86	80403.05
Housesize	Size of the house, square meters	159.067	60.777
Parcelsize	Size of the parcel, square meters	1597.09	2337.60
Fireplace	1 if house has fireplace, 0 otherwise	0.769	0.421
Brick	1 if house has masonry exterior, 0 otherwise	0.437	0.496
Garage	1 if garage on property, 0 otherwise	0.697	0.459
Bedrooms	Number of bedrooms	3.142	0.498
Deck	1 if property has wooden deck, 0 otherwise	0.283	0.450
Pool	1 if property has swimming pool, 0 otherwise	0.056	0.229
Year	Year house was constructed	1981.17	18.211
Impervious	Impervious surface in neighborhood, percent	14.981	10.917
Commons	Commons space in neighborhood, percent	5.304	10.955
Floodzone	1 if parcel inside a flood zone, 0 otherwise	0.499	0.500
Distmarsh	Meters to marsh, lake or river	230.181	145.076
Boatdock	1 if property has boat dock, 0 otherwise	0.050	0.218
Wateracc	1 if parcel has water access (no dock), 0 otherwise	0.018	0.135
Waterview	1 if parcel has view (no access) of marsh or river, 0 otherwise	0.041	0.198
Postfirm	1 if house was constructed after community joined National Flood Insurance Program, 0 otherwise	0.302	0.459
Race	Percent of black residents in blockgroup (2000)	17.754	18.458
Income	Median household income in blockgroup (2000)	55200.27	15632.79

N=6,225

Table 2: Regression estimates of the Hedonic Price Model (dependent variable, log of property's most recent sale price, constant 1994 dollars).

Variable	Beta Coefficient	t- Ratio	Marginal Effect
Intercept	-41.541	-6.715*	n.a.
Housesize	0.743	43.103*	$1402.73
Parcelsize	0.084	8.817*	$15.88
Fireplace	0.045	5.316*	$14,068.93
Brick	-0.030	-4.362*	-$8,985.68
Garage	0.065	6.690*	$20,413.54
Bedrooms	0.016	1.798*	$5,019
Deck	0.025	3.073*	$7,625.29
Pool	0.039	2.620*	$12,162.06
Year	6.131	7.501*	$928.41
Impervious	-0.008	-1.442	-$165.61
Commons	0.059	18.731*	$3,351.41
Floodzone	0.009	0.990	$2,975.66
Distmarsh	-0.036	-12.009*	-$47.42
Boatdock	0.328	12.591*	$116,460.9
Wateracc	0.269	7.466*	$92,647.58
Waterview	0.038	2.064*	$11,737.81
Postfirm	0.023	2.058*	$7,271.73
Race	-0.045	-11.793*	-$762.06
Income	0.203	14.644*	$1.10

Notes: N=6,255, R^2=78.5%. The double-log functional form was used, i.e. all continuous variables were transformed by their natural logarithms. The t-ratios are computed from White's consistent variance estimates. * indicates rejection of the one-tailed hypothesis test at the five percent level. For the dummy variables, the marginal effect given is the change in the average property price due to the presence of the attribute.

Table 3: Residential Subdivision Design Simulations

<u>Scenario 1</u>	
Commons	10 %
Impervious Surface	14.52 %
Lot size	1,760 m^2
Number of Homes	94
Home Sale Price	$317,777
Developer's Revenue	$29,871,019
Change in Revenue from Base	- $128,981
<u>Scenario 2</u>	
Commons	15 %
Impervious Surface	14.04 %
Lot size	1,760 m^2
Number of Homes	88
Home Sale Price	$335,554
Developer's Revenue	$29,528,717
Change in Revenue from Base	- $471,283
<u>Scenario 3</u>	
Commons	10 %
Impervious Surface	15 %
Lot size	1,660 m^2
Number of Homes	100
Home Sale Price	$316,268
Developer's Revenue	$31,626,800
Change in Revenue from Base	+ $1,626,800

Note: Base case is the conventional design, with 20 ha, 100 homes, 5% Commons area, 15% impervious surface area , $300,000 per home, $30mil revenue to developer. Home prices are calculated from the estimated hedonic regression.