AN ANALYSIS OF ATTRIBUTES OF CONSERVATION SUBDIVISIONS IN A COASTAL GEORGIA HOUSING MARKET

by

HOVHANNES NAHAPETYAN

(Under the Direction of Warren Kriesel, Jeffrey Mullen)

ABSTRACT

The study analyzes some of the defining characteristics of conservation subdivisions in an attempt to derive the marginal implicit prices and, therefore, price effects on residential single family houses of those characteristics. The hedonic property valuation method with log-log functional form is used based on data obtained from Chatham County, Georgia residential housing market. Variables featuring percentage of open space and percentage of impervious surface at subdivision level are of particular interest, since they constitute defining elements of conservation subdivision. Other variables of environmental nature including distance to hydrological objects such as marshes and rivers and having access to water bodies and/or nice view are also of major importance to the study. Results indicate that the availability of an open space within the subdivision has significant influence on houses prices within that subdivision.

INDEX WORDS: Housing Market, Open Space, Hedonic Price, Impervious Surface, Water Access, New Urbanism.

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HOVHANNES NAHAPETYAN

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by

HOVHANNES NAHAPETYAN

Major Professor: Warren Kriesel
Co-Major Professor: Jeffrey Mullen

Committee: John Bergstrom

Electronic Version Approved:

Maureen Grasso
Dean of the Graduate School
The University of Georgia
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CHAPTER I

INTRODUCTION

The post World War II period can be considered revolutionary in the context of residential housing development resulting in suburbia becoming the most preferred dwelling place for most Americans. However, rapidly growing suburban areas have created a wide variety of challenged ranging from environmental to social to economic issues that pose serious threats to the well-being of the residents of suburbia and they demand new approaches to the conventional type of development. Some of the most criticized features of such development are monotonous subdivision designs lacking architectural uniqueness, loss of open space in general and environmentally sensitive areas in particular, and the alienation of residents from their neighbors. From an economic perspective expansion of suburban development is not beneficial since local governments have to spend limited resources on expanding the existing infrastructure instead of improving the existing services. Isolation of land uses makes automobiles a necessity increasing expenses related with maintaining cars and translating into higher levels of traffic congestion and pollution (Tu and Eppli, 1999).

The type of land use pattern characteristic of America after World War II, described as low density, single-use zoned and highly automobile dependent, is known as conventional, suburban development or sprawl.

The rate of residential development and its impacts on the environment is highly correlated with the rate of population growth. Statistical data regarding population and its growth trends are utilized to project the extent of human impact and its consequences on the environment. However, population growth rate is only one of the major factors to determine the effects of human nature on the environment. Among other important factors are "what these people do, where they live, and how they get around" (Beach, 2002). According to the U.S. Department of Housing and Urban Development there was a substantial increase in the rate of population growth in suburban areas as compared with central cities resulting in growth rate of 11.9 percent between 1990 and 1998 while that in central cities was only 4.7 percent during the same period. Central cities are now home for only 38 percent of the U.S. population as compared with 45 percent in the 1979s. At the same time, the land consumption rate is twice the rate of population growth. The land use rate in the 1990s increased at approximately two times as contrasted with that of the 1950s. Between 1994 and 1997, land consumption in the U.S. increased by 2 percent while population growth rate was only 1 percent annually. On average, 2.3 million acres of land are being developed annually. A substantial portion of land is consumed for residential development on lots that have more than one acre area (U.S. Department of Housing and Urban Development, 2000).

As a result of urbanization, the land surface area is converted into an impervious one. The latter has negative effect on ground water recharge and increases both volume and frequency of surface water runoff. According to the National Water Quality Inventory -1996 Report to Congress, 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 (U.S. Environmental Protection Agency (U.S. EPA), 1998).

Between 1990 and 2000, Georgia experienced a rapid increase in population. During this period, the United States population increased by 13.2 percent, while Georgia had 26.4 percent increase (U.S. Census Bureau, 2003). According to the United States Census Bureau, the state's population is projected to increase by 37 percent between 1995 and 2025. Because of such a rapid population increase, Georgia will experience increased demand for residential development, and particularly for single family dwelling units.

The current state of residential development in Georgia could be described as one possessing the main attributes of urban sprawl. As a result of such development vast amounts of farmland and natural areas are consumed to build single-family homes on large lots. Rapid disappearing of open space is a consequence of developers trying to construct as many housing units on a property as possible (Conservation Subdivisions Atlanta Regional Commission). Therefore, the land development pattern is becoming an important matter to insure sustainable development.

The negative impact of the current land use pattern on coastal areas is higher than on inland areas. Coastal counties constitute only 17 percent of the land area of the United States but more than half of America's citizens live in these area. Moreover, it is projected that between 1998 and 2015 the number of coastal residents will be increasing from 139 million to 165 million which is an equivalent of almost 20 percent growth (Beach, 2002). Even if the suburban type of residential development expands at the same rate as population, coastal area management will become a formidable task. However, the mismatch between land development and population growth magnifies the impact of population growth on coastal sustainability.

Coastal Georgia is not an exception in terms of population growth. Much of the population growth is due to mild climate, unique recreational opportunities, coastal resources, and natural beauty characteristic to coastal areas that make it an attractive place to live. According to the U.S. Department of Agriculture (USDA), 2006, County-Level Population Data for Georgia, the population of Bryan County increased by 51.7 percent between 1990 and 2000 and grew by 21.9 percent between 2000 and 2005. The second highest population growth rate occurred in Camden County. Between 1990 and 2000, the population of Camden County increased by 44.7 percent and between 2000 and 2005 by 4.8 percent. In response to the demand for new housing the coastal real estate market has evolved into what is characteristic of the conventional, low density, and spread out type of development.

The negative impact of such development on the environment has been substantial. During the period from 1992 to 1997 about 17,000 acres of combined forest, scrub/shrub, and grassland were converted into residential development. There were significant losses of wetlands in Coastal Georgia. Transformation of wetlands into residential development usually followed certain pattern. First, natural vegetation was removed from the wetland. Second, the area was filled and planted with evergreen forest seedlings. However, it was not incorporated into the silviculture industry because, after the harvest of the matured forest stand the land was sold to developers and converted into residential subdivisions. From 1992 to 1997, about 7,000 acres of wetland were transformed into evergreen forests (National Oceanic and Atmospheric Administration (NOAA) Costal Services Center). Besides such negative environmental consequences of suburban type of residential development as loss of open space, wetlands, biodiversity, habitat, air and water pollution, and increased runoff, there are economic, social, and health issues characteristic of conventional type of land use pattern. There are numerous studies (Burchell and Mukhenji, 2003; Speir and Stephenson, 2002) that assessed the public water and sewer costs associated with low density housing pattern. The results showed that more spread out housing patterns are more costly to supply with public water and sewer services.

Another negative aspect of the conventional type of development is that it affects human health. A study found that people living in conventional types of neighborhoods usually walk less, weigh more and suffer form hypertension (high blood pressure) more often then their counterparts living in less conventional residential subdivisions. The implications of the study proved to be consistent after taking into account such factors as age, education, gender, race and ethnicity (McCann, and Ewing, 2003).

As a result of recognition of a need to mitigate sprawl and its negative economic environmental and social consequences several movements have evolved and are increasingly gaining popularity and acceptance among the general public, developers, and public officials. Such environmentally conscious land planning alternatives to the conventional type of development such as Conservation Subdivisions, New Urbanism, and Smart Growth provide for an opportunity to accommodate increasing demand for housing while protecting open space, habitat, wetlands, and mitigating the deterioration of air and water quality.

Smart Growth Concepts

According to the U.S. EPA, "Smart growth is a development that simultaneously serves the economy, the community, and the environment". Instead of approaching the issue of development from a growth/no growth standpoint, smart growth defines principles which allow for the accommodation of demand for new residential development while minimizing the negative impact on the environment as much as possible. In 1996, the U.S. Environmental Protection Agency collaborated with several non-profit and governmental organizations and as an outcome of the cooperation the Smart Growth Network was formed (SGN). The formation of the Network was a response to increasing community concerns and the realization of necessity to seek new ways of expansion of residential development that would benefit the economy, protect and preserve the environment, and improve quality of life within communities. Currently the

Network consists of wide variety of partners including environmental organizations, historic preservation groups, professional organizations, real estate developers, and other organizations representing real estate interests as well as state and local governments (Smart Growth Online, 2006). The purpose of the Network is to promote smart growth principles which include the following:

1. Create a wide variety of housing types and choices;
2. Create communities that are pedestrian friendly and encourage walking and bicycling activities;
3. Encourage stakeholder involvement into community affairs;
4. Design unique and attractive places that create a strong sense of place;
5. Make predictable and cost-effective decisions with regard to future development projects;
6. Preserve and protect open space, wildlife, farmland, natural beauty, and environmentally sensitive areas;
7. Implement transit-oriented development with a variety of transportation choices;
8. Revitalize and further development existing residential communities;
9. Take advantage of compact residential development (Smart Growth Online).

According to Knaap and Talen (2005), the main principles of smart growth are anchored on four propositions:

1. The dominant form of residential development in after World War II America can be characterized as urban sprawl. The reasons behind such type of land use can be of economic nature, a result of consumer preferences, or a consequence of public policies promoting that kind of development pattern.

2. Urban sprawl described as low density, unplanned, single-use zoned, and highly automobile dependent is homogeneous and therefore, aesthetically not attractive.

3. Urban sprawl has negative effect on the environment, does not encourage social interaction among neighbors, requires excessive government spending, and impairs human health

4. Urban sprawl, and its negative consequences, can be mitigated by development patterns that "promote compact growth, mixed land uses, bicycle and pedestrian friendly environments, public transit, urban revitalization, and farmland preservation" (Knaap and Talen, 2005).

Smart growth principles have attained widespread recognition and are increasingly becoming a part of planners, policymakers and developers decision making process. In response to this popularity, more and more local governments are considering the principles and policies of smart growth as a solution to their problems. Over the past few years there has been significant increase in the number of reforms implemented across America. According to the American Planning Association, 17 governors issued 19 executive orders regarding planned growth and development based on smart growth principles during the past two years as compared to 12 orders during the last eight years. Between 1999 and 2001, there were issued legislative task force reports regarding smart growth and implementation of its principles in 8 states as compared with 10 reports between 1990 and 1998. In 2001, 27 governors of different political views (15 Republicans, 10 Democrats, and 2 Independents) presented planning and smart growth proposals in 2001. During the same time, voters supported for measures nationwide to constraint sprawl, suspend many road-building projects, and advocated for alternative ways of transportation (New Urbanism, 2006).

New Urbanism Concept

New urbanism or traditional neighborhood development has recently gained increasing popularity and interest among urban architects, planners and designers (Tu and Eppli, 2001). New urbanism calls for the provision of mixed income and residential communities ranging from apartments to single-family homes. The latter results in dwelling units that are both affordable and up-scale allowing for people of different income levels to live in the same area. Simultaneously, new urbanism advocates for more dense residential development in an attempt to protect environmentally sensitive areas, important habitats, farmlands, different types of open space, and natural environments. According to new urbanism principles, instead of building one to three housing units per acre in the suburban areas, there should be eight to fifty residential units per acre. This helps to meet the demand for new residential development and simultaneously protects natural environments (Hikichi, 2003).

According to Fulton (1996), "New Urbanism began as a reaction to conventional suburban planning as it has been practiced in the United States since the 1940s." New urbanism considers the decentralized, car-dependent suburban development responsible for increasing pollution and congestion on major roads and highways, a lack of interaction among neighbors, and the loss of open space. The other most criticized aspect of conventional type of development is that it provides limited opportunities for children and those who do not own cars. New urbanists believe that traditional neighborhoods in both urban and suburban settings result in higher satisfaction rates among the residents of such neighborhoods. One of the earliest manifestations of new urbanism principles was the design and construction of the town of Seaside, Florida (Fulton, 1996).

The Congress for the New Urbanism (CNU) was founded in 1993 by a group of architects. They each had many years of experience in creating buildings, designing neighborhoods, and regions that provided a high quality of life for all residents, while preserving the natural environment. They were brought together by Peter Katz, who soon became the first Executive Director of CNU. Currently, CNU has over 2,300 members in 20 countries and 49 states. More importantly, there are now over 210 new urbanism type of developments that are either completed or under construction in the United States (Congress for the New Urbanism, 1997-2007).

New urbanists follow certain principles which are clearly defined in the CNU Charter. The list is summarized by Ellis (2002) : metropolitan regions that are made of well-structured and clear cut cities, towns, and neighborhoods with easily identifiable centers and edges; densely built environment that protects farmland and natural environments; revitalization of city centers by means of infill development; highly interconnected and web-like streets that encourage pedestrian and bicycle provide access to major destinations; mix land uses containing housing, work places, commercial areas, schools, and recreational facilities necessary to the everyday life of residents within the communities; well designed and placed civic buildings and public gathering places to reinforce the uniqueness of the community and make it more attractive; the incorporation of local climate, topography, and historical aspects into the architectural and landscape design to ensure attractive urban settings; a wide variety of parks and conservation lands that are situated within neighborhoods and serve the purpose of both defining and connecting different neighborhoods and districts.

There have been a number of studies showing that New Urbanism Type of development sells at a premium compared to conventional sprawl (Tu and Eppli, 1999; Song and Knaap, 2003; Tu and Eppli, 2001). Tu and Eppli (2001) explored the price differential that homebuyers pay for houses in New Urbanist developments relative to houses in conventional suburban development using data on over 5000 single-family home sales from 1994 to 1997 in three different neighborhoods (Kentland, Maryland; Laguna West, California; Southern Village, North Carolina). Hedonic research results revealed that homeowners paid more to reside in a traditional neighborhood development, and that this premium was statistically significant for each of the three New Urbanist communities.

Yan Song and Gerrit-Jan Knaap (2003) developed qualitative measures of urban form and examined those forms using hedonic price analysis in Portland, Oregon. They found that differences in the characters of urban forms were capitalized into residential values. Further, they found that homes in a New Urbanist neighborhood commanded an aggregate price premium.

Conservation Subdivisions

Conservation subdivisions are a type of residential development in which clustering of houses on small lots allows a significant portion of the subdivision to be set aside as a common and permanently protected open space. They could be compared in many aspects with golf course communities. However, instead of a standard golf course they represent different types of wetland, forested areas, meadows, farmlands, and many other types of open space in an as undisturbed form as possible. They differ from conventional subdivisions, in which most of the area of a subdivision represents a built environment consisted of houses and streets and no open space left over. Conventional subdivisions are scarce in terms of green spaces for walking and other recreational purposes, habitat for wildlife, and opportunities for neighbors to socialize. In contrast, conservation subdivisions feature all of the above mentioned attributes. Additionally, developers can generate more profit by building conservation subdivisions, since they tend to require lower infrastructure construction costs and local governments can benefit because of lower maintenance costs (Wenger and Fowler, 2001).

The majority of conservation subdivision Ordinances require 40 to 60 percent of total areas be set aside as an open space. However, there is some controversy over whether the percentage should be counted based on total or buildable area of a particular subdivision. The difference between total and buildable areas is in that some environmentally sensitive areas such as wetlands and habitats of endangered species are protected by laws and regulations and can not be developed. There also exist some areas where building is very difficult or extremely costly making the development of those areas unjustified from economic standpoint. Deducting the aforementioned areas from the total acreage leaves the developer with a portion of the parcel that can be built. Some ordinances require setting aside up to 60 percent of the areas with the potential of being developed while others based their requirements on total acreage of the parcel. A third option, constituting a consensus between the two aforementioned ones is also a possibility. In this case some percentage of the area with development potential is included in the calculation of total area of the open space (Tiffany et al., 2005).

Properly designed conservation subdivisions can be beneficial for residents, developers, and local governments. Some of the positive aspects of such type of residential development include provision of recreational opportunities, prevention of water quality degradation, preservation of wildlife habitat, reduction of infrastructure construction and maintenance costs. Conservation subdivisions can serve as means for protection of water quality and preservation of wildlife habitat. Clustering houses on only a portion of the subdivision area allows conservation subdivisions to have less impervious surface coverage than conventional subdivisions.

Impervious surfaces, characterized mainly as built surfaces, include rooftops, roads, sidewalks, and parking lots. These types of surfaces are covered by such impenetrable materials as concrete, stone, and asphalt and negatively affect on the hydrologic cycle because they prevent water from infiltrating soil. When a significant portion of the area constitutes impervious surface runoff reaches water bodies much faster than in the case of less imperviousness causing the water to rise to higher levels. The consequences of such alteration of the hydrologic cycle are bank erosion, intensified downstream sedimentation, and impairment of aquatic habitat. The runoff also contains different kinds of pollutants (oil, metals etc.) that directly flow to waterways causing a wide variety of environmental issues.

Fragmentation and eventually loss of wildlife habitats is an increasingly common occurrence across Georgia and conservation subdivisions can be a way of mitigating the negative impact of residential development from that respect. Conservation subdivisions that are built on relatively large areas and therefore, preserve substantial amount of open space are capable of protecting large blocks of wildlife habitat that meet habitat related demands of a wide variety of species. Even relatively smaller subdivisions can serve the environment providing corridors that link fragmented habitats and mitigated the negative effects of fragmentation on fauna and flora (Wenger and Fowler, 2001).

The conservation type of development is beneficial from developers' perspective since clustering houses and providing for open space reduces costs related with infrastructure development. Moreover, replacement of large areas of impervious surfaces characteristic to conventional type of development with natural areas in the form of open space serves as a natural flood protection by means of infiltrating water into the soil and thus significantly reducing costs related with building expensive stormwater management facilities (Tiffany et al., 2005). Finally and perhaps most importantly, if conservation subdivisions carry a price premium over conventional ones than building conservation type of subdivisions will be translated into increased revenues for the developers.

Possibility of a price premium is beneficial for the local governments, since higher house prices translate into increased revenues from property taxes. Therefore, apart from lower maintenance cost associated with such types of development, the potential of an increased tax base can serve as a source of motivation for the local governments to create better conditions for developers of conservation subdivisions.

Preservation of open spaces within conservation subdivisions provides many recreational and social benefits for the residents of those subdivisions. Existence of paths and trails creates walkable neighborhoods enabling residents to go for a walk, exercise, enjoy the beauty of nature, and serves as a pleasant gathering place to interact and socialize as well as organize picnics and other social events. Clustering homes and reducing the distance between the houses reduces isolation and creates an opportunity for neighbors to more freely interact thus mitigating the social barriers characteristic to conventional subdivisions. Even though open spaces within subdivisions can be designed to include such recreational facilities as soccer and baseball fields, the idea behind conservation subdivisions is preserving open space as a means of protecting environmentally sensitive areas as well as sites of cultural and historic importance (Belansky and Justus, 2000).

Problem Statement

Conservation subdivisions offer many advantages over conventional or suburban types of development. Those advantages include mitigation of the negative impact of population growth and sprawl, protection of environmentally sensitive areas and wildlife habitat, provision of social, cultural and recreational benefits, reduction of infrastructure development costs for developers, and infrastructure maintenance costs for local governments as a result of the significant preservation of open space (Belansky and Justus, 2000; Kaplan, Austin and Kaplan, 2004; Mohamed, 2006; Wenger and Fowler, 2001; Tiffany et al., 2005). Moreover, local governments can benefit from conservation subdivisions in the form of increased tax revenues if houses in such neighborhoods are found to carry price premium over conventional ones. However, very little is known about the economics of conservation subdivisions. Market demand is the major determinant in a developer's decision making process. If homebuyers place high value on the environmental attributes in their neighborhoods, and if these environmental attributes are improved by the housing development design features, then the developers may realize higher profits. In other words if conservation subdivisions are more attractive to consumers and carry a price premium over conventional types of development developers will build conservation type of properties because of higher revenues. Therefore, it is essential to examine market acceptance of conservation subdivisions and whether this type of development carries price premium over conventional subdivisions.

There is extensive research showing that open space has positive influence on nearby housing units (Bolitzer and Netusil, 2000; Mahan, Polasky and Adams, 2000; Lutzenhiser and Netusil 2001; Geoghagen, 2002; Irwin, 2002; Thorsnes, 2002). However, conservation subdivisions per se have not been extensively examined. It is important to note that conservation subdivisions represent a trade-off between smaller lots and conserved open space. The price effect of conserved open space in the context of clustered homes on smaller lots may be significantly different from that of open space in Conventional Subdivisions. Even though smaller lots have a negative effect on property values the preservation of open space may more than compensate for the negative impact. Subdivisions that can provide such unique features as exclusivity, privacy, and a perception of prestige are highly valued by households and are capitalized into housing prices built in such subdivisions (Mohamed, 2006).

Even though past studies have examined conservation subdivisions from an economic standpoint (Lacy, 1990; Peiser and Schwann, 1993; Mohamed, 2006), those studies either did not include econometric analysis (Lacy, 1990), or as Mohamed (2006) commented "the subdivisions that the authors examined (Peiser and Schwann, 1993) were very different from the design, ecological and social constructs of today's conservation subdivisions". Even though Mohamed (2006) used econometric analysis to examine the economic value of conservation subdivisions, the study was done with respect to developed lots, not homes. More importantly, there is no research that examines market acceptance of conservation subdivisions in a coastal area context.

Thesis Objectives

The objective of this study is to analyze the possibility of price premiums for houses in conservation type of development associated with conservation subdivision characteristics in the coastal real estate market of Georgia with particular attention to marshland environment. Using the hedonic pricing method and controlling for other variables such as housing and lot characteristics the economic value of each housing attribute will be analyzed. Results will help developers and planners make decisions regarding the use of conservation subdivisions as an alternative to suburban type of development or sprawl. Improving the information base about conservation subdivisions will help local governments make decisions regarding development alternatives. Even though development costs are attributed to the developer, long-run infrastructure maintenance is usually implemented by local governments. Moreover, the possibility of price premiums and associated increased tax revenue may create incentives for local governments to implement policies aimed at motivating developers to build conservation subdivisions.

Hypothesis

The main proposition of the study is that conservation subdivisions carry a price premium over conventional or traditional ones. It will be hypothesized that the mere fact of a house being located in a conservation subdivision ceteris paribus will be sold at higher price than a residential unit that can be characterized as a representative of typical suburban development. In order to test the hypothesis, a hedonic pricing model will be utilized that along with structural, neighborhood, and environmental (other than those related with conservation subdivisions) attributes of a house will include variables that distinguish conservation subdivisions from the conventional ones. Results of the OLS regression analysis will be used to create hypothetical scenarios for the two types of development. Predicting the estimated price of the home located in the conservation subdivision and comparing it with the one in the conventional subdivision will allow drawing conclusions about the existence of a price premium associated with the conservation subdivision attributes.

Organization of the Thesis

The thesis is comprised of 5 chapters. The first chapter briefly described environmental, economic and social consequences of conventional type of development. The main features of environmentally conscious movements as smart growth, new urbanism, and conservation subdivision were discussed. In describing aforementioned alternatives to suburban development as a means of accommodating growing demand in residential housing while mitigating the negative impact of such growth, particular attention was given to conservation subdivisions. Objectives of the thesis as well as the hypothesis to be tested outlined the purpose of conducting this study.

Chapter II contains the review of related economic literature that serves as a theoretical foundation for conducting this study. Chapter III describes the research methodology employed in the analysis. It contains presentation of non-market valuation in general, and hedonic pricing models utilized in the study in particular. Such issues as model specification, functional form of the model, and data collection methodology are also included into this chapter. Chapter IV presents empirical results and their interpretation. The last chapter constitutes a summary of empirical results, implications and points out limitations of the study.

CHAPER II

LTITERATURE REVIEW

The chapter provides a review of related literature that serves as a basis for the development of the methodology employed in the study. Unfortunately, relevant literature on conservation subdivisions is quite limited because this type of residential housing development is a relatively new phenomenon. To somehow compensate for this limitation several open space studies are included in the review. Inclusion of this kind of empirical studies is useful because they examine the effect of different types of open space on residential housing prices, and one of the major characteristics of a conservation subdivision design is setting aside a certain percentage of developable land as permanently protected open space. In other words, studies on both open space and conservation subdivisions examine whether the presence of undeveloped land is capitalized into residential housing prices.

However, it should be noticed that there may be significant differences in terms of the effect on single family houses between different types of open space located inside conservation subdivisions and those that lie outside of subdivisions. One of the reasons for such a difference is that conservation subdivisions represent a trade-off between smaller lot size and provision of permanently protected open space. Other reasons are summarized by Mohamed (2006) on the basis of studies conducted by Kaplan et al. (2004) and Thompson (2004). According to the summarization conservation subdivisions are characterized by a group of unique features of social and design nature (exclusivity, privacy, and a perception of prestige) that are jointly valued by homebuyers. Moreover, properly designed subdivisions have the potential of offering such aesthetical values and environmental benefits that supersede those of the other types of open space (Mohamed, 2006).

The chapter starts with the presentation of some of the empirical studies related to the valuation of open space defined broadly to include different types of open areas such as parks, natural areas, forested preserves, and agricultural land. Since the Georgia coast is abundant with different types of wetland areas, studies evaluating the impact of different types of wetlands on property prices by means of hedonic price models are considered separately. The chapter closes with an the examination of the empirical studies of conservation subdivisions that, in addition to the above mentioned studies, provide a theoretical and empirical foundation for the development of this study.

Open Space Valuation

The earliest studies that utilized actual market prices of residential houses to estimate the implicit price of an open space focused on parks (McConnell and Walls, 2005). One such study was conducted by Kitchen and Hendon (1967) in which authors examined the impact that a neighborhood park had on residential housing values in Lubbock, Texas. The park consisted of 10 acres containing playground equipment, landscape areas and shelter. It was hypothesized that as real estate properties were further from the neighborhood park their value declined. To test the hypothesis simple correlations of assessed value of the property and distance, assessed value of the land and distance, and sale price of the property and distance were performed using data on 480 properties in the ring or zone around the park. A linear correlation technique was employed based on the examination of the data by means of scatter diagram which revealed linearity of the relationship. The analysis of assessed value of the property and distance from the park revealed a correlation coefficient of .0049 which was an indication of the absence of strong relationship. The coefficient of correlation between the sale price of properties and distance from the park was the opposite of the hypothesized sign and had a value of .0541 indicating that the closer a property is to the park the less valuable it becomes. However, it should be noted that significance tests conducted for the two analyses indicated that the correlation coefficients did not differ significantly from zero. The authors also stated that assumed homogeneity of the housing characteristics and prices might be the reason for the low relationship of unexpected sign. The statement was reinforced by the analysis of assessed value of land and distance from the park which revealed a coefficient of -0.17. A significance test indicated that -0.17 was a significant value. The authors summarized their findings stating that the distance of a property from a park might have effect on its value. They concluded that as a parcel of land was located further away from the park its value diminished which was an indication of significant economic benefits for the properties in close proximity to a park.

A study conducted by Weicher and Zerbst (1973) examined the effect that five neighborhood parks had on nearby single-family housing units in Columbus, Ohio. The authors distinguished three types of properties depending on their location with respect to the parks. The types featured 1) properties that were adjacent to a park and house faced the park, 2) properties that were adjacent to a park and house backed the park, and 3) properties that were adjacent to a park and house faced area of heavy recreational use, or park building. The last distinction was necessary because some houses faced park buildings or other recreational facilities that obstructed the view while most houses had a view of open space, trees, and grass. To estimate the effect of parks on nearby property values authors used ordinary least square regression using housing sales data within the period of 1965-1969. Five regression equations were tested for different groups of parks combined on the basis of special relationship between the park and adjacent property and one equation included the data from all five parks. Three dummy variables were used to account for the differences in location with respect to the park and the results were compared with similar house prices located one block away from the park. The first three regressions showed that 1) properties with houses facing an adjacent park sold for $1130 or about 7 percent more; 2) properties with houses backing onto a park sold for about the same price as the ones located one block away from the park; 3) properties with houses having an obstructed view of a park sold for about $1150 or about 8 percent less. The regression results of the equation combining the data from all five parks were similar to those of the previous equations. However, the coefficients for the dummy variables were substantially larger for properties facing or backing onto a park. Properties that faced a park sold for 23 percent more than similar properties elsewhere, and those in the other two classifications sold for 7 percent less. To summarize the findings with regard to the effect of neighborhood parks on residential property values it was shown that houses facing open space not obstructed with heavily used recreational facilities carried price premium of 7 to 23 percent over similar properties lacking such feature, while those in the other two categories sold for 7 to 8 percent less.

Bolitzer and Netusil (2000) examined the relationship between the sale price of homes and open space within 1500 feet of a home in Portland, Oregon using data set containing 16402 observations. The authors estimated three different hedonic models using linear and semi-log functional forms for each of the three models. Open space was categorized as public parks, private parks, cemeteries and golf courses. The first model estimated the effect of any type of open space by means of an open space dummy variable that captured the effect of any type open space on residential houses within 1500 feet of a home. The coefficient for the open space dummy variable, that was hypothesized to be positive was of expected sign and statistically significant in both linear and semi-log models. For the linear model, the open space coefficient showed that a home situated within 1,500 feet of any type of open space sold for $2105 more than an identical home situated more that 1,500 feet of any type pf open space. According to the results from the semi-log model the existence of an open space within 1500 feet of a house increased a home's value by 1.43 percent which using the mean sale price for homes translated into $1247. The second model estimated the effect of different types of open spaces on house prices. Coefficients for public parks and golf courses were statistically significant in both the linear and semi-log functional forms. For the linear model the existence of a public park within 1500 feet of a home increased the sale price of a home by $2262 and the estimated effect from a golf course was $3400. The estimated coefficients in semi-log model were $845 and $3940 respectively. Coefficients of dummy variables for private parks and cemeteries were negative but not statistically significant.

Lutzenhiser and Netusil (2001) examined the effect of open space on a home's price in Portland, Oregon using a data set consisted of 16,636 single-family home sales between 1990 and 1992. The study is similar to that conducted by Bolitzer and Netusil (2000). One of the major differences is the functional form of the hedonic price function. The authors estimated the hedonic price function using a Box-Cox transformation of the dependant variable. The other difference of a great importance to us is distinguishing between urban parks and natural area parks. Urban parks were defined as a type of open space having more than 50 percent of the area developed for recreation, whereas natural area parks were classified as such if more than 50 percent of the park was preserved in native vegetation. Distinction of this type is important since the type of open space within conservation subdivision is very similar by nature to natural area parks. The study also included such types of open space as cemeteries, golf courses, and specialty parks/facilities which are of less importance to our objective. Authors estimated two models. The first model estimated the relationship between a home's price and distance to one of the five open space types within a 1,500 feet radius by means of dummy variables. According to the results natural area parks that are of special interest to us had the largest effect ($10,648) which was statistically significant at a one percent level. The second model estimated the effect that distance to an open space had on the sale price of a home. Created dummy variables distinguished seven different zones ranging in size from 200 to 300 feet. Natural area parks were found to have a positive and statistically significant effect on the sale price of a house for al seven zones. The largest statistically significant effect ($11,210) was estimated for homes located within 200 feet of natural parks.

Geoghegan (2002) developed a hedonic pricing model with semi-log functional form to empirically examine the extent to which different types of open spaces were capitalized into residential property values located near open spaces within a radius of 1600 meters. In particular, the author distinguished two types of open spaces on the basis of their development potential: permanent open space, such as parks and land that had conservation easements; and developable open space, such as privately owned forests and agricultural land. The study area was a suburban county of Washington, DC and Baltimore, Maryland based on a dataset comprised of 5599 observations. It was hypothesized that coefficients on the two types of open space variables would be positive, while the coefficient on the permanently preserved open space would be larger than that of developable open space. The results were consistent with the hypothesis. The estimated coefficients on both permanent open space and developable open space variables were positive. Moreover, the estimated coefficient on permanently preserved open space was three times the magnitude of the developable open space coefficient. The estimated coefficient on permanently preserved open space was statistically significant (at 5 percent level) and the estimated coefficient on developable open space variable was statistically significant at slightly less than the 10 percent level. The author' conclusion was that the home buyers valued permanent open space more than developable open space.

Irwin (2002) examined marginal values of different types of open space using residential data consisted of 55,799 observations from ex-urban counties within a central Maryland region belonging to the Washington D.C. - Baltimore metropolitan area. Open space was differentiated by development potential (whether land is developable or permanently preserved), land ownership (private or public preserved open space), and land use type (cropland, pasture, and forests that are developable). Based on the above mentioned classification the author distinguished the following six different measures of open space: 1) cropland that was privately owned; 2) pasturelands that were privately owned; 3) forested land that were privately owned; 4) privately owned land that was protected from development; 5) non-military open space land owned by the federal, state, or county governments; and 6) military land that was owned by the federal government. It was hypothesized that preserved open space carried a price premium and pasturelands had greater value than either croplands or forests because pasturelands provide more scenic views. The author examined three functional forms of a hedonic pricing model (log-log, semi-log, and linear) and, on the basis of adjusted R^2 values, gave preference to the results obtained from the estimation of the log-log functional form. The estimated coefficients for the open space variables were interpreted with respect to pasturelands. In particular, using mean values of all explanatory variables the author estimated the change in the mean price of a house resulting from converting one acre of pastureland to another land use. The author found that changing one acre of developable pastureland to privately owned conservation land increased the mean value of a residential housing unit by $3,307 or 1.87 percent of the predicted housing price. Converting one acre of pastureland to publicly owned, non-military land use increased the residential property value by $994 or 0.57 percent of the predicted value. However, the results showed that conversion of one acre of pasture to forested land decreased a home's sale price by 1.424 or 0.82 percent. Interpretation of the estimated coefficient proved to be consistent with the author's hypothesized scenario.

Thorsnes (2002) examined the effect of proximity to tracts of permanently preserved forested land on the sale price of a house in the Grand Rapids, Michigan metropolitan area. The empirical research was conducted using observations on sales of not only single-family houses but also of vacant building lots in three residential subdivisions bordering on one side a forest preserve. According to the author, inclusion of the observations on sales of vacant building lots would provide more accurate estimates because of the relative homogeneity of such observation as opposed to more diverse and unobservable house characteristics that might result in biased estimated coefficients and could produce larger standard error. The data set consisted of observations on 431 lot sales and 486 house sales. The author examined linear and log-linear functional forms for a hedonic pricing model. The results indicated that the price premium associated with permanently preserved forested land was statistically significant for the three subdivisions ranging from $5,800 to $8,400.

Wetland Valuation

Wetlands provide a variety of services ranging from environmental services such as water purification, flood control, wildlife habitat, biodiversity, and groundwater recharge, to recreation and aesthetic services.

Studies using the hedonic price technique to estimate the effect of wetlands on residential properties have usually focused on such attributes of wetlands as type, size, proximity and shape. Several studies categorize wetlands into the following four classes: forested, scrub-shrub, emergent vegetation, and open water. Wooded swamps and bogs classified as forested wetlands are usually located along rivers and streams and contain the least amount of water. Scrub-shrub wetlands are more open than forested wetlands and support a great variety of vegetation. Although emergent-vegetation wetlands can be flooded during the year containing up to three feet of water, these types of wetlands can also be free from extensive amounts of water during most the year. Shallow ponds and reservoirs are classifies into the category of open-water wetlands and contain the highest amount of water among the four types (McConnell and Walls, 2005).

Lupi, Graham-Tomasi, and Taff (1991) examined the relationship between wetland areas and nearby property values. The study was conducted using a hedonic pricing model on a dataset consisting of 18,863 observations of residential properties sold in Ramsey County, Minnesota during the period 1987- 1989. Ordinary least squares was used to estimate the model. The author concluded there was a statistically significant positive impact from wetlands on property values. Two variables featuring wetland acres and wetland acres squared were used to account for a nonlinear relationship between wetland acres and property values. According to the estimated hedonic equation the highest impact on houses from wetlands would occur from a wetland area of 283 acres. The authors also calculated the estimated willingness to pay (WTP) per residential property for an increase in the size of wetland areas by one acre. Estimated WTP for mean wetland acreage of 29.26 acres per property was $42.66. The authors also calculated the total WTP for the county by multiplying per property WTP $42.66 by 157,000 residential properties in the county. The multiplication yielded an estimate 6.7 million dollars as a value of one acre increase in wetlands in Ramsey County.

A study conducted by Doss and Taff (1996) examined the effect of proximity to wetlands as well as different types of wetlands on nearby housing values in Ramsey County. The relationship was examined by means of a hedonic pricing model with quadratic functional form based on dataset of 32,417 observations from Ramsey County, Minnesota. However, it should be noted that, instead of using data on actual sales prices, the authors used assessor market values. It was mentioned that, in spite of the advantage of significantly increasing the number of observations, assessed values might result in greater bias to the estimates. Four types of wetlands were distinguished in the study: forested, scrub-shrub, open water, and emergent vegetation. The estimated coefficients on the distance variables to the four types of wetland as well as those on squared terms of the distance variables were significant at least at the 0.01 level. The only exception was the estimated coefficient on squared distance to the forested wetlands. Parameter estimates for the distance variables indicated the effect of being located 10 meters closer to a type of wetland, and the means distance to that particular wetland type was used as a starting point for calculations. The results indicated that a decrease in distance of 10 meters to a forested wetland resulted in a decline of a home's price by $145. The other three types of wetland had a positive effect at the mean distance on nearby residential units. Movement of an additional 10 meters towards an emergent-vegetation wetland indicated an increase in a housing value by $136; the effect of open-space wetlands was estimated to be $99, and that of scrub-shrub wetlands was $145.

Another study conducted by Mahan, Polasky, and Adams (2000) examined the effect of wetland characteristics on residential property values. The authors distinguished between four types of wetlands (open water, emergent vegetation, scrub-shrub, and forested) and measured the impact of wetlands from size and distance (distance to different types of wetlands) perspective. The study was conducted using a dataset containing 14,233 observations of home sales in Portland, Oregon. The study area included 840 forested, 680 scrub-shrub, 1,700 emergent-vegetation, and 790 open space wetland sites. The authors estimated a hedonic price function using least square regression analysis. In the hedonic model the sales price was define as the natural log of the sales price and the distance variables were the natural log of the distance. According to the result from the estimated model there was a positive relationship between the size of the nearest wetland and house values as well as between distance and house prices. Increasing the nearest wetland size by one acre, calculated at the mean house value of $122,570, would result in an increase of $24.39 in the house value. Reduction of the distance to the nearest wetland by 1,000 feet, calculated at the mean house value and at a distance of one mile would increase the house value by $436.17.

Conservation Subdivision Valuation

Unfortunately, the number of empirical studies conducted on Conservation Subdivisions is very limited and there is a gap of scientific information regarding the economics of conservation subdivisions. As was mentioned earlier, examining of the effect of a wide variety open space on nearby residential housing units is not a representative of the effect of different types of open space within conservation subdivisions. Although open space within conservation subdivisions provides unique environmental, social and recreational opportunities for the residents, the provision of open space is accompanied with clustered housing units on smaller lots which have been proved by almost all empirical studies to have significant negative impact on a housing price (Mohamed (2006), Geoghegan (2002), Lutzenhiser and Netusil (2001) Mahan, Polasky, and Adams (2000), Bolitzer and Netusil (2000), and Doss and Taff (1996)). Therefore, the interaction and outcome of the two competing features in the market is not clear-cut and needs to be examined (Mohamed, 2006). This section is comprised of studies that examined conservation subdivisions from economic viewpoint.

Lacy (1990) calculated and compared the appreciation rate for conservation and conventional subdivisions in Concord and Amherst, Massachusetts. Two conservation subdivisions (Meriam Close and Echo Hill South) were compared with similar conventional subdivisions (town-wide data from Concord and Orchard Valley) separately. In addition to providing a dwelling place, residential houses are usually considered an investment and a way of dealing with inflation by home-buyers. Therefore, the appreciation rate for a house is of a great interest to home-buyers. A common concern for all the participants in a hosing real estate market is that conventional subdivisions, in spite of the benefits of the provision of open space, may experience lower market appreciation rates because of clustered housing units resulting in smaller lots. To address the issue, the author examined whether market appreciation rates for homes in conservation subdivisions could be equal to those for homes constructed in conventional subdivisions. The method of analysis for the determination of appreciation rates was measuring the percent change in the sales price of a house by subtracting the average sale price of homes in the first year of the study from the average sales price of homes in the last year, then dividing by the initial price and multiplying by one hundred to convert it into percentage form.

Meriam Close Conservation Subdivision consisted of 24.1 acres 72 percent of which was permanently protected open space. There were 20 housing units from the subdivision and 116 observations from the Town of Concord obtained during 1980-1988 period. The results revealed that the cumulative appreciation rate for the conservation subdivision was 167.9 percent (21 percent annually). The rate for the Town of Concord was 141.9 percent (18.4 percent annually). The results showed that the appreciation rate for the conservation subdivisions was significantly higher than that for the conventional subdivisions.

Echo Hill South contained 102 housing units and nearly half of the total area (over 36 acres) was preserved as an open space. Orchard Valley served as an example of conventional subdivision providing 125 observations. Home sale prices included transactions that had taken place from 1968 to 1989. The cumulative appreciation rate for the Echo Hill South Conservation Subdivision was 462 percent (22 percent annually) and that for Orchard Valley Conventional Subdivision was 410 percent (19.5 percent annually). The results for the second case were similar to the first one in that they showed significantly higher appreciation rate for the conservation subdivision.

As far as I am aware, the study conducted by Mohamed (2006) is the only one that utilized OLS regression as well as ANOVA to examine the effect of conservation subdivisions per se on sale prices of housing lots. The dataset for the study consisted of 184 randomly selected observations on vacant developed lots in Kingstown, Rhode Island that were built and sold between 1993 and 2002. The author distinguished three types of subdivisions: conservation, conventional, and minor subdivisions. The latter type of subdivision was expected to be sold at lower price because of some specific feature characteristic to the type of development (shared driveways, irregularly shaped parcels, and closeness to busy streets). For the three types of subdivisions the author uses two dummy variable one of them featuring conservation subdivisions. Other variables such as natural log of lot size, year of transaction, availability of public water and sewer infrastructure, accessibility expressed in terms of distance to major roads, distance to scenic districts, distance to coastlines, median housing price, number of lots, and time for lots to sell were included in the model to obtain the effect of conservation subdivisions on developed lots. Four regression models were estimated that included different combinations of the above mentioned variables. Adjusted R^2 for each of the four models was 0.94 and the results showed that Conservation Subdivisions carried price premium ranging from 12 percent to 16 percent.

This chapter examined a wide variety of studied measuring the impact of different types of open space on residential housing or lot prices with an aim of identifying and quantifying non-market benefits provided by a open space as capitalized into nearby residential house or lot prices. Quantification of such benefits can serve as an economic justification for the preservation of valuable types of open space. Consideration of conservation subdivision and examination of a possibility of a price premium associated with such type of development is important, since conservation Subdivisions serve as a tool for the preservation of a wide variety of open space.

CHAPTER III

METHODOLOGY

This chapter is devoted to the presentation of the research methodology employed in the study to empirically estimate the affects of the main characteristics of conservation subdivisions on property prices.

The chapter starts with a brief description of non-market valuation techniques in general and hedonic price models in particular. It will be followed by the presentation of the theoretical framework behind hedonic property models, along with consideration of some of the problems related to the utilization of the technique. Issues concerning model specification and the criteria used in choosing the functional form of the model will be presented. The variables included into the hedonic model will be specified and described. The chapter will be summarized by a brief description of the study area, data collection methodology, as well as data sources and methods employed to obtain necessary variables.

Non-Market Valuation

The need for developing non-market valuation techniques is embodied in the fact that some of the environmental goods and services are not provided by ordinary markets. Unlike such ordinary goods and services as bread, cars, homes and haircut, the values of which can be determined by observing demand curves in respective markets, the environmental goods and services are not bought and sold in private markets and, therefore, it is not possible to reveal their economic value by applying the same economic theory utilized in determining the values of ordinary goods and services.

To address the issue of evaluating non-market goods and services, economists have developed different techniques, commonly known as non-market valuation methods that allow placing monetary values on such goods and services. The non-market valuation methods are generally classified into two categories: stated preference methods and revealed preference methods. The major difference between the two categories is in the means of obtaining data to estimate the values of environmental goods and services. Revealed preference methods rely on data from real markets where consumers maximize their utility subject to constraints. In contrast, data obtained by means of stated preference methods are based on responses to hypothetical questions and observations of people's behavior in hypothetical markets (Freeman, 2003 p. 24). According to Freeman (Freeman, 2003 p. 25) stated preference methods can be differentiated based on the elicitation format. The referendum format asks a person if he/she would be willing to pay a certain amount of money for a change in environmental goods and services. Data obtained as a result of the implementation of the technique are further used to estimate willingness to pay (WTP) or indirect utility functions.

Contingent ranking and choice experiment formats provide respondents with hypothetical alternatives distinguished from each other by environmental components as well as other characteristics. The respondents are asked to choose the most preferred alternative. Participants' choices are further analyzed to reveal the marginal rate of substitution between an environmental amenity and other characteristics implicit to ordinary markets and therefore, having monetary values. The latter allows for the computation of a respondent's (WTP) function for non-market goods and services of interest.

Contingent activity or contingent behavior format constitutes another type of stated preference methods. Based on participants' responses to the question of how he/she would change the level of some activity due to a specified change in an environmental characteristic, a marginal willingness to pay function can be estimated.

The last format discussed by the author is known as conjoint analysis or attribute-based stated choice. Respondents are asked to rank bundles on some scale. This technique is very similar to that of contingent ranking. If one or more elements of a bundle have market value than values of non-market goods can be inferred by analyzing the choices made by the participants. However, there are some generic problems and issues related with the use of states preference methods. The major concern is that the hypothetical nature of questions may cast doubt on reliability of the data and, if that is the case, produce biased inferences.

In contrast to stated preference methods, which rely on hypothetical situations to observe values people place on non-market goods, revealed preference methods reveal values of the goods and services by observing actual consumer behavior in existing markets. Revealed preference methods rely on the assumption that there is a complimentary or substitute relationship between non-market goods and services and market goods and the relationship affects peoples' choices with regard to market goods (Freeman, 2003 p.24). Travel cost model is an example of revealed preference methods. It examines visitors' out-of-pocket travel expenditure and the time spent to travel to a recreational site to derive the value of the site (McConnell and Walls, 2005). The household production model is another example that examines additional household spending on cleaning and repair of materials damaged due to poor air quality or some other cause related with the environment conditions. The hedonic pricing method is a widely used revealed preference method. Currently, it is predominantly used with respect to property prices. It relies on the housing market to identify and quantify various environmental goods and services associated with and reflected in house prices. However, it can be used to estimate marginal implicit prices of the characteristics of any product class that contains closely related products with different combinations of characteristics (Freeman, 2003 p. 124). For instance, Griliches (1961) applied the theory to prices of automobiles to try to estimate marginal implicit values of different characteristics comprising an automobile. Rosen (1974) further developed hedonic price model providing the formal theory of hedonic pricing technique within competitive markets in equilibrium. According to Rosen, goods have value due to their utility-generating characteristics. Economic agents can reveal the implicit prices or hedonic prices of those characteristics by observing the relationship between prices of differentiated products and associated amounts of characteristics comprising those products. Hedonic prices are econometrically estimated by regressing product price on characteristics and constitute the partial derivative of the price of a product with respect to its characteristic (Rosen, 1974).

Hedonic Price Theory

As was mentioned above a product class having enough products of different combinations of characteristics can be used to estimate a relationship, called the hedonic price function. The relationship defines a function that links the price of a product to the characteristics comprising the model (Rosen, 1974). The hedonic property value model gives the relationship between house price and various house characteristics which are separately or in combination valued by homebuyers and, therefore, have their value reflected in sales prices. Following

Freeman (2003) the price of a house can be represented as a function of its attributes in the following way:

$$P_{hi} = f(S_i, Q_i, N_i) \quad (1)$$

Here P_{hi} represents housing price, S is a vector of structural housing attributes (such as number of bedroom, number of bathrooms, lot size, and square footage of the house), Q encompasses a location-specific environmental characteristics (such as distance to a lake, marsh, river, availability of open space, house being within flood zone and percent of impervious surface), and finally N is a vector of neighborhood-specific characteristics (such as qualifying for flood insurance, racial composition, and local school quality). Once a hedonic property price function is established through multiple regression analysis, partial derivative of the function with respect to any attribute constitutes the marginal implicit price for that characteristic. Following the discussions of the model by Rosen (1974) and Freeman (2003), it will be briefly described how the model is emerging in a competitive housing market. A consumer's utility with fixed income (I) is determined by the housing characteristics (S, Q, N) that the person occupies as well as all other goods and services (X), a Hicksian composite good:

$$U = U(X, S_i, Q_i, N_i) \quad (2)$$

The consumer maximizes her utility subject to the budget constrain:

$$(I - X - P_{hi}) \quad (3)$$

The maximization yields the following result for every characteristic comprising the house:

$$\frac{(\partial U/\partial q_j)}{(\partial U/\partial X)} = \frac{\partial P_{hi}}{\partial q_j} \quad (4)$$

The left-hand side of the equation represents the marginal rate of substitution between q_j characteristic and the composite good as well as the marginal willingness to pay (MWTP) for the characteristic (McConnell and Walls, 2005). The latter shows the additional amount of money that the consumer is willing to pay to obtain a higher level of the characteristic. According to earlier interpretation of the hedonic price function, the right-hand side of the formula represents the marginal implicit price (MIP) for the characteristic q_j, which can be assumed to be an environmental attribute of the house. The marginal implicit price shows the additional amount of money that the consumer has to pay to obtain a higher level of the characteristic. In other words the consumer's utility maximization problem requires that her marginal willingness to pay for each characteristic be equal to marginal implicit price for that attribute. The relationship between marginal implicit price and marginal willingness to pay functions are represented graphically below (Figure 3.1).

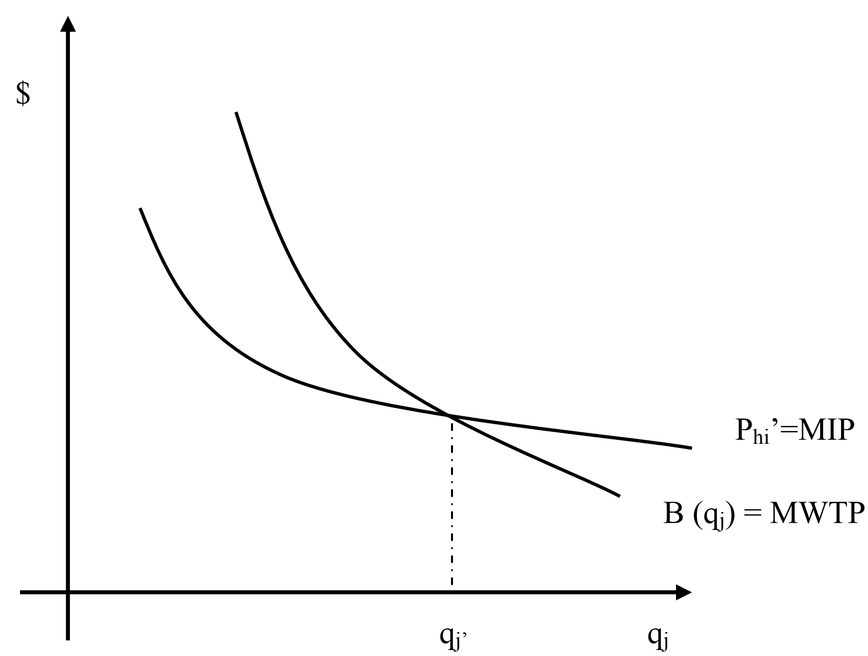

Figure 3.1: The Relationship between Marginal Willingness to Pay and Marginal Implicit Price.

Here P_{hi}' denotes the marginal implicit price for q_j obtained by taking derivative of the hedonic price function (equation 1) with respect to q_j and $B(q_j)$ in turn represents the marginal willingness to pay function associated with the same characteristic. The latter is obtained by maximizing equation (2) subject to equation (3) while holding the utility level constant. The consumer moves along the marginal willingness to pay function up to the point where her marginal willingness to pay to obtain one more unit of the characteristic is just equal to the marginal implicit price of the characteristic. Alternatively, the point of intersection of the two curves represents the utility-maximizing equilibrium point. Therefore, estimating the hedonic property function (equation 1) allows for the determination of the value of each characteristic comprising a house and contributing to the formation of its price.

However, the hedonic property price technique is not without limitations. There are several assumptions that must correspond to reality for the model to perform properly and the marginal implicit prices to reflect consumers' marginal willingness to pay functions. First, the real estate market should be in equilibrium and housing prices should be market-clearing prices. If the housing market is in disequilibrium, or existing prices can not be characterized as market-clearing ones then marginal implicit prices for house attributes do not reflect homebuyers' marginal willingness to pay for those attributes (Freeman, 2003). Second, the implicit price function must be differentiable and continuous. The latter requires a stock of houses with significantly differentiated characteristics for homebuyer to choose from. However, in some instances, housing options are quite limited, meaning that homebuyers may not be able to maximize their utility (McConnell and Walls, 2005). The third important assumption is that the housing market under consideration can be treated as a single market. If this is not the case than separate hedonic price functions should be estimated for each submarket to produce valid estimates of implicit prices (Freeman, 2003).

Data Collection/Methodology

Chatham County served as the study area for the thesis. The decision with respect to the site was partially based on the availability of data. The other reason was that the county residential market is relatively big and it would be possible to provide for enough variation of the characteristics. A subset of single family residential housing units sold between 1969 and 2006 was sampled to conduct the necessary econometric analysis.

Chatham County is one of Georgia's six coastal counties and is located on the southeast of Georgia. It is comprised of eight municipalities: Savannah (county seat), Bloomingdale, Garden City, Pooler, Port Wentworth, Thunderbolt, Tybee Island, and Vernonburg. According to the U.S. Census Bureau (2006), there were 107,922 housing units in the county in 2005. In 2006 total number of population was 241,411. In 2005 white persons represented 55.1 percent of total population while percentage of black persons was 41.3. Median income in 2004 was estimated to be $38,248.

Data used in the study come from the following sources: (1) Chatham County Tax Assessor's Office; (2) Odum School of Ecology, University of Georgia; and (3) U.S. Census Bureau. All of the property structural, environmental, and neighborhood variables, except for the variables regarding percentage of impervious surface and race, were obtained from data files provided by the Tax Assessor's Office. Data on impervious surfaces at the neighborhood level came from the Odum School of Ecology. The variable presenting the percentage of black population at Census block group level was generated using data provided by U.S. Census Bureau.

Data received from Tax Assessor's Office came in three separate files. The first file contained partial information (such as sales data, sales price, lot size, assessed land value, a assessed building value, and assessed real estate value) on properties in Chatham County which amounted to 105,338 units. The properties included residential units, as well as commercial and industrial facilities. Only single family residential houses are of interest to this study and it was decided to use only those residential properties that were located in R1 zoning districts. There were 31671 properties of this character. According to the "Zoning Regulations for Chatham County" a R1 zoning district contains single family residential dwelling and certain non-family units and promotes low-density residential development with the provision of adequate open space. Using GIS software non-family uses were excluded from the data set. Some of the properties had assessed building values of very small amount suggesting the absence of a house on the lot. Therefore, the properties that had building value less than $10,000 were deleted from the data set to make sure that the properties contained houses. A dataset containing 26,608 observations was imported into SAS for further processing. Using SAS software the open space variable was created at the neighborhood level by dividing the total area of open space in the neighborhood by the total area of that neighborhood. The neighborhoods were defined by the assessor's office, and they are typically determined by neighborhood boundaries. Furthermore, houses that were sold before 1969 and after 2006 were deleted.

The second file contained information on hydrological objects such as marshes and rivers. According the information stored in the file there were 802 swamp/marshes and 608 stream/rivers. Using the GIS software distance variables were created at 10 meter interval and were computed for houses that were located up to 500 meters from a hydrological object. The distance variable was combined with the variables obtained from the first file.

The third file contained data on house structural characteristics (number of fireplaces, number of garages, presence of a dock, a deck, a pool, the year the house was built, number of bedrooms, and exterior material of the house), and environmental attributes (whether the house had direct access to a hydrological object and/or was characterized as having nice view with regard to a hydrological object). Such hydro features as creeks, marshes, rivers were considered in determining whether a house could qualify as having direct access to a water body. Additionally, such hydro objects as lakes, ponds, and lagoons were combined with the above mentioned features to produce the view variable.

The data containing information on impervious surface were in GIS compatible format, so GIS software was used to generate the impervious surface variable. The latter shows the percentage of imperviousness at neighborhood level. Some observations did not have a value for the bedroom variable and therefore these were deleted. Also there were observations that had "missing values" (no information available) for such variables as dock, garage, deck, pool, and impervious surface. Those observations were also deleted from the dataset. Some of the observations had unbelievably small parcel sizes. The parcels that had area less than 0.05 hectares were deleted. There were houses that were reported as being built before 1750. Those houses were also deleted. It was also decided to delete the observations on houses that had real price of less than $20,000 and greater than 4,000,000 to get rid of outliers. The real price of the house represents the selling price of a house that is adjusted for inflation using a price index calculated for Chatham County property market. The creation of the index involved the following steps: the base year for the adjustment was chosen to be that of 2006. The index for each year was calculated by dividing the average price for that particular year by the average price in 2006 and the result was multiplied by 100. To convert the house price for the year into the real price, the house price for that particular year was divided by the appropriate index and multiplied by 100.

As a result of the above mentioned “cleaning” procedures the final data set contained 8196 observations in 235 neighborhoods that were used in the estimation of the log-log hedonic property model.

Model Specification/Variables

The purpose of the study is to estimate the effects on house prices of characteristics that are unique to conservation subdivisions. The latter will allow making inferences with regard to the possibility of existence of a price premium related with that type of subdivisions. Availability of data on house prices and other attributes comprising a house enables the application of the hedonic property value model to achieve the goal of the study.

The variables included in the study are very common for studies involving hedonic price functions. A few examples of these studies involving such variables are Mohamed (2006), Mahan, Polasky, and Adams (2000), Bolitzer and Netusil (2000), Doss and Taff (1996), and Lupi, Tomasi, and Taff (1991). The variables used in the model, along with their hypostatized effects on house prices are defines and presented below and in the Table 3.1.

REALPRICE = the dependent variable that represents the selling price of a house was adjusted for inflation using a price index calculated for Chatham County property market. The base year for the adjustment was chosen to be that of 2006. Using real sales price of a house is generally preferred to such alternatives as self-assessed, appraised, or census tract estimates since actual sales prices reflect consumers' actual market behavior and are closest to equilibrium prices (Mahan, Polasky, and Adams, 2000).

EFFAREA = the area of total structure in square meters. Hypothesized as a positive influence.

PARHEC = the parcel size in hectares. Hypothesized as a positive influence.

BEDS = the number of bedrooms in the house. Hypothesized as a positive influence.

FIREP = Dummy Variable, takes a value of one if the house has one or more fireplaces and takes a value of zero otherwise. Hypothesized as a positive influence.

BRICK = Dummy Variable, takes a value of one if the exterior of the house is brick or stone and takes a value of zero otherwise. Hypothesized as a positive influence.

GARAGE = Dummy Variable, takes a value of one if the house has one or more garages and takes a value of zero otherwise. Hypothesized as a positive influence.

DOCK = Dummy Variable, takes a value of one if the house has a dock for boats and takes a value of zero otherwise. Hypothesized as a positive influence.

DECK = Dummy Variable, takes a value of one if the house has a deck and takes a value of zero otherwise. Hypothesized as a positive influence.

POOL = Dummy Variable, takes a value of one if the house has a pool and takes a value of zero otherwise. Hypothesized as a positive influence.

ACYRBLT = the year the house was built. Hypothesized as a positive influence.

ISPC = the percentage of impervious surface in the neighborhood. Hypothesized as a negative influence.

OPENSPACE = the percentage of open space in the neighborhood. Hypothesized as a positive influence.

DISTRIVMAR = the distance in meters to the closest river or marsh. Hypothesized as a negative influence.

LINTERDF = interaction variable relating distance to the closest river or marsh and flood zone. Obtained by multiplying the distance variable by one if the parcel is in flood zone and by zero otherwise. Hypothesized as a positive influence.

WATERACC = Dummy Variable, takes a value of one if the house has water access and takes a value of zero otherwise. Hypothesized as a positive influence.

WATERV = Dummy Variable, takes a value of one if the house has a view and takes a value of zero otherwise. Hypothesized as a positive influence.

BLTPOSTFIRM = Dummy Variable, takes a value of one if the house was constructed after the community joint Federal Flood Insurance Program and takes a value of zero otherwise. Houses that meet this condition were constructed to better withstand hurricanes. Hypothesized as a positive influence.

PCRACE = the percentage of black population at Census block group level. Hypothesized as a negative influence.

It should be mentioned that some of the variables are quite general for any type of hedonic property value analysis (such as number of bedrooms, total area of the structure, race composition). Another set of variables is unique to conservation subdivision and is of central interest to the study (such as percent of open space within subdivisions and percent of impervious surface at subdivision level). The third set of variables is peculiar to houses located in coastal counties (such as the variable separating houses that were constructed after the community they belong joined the Federal Flood Insurance Program).

Table 3. 1. Variable definitions, measurement units, and expected signs.

Variable	Definition	Units	Expected Sign
REALPRICE	home selling price	dollars	
EFFAREA	the area of total structure	square meters	positive
PARCELHEC	parcel size	hectares	positive
ISPC	the percentage of impervious surface in the neighborhood	percent	negative
OPENSPACEPC	the percentage of open space in the neighborhood	percent	positive
DISTRIVMAR	the distance to the closest river or marsh	meters	negative
PCRACE	percentage of black population at Census block group level	percent	negative
FIREP	DV for fireplace	1 if one or more fireplaces, 0 otherwise	positive
BRICK	DV for brick or stone exterior	1 if one or brick or stone, 0 otherwise	positive
GARAGE	DV for garage	1 if one or more garages, 0 otherwise	positive
ACYRBLT	the year the house was built	years	positive
BEDS	the number of bedrooms in the house	actual number	positive
DOCK	DV for dock	1 if dock, 0 otherwise	positive

DECK	DV for deck	1 if deck, 0 otherwise	positive
POOL	DV for pool	1 if pool, 0 otherwise	positive
LINTERDF	interaction variable distance to the closest river or marsh and flood zone	distance to marsh/river if in flood zone, 0 otherwise/meters	positive
WATERACC	DV for access	1 if access, 0 otherwise	positive
WATERV	DV for view	1 if view, 0 otherwise	positive
BLTPOSTFIRM	DV for federal flood insurance program (FFIP)	1 if befor joining FFIP, 0 otherwise	positive

Functional Form of the Model

One of the most important methodological issues associated with hedonic property model is the choice of functional form (McConnell and Walls, 2005). Functional forms that have been used include the linear (Thorsnes, 2002; Irwin, 2002), the quadratic (Doss and Taff, 1996), the log-log (Irwin, 2002; Mahan, Polasky, and Adams, 2000), the semi-log (Bolitzer and Netusil, 2000), and the Box- Cox transformation (Lutzenhiser and Netusil, 2001). Generally, economic literature is not clear as to which of the above mentioned functional forms and in what situations are superior to others. According to Freeman (2003) the only restriction in using a functional form is that the first derivative of the hedonic function with respect to an environmental attribute be positive if the attribute is a good and be negative if the attribute is a bad. Certain types of Box-Cox transformations that allow for various transformations of independent variables are more flexible than the other functional forms and can provide the most accurate estimates of marginal implicit prices (Freeman, 2003). However, Cropper et al. (1988) found that when important explanatory variables are omitted from the model employing a Box-Cox transformation, the simple linear model produces more accurate estimates of marginal implicit prices. It should be mentioned that the omitted variable problem is quite common for a hedonic price analysis because it is difficult to identify and measure all the house attributes that have influence on its price.

This study will use log-log functional form in generating marginal implicit prices for the variables employed in the analysis. The latter means that both the dependant variable and the set of independent variables represent natural logs of initial values. The choice of the functional form from theoretical viewpoint is based on past literature as well as the reasoning that the effect on house prices of one unit increase in the variables included in the model is most likely to be dependant on the amount of that variables rather than being constant. The log-log functional form accounts for such dependence and therefore produces more accurate results than those obtained from the linear model. As to the empirical side of the functional for the choice is based on the R^2 criteria and the overall performance of the model (whether variables have their expected signs and are statistically significant). Three functional from included the linear, the log-linear, and the log-log were empirically estimate. Based on the above mentioned criteria it was decided that the log-log functional form performed the best. Therefore, the model employed in the study has the following form:

$LOGREALRPICE = \beta_0 + \beta_1 LOGEFFAREA + \beta_2 LOGPARHEC + \beta_3 FIREP + \beta_4 BRICK +$

$\beta_5 GARAGE + \beta_6 BEDS + \beta_7 DOCK + \beta_8 DECK + \beta_9 POOL + \beta_{10} ACYRBLT + \beta_{11} LOGISPC +$

β_{12}LOGOPENSPACE + β_{13}LOGDISTRIVMAR + β_{14}LINTERDF + β_{15}WATERACC + β_{16}WATERV + β_{17}BLTPOSTFIRM + β_{18}LOGPCRACE

In hedonic pricing models with log-log functional form beta-coefficients represent elasticities. In other words, the beta coefficients can be interpreted to show percent increase in the dependent variable due to one percent increase in the value of an independent variable. Therefore, recovering the marginal implicit price for a variable from the estimated model requires the following transformation:

$$\text{MIP} = \beta * \frac{\bar{y}}{\bar{x}}$$

The implicit price for a dummy variable is obtained by taking the anti-log of the beta-coefficient of the variable then subtracting one and multiplying by one hundred. The result shows the percentage change in the sales price of the house represented by the mean value of all houses in a dataset (Halvorsen and Palmquist, 1980).

CHAPTER IV

RESULTS

The first part of the chapter starts with a presentation of the descriptive statistics of the variables included in the regression analysis. It will be followed by a consideration of some econometric issues concerning estimation procedure and obtainment of accurate estimates. Description and interpretation of the results obtained from ordinary least square regression analysis is presented. The chapter ends with a description and interpretation of the results obtained from ordinary least square regression analysis.

Descriptive Summary

The data set used in the estimation procedure contained 8196 observations in 235 neighborhoods and included 18 independent variables. The descriptive statistics of the variables used in the estimation procedure is presented in Table 4.1, and includes mean, median, standard deviation, minimum and maximum values. The average house sales price (adjusted for inflation using a price index calculated specifically for Chatham County property market) was $247,375 with a range of $26,794 to $3,431,072 and the median was $200,000. Only 5.9 percent of the houses sold under $100,000. The majority of houses (73.2 percent) sold between $100,000 and $300,000. Houses that were sold for $300,000 to $500,000 and $500,000 to $700,000 constituted 14.7 percent and 3.7 percent respectively. Most of the houses were sold between 1990 and 2006 (87.9 percent).

Table 4. 1: Means, medians, standard deviations, minimum and maximum values of variables.

Variable	Mean	Median	Std. Dev.	Minimum	Maximum
REALPRICE	247,375.34	200,062.51	195,376.76	26,794.8	343,1072.1
EFFAREA	159.71289	144.6453	62.432227	41.805	737.10576
PARHEC	0.1721494	0.1109034	0.2783851	0.050053	10.237539
FIREP	0.749756	1	0.4331799	0	1
BRICK	0.4591264	0	0.498357	0	1
GARAGE	0.6754514	1	0.4682345	0	1
BEDS	3.1417765	3	0.5156792	1	6
DOCK	0.0558809	0	0.2297056	0	1
DECK	0.2624451	0	0.4399901	0	1
POOL	0.0583211	0	0.234364	0	1
ACYRBLT	1980.26	1983	18.665244	1820	2006
ISPC	12.236931	12.4301994	8.5438468	0.08373	48.355556
OPENSPACE	0.0345919	0	0.0683251	0	0.8610037
DISTRIVMAR	307.12592	220	294.02104	1	500
WATERACC	0.0506345	0	0.2192635	0	1
WATERV	0.0377013	0	0.1904845	0	1
BLTPOSTFIRM	0.272816	0	0.4454342	0	1
PCRACE	18.349356	9.3630084	19.848551	0	100

Houses sold from 1969 to 1979 and from 1979 to 1989 constituted only 3.6 percent and 8.5 percent respectively.

The average parcel size was 0.17 hectares, ranging from as low as 0.05 hectares and as large as 10.2 hectares. Approximately 41.6 percent of homes had parcels size less than 0.1 hectares, and 41.3 percent had parcel size ranging from 0.1 hectares to 0.2 hectares. Homes having parcel size in the range of 0.2 hectares to 0.4 hectares constituted 11.7 percent of the sample. The average number of bedrooms was 3.14 ranging from as low as 1 bedroom and as high as 6 bedrooms.

As to the characteristics of a conservation subdivision, the mean for the variable showing percentage of open space at neighborhood level was approximately 3.46 percent. While some of the subdivisions had zero value for this variable, there were some subdivisions that had up to 48 percent of the area set aside as open space. Approximately 54.6 percent of the subdivisions did not have any open space. Subdivisions having open space ranging from 0 percent to 10 percent and 10 percent to 30 percent constituted 29.5 percent and 15 percent respectively. Only 1 percent of the subdivisions had open space ranging from 30 percent to 50 percent.

The variable showing the percentage of imperviousness at the neighborhood level yielded the following results: the mean value for the variable was 12.2 percent with as low as 0.08 percent to as high as 48.4 percent. Approximately 40 percent of the houses were located in neighborhoods having less than 10 percent imperviousness and 46.7 percent of them were located in subdivisions having from 10 percent to 20 percent imperviousness. Subdivisions that had imperviousness ranging from 20 percent to 30 percent and 30 percent to 50 percent constituted 9.5 percent and 3.7 percent respectively.

Model Diagnostics

The hedonic property model with the log-log functional form was estimated using ordinary least square (OLS) regression analysis. If certain assumptions hold, then the OLS estimator is the best linear unbiased (BLUE), meaning that it has minimum variance among all linear unbiased estimates. However, if one or more assumptions are violated then the OLS estimator may not be the best choice (Kennedy, 2003).

Even though the estimated model yielded high R^2, and 15 out of 18 variables were statistically significant at the 95 percent confidence level, there is a need for further analysis of possible violation of some of the assumptions.

Multicollinearity

One of the assumptions of OLS regression is that there is no strong linear relationship among the independent variables. Violation of the assumption is called multicollinearity. In fact, it is quite common for the independent variables to be somewhat correlated. However, when there is exact linear correlation among the variables, then perfect collinearity is said to be present in which case the OLS estimator is not defined (Hill, Griffiths, and Judge, 2001). Notwithstanding the perfect collinearity case, the OLS estimator is unbiased and still has minimum variance. The major negative consequence of collinearity is that the variances of OLS estimates become large making results of hypotheses tests erroneous. In particular, large variances of OLS estimates result in small critical values of the t-tests supporting the null hypothesis that the estimates are not significantly different from zero.

Collinearity can be detected in several ways. One method is examining the correlation matrix of independent variables. A correlation coefficient that is greater than 0.8 (in absolute value) indicates a strong relationship between two variables indicating a presence of collinearity.

The disadvantage of the method is that it can only detect high correlation between two variables and is not useful for the situations when more than two variables are strongly correlated (Kennedy, 2003). The examination of the correlation matrix of the variables did not indicate any strong evidence of presence of severe collinearity, since no two of the variables had a correlation coefficient greater than 0.7 in absolute value.

Another way of detecting collinearity is that of using condition index, which is calculated by taking the square root of the ratio of largest eigenvalue divided by the smallest eigenvalue. If a condition index is between 10 and 30, than collinearity is a concern, and if a condition index has a value greater than 30, than severe collinearity in present in the sample (Gujarati, 1995). The condition index for the model was calculated in SAS yielding a value of 749 which, in turn, indicates a presence of severe collinearity.

Even though the second method indicated presence of collinearity in its severe form, the model displays none of the consequences typical to the problem: most of the independent variables (15 out of 18) are statistically significant and all of them have their hypothesized signs. Therefore, the presence of collinearity probably does not have effect on the results.

Heteroskedasticity

Another assumption of OLS regression is that the variances of the error terms are homoskedastic, meaning that they have constant variance. If the assumption is violated then heteroskedasticity exists. In the presence of heteroskedasticity the OLS estimator is still unbiased but it no longer has minimum variance among all linear unbiased estimators (Kennedy, 2003). Apart from the inefficiency of OLS estimates, heteroskedasticity also has consequences of an inferential nature. Since the calculation of variances (standard errors) of OLS estimates are based on the variances of error terms, the variances (standard errors) of beta coefficients are biased in the presence of heteroskedasticity. Therefore, they can no longer be trusted for constructing confidence intervals and conducting hypothesis testing.

There are several ways to test for the presence of heteroskedasticity, three of which were conducted in the study (visual inspection of the residuals, the White test, and the Breusch-Pagan test).

Examination of the residual plots is the first step to take in determining whether heteroskedasticity exists. This method involves plotting residuals against the fitted values as well as against the independent variables that are suspected of causing unequal error variances. If the plots show that the absolute magnitudes of the residuals do not significantly vary across different values of the independent variables or fitted values, then the error variances are probably homoskedastic. However, if there is a noticeable variation in the absolute magnitudes of the residuals, then further analysis is necessary (Kennedy, 2003).

The plot depicting residuals against fitted values did not reveal any strong evidence of heteroskedasticity. The results were identical in the plots depicting residuals against such independent variables as LOGEFFAREA, LOGPARHEC, and LOGPCRACE. The plots involving LOGISPC and LOGDISTRIVMAR could display some variation. However, there was no strong evidence to support the possibility of existence of non-constant variance due to those independent variables. It should be noted that the BEDS variable displayed some variation and may be thought to cause heteroskedastic error terms. Therefore, two formal tests were conducted.

The White general test for heteroskedasticity undertakes the following procedure: squared OLS residuals are regressed on all distinct regressors, their squares, and their cross-products. The test statistic (nR^2) is asymptotically distributed as Chi-square (q), where n is the number of observations and q is the number of repressors. The null hypothesis states that the error terms are homoskedastic. If the Chi-square value obtained from conducting the test is greater than the critical value of a chosen significance level than the null hypothesis is rejected meaning that variances of error terms are not constant. The White test was conducted in SAS and yielded a Chi-square value of 625.67 with degrees of freedom (DF) equal to 180. The value is greater than the Chi-square critical value of 212.3 at 5 percent significance level (DF180). Therefore, the null hypothesis was rejected indicated that the assumption of homoskedastic error terms is violated.

The Breusch- Pagan test is another way of testing for heteroskedasticity. Unlike the White general test, which does not require making any specific assumptions about the form of heteroskedasticity, the Breusch- Pagan test is based on the assumption that a set of variables is the cause of non-constant variances of the error terms (Greene, 2003). The test statistics under the null hypothesis of homoskedastic error variances is equal to one-half of the explained sum of squares (SSE), and follows χ^2 distribution with degrees of freedom (DF) equal to p. The SSE is obtained by regressing errors squared (from the initial model) divided by the average of the same errors squared on a set of variables that are suspected of causing heteroskedasticity. Here, p (DF) equals the number of variables in the set.

The test was conducted in STATA (the latter displays the test statistics, P-value, and degrees of freedom) and was based on the conclusions made from the examination of residual plots. First, the test was conducted on the assumption that BEDS variable was influencing the error variances. The test yielded χ^2 value of 38.901 and P-value of $4.5e^{-10}$. Therefore, the null hypothesis was rejected at 5 percent significance level. Second, the test was conducted on the assumption that LOGISPC variable was causing heteroskedastic error variances. The test yielded χ^2 value of 337.2723 and P-value of $2.5e^{-75}$. Therefore, the null hypothesis was rejected at 5 percent significance level. Third, the test was conducted on the assumption that LOGDISTRIVMAR variable was the cause of heteroskedastic error variances. The test yielded χ^2 value of 20.688 and P-value of 5.4e^{-06}. Therefore, the null hypothesis was rejected at 5 percent significance level. Finally, the test was conducted on the assumption that the three variables (LOGDISTRIVMAR, LOGISPC, and BEDS) were influencing the error variances. The test yielded χ^2 value of 402.7228 and P-value of 5.7e^{-87}. Therefore, the null hypothesis was rejected at 5 percent significance level. It was concluded on the basis of these tests that the error terms are not homoskedastic.

As was mentioned above, one of the serious consequences of violation of the homoskedasticity assumption is the resulting bias in the standard errors of the beta coefficients. Therefore, inferences based on the standard errors of the OLS estimates are no longer valid. However, as White (1980) showed in his famous paper titled "A Heteroskedasticity-Consistent Covariance Matrix and a Direct Test for Heteroskedasticity" it is possible to obtain an estimator of covariance matrix that is valid even when the error terms of the linear regression model are not homoskedastic and the form of heteroskedasticity is unknown. Moreover, as the author states "comparing the elements of the new estimator to those of the usual covariance estimator, one obtains a direct test for heteroskedasticity." The estimator is known as White estimator or alternatively, heteroskedasticity-robust estimator, since it produces valid estimates regardless of the presence and form of heteroskedasticity (Wooldridge, 2003).

The procedure was implemented in STATA and, as a result, heteroskedasticity-consistent estimates were obtained. Following White's recommendation, standard errors obtained from heteroskedasticity- consistent White estimator were compared with the usual standard errors.

Even though there were some changes in the values of standard errors, all the variables that were statistically significant (not significant) remained so.

Empirical Results

Ordinary least square regression was conducted to estimate marginal implicit prices (MIP) of the variables included in the hedonic property pricing model in log-log functional form described in Chapter III. The results are presented in Table 4.2 and include adjusted R^2, parameter estimates, and their respective standard errors.

Table 4.2: Parameter estimates, standard errors, and level of significance

Variable	Parameter Estimate	Standard Error	Robust Standard Error
Intercept	5.11598***	0.4758463	0.6391606
LOGEFFAREA	0.82166***	0.0130159	0.0168821
LOGPARHEC	0.10181***	0.007227	0.0095781
LOGISPC	-0.03511***	0.0041237	0.0048898
LOGOPENSPACE	0.04069***	0.0030216	0.0032352
LOGDISTRIVMAR	-0.00572**	0.0024373	0.0023743
LOGPCRACE	-0.05***	0.0028289	0.0032429
FIREP	0.07958***	0.0078698	0.0083773
BRICK	0.011	0.0067659	0.0069466
GARAGE	0.09629***	0.0081127	0.0092464
ACYRBLT	0.00162***	0.000248	0.0003345

BEDS	0.00202	0.0070626	0.0083296
DOCK	0.24049***	0.0173022	0.049476
DECK	0.05325***	0.0075498	0.00813
POOL	0.06463***	0.0133024	0.0145958
LINTERDF	0.01007***	0.001639	0.0018276
WATERACC	0.27798***	0.0182805	0.059498
WATERV	0.17947***	0.0166953	0.0162785
BLTPOSTFIRM	0.00746	0.0109808	0.0113686

n = 8196, R^2 =73.5 percent

*** - significant at α = 0.01, ** - significant at α = 0.05

Dependent Variable: Log of House Price

The adjusted R^2 measures the proportion of the total variation in dependent variable that is explained by the linear combination of the independent variables (Johnston and DiNardo, 1997). The adjusted R^2 for the regression model was 0.735 meaning that 73.5 percent of the variation in the house prices is explained by the set of independent variables used in the model. Since regression analyses based on cross-sectional data are usually characterized by relatively low adjusted R^2 , one can conclude that the model performs quite well. Moreover, 15 of the 18 variables were statistically significant at 5 percent significance level reinforcing this conclusion.

Before proceeding to the derivation of MIP for the appropriate variables it should be mentioned that one of the reasons in choosing the log- log functional form was the assumption that some of the variables are most likely to have non-linear relationship with the dependent variable. Recalling the equation for MIP (MIP = $\beta^* \bar{y} / \bar{x}$), it is clear that the latter depends on the value of the dependent variable as well as that of the particular independent variable. To facilitate the derivation of the MIP for a variable, the mean value for REALPRICE variable will be taken to represent the $\bar{y}$ and the MIP will be calculated for a particular value of $\bar{x}$ keeping in mind that changing that value of $\bar{x}$ will change the value of the MIP. In other words the MIP for a variable is dependent on the particular value of that variable.

LOGEFFAREA was significant at 5 percent significance level (p-value=0.0001) and had the hypothesized positive sign, suggesting that an increase in the area of the total structure will have a positively effect on the house price. The MIP for the variable was $1272.65 (LOGEFFAREA equals 160 square meters), meaning that home owners would be willing to pay $1272.65 for the next square meter of the structure.

LOGPARHEC was significant at 5 percent significance level (p-value=0.0001) and had the hypothesized positive sign, suggesting that an increase in the parcel size will have a positive influence on the house price. The MIP for the variable was $146,299 (LOGPARHEC equals 0.17 hectares). Since the variable was calculated using hectares as a measurement unit, the conversion into square meter measurement unit will result in the MIP of $14.63. Therefore, home owners would be willing to pay $14.63 for the next square meter of the parcel.

BEDS had the hypothesized positive sign suggesting that an increase in the number of bedrooms have a positive influence on the house price. However, it was not significant even at the 10 percent significant level (p-value=0.7749). The MIP for the variable was $499.7 meaning that home owners would be willing to pay $499.7 to have one more bedroom.

ACYRBLT was significant at 5 percent significance level (p-value=0.0001) and had the hypothesized positive sign, suggesting that new houses are preferred to old ones.

FIRE was significant at 5 percent significance level (p-value=0.0001) and had the hypothesized positive sign suggesting that the availability of a fireplace has a positive influence of the house price. The MIP for the variable was 0.0828. According to the interpretation of the MIP for Dummy Variables, home owners would be willing to pay $20,490 more to have a fireplace in the home.

BRICK was almost significant at 10 percent significance level (p-value=0.1041) and had the hypothesized positive sign suggesting that homeowners prefer to houses with brick or stone exterior. The MIP for the variable was 0.0111. According to the interpretation of the MIP for Dummy Variables, home owners would be willing to pay $2,736 more to have a house with a brick exterior.

GARAGE was significant at 5 percent significance level (p-value=0.0001) and had the hypothesized positive sign suggesting that the availability of a garage has a positive influence on the house price. The MIP for the variable was 0.10116. According to the interpretation of the MIP for Dummy Variables, home owners would be willing to pay $25,000 more to have a fireplace in the home.

DOCK was significant at the 5 percent significance level (p-value=0.0001) and had the hypothesized positive sign suggesting that the availability of a dock has a positive influence on the house price. The MIP for the variable was 0.27187. According to the interpretation of the MIP for Dummy Variables, home owners would be willing to pay $67,254 more to have a dock on the property.

DECK was significant at 5 percent significance level (p-value=0.0001) and had the hypothesized positive sign suggesting that the availability of a deck has a positive influence of the house price. The MIP for the variable was 0.05469. According to the interpretation of the MIP for Dummy Variables, home owners would be willing to pay $13,529 more to have a deck.

POOL was significant at 5 percent significance level (p-value=0.0001) and had the hypothesized positive sign suggesting that the availability of a pool has a positive influence of the house price. The MIP for the variable was 0.06676. According to the interpretation of the MIP for Dummy Variables, home owners would be willing to pay $16,515 more to have a pool on the property.

WATERACC was significant at 5 percent significance level (p-value=0.0001) and had the hypothesized positive sign suggesting that having water access has a positive influence of the house price. The MIP for the variable was 0.3204. According to the interpretation of the MIP for Dummy Variables, home owners would be willing to pay $79,273 more to have water access.

WATERV was significant at 5 percent significance level (p-value=0.0001) and had the hypothesized positive sign suggesting that the availability of a river or marsh view has a positive influence of the house price. The MIP for the variable was 0.19658. According to the interpretation of the MIP for Dummy Variables, home owners would be willing to pay $48,629 more to have a nice view from the home.

BLTPOSTFIRM was not significant at 10 percent significance level (p-value=0.4969) but had the hypothesized positive sign suggesting that homeowners preferred houses that were built to the standards of the National Flood Insurance Program. The MIP for the variable was 0.00748. According to the interpretation of the MIP for Dummy Variables, home owners would be willing to pay $1852 more for homes built to withstand floods.

LOGDISRIVERMARSH was significant at 5 percent significance level (p-value=0.0190) and had the hypothesized negative sign, suggesting that an increase in the distance from a hydrological object (marsh or river) will have a negative effect on the house price. The MIP for the variable was $4.61 (the distance equals 307 meters) and had negative sign, meaning that moving an additional meter from a hydrological object would decrease the house price by $4.61.

LINTERDF was significant at 5 percent significance level (p-value=0.0001) and had the hypothesized positive sign, suggesting that homeowners pay less for marshland proximity inside flood zones. The MIP for the variable was $3.5, meaning that if the house is located in a flood zone than moving an additional meter away from a hydro object would increase the house price by $3.5.

LOGPCRACE was significant at 5 percent significance level (p-value=0.0001) and had the hypothesized negative sign, meaning that an increase in the percentage of the variable has a negative influence on house prices. The MIP for the variable was $674.1(LOGPCRACE equals 18 percent) with a negative sign, meaning that a one percent increase in the percentage of black persons will decrease the house price by $674.1.

LOGOPENSPACEPC was significant at 5 percent significance level (p-value=0.0001) and had the hypothesized positive sign, meaning that an increase in the percentage of the variable has a positive influence on house prices. The MIP for the variable was $2,909.8 (the variable equals 3.5 percent), meaning that a one percent increase in the percentage of open space will increase the house price by $2,909.8.

LOGISPC was significant at 5 percent significance level (p-value=0.0001) and had the hypothesized negative sign, meaning that increase in the percentage of the variable has a negative influence on house prices. The MIP for the variable was $709.8 (LOGISPC equals 12 percent), with a negative sign, meaning that a one percent increase in the percentage of imperviousness will decrease the house price by $709.8.

So far the analysis has developed to assess the marginal implicit prices of the major characteristics of conservation subdivisions, along with other attributes of environmental nature that constitute an object of interest to the study. However, the objective of the study would not be fully accomplished without an attempt to try to obtain the estimated price of a house in a hypothetical conservation subdivision and that of a house in a hypothetical conventional subdivision. Comparing prices of the two alternatives will determine whether or not homes located in conservation subdivisions carry a price premium over those built according to the conventional standards of traditional development.

To proceed with the above mentioned goal it will be assumed that the hypothetical area to be built according to either conservation or conventional standards consists of a total area of 20 hectares. It is further assumed that there will be a total of 100 houses built on the site. Since the existence of a price premium is dependent upon the trade-off between three major characteristics of conservation subdivisions including percentage of open space, percentage of impervious surface, and the size of the parcel of a house, there is a need to obtain the values of the three to proceed with the assessment procedure. Since the majority of conservation subdivision ordinances require 40 to 60 percent of total areas be set aside as an open space (Tiffany et al., 2005), the percentage of open space variable for a conservation subdivision was chosen to be 50 percent. The percentage of imperviousness for both types of residential development was obtained from the National Oceanic and Atmospheric Administration (NOAA) website. The site features a hypothetical project implemented in a prime coastal Georgia residential site. The main purpose of the project is to assess possible benefits and costs of environmental, economic, and social nature related with three types of development two of which feature conservation and conventional subdivisions. According to the site the conventional subdivision has 15 percent open space. The percentage of impervious surface for conservation subdivision is 14 percent, and the conventional subdivision has 26 percent imperviousness. In order to assess the possible price premium related with homes that are located in a conservation subdivision, it will be assumed that two homes each of which is located in one type of subdivision are similar in every attribute. The only difference comes from conservation subdivision characteristics. The two homes have the following common characteristics: they have an effective area of 160 square meters, distance to either a river or a marsh is 250 meters, both are located in a neighborhood with a black population of 20 percent, have 1 fireplace, brick exterior, 1 garage, 4 bedrooms, no dock, 1 deck, 1 pool, are were built in 2005, are in a flood zone and within 50 meters from a river or a marsh, have no water access and were built in a community that participates in the Unites Flood Insurance Program. The percentage of imperviousness for the two subdivisions can be divided into two categories the first category being the area of houses and the other being the area of infrastructure. The area covered by houses is the same for both subdivisions, since it is assumed the housing units in two subdivisions are identical. Since each house has 160 square meters of total area and there are 100 houses the houses constitute 8 percent of 20 hectares of total subdivision (it is also assumed that each house has only one storey). Therefore, the conservation subdivision has 6 percent (14percent minus 8 percent) of the total area devoted to the infrastructure and the conventional subdivision has 18 percent (26 percent minus 8 percent) set aside for the same purpose. The later means that 12 percent (18 percent minus 6 percent) could be converted into an open space. To summarize the conservation subdivision will have 50 percent of the total area as open space and 6 percent as infrastructure. The remaining 44 percent will be devoted to the parcels. As to the conventional subdivision, there will be examined three scenarios. The first one will have 15 percent of open space which if combined with 18 percent of infrastructure results in 67 percent of total parcel area. The second one will have 10 percent of open space which if combined with 18 percent of infrastructure results in 72 percent of total parcel area. The third one will have zero percent of open space which if combined with 18 percent of infrastructure results in 82 percent of total parcel area.

The values of the conventional subdivision characteristics along with the ones characterizing conservation subdivisions were plugged into the following formula that is derived from the estimated regression equation:

$LOGREALPRICE= \beta_0 + \beta_1 LOGEFFAREA + \beta_2 LOGPARHEC + \beta_3 FIREP + \beta_4 BRICK + \beta_5 GARAGE + \beta_6 BEDS + \beta_7 DOCK + \beta_8 DECK + \beta_9 POOL + \beta_{10} ACYRBLT + \beta_{11} LOGISPC + \beta_{12} LOGOPENSPACE + \beta_{13} LOGDISTRIVMAR + \beta_{14} LOGLINTERDF + \beta_{15} WATERACC + \beta_{16} WATERV + \beta_{17} BLTPOSTFIRM + \beta_{18} LOGPCRACE$

Plugging respective values of the variables from the first scenario yielded a price premium of approximately \$9,121 for homes located in conservation subdivisions. If percentage of open space in the conventional neighborhood decreases from 15 percent to 10 percent, than the price premium for conservation subdivision houses increases to approximately \$12,063. Lastly, the third scenario yielded a price premium of approximately \$36,746 for homes in the conservation subdivision.

Two variables are of special importance to the study (ISPC and OPENSPACEPC), since those variables distinguish conservation subdivisions from conventional ones. Therefore, using the values in the hypothetical conservation subdivision of the variables, a more detailed explanation of the relationship between those variables and their respective MIP's is presented in a graphical form. Figure 4.1 shows the relationship between percentage of impervious surface and the respective MIP:

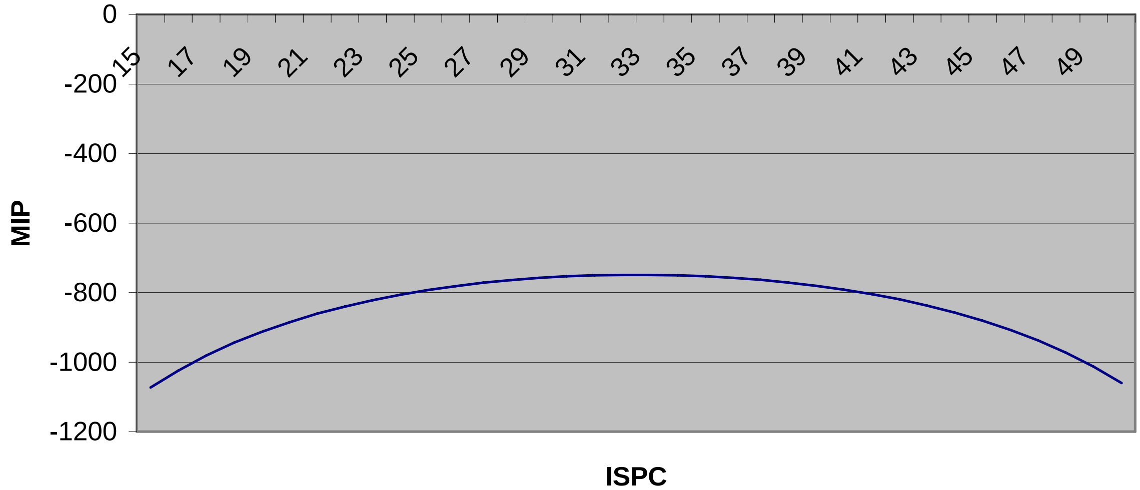

Figure 4.1: The Relationship between ISPC and MIP

It should be noted that percentage of imperviousness increases at the expense of the percentage of open space. In other words, if the impervious surface area increases by one percent the open space area decreases by one percent. According to Figure 4.1, increasing imperviousness by one percent decreases the house price by an amount equal to the respective MIP value. However, the rate at which the house price decreases in not constant. Increasing percentage of impervious surface by one percent produces a larger change at low levels of imperviousness (up to 20 percent), the magnitude of which decreases as the imperviousness increases (from 20 percent to 33 percent). However, the MIP increases at an increasing rate (starting from 34 percent) and becomes quite large at higher levels of imperviousness (from 45 percent to 50 percent). The reason for such pattern is that as the percentage of impervious surface increases that of the open space decreases (for instance if impervious surface equal 50 percent then open space equals 14 percent) and at lower levels of open space changes in it have increasingly higher effect on the house price. The relationship between percentage of open space and its MIP is represented in Figure 4.2:

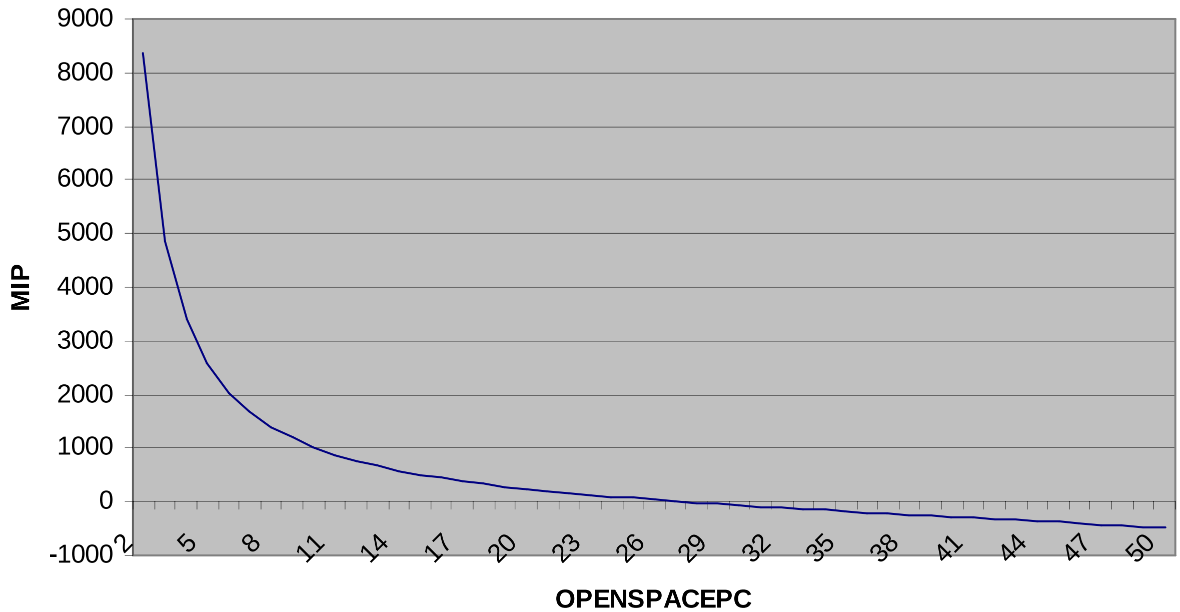

Figure 4.2: The Relationship between OPENSPACEPC and MIP

The percentage of open space is increasing at the expense of the parcel size. Therefore increasing open space has positive effect on the house price as long as its positive effects surpasses the negative effect from decreasing the parcel size.

According to the Figure 4.2 increasing percentage of open space produces quite large positive change in house price at low levels of open space (up to 10 percent level) and drops sharply at higher levels of percentage of open space (from 10 percent to 23 percent). Starting from 23 percent level the positive impact on the house price of an increase in the percentage of open space does not overcome the negative impact on the house price of decreasing the parcel size. Therefore, 23 percent of open space in the profit maximizing amount of open space for our hypothetical subdivision.

To summarize the two figures reinforce the notion that MIP's for continuous variable are not constant and depend on the values of those variables.

As was mentioned in the Chapter I, conservation subdivisions are also beneficial to the local governments if it is found that there is a price premium associated with such subdivisions. Higher prices of the houses translate into new tax revenues thus increasing the tax revenue base for the local governments. Having calculated the price premiums for different combinations of conservation subdivision characteristics allows calculating respective tax gains for the local government. According to the Georgia Department of Revenue website the tax rate on personal property is calculated by subtracting $2000 (homestead exemption) from assessed value of the house and multiplying the result by the appropriate millage rate. The assessed value for the house constitutes 40 percent of the fair market value of the house. The appropriate millage rate depends on the particular tax district and equal to 40.42 per $1000 for Savannah tax district. It is assumed that the hypothetical conservation subdivision is located in the Savannah tax district. In the case of a price premium of $9,121 the prices of homes in conservation and conventional subdivisions equal to $331,377 and $322,255 respectively. Plugging the appropriate numbers into the formula yields the additional tax gain of $14,750 for the local government for total of 100 houses. If the price premium equals to $12,063, then the local government gains additional revenue of $19,505. In the case of a price premium of $36,746 the total gains from the conservation subdivision equal to $59,416.

The other source of benefit for the local governments is a reduction of infrastructure maintenance costs. Developers usually build the necessary infrastructure for a particular subdivision but the maintenance of it is implemented by the local governments. The conventional subdivision in our example has 12 percent more impervious surface as compared to the conservation subdivision. Therefore, conversion of the conventional subdivision into conservation one would save the costs for the local government related with the maintenance of additional 12 percent of infrastructure. It would also lower the costs for developers who do not need to build that additional 12 percent of infrastructure.

Lowering the percentage of impervious surface has positive influence on the environment. The impervious surfaces are covered by such impenetrable materials as concrete, stone, and asphalt and negatively affect on the hydrologic cycle because they prevent water from infiltrating soil. When a significant portion of the area constitutes impervious surface runoff reaches water bodies much faster than in the case of less imperviousness causing the water to rise to higher levels. The consequences of such alteration of the hydrologic cycle are bank erosion, intensified downstream sedimentation, and impairment of aquatic habitat. The runoff also contains different kinds of pollutants (oil, metals etc.) that directly flow to waterways causing a wide variety of environmental issues. Therefore lowering the percentage of impervious surface and substituting it by open space presents a win-win situation for local governments, developers, residents, and the environment.

Therefore, the results show that conservation subdivisions are not only environmentally and socially justified but also prove to be economically beneficial to both developers and local governments.

CHAPTER V

SUMMARY AND CONCLUSIONS

Summary

After World War II period can be considered revolutionary in the context of residential housing development resulting in suburbia becoming the most preferred dwelling place for most Americans. However, rapidly growing suburban areas have created a wide variety of challenged ranging from environmental to social to economic issues that pose serious threats to the well-being of the residents of suburbia and demand new approaches to the conventional type of development (Tu and Eppli, 1999). Some of the negative environmental consequences of such types of development include loss of open space/natural areas, habitat, biodiversity, increased runoff resulting in pollution of water bodies and alteration of natural hydrological cycle. From an economic perspective expansion of suburban development is not beneficial for both the developers and the local governments. This type of development requires increased infrastructure costs (roads, sewer and water systems) reducing revenues of the developers. Since local governments are usually responsible for the maintenance costs related with the existing infrastructure conservation type of development is not beneficial for the local governments as well (Tiffany et al., 2005 and Tu and Eppli, 1999).

Conservation subdivision are considered an environmentally friendly type of residential development and are opposed to the more traditional types of development described above and characterized by large lots, absence of an open space, and greater amount of imperviousness.

Conservation subdivisions are a type of residential development in which clustering of houses on small lots allows a significant portion of the subdivision to be set aside as a common and permanently protected open space. Conventional subdivisions are scarce in terms of green spaces for walking and other recreational purposes, habitat for wildlife, and opportunities for neighbors to socialize (Wenger and Fowler, 2001).

Even though conservation subdivisions offer many advantages over conventional or suburban type of development, very little is known about the economics of conservation subdivisions. If this type of development is more attractive to consumers and carries a price premium over conventional type of development, developers will build conservation type of properties because of higher revenues. Therefore, it is essential to examine market acceptance of conservation subdivisions and whether this type of development carries price premium over conventional subdivisions. The study is aimed to accomplishing the above mentioned goal.

The first chapter of the thesis described the major negative consequence of traditional residential development or sprawl from economic, environmental and social viewpoints. It included the presentation of ideology behind some of the movements and development types that attempts to address the undesirable consequences of sprawl. In particular, the smart growth, an environmentally conscious movement, and the new urbanism, an alternative to conservation subdivisions, were presented and described in the study.

The second chapter of the thesis included the review of some of the empirical studies on the basis of which the theoretical framework for the study was constructed and the empirical analysis was implemented. The empirical studies examined were classified into three categories: studies related with open space valuation, studies on the effects of wetland size and proximity on house prices, and studies related with conservation subdivisions.

The chapter started with the presentation of some of the studies related to the valuation of open space defined broadly to include different types of open areas such as parks, natural areas, forested preserves, and agricultural land. The results from the studies showed that permanently preserved open space/natural areas had positive influence on nearby housing units and therefore, were capitalized into the house prices ((Bolitzer and Netisil (2000); Lutzenhiser and Netusil (2001); Geoghegan (2002); and Thorsnes (2002)).

Since the Georgia coast is abundant with different types of wetland areas, studies evaluating the impact of different types of wetlands on property prices by means of hedonic price models were considered separately. Several studies categorized wetlands into the following four classes: forested, scrub-shrub, emergent vegetation, and open water. The results of the studies showed that size of and proximity to wetlands had positive effect on house prices. The only exceptions were wooded swamps and bogs classified as forested wetlands (Lupi, Graham-Tomasi, and Taff (1991); Doss and Taff (1996); and Mahan, Polasky, and Adams (2000)).

The chapter closed with examination of the empirical studies on conservation subdivisions. Unfortunately, there are very few studies conducted on conservation subdivisions and there is a gap of scientific information regarding the economics of conservation subdivisions. The first study examined the appreciation rate of homes in conservation subdivisions and compared it to the appreciation rates of homes in conventional subdivisions (Lacy (1990)). The author foud higher appreciation rates for conservation subdivisions. The second study examined possibility of price premium related with special attributes of conservation subdivisions (Mohamed (2006)). The author found that conservation subdivisions carried a price premium over conventional ones.

This third chapter was devoted to the presentation of the research methodology employed in the study to empirically estimate the affects of the main characteristics of conservation subdivisions on property prices. It started with a brief description of non-market valuation techniques in general and hedonic price models in particular. Some of the non-market valuation techniques that were presented included the travel cost model, the household production model and contingent valuation model. It was followed by the presentation of the theoretical framework behind hedonic property models, along with consideration of some of the problems related to the utilization of the technique.

Issues concerning model specification and the criteria used in choosing the functional form of the model were presented and discussed. The variables included into the hedonic model were specified and described. The chapter was summarized by a brief description of the study area, data collection methodology, as well as data sources and methods employed to obtain necessary variables.

The forth chapter started with a presentation of the descriptive statistics of the variables included in the regression analysis. It was followed by a consideration of some econometric issues concerning estimation procedure and obtainment of accurate estimates. In particular, two violations of OLS assumptions were tested including multicollinearity and heteroskedasticity. Correlation matrix and condition index methods were used to detect multicollinearity. Even though the second method indicated presence of collinearity in its severe form, the model displayed none of the consequences typical to the problem: most of the independent variables (15 out of 18) were statistically significant and all of them have their hypothesized signs. There are several ways to test for the presence of heteroskedasticity, three of which were conducted in the study including visual inspection of the residuals, the White test, and the Breusch-Pagan test.

The conclusion was that homoskedasticity assumption was violated in the model. Heteroskedasticity robust White estimator was used to correct for the non-constant error variances. Description and interpretation of the results obtained from ordinary least square regression analysis were presented.

The chapter ended with the estimation of a possibility of a price premium associated with homes located in conservation subdivision as well as tax gains for local governments due to the price premiums. The estimation was conducted based on the results obtained from OLS regression analysis in two hypothetical subdivisions featuring major characteristics of conservation and conventional subdivisions.

Conclusions

The main objective of this study was to analyze the possibility of a price premiums for houses in conservation type of development associated with conservation subdivision characteristics in the coastal real estate market of Georgia. It was hypothesized that houses located in conservation subdivisions would sell for higher prices than those in conventional subdivisions due to the special features of conservation subdivisions (provision of a open space and low level of imperviousness). To test the hypothesis a hedonic pricing model with log-log functional form was utilized that along with structural (number of bedrooms, actual year build, effective area of the house, availability of a fireplace etc.,), neighborhood (percentage of black population and neighborhoods that joint Federal Flood Insurance Program), and environmental (whether the house had a water access and/or view on river or marsh, distance to a hydro object, distance to a hydro object if the house was located in the flood zone, and houses having dock) characteristics of the house included variables that distinguished conservation subdivisions from the conventional ones (small parcel size, low level of imperviousness, and availability of a open space). A dataset of 8196 observations in 235 neighborhoods obtained from Chatham County, Georgia was utilized to conduct OLS regression analysis. The adjusted R^2 for the regression model was 0.735 meaning that 73.5 percent of the variation in the house prices is explained by the set of independent variables used in the model. Moreover, 15 out of the 18 variables had their hypothesized signs and were statistically significant at 5 percent significance level. The other three variables (BRICK, BEDS, and BLTPOSTFIRM) had their hypothesized signs but were not statistically significant at 5 percent significance level. The three distinguishing variables had their expected signs and were statistically significant at one percent significance level. In particular the results showed that an increase in the percentage of the open space had a positive influence on house prices a decrease in the parcel size had negative impact on the house price, and an increase in the percentage of impervious surface had negative influence on the house price.

Having obtained the coefficients for the variables in the model allowed testing the main proposition of the study according to which the negative effect on house prices of smaller lots is more than compensated by the preservation of open space and lower level of imperviousness. To test the hypothesis two hypothetical subdivisions having 20 hectares of total area were created in which houses had the same attributes except those that distinguished conservation subdivision from conventional ones. The results indicated that, indeed there is a price premium associated with conservation subdivisions. If the percentage of open space equals 50 percent and the percentage of impervious surface equals 14 percent in the conservation subdivision, while the respective values of the characteristics of conventional subdivision equal to 15 percent (open space) and 26 percent (impervious surface) there is a price premium of $9,121 associated with the homes in the conservation subdivision. If the percentage of open space in the conventional neighborhood decreases from 15 percent to 10 percent, then the price premium for conservation subdivision houses increases to $12,063. Lastly, if it is assumed that the conventional subdivision does not have any open space then the price premium for homes in the conservation subdivision carry a price premium of $36,746.

However it should be noted that there is a trade-off between open space and parcel size. Assuming that infrastructure is at the optimal level (6 percent in our hypothetical situation) a further increase in the open space can be done at the expense of a decrease in the parcel size. The trade-off is beneficial up to the point where positive effect on the house price of increasing the open space compensates for the negative effect from decreasing the parcel size. In our hypothetical subdivision the optimal level of open space equals to 27 percent. Further increase of open space would lower the price of the house. The results indicate that for this particular case the optimal level of open space lie between the requirements of conservation subdivisions and that of conventional ones.

The other objective of the thesis was to calculate the possible tax gains for the local governments associated the price premiums for conventional subdivision homes. The calculation was based on the results from the hypothetical subdivisions as well as the information on the tax rate on personal property in Chatham County. In the case of a price premium of $9,121 the additional tax gain for the local government for 100 houses was $14,750. If the price premium equals to $12,063, then the local government gains additional revenue of $19,505. In the case of a price premium of $36,746 the total gains from the conservation subdivision equal to $59,416.

The variables of environmental nature that were of particular importance to the study had their hypothesized signs and were statistically significant at 5 percent level except the one distinguishing between the houses that were build in accordance with the requirement to qualify for the Federal Flood Insurance Program.

The variable indicating the distance of the house from a hydrological object (marsh or river) had hypothesized negative sign on the house price, meaning that as a house's price decreases with an increase in the distance from a hydrological object. However, the interaction term relating the distance to a hydrological object and flood zone was negative and corresponded to the hypothesized sign, meaning that homeowners prefer to be further away from hydro objects to avoid from flooding and other types of damages.

Having view on a river or a marsh had a positive influence of the house price. The homeowners would be willing to pay $48,629 more to have a nice view from their homes. Homes with water access proved to have substantial positive influence on the house price. The homeowners would be willing to pay $79,273 more to have water access.

To summarize the findings of the study, conservation subdivisions appear to represent a win-win-win solution. They carry a significant price premium for developers, likely reduce expenses of local governments while increasing their tax revenues, and improve environmental quality.

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