HOUSE AND LANDSCAPE VALUE: AN APPLICATION OF HEDONIC PRICING TECHNIQUE INVESTIGATING EFFECTS OF LAWN AREA ON HOUSE SELLING PRICE

by

MADISON CHARLES COLEY

(Under the Direction of Wojciech J. Florkowski)

ABSTRACT

Hedonic pricing technique is used to determine the effect of a landscape element such as the lawn area on the home selling price. Single family homes in Athens-Clarke County, Georgia, sold between 1998 and 2000, are the study's focus. Data included house attributes, e.g., bedroom number, and landscape characteristics including lawn area and turfgrass species. Results show that lawn area and the use of zoysiagrass as the dominant species in the lawn positively and significantly influenced the price. Results are of interest to the real estate and landscaping industries, homeowners, and research and extension specialists advising about turfgrass selection and care.

INDEX WORDS: Hedonic method, Potential Lawn Area, Turfgrass Value

HOUSE AND LANDSCAPE VALUE: AN APPLICATION OF HEDONIC PRICING TECHNIQUE INVESTIGATING EFFECTS OF LAWN AREA ON HOUSE SELLING PRICE

by

MADISON CHARLES COLEY

B.S.A., The University of Georgia, 2003

A Thesis Submitted to the Graduate Faculty of The University of Georgia in Partial Fulfillment

of the Requirements for the Degree

MASTER OF SCIENCE

ATHENS, GEORGIA

2005

HOUSE AND LANDSCAPE VALUE: AN APPLICATION OF HEDONIC PRICING TECHNIQUE INVESTIGATING EFFECTS OF LAWN AREA ON HOUSE SELLING PRICE

by

MADISON CHARLES COLEY

Major Professor: Wojciech Florkowski

Committee: Barry Barnett
Michael Bowker
Clint Waltz

Electronic Version Approved:

Maureen Grasso
Dean of Graduate School
December 2005

ACKNOWLEDGEMENTS

First and foremost I would like to thank my parents and family for encouraging me to pursue my post graduate education and supporting me throughout this process. The work ethic and respect for education my parents instilled has carried me through my undergraduate and graduate studies.

I would also like to thank my major professor, Dr. Wojciech Florkowski, for guiding me throughout the completion of this thesis. Without his help I would not have ever known the method behind a hedonic study and I would probably still be trying to decide on a thesis topic. At times, I dreaded the lonely two-hour drive to Griffin, but the knowledge I received from each trip was well worth the drive. I also want to thank my committee members for not only agreeing to serve on my committee, but also for their help throughout the thesis process. Dr. Michael Bowker was very helpful no matter what I had to ask. He not only helped me with the data and elasticity calculations, but we also got to talk extensively about a shared hobby. Without the instruction of Dr. Clint Waltz I would not have gained the training in identifying turfgrass varieties to complete the research for this study. Lastly, Dr. Barry Barnett, whose Agricultural Policy class taught me that there was more to agriculture than what happened on the farm. His instruction is one of the reasons that I decided to continue my education and pursue a career in agricultural policy.

TABLE OF CONTENTS

LIST OF TABLES

Page

LIST OF FIGURES

CHAPTER 1

INTRODUCTION

Stocks, bonds, home entertainment, children's education, and the purchase of a family car are very important investments made by a typical family. However, for a number of families the largest and most important investment is the purchase of a home. A home not only provides a family with a place to live, but it offers the family an opportunity to earn a return on the investment by eventually selling the house. Enhancing the value of a home is, therefore, important. A number of factors are used to calculate the selling price of a house. Among the important factors is the house's location, the square footage of the house, and attributes of the house including the number of bathrooms and the presence of a garage. The purpose of this study is to determine the economic value of potential lawn area and quality on the selling price of a home. This study is not only important to real estate agents, homeowners, and buyers, but also to the turfgrass and landscape industries. By quantifying the effect of potential lawn area on a home's selling price, a landscaper may use the results as a method of soliciting new business or by changing the lawn services that are offered. The results of the study will also help real estate agents and homeowners to place the proper emphasis on lawn and landscape appearance and quality in preparation of the house sale.

During the past decade the homeownership rates and median home values have been increasing throughout the United States. According to the U.S. Census Bureau, in 2000 almost 67 percent of homes were owned by the families living in the house. In Georgia alone, the homeownership rate increased by 2.6 percent between 1990 and 2000, while the homeownership rate in the entire United States increased from 64.2 percent in 1990 to 66.2 percent in 2000. The increase of homeownership rate was associated with the changes in the median house values.

The median home value, adjusted for inflation, increased from $101,100 to $119,600, between 1990 and 2000. The median home value in Georgia increased from $91,100 in 1990 to $111,200, a 22 percent rise, between 1990 and 2000. The census data show that homeownership rates and median home values should continue to increase in the United States in the foreseeable future.

The study's geographic focus is Athens-Clarke County, Georgia. In 1990 the voters of the city of Athens and Clarke County decided that the two should operate as a unified government. Athens is a college town located about 60 miles northeast of Atlanta, Georgia, the state's capital. There are around 35,000 home located in Athens, which has a population of over 100,000. The homes in this study are single family homes that were sold between 1998 and 2000. Each home had to be located on a lot less than 3 acres in size and had to have a courthouse transaction indicating that the house was sold. Information about housing and landscaping attributes were also collected for each home. The data, which included, among others, lot size, number of bathrooms, and heated square footage, was collected from the Athens-Clarke County Tax Assessor's Office. Potential lawn area (PLA) was calculated using two different methods. The first method, which was introduced by Robbins and Birkenholtz (2003), obtained PLA by subtracting certain house measurements from the lot size. The second method calculated PLA by subtracting the amount of impervious space from the lot size. The impervious space data were provided by the Athens-Clarke County Transportation and Public Works Department. The dominant turfgrass species along with a turfgrass color and turfgrass quality score for each home were obtained specifically for this study. The turfgrass species included bermudagrass, zoysiagrass, tall fescue, centipedegrass, and St. Augustinegrass, while the category "other" included other turfgrass species or lots where turfgrass was not present. Information about turfgrass was obtained by the author from curbside observations of each property.

House selling price is not exclusively influenced by its house attributes. The aesthetic value is associated with a home and its landscape features. However, the aesthetic value is difficult to measure because the aesthetic standard varies from person to person. For example, a homeowner may value flower beds and shrubs more than trees and turfgrass. In this study the actual selling price of the house is used assuming that the price reflects the landscape's aesthetic value for each property.

The hedonic pricing technique has been viewed suitable because this study focused on determining the price of a single item, which has a number of attributes differentiating one house from another and determining its price. The use of a hedonic study can be associated with any product that can be accurately described by a set of its own characteristics. However, among the most frequent applications of the hedonic method are studies involving the real estate industry. The Ordinary Least Squares (OLS) method will be used on this hedonic study to obtain the regression results and determine what effect lawn area has on the selling price of a home.

The importance of this study stretches far beyond the increased commissions real estate agents may receive or the increase in number of customers expected by a landscaper. Because a home is usually a family's most important investment, homeowners need to know what steps they can take to extract an acceptable return on that investment. The results of the study will show homeowners that by choosing the preferred turfgrass species and maintaining a healthy lawn they will be able to increase the selling price of their home.

CHAPTER 2

REVIEW OF LITERATURE

Introduction

Over the years, many papers reported results of applied hedonic studies. Many of these papers deal with real estate industry, but that is not the only area of study that uses the hedonic pricing approach. The following chapter reviews literature on empirical studies using the hedonic approach. The first section discusses the development of the hedonic method and explains the workings of a hedonic study. Next, a section reviews previous hedonic studies that focus on property and land values. This section also includes a discussion of results from such studies. The third section discusses articles dealing with the data collection process used in hedonic studies. Last, but not least, is a section reviewing literature related to hedonic studies on turfgrass and landscape.

Hedonic Analysis Development

What is a hedonic study? When and where did the idea begin? The answer to these two questions may vary with each person asked. In his 1998 article, "Andrew Court and the Invention of the Hedonic Price Analysis," Allen Goodman traces hedonic price analysis to Andrew Court's work for the automobile industry. In a 1939 article, Court used weighted characteristics, hedonics, to develop, "an idea of usefulness and desirability," for automobiles. However, Court's work on hedonic price analysis resulted in little response from the economic community.

Hedonic prices and price analysis may have remained unnoticed if not for Sherwin Rosen's much cited 1974 article in the Journal of Political Economy, "Hedonic Prices and Implicit Markets: Product Differentiation in Pure Competition." In this article, Rosen states, "Hedonic prices are defined as the implicit prices of attributes and are revealed to economic agents from observed prices of differentiated products and the specific amounts of characteristics associated with them" (p. 34). Rosen also develops the hedonic price function in this article. He proposes that the price is a function of a **z** vector, which is a vector of attributes and characteristics, each making a meaningful contribution to the price. In other words, the price can be decomposed into a series of a product attribute valuations. Rosen's article is cited in numerous studies which applied the hedonic analysis.

<u>Hedonic Property Value Analysis</u>

The use of a hedonic study can be associated with any item that has its own set of characteristics. However, among the most frequent applications of the hedonic method are studies in the real estate industry. Pagourtzi *et al*. (2003) noted that the hedonic price function shows the relationship between characteristics and prices. The authors went on to state, "…hedonic estimation in housing studies has been for the purpose of making inferences about non-observable values of different attributes…" (p. 396). The different attributes used in hedonic studies vary from field to field.

Tyrväinen (1997) used the hedonic pricing method to show that the price of a home reflects the homeowner's willingness to pay for values of an urban forest and access to that forest in Joensuu, Finland. His study concluded that an increase in the number of rooms, presence of a flat roof, age of the house, and if the house was considered low status housing all had a negative effect on the final selling price, but the percentage of green space, lot size, and if the residence had a sauna all increased the final selling price.

Kim and Wells (2005) showed the effects forest density had on property values in the Greater Flagstaff Area, Arizona. In their article they said that, "An increase of 10,000 m^2 of medium forestry canopy closure around the average residence increases the property's sale price by $1,700. A similar increase in high canopy closure yields a $500 decrease in the house sale price." (p. 179). Kim and Wells also found that if a home in the Greater Flagstaff Area had a garage, the selling price of that house increased by $15,934.

Le Goffe (2000) focused on measuring non-market benefits with a hedonic price method. He examined the rental price of cottages in rural France to see if there was a relationship between the renting price of the cottage and intrinsic, location, and environmental characteristics. The conclusion was that the renting price of rural cottages decreased if the cottage was located near a livestock farm, but the renting price increased if the cottage was located near "permanent grassland" (p. 400).

Shonkwiler and Reynolds (1986) applied the hedonic method to rural land prices. They found that land prices were determined by property, spatial, and location characteristics with respect to population. Rural land, which had the potential for commercial development, sold for a price about 57 percent higher than rural land with no commercial development in its future. Land that was sold with the possibility of residential development only sold for a little over 16 percent higher than land that could not have residential development.

Craig, Palmquist, and Weiss (1998) took a somewhat unorthodox approach toward hedonic study. In studying land values in the antebellum United States, the authors argued that land values in the antebellum South were based on the types of transportation available in the county, population, location, and whether a county was classified as a “cotton” or “sugar” county. Their study found that the selling price of land in “sugar” counties had a 249 percent premium in 1850 and a 233 percent premium in 1860. Those premiums related to increases in land values of $30.15 per acre in 1850 and $46.10 per acre in 1860. “In 1850 on average, having river or canal access increased land values by about 22 percent or $2.70 per acre, whereas rail access increased land values by 15 percent or $1.80 per acre.” (p. 180).

Do and Grudnitski (1995) were the first to use a traditional hedonic pricing model to study the effect of golf course location on the selling price of single-family homes. Their study, which took place in San Diego County, California, concluded that golf course properties had a 7.6 percent premium in their selling price due to the course proximity.

The cited studies showed that the presence of specific home amenities and landscape features in the context of feature location to a house had a significant effect on the selling price. The landscape features were either natural, e.g., forest density, or resulted from human decisions, e.g., permanent pasture. However, increasingly important are landscape features that are shaped by owners for the purpose of aesthetics or associated with lifestyle choices, e.g., golf course proximity.

Data Collection for Hedonic Studies

Data are collected from the Internet, library, surveys, personal observations, etc. For hedonic studies, however, the literature shows three main data collection processes: census data, multiple listings data, and geographic information systems (GIS). Each of these methods has its advantages and shortcomings. Shultz and King (2001) used census data instead of multiple listing services or property-tax assessments to study hedonic price estimates of amenities and land use. They discussed three problems with using census data in hedonic studies. First, the data may have been outdated because the U.S. Census Bureau conducts its census every ten years. Second, the housing data from a census are not based on actual prices, but on individual assessments of properties. Third, the housing data do not include many structural characteristics of the house.

An alternative source of data is the use of multiple listings. Tax assessor data are one of the most common forms of multiple listing data and a source of data about the real estate market. Dubin (1998) suggests that multiple listings data provide housing characteristics needed to estimate a hedonic regression. He uses multiple listings data to predict housing prices in Baltimore, Maryland. In his study, Dubin found that a fireplace increased a home's selling price by $9,000 and that the selling price of a house decreases by $5,600 if the house is considered a row house. Multiple listings data are usually easy to collect and organize because most of them can be found in electronic data bases which can be accessed through the Internet or in the tax assessor's office.

With the ever increasing expanse of technology, a new wave of data collection is taking the hedonic world by storm. GIS data are collected from satellite images of the Earth's surface. Improving resolution leads to accurate images which become available as the satellite technology continues to evolve. Patterson and Boyle (2002) report that GIS data are helpful when using hedonic models to study the effect of attributes or amenities on the sale price of residential property, especially in determining the distance between a house and amenity. For example, Geoghegan, Wainger, and Bockstael (1997) insist that using spatial data, such as data generated from the GIS, in ecological and environmental studies has the potential to be of great asset in measuring the value of landscape features. Their study, which focused on residential values around Washington, D.C., concluded that the residential value decreased by 1.7 percent for every 10 percent increase in the distance from the residence to Washington, D.C.

Literature on Turfgrass and Landscape

A recent article in U.S. News and World Report (May 16, 2005, p. 57) states that turfgrass covers roughly 40 million acres in the United States and turfgrass has become the nation's leading irrigated crop. Christina Milesi, who is a researcher at the National Aeronautics and Space Administration (NASA), says in the article, "the 2 percent of the U.S. land surface that is covered in lawns could account for about 5 percent of the . . . carbon dioxide absorbed by all plants" (p. 57). Even though turfgrass may be the largest irrigated crop in the United States there have been hardly any studies on the value of turfgrass in relation to the selling price of a home.

Despite the recognized importance of turfgrass, there have been numerous studies measuring the effect of trees on the selling price of a home. Payne (1973) introduced the idea that excessive tree cover had a negative effect on residential value. He concluded that, "Adding more than thirty trees to a half-acre lot actually reduced the total property value;" (p. 75). However, it appears that homeowners' preferences disagree over time. Anderson and Cordell (1988) used the hedonic pricing method to study the effects that trees had on residential property values in Athens, Georgia. Their study looked at 844 single family homes that were sold between 1978 and 1980, and concluded that the presence of trees on the lot was associated with a 3.5 to 4.5 percent increase in the value of the home. More recently, Sydor (2005) conducted a similar study in Athens, Georgia. His hedonic study concluded that a 10 percent increase in relative tree cover could result in a premium of up to $3,240 on the value of the residence.

Rosiers *et al.* (2002) used a hedonic study to measure landscaping effects on house values. The article stated, “While the impact of tree cover on residential prices has already been the object of several studies, little attention has been devoted to landscaping as such” (p. 139). Their study found that a 1 percent increase in ground cover resulted in a 0.2 percent increase in selling price. However, the study also found that as the density of visible vegetation on the property increases, there is a 2.2 percent drop in the price of the house. Finally, here is more evidence that various landscape features are valued differently by house buyers. Luttik (2000) used the hedonic pricing method to determine the effect certain environmental factors had on house prices in the Netherlands. Luttik’s study concluded that a house in Leiden that had a water view had a 10 percent premium on its price, and that there was a 7 percent premium on houses with attractive landscape and water features. The guidelines for attractive landscapes with water features were not discussed in the article.

One problem that limits the turfgrass value assessment is the calculation of the turfgrass area. Robbins and Birkenholtz (2003) introduce a method for calculating the potential lawn area (PLA). The method defines the PLA as equal to the overall lot size in square feet less the house square footage divided by the number of floors in the house. The method is flexible and can be applied to any home in any city. To get the final PLA, the authors multiplied the PLA by a multiplier (equal to 0.816) to account for impervious space and other non-lawn space of each lot. An impervious space is any part of a lot that is resistant to water. Robbins and Birkenholtz (2003) use this method to calculate lawn coverage because the satellite images and aerial photos available were not at high enough resolutions to adequately measure lawn cover.

The Robbins and Birkenholtz (2003) formula accounting for lawn area is:

(1) $PLA = LSQ - (SQ/FLR) * 0.816$

where PLA is potential lawn area, LSQ is lot size in square feet, SQ is house square footage, FLR is the number of floors, and 0.816 is the multiplier used to account for impervious and other non-lawn space.

CHAPTER 3

DATA AND METHODS

The Data

In contrast to secondary data sources, for example, publicly posted data bases, a study that is focused on microeconomic issues within a local community calls for a special data gathering process. The objectives of this study require data on private residences. Collecting data on individual residences is tedious because many counties do not have computerized databases that include tax assessor housing data. Among counties that do have such databases, many are not accessible over the Internet. A researcher in need of collecting such data might encounter difficulties that require effort and ingenuity. The Athens-Clarke County Tax Assessor's database is computerized, but it can only be accessed from the computers at the Tax Assessor's office. Access to the potentially sensitive information is limited for security reasons.

The data used in this study can be separated into two subsets, housing data and landscape data. The bulk of the data in the housing data set was obtained from a previous study by Sydor (2005). Sydor focused on the value of trees in Athens-Clarke County, Georgia, and linked their value to the house selling price. The data from that study was obtained as a part of the housing data subset and included information about residential real estate. Data referred to house attributes, such as selling price, year of sale, heated square footage of the house and other relevant information. Property specific characteristics were also obtained. Some of these variables were listed among data provided by Sydor (2005), e.g., the lot size or the bare land value. Other measures such as the PLA and the amount of impervious space were developed specifically for this study. The PLA was calculated using the calculation method introduced by Robbins and Birkenholtz (2003). The amount of impervious space, which is the area of the lot that can not saturate water, was collected from a data set provided by the Athens-Clarke County Transportation and Public Works Department. The landscape data subset included measures pertaining to turf surrounding the house. Landscape attributes, for example, the turfgrass species, turfgrass color score, and the turfgrass quality score for each of the surveyed residential properties were included in the landscape data subset and measured using the procedure developed for this study.

The original dataset contained 272 observations. However, the impervious space data for one of the observations was larger than the lot size. Because this was clearly an error, this observation was removed from the dataset. Therefore, the dataset used for this study contained 271 observations.

Housing Data Subset

The house attributes included in the data set refer to homes located within Athens-Clarke County, Georgia. Athens-Clarke County is located 60 miles northeast of Atlanta, the state capital, and includes the cities of Athens and Winterville. Athens, GA is home to the 35,000 students of the University of Georgia. The housing data set was constructed by using the Multiple Listings Catalog (MLS) at the Athens-Clarke County Tax Assessor's Office. The data set only included single family homes in Athens-Clarke County that were sold between 1998 and 2000. The homes had to have a lot size less than or equal to three acres and had to have a courthouse provided transaction. Furthermore, the data set did not include any apartments or condominiums, any homes that were inherited or in an estate, or any homes that had not been labeled as a market transaction in the Tax Assessor's database.

The attributes reported for each house were; house heated square footage, selling price, number of floors, number of rooms, number of bathrooms, garage square footage, porch square footage, open and screened porch square footage, deck square footage, basement square footage, year of construction, the age of the home, and the year of sale. Attributes of the land lot, referred to as the landscape data set, were also collected and included lot size in acres and square feet, lot value per acre, lot value, the PLA in acres and square feet, and the leaf coverage area in square feet. The impervious space in square feet was also collected. However, all of these variables were not used in the regression model. Table 1 lists each variable that was used in the regression and its definition. The descriptive statistics of the variables, e.g., means, medians, can be found in Table 2.

The average selling price of the studied homes was $122,486. However, the prices ranged from as low as $6,000 to the highest price of $370,000. Along with the selling price of the home, the data set included lot size, lot value, and the lot value on a per acre basis. The lot size ranged from 0.06 acres to 2.92 acres. The median lot size was only 0.37 acres which indicates that more than half of the homes in the study were located on lots less than a half-acre in size. Like many urban areas in the United States, Athens-Clarke County consists of affluent neighborhoods and low-income neighborhoods.

Some housing attributes did not apply to every household in the data set. Of the 44 houses that had a garage or a basement the average garage was 501.14 square feet and the average size of the basement was 985.55 square feet. Almost 93 percent or 251 homes had an open porch. The size of open porches ranged from a minimum of eight square feet to a maximum of 1,006 square feet. Clearly, the data set contains some very different properties with regard to an open porch size. An open porch is a southern tradition and the mild climate permits the use of such areas almost year-round. However, only about 28 percent of the homes had a screened porch. A screened porch can be more expensive than an open porch and its presence depends on the design of the house. Some homes were constructed with a screened porch, others allowed for its later addition, while some designs are not amenable to this amenity. The median size of a screened porch was 167.5 square feet.

House specific characteristics were also calculated. The median home in the study had six rooms, two bathrooms, one story, was 46 years old, and sold for $105,000. The 2000 United States Census reported that the median Georgia home had 5.5 rooms and sold for $111,200. According to data from Athens-Clarke County the earliest home was constructed in 1886 and the newest homes were constructed in 1998. Table 3 shows shares of homes per each size category of rooms, bedrooms, and construction year. Almost 85 percent of the homes in the study were one-story homes, while only a little over 13 percent of the homes had a total of four or fewer rooms. Another interesting fact is that 28.8 percent of the homes were constructed before 1941. This indicates that almost a third of the homes in the dataset were almost 60 years old at the time of their purchase.

The Landscape Data Subset

The landscape data subset can be broken down into two categories, i.e., turfgrass description and impervious space data. The turfgrass description was collected by visiting each of the 271 houses and conducting an individual turfgrass assessment. The purpose of the assessment was to determine the turfgrass species and to assign the turfgrass color score and the overall quality score. The impervious space data was collected from a database provided by the Athens-Clarke County Transportation and Public Works Department. The database included the amount of impervious space, in square feet, for every household in Athens-Clarke County. The database, which had over 35,000 entries, had to be scaled down to include only the 271 houses that were in the original sample.

Turfgrass description

Turfgrass presence around the residence and its effect on the house selling price has been acknowledged, but there has been little evidence of a formal investigation linking the two. Among reasons for the lack of relevant studies has been the absence of readily available data. First, turfgrass varies in its appearance and quality, which can be difficult to measure. Second, turfgrass must be assessed separately for each residence. An assessment requires a physical inspection of turf at each location demanding time and skills.

Prior to conducting the assessments practical training was received on identifying turfgrass species, turf color, and turf condition by visual inspection. An assessment involved the identification of the dominant turfgrass species in the front yard of the homes because all assessments were conducted from the curb or sidewalk. This was necessary because it assures a fast data collection process, while avoiding a cumbersome and prolonged process of receiving a permit from the homeowner. Furthermore, there was no guarantee that a permit would be granted leaving the observation from the street as the only option. These observations were taken five to seven years after the house was sold, therefore, it was assumed that the turfgrass species did not change during that time.

The turfgrass assessments were conducted from the middle of May until the end of June, 2005. This period was chosen because the warm-season turfgrasses had ample time to enter their vegetative stage after their winter dormancy. The period was also suitable for the evaluation of the only cool-season turfgrass, tall fescue, considered in the study. The different turfgrass species that were assessed were bermudagrass, centipedegrass, zoysiagrass, tall fescue, and St.

Augustinegrass. The category "Other" on the turfgrass check sheet (Appendix) classified turfgrass that was unidentifiable and yards that did not have any turfgrass.

The turfgrass check sheet included boxes for the turfgrass quality score (TQ) and the turfgrass color score (TC). The National Turfgrass Evaluation Program (NTEP) measures TQ and TC on a scale from one to nine. These scores are based on visual observations of the turfgrass. The score of nine implied the highest quality or color score, respectively, and the score of one being the worst according to the industry standard set forth by the NTEP for evaluating turfgrass quality and genetic color. Each individual turfgrass assessment resulted in a dominant turfgrass species and an overall TQ score and TC score. A turfgrass index score was also developed. The index was the summation of the TQ score and the TC score from each assessment.

Figure 1 "Shares of turfgrass species of 271 residential properties in Athens-Clarke County area, May-June 2005," shows the breakdown of the turfgrass species based on 271 assessments. Bermudagrass, which was the dominant turfgrass species at 131 assessed residencies, accounted for nearly half of the turfgrass assessments. Centipedegrass, which accounted for 31 percent of the assessments, was the second most common turfgrass species. These results were in line with expectations because the bermudagrass and centipedegrass species are usually considerably less expensive than the other warm season turfgrasses. However, St. Augustinegrass was the dominant turfgrass species on only two of the 271 assessments. This is surprising because St. Augustinegrass is a grass that thrives in sun or shade. Because Athens-Clarke County is an urban area and there is a significant tree cover in most residential neighborhoods, St. Augustinegrass was expected be more prominent on a larger number of properties.

Along with dominant turfgrass species, an overall TQ score and TC score were also recorded. Figure 2 displays the average TQ and TC scores for each of the different turfgrass species.

Of the five different turfgrass species, zoysiagrass had the highest average TQ score, 7.85. Zoysiagrass' high cost and quality are reasons why it usually can be found in affluent neighborhoods where homeowners have the means to maintain a high quality lawn.

The highest two average TC scores occur for the tall fescue species and St. Augustinegrass. Both species tend to be a darker shade of green than the other turfgrasses and this is likely a reason for high average color scores. Another reason tall fescue had a high average color score was the delay in the onset of warm weather. The mild spring of 2005 had not induced dormancy in the tall fescue.

Impervious space

Impervious space is defined as any area within a property's limits where water can not soak into the ground. Examples of impervious spaces are driveways, roofs, and home footprints. The Athens-Clarke County Transportation and Public Works office uses this data to calculate the stormwater and runoff fees for individual residences. In this study the impervious space data was used as an alternative way to calculate the PLA. A subtraction of the amount of impervious space, in square feet, from the size of the lot, in square feet, determines the amount of area on a lot where turfgrass could be grown. A potential problem is that the collection of impervious space data was from a 2005 database, while the house specific information refers to houses sold between 1998 and 2000. The amount of impervious space was calculated by selecting the 271 sample lots out of a database of over 35,000 homes. The average size of impervious space for the sample data was 3,225 square feet. The houses were identified by their tax assessor parcel number, from the database provided by the Athens-Clarke County Transportation and Public Works Department.

When the PLA was calculated using the impervious space data method instead of the method introduced by Robbins and Birkenholtz (2003) the results were not very similar. The impervious space method can be expressed as:

(2) PLA = LSQ – IMPSP

where PLA is potential lawn area, LSQ is lot size in square feet, and IMPSP is the amount of impervious space in square feet. The PLA calculated from the impervious space method resulted in a mean of 25,031 square feet. This calculated mean was roughly 4,000 square feet larger than the approximate lawn area obtained by using a modification of the method proposed by Robbins and Birkenholtz (2003). This large discrepancy is attributed to the PLA multiplier of 0.816 used in Robbins and Birkenholtz (2003) formula..

In this study a modified method of calculating the PLA is proposed. The method takes into account the Robbins and Birkenholtz (2003) method. However, the proposed method also accounts for house amenities that present an extension of the house, for example a porch. The specific formula used in this study to calculate the PLA is:

(3) PLA = (LSQ – ((HSQ-BASEM)/FLR) – GSQ – DSQ – PCSQ – OPSQ – SPSQ) * 0.816

where the PLA is potential lawn area, LSQ is lot size in square feet, HSQ is heated square footage, BASEM is basement square footage, FLR is number of floors, GSQ is garage square footage, DSQ is deck square footage, PCSQ is porch square footage, OPSQ is open porch square footage, SPSQ is screened-porch square footage, and 0.816 is the multiplier to account for impervious and other non-lawn space.

Table 1. Variable names, definitions and measurement units.

Variable	Definition	Units
SP	Home selling price	$
HSQ	Heated square footage	Square feet
OPSQ	Open porch area in square feet	Square feet
OPSQ1	Open porch dummy	1 if open porch present; 0 otherwise
DSQ	Deck area in square feet	Square feet
DSQ1	Deck dummy	1 if deck present; 0 otherwise
RMS	Total number of rooms in the house	Actual number
BRS	Total number of bathrooms in the house	Actual number
BRS1	Dummy variable for number of bedrooms	1 if BRS>1; 0 otherwise
PLA	Potential lawn area in square feet	Square feet
PLAM1	Potential lawn area dummy	1 if PLA<=10000 square feet; 0 otherwise
PLAM2	Potential lawn area dummy	1 if PLA between 10001 and 15000 square feet; 0 otherwise
PLAM3	Potential lawn area dummy	1 if PLA between 15001 and 25000 square feet; 0 otherwise
PLAM4	Potential lawn area dummy	1 if PLA>=25001 square feet; 0 otherwise
IMPSP	Amount of impervious space in square feet	Square feet
LC	Leaf coverage in square feet	Square feet
LC2	Leaf coverage squared	Square feet
LCPLA	Ratio of leaf cover to potential lawn area	Actual number
BERM	Bermudagrass	1 if bermudagrass; 0 otherwise

CENT	Centipedegrass	1 if centipedegrass; 0 otherwise
ZOYS	Zoysiagrass	1 if zoysiagrass; 0 otherwise
FES	Tall Fescue	1 if tall fescue; 0 otherwise
STAUG	St. Augustinegrass	1 if St. Augustinegrass; 0 otherwise
OTH	No turfgrass or unidentifiable species	1 if Other; 0 otherwise
INDEX	Turfgrass quality and color index	Summation of TQ and TC
DATE1	Year of sale dummy	1 if year=1998; 0 otherwise
DATE2	Year of sale dummy	1 if year=1999; 0 otherwise
DATE3	Year of sale dummy	1 if year=2000; 0 otherwise
AGE	Age of the house	Actual nuumber

Table 2. Means, medians, standard deviations, and ranges of variables used in the empirical model estimation.

Variable	Mean	Median	Std. dev.	Minimum	Maximum
SP	122,496.89	105,000.00	70,621.50	6,000.00	370,000.00
HSQ	1,729.82	1,481.00	855.25	613.00	5,868.00
OPSQ[a]	219.30	144.00	218.81	8.00	1,006.00
OPSQ1	0.93	1.00	0.26	0.00	1.00
DSQ[b]	245.31	208.00	181.87	20.00	888.00
DSQ1	0.21	0.00	0.41	0.00	1.00
RMS	6.02	6.00	1.60	3.00	12.00
BRS	1.86	2.00	0.87	1.00	6.00
BRS1	0.62	1.00	0.49	0.00	1.00
PLA	21,526.39	12,017.00	22,303.62	963.00	101,979.00
PLAM1	0.37	0.00	0.48	0.00	1.00
PLAM2	0.25	0.00	0.43	0.00	1.00
PLAM3	0.12	0.00	0.33	0.00	1.00
PLAM4	0.26	0.00	0.44	0.00	1.00
IMPSP	3,225.08	2,494.00	2,827.54	0.00	33,541.00
LC	25,380.59	27,850.24	12,004.87	0.00	43,516
LCPLA	2.36	1.85	2.32	0.00	21.27
LC2	787759371	775635868	569764299	0.00	1893642256
BERM	0.49	0.00	0.51	0.00	1.00
CENT	0.31	0.00	0.46	0.00	1.00

ZOYS	0.05	0.00	0.21	0.00	1.00
FES	0.06	0.00	0.24	0.00	1.00
STAUG	0.01	0.00	0.09	0.00	1.00
OTH	0.08	0.00	0.28	0.00	1.00
INDEX	12.27	14.00	4.33	0.00	18.00
DATE1	0.15	0.00	0.36	0.00	1.00
DATE2	0.21	0.00	0.41	0.00	1.00
AGE	46.49	46.00	22.83	2.00	114.00

[a] Statistics calculated from all non-zero data, 251 observations.
[b] Statistics calculated from all non-zero data, 58 observations.

Table 3. Frequency distribution of selected house attributes.

House attribute	Number	Percentage
Number of bathrooms		
1	104	38.4
1.5	12	4.4
2	86	31.7
2.5	23	8.5
3	27	10.0
3.5	13	4.8
4	3	1.1
4.5	2	0.7
>4.5	1	0.4
Number of rooms		
<3	6	2.2
4	30	11.1
5	82	30.3
6	72	26.6
7	30	11.1
8	27	10.0
9	24	8.9
Number of floors		
1	230	84.9
1.5	11	4.1
2	30	11.1

Year built		
<1941	78	28.8
1941-1950	40	14.8
1951-1960	57	21.0
1961-1970	42	15.5
1971-1980	22	8.1
1981-1990	11	4.1
1991-1998	21	7.7

Note: Results computed by using Microsoft Excel. Percentages were rounded to the nearest decimal. The sums may not equal 100 percent due to rounding.

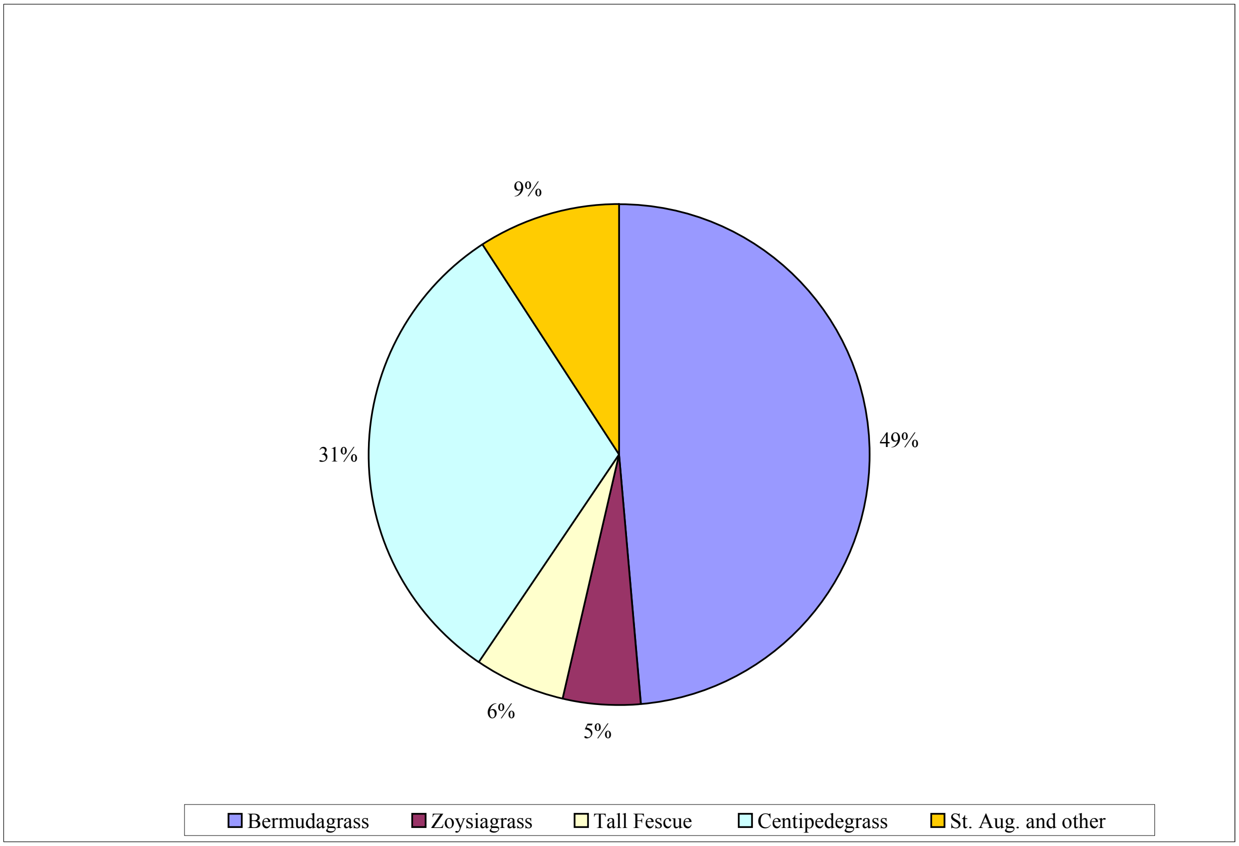

Figure 1. Shares of turfgrass species of 271 residential properties in Athens-Clarke County area, May-June 2005.

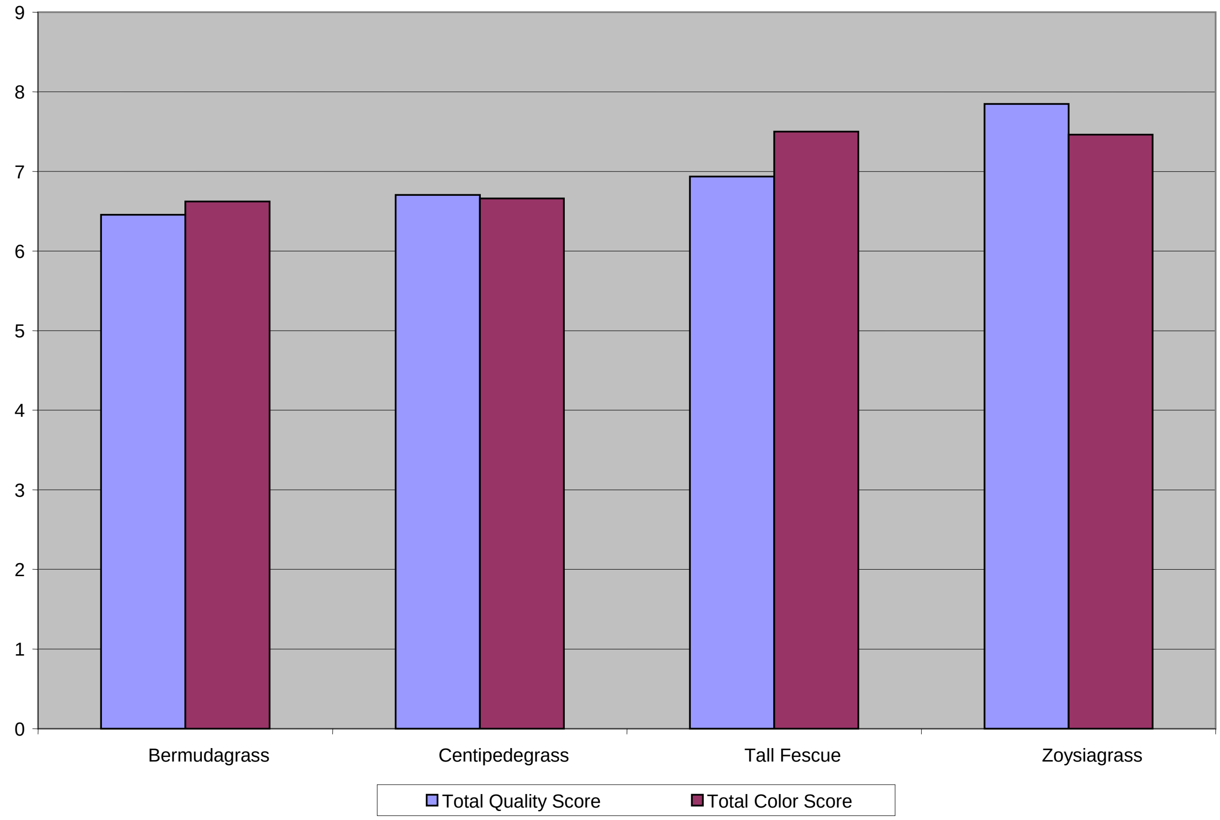

Figure 2. Average turfgrass quality and color scores for each turfgrass species.

CHAPTER 4

ESTIMATION AND RESULTS

The Model

Functional form selection

Since the development of the hedonic pricing method, there has been much debate on the choice of a proper functional form of the regression model. There is no guidance in economic theory that would support the best possible functional form or robust criteria for deciding the optimal form. Instead, researchers are left to base their choice on the rational goodness-of-fit measures and the signs and significance of estimated coefficients. In their 1998 study, Craig, Palmquist, and Weiss (1998) obtained the "best fit" for their data with the semi-log functional form. Le Goffe (2000) obtained the best estimates from the linear functional form for his hedonic study on the pricing of agricultural and forestry externalities. Kim and Wells (2005) also used the linear functional form for their study on forest density and property values in Arizona. There have also been studies that used more than one functional form for estimation in a simple hedonic study. In his study of leaf coverage area in Athens, Georgia, Sydor (2005) used the linear functional form, the linear-log functional form, and the Box-Cox transformation functional form. The common approach, whether reported in a study or not, is to test several functional forms and to use the functional form that works best with the data in the study.

This study follows the method of Craig, Palmquist, and Weiss (1998) in applying the semi-log functional form to estimate the specified empirical model. Sirmans, Macpherson, and Zeiss (2005) state, "…the hedonic pricing model is often estimated in semi-log form with the natural log of price used as the dependent variable" (p. 4). The semi-log functional form was chosen because its results will show the rate of increase or decrease that the independent variables cause in the dependent variable.

Empirical Specification

The dependent variable chosen for this study was the selling price of the home. Selling price was determined to be a suitable dependent variable because it represented the value of the home when it was sold, i.e., the price was determined by the market conditions. Another reason is because the effects of the variables used in the model would be easy to interpret in terms of house selling price. The selling price of a home being used as the dependent variable is also commonly applied in the literature involving hedonic property value analysis (for example, Anderson and Cordell 1988; Kim and Wells 2005; Sydor 2005).

Following Rosen (1974) the hedonic price function can be expressed as:

$$(4) \qquad P_h(\mathbf{Z}) = \mathbf{G}^h(\mathbf{Z}_1, \mathbf{Z}_2, \ldots, \mathbf{Z}_n)$$

where P_h is the selling price of a house and $\mathbf{Z}_1, \mathbf{Z}_2, \ldots, \mathbf{Z}_n$ are house and house surrounding attributes.

In any hedonic study the question of the independent variables to be used in the hedonic model must be addressed. The addition or subtraction of certain attributes or characteristics could cause major changes in the results from a hedonic study. In this study, the selected independent variables can be classified into two different categories. The first category consists of features of a house. These variables not only included the basics of a house, but also included certain amenities that help differentiate one house from another. The basic house features included the total number of rooms, heated square footage, and the age of the house. The age was calculated by subtracting the year of construction from 2000, given this the newest house was constructed in 1998. The variables that were included not only represent attributes found in any single-family home, but they were also available from the Athens-Clarke County Tax Assessor data. The two amenity variables chosen for the empirical model were dummy variables indicating the presence of a deck and the presence of an open porch. Both of these variables were chosen because they are simple amenities that almost any homeowner could add to a single-family home. Other dummy variables depicting the features of the house included a dummy variable for the number of bathrooms and dummy variable accounting for the year of sale. The base of the binary variable for the bathroom number was a home that had one bathroom. The year of sale dummies were place in the model to account for the fact that the homes included in the sample were sold during a three-year period. The base year was set at 2000 because more than 60 percent of the transactions occurred in that year. The year of sale dummies in the model represented homes that were sold in 1998 and 1999. All of the house features, except for the year of sale and open porch square footage, are listed by Sirmans, Macpherson, and Zietz (2005), as the twenty most common characteristics used in hedonic pricing equations.

The second category of variables includes the landscape features attributed to the house and its lot. Included among these variables were the amount of impervious space and the leaf coverage area. The impervious space variable was included to show the effect that non-lawn area has on the selling price of homes in Athens-Clarke County. Leaf coverage and the ratio of leaf cover to the PLA were both included to depict the relationship of other landscape features on the selling price of a home and effects of the trade-off between trees in the landscape and lawn area. Also included in this category were dummy variables for the turfgrass species of centipedegrass, zoysiagrass, tall fescue, and St. Augustinegrass. The “Other” category referred to residential properties without a lawn or lawns, where the turfgrass species could not be determined. Bermuda grass was used as the comparative base for the turfgrass dummies because it was the most prevalent turfgrass species observed from the individual assessments. An index score, which was the summation of TQ and TC from each assessment, was also included in the empirical model to see the effects of a combination of turfgrass quality and turfgrass color on the selling price of homes in Athens-Clarke County.

Dummy variables for the amount of PLA for each home were used in this study. The PLA dummy variables represented a range of different lawn areas. The base case was set to include homes that had a PLA of 10,000 square feet or less. This PLA category accounted for almost 37 percent of all observations. The other PLA dummy variables were set to include the observation where the PLA was between 10,001 and 15,000 square feet, 15,001 and 25,000 square feet, and greater than 25,001 square feet, respectively.

The empirical model used for the estimation included the following variables:

$$\log(P_h) = \alpha + \beta_1 PLAM2 + \beta_2 PLAM3 + \beta_3 PLAM4 + \beta_4 IMPSP + \beta_5 LCPLA + \beta_6 RMS + \beta_7 LC2 + \beta_8 LC + \beta_9 OPSQ1 + \beta_{10} DSQ1 + \beta_{11} BRS1 + \beta_{12} CENT + \beta_{13} ZOYS + \beta_{14} STAUG + \beta_{15} OTH + \beta_{16} INDEX + \beta_{17} DATE1 + \beta_{18} DATE2 + \beta_{19} HSQ + \beta_{20} AGE. \tag{5}$$

Table 1 and Table 2 provide full descriptions of each variable.

Expected effects of the independent variables

Prior to model estimation it is appropriate to clarify expectations with regard to the effects independent variables may have on the selling price of a home. In the case of hedonic price analysis it is particularly important because of the product-specific nature of the variable selection process. The effect of the PLA is directly linked to the objective of this study which is to examine the effect of the lawn area on the selling price. The PLA variables used in the model are dummy variables and have various expected signs. The PLA variables represent four categories of lawn sizes. Although homeowners generally seem to prefer to have a lawn, a particularly large lawn may be a disadvantage. The larger the lawn, the more time, effort and money it takes to maintain it. On the other hand a very small lawn may not be eye-appealing and, while still requiring maintenance, not of a sufficiently large size to enjoy it. The effects of the lawn sizes are measured against the smallest size selected in this study, i.e., 10,000 square feet. Therefore, it is expected that the second and, perhaps, the third size category may have the positive effect. The second category includes lawns that were centered around the mean lawn area calculated from the sample. The largest lawn size category, the PLAM4, may have a negative effect on the price of a house because of the necessary effort required to maintain it.

The impervious space variable is expected to be negative because impervious space occupies areas that could be covered in turfgrass. Not only a turfgrass could be more aesthetically pleasing but homeowners pay less for every square foot of impervious space because such a space increases runoff.

Anderson and Cordell (1988) and Sydor (2005) who conducted their studies in Athens-Clarke County found that the presence of trees, which can translate into leaf coverage, had a positive effect on the selling price of a house. The positive effect of the leaf coverage area should lead to an increase in the selling price of the home. Other landscape-related features were described by additional variables, including the dummy variables for some of the turfgrass species. The turfgrass quality and color index score is also expected to have positive effects. When compared to the base turfgrass species, i.e., bermudagrass, zoysiagrass is expected to be positive. The positive influence on the house selling price is expected because zoysiagrass is an expensive grass. Considered a "luxury" turfgrass suggests that zoysiagrass may be present in the affluent areas of a town or county, but even there it is not necessarily the dominant turfgrass species. The tall fescue dummy variable is expected to have a negative effect because it is a turfgrass that is planted by sowing seed. Tall fescue does not have the high costs associated with the laying of sod, but, considered a cool season turfgrass, it does poorly in summer. The turfgrass quality and color index variables, which is a combination of the TQ and TC scores for each home should also have a positive effect because it is assumed that homeowners would like a lawn that had a high turfgrass quality and color score.

For the house specific characteristics, it is expected that variables including the number of rooms, the presence of a deck or open porch, the heated square footage should exert a positive influence on the house price. The number of rooms and the bathroom dummy should have a positive influence on the selling price because a house with many rooms and bathrooms indicates a large house, which is likely to be highly priced. The open porch and deck variables are expected to have a positive influence because these amenities add to the value of the house. The age of the house is expected to have a negative effect on the dependent variable because newer homes were likely more expensive to build and have been less depreciated.

Results

The SAS system was used to estimate the empirical model applying the ordinary least squares (OLS) regression. Diagnostics tests for the presence of autocorrelation, heteroskedasticity, and multicollinearity were applied. Autocorrelation is usually present in time-series data. It exists when there is correlation in a model's error terms. In respect to cross-sectional data, autocorrelation implies that the error terms are related or move together. The existence of autocorrelation leads to a larger variance and standard errors that are not efficient. However, the estimators remain unbiased but they are not the best linear unbiased estimators (B.L.U.E.). The Durbin-Watson test was used to check for autocorrelation. The Durbin-Watson statistic is calculated from the residuals of the regression. A Durbin-Watson statistic of 2.00 signifies that autocorrelation is not present, however, as the Durbin-Watson statistics moves away from 2.00 there is an increasing possibility that autocorrelation exists. (Kmenta 1997; Kennedy 2003)

Heteroskedasticity occurs when there is a difference in the variances of all the variables. It usually occurs with cross-sectional data. Heteroskedasticity causes the least squares estimator of all variables to no longer be B.L.U.E. The presence of heteroskedasticy will also cause the standard errors to be incorrect. Inaccurate standard errors result in misleading assumptions about the model. When heteroskedasticity is a problem the estimates are not efficient because of inflated variances, but the estimators are consistent. To check for heteroskedasticity the residuals of the regression are plotted against the values of variables in the model. When there is more than one functional form the residuals from every model should be plotted to determine the presence of heteroskedasticity. If it appears that heteroskedasticity is present, further tests would be needed to diagnose the problem. (Kmenta 1997; Kennedy 2003)

Multicollinearity exists when the independent variables of the hedonic model are correlated. Multicollinearity causes the estimates to have large variances and covariances, which causes the validity of the estimate to be questioned (Kmenta 1997; Kennedy 2003). Most statistical packages offer tests for detecting multicollinearity. A collinearity diagnostics tests was performed on the model to detect any case of multicollinearity. A problem exists if any of the condition indexes from the diagnostics test are greater than 50.

The specified empirical model had a log-linear functional form where the selling price of the home was the dependent variable. The model was estimated by OLS with a cross-sectional dataset. Models estimated with cross-sectional data tend to have a smaller overall explanatory power than similar models estimated using time series data. For example, a substantial drop in the value of the adjusted R-squared is expected. The adjusted R-squared in the case of this study was 0.62. The F-value of 21.97 indicated that a number of the explanatory variables significantly influenced the dependent variable.

Because of the objective of this study the result regarding the significance and the sign of the coefficients representing the PLA dummy variables was important. The PLAM2 variable, which was the dummy variable for homes that had a PLA between 10,001 and 15,000 square feet had a positive and statistically significant effect on the home selling price when compared to the base PLA variable. The estimate of 0.12939, which was statistically significant at the 0.10 level, reaffirms the expectations that as the PLAM2 would positively affect the selling price of a house. For example, a home priced at $100,000 that has a PLA between 10,001 square feet and 15,000 square feet can be expected to ass to the selling price about $12,939, holding all things equal. However, the PLAM4 variable, which indicating a home with more than 25,001 square feet of PLA, had a negative effect on the dependent variable. The selling price of a home would be heavily discounted. The results from the PLA dummies agree with the expectation that as lawn size increases the positive change in price that results from that increase only occurs to a certain size. In other words, although homeowners like to have a lawn, there seems to be a loss in utility when the lawn becomes too large. This finding is consistent with that of Rosiers, Thériault, Kestens, and Villeneuve (2002) who found that an increase in the density of vegetation decreased the selling price of a house by 2.2 percent.

The leaf coverage effect is consistent with the effect of the leaf coverage results reported by earlier studies. Leaf coverage was positive and statistically significant. The leaf coverage variable being positive and statistically significant supports the findings by Anderson and Cordell (1985) and Sydor (2005). Both studies found a positive relationship between a home's value and the existence of trees for homes in the Athens-Clarke County area. The effect of leaf coverage squared is consistent in directional effect with the report by Payne (1973) who concluded that after a certain threshold value, the increasing number of trees will decrease the value of a property. The ratio of leaf coverage to the PLA was negative and statistically significant with an estimate of -0.05578. This result suggests that there is a trade-off between the leaf coverage and lawn area.

Other statistically significant variables that positively influenced the dependant variable were the amount of impervious space, presence of an open porch, presence of a deck, number of rooms, the bathroom dummy, and heated square footage. The positive and statistically significant effect of the impervious space variable was a surprise. However, this may be explained by the fact that the amount of impervious space included not only the driveway and footprint of the home, but also amenities that were an extension of the home, i.e., a deck.

The turfgrass variables that were statistically significant were the dummy variables for zoysiagrass and tall fescue. As expected, the estimate for zoysiagrass, 0.19242, was positive and the estimate for tall fescue, -0.18062, was negative. These results indicate that having zoysiagrass, in the front yard, instead of bermudagrass increases the selling price of the home assuming all other things are constant. However, the selling price of homes decreases if tall fescue encompasses the front yard instead of bermudagrass. For illustrative purposes, a house that is priced at $100,000 and has bermudagrass in its lawn will be used as an example. Holding all things equal, if the home had zoysiagrass instead of bermudagrass the selling price would increase by $19,242, but having tall fescue instead of bermudagrass would decrease the selling price by $18,062. None of the other turfgrass variables were statistically significant, therefore, their presence had the same effect as having a bermudagrass lawn. These numbers should be treated with caution because changing a lawn's turfgrass species requires a substantial amount of work, time, and a purchase of sod. In addition, lawn renovation is associated with the replacement or installation of an irrigation system

The Durbin-Watson statistic for the semi-log form was 1.917. This value of the Durbin-Watson statistic, close to two, indicates that autocorrelation is likely absent in this model. None of the variables had a condition index that was greater than 50 in the diagnostics test for the presence of multicollinearity. Condition indexes less than 50 indicate that multicollinearity has not been detected in the specified model. None of the residual plots indicated the presence of heteroskedasticity. Table 4 shows a list of the variables with their respective parameter estimates, t-statistics, variable means, the F-value, the adjusted R^2, and the Durbin-Watson statistic.

Table 4. OLS estimates, t-statistics, and means from the semi-log model.

Variable name	Parameter estimate	t-statistic	Mean
Intercept	10.23848*	46.65	--
PLAM2	0.12939***	1.75	0.25
PLAM3	-0.02702	-0.29	0.12
PLAM4	-0.28617*	-2.95	0.26
IMPSP	0.00004*	4.331	3,225.08
LCPLA	-0.05578*	-3.31	2.36
LC	0.00002***	1.75	25,380.59
LC2	-1.27707E-10	-0.690	787759371
RMS	0.07297*	3.26	6.02
OPSQ1	0.00025***	1.867	0.93
DSQ1	0.12538***	1.92	0.21
BRS1	0.16903**	2.56	0.62
CENT	0.07517	1.32	0.31
ZOYS	0.19242***	1.62	0.05
FES	-0.18062***	-1.66	0.06
STAUG	0.03156	0.11	0.01
OTH	0.10418	0.61	0.08
INDEX	-0.00257	-0.23	12.27
DATE1	0.04724	0.67	0.15
DATE2	-0.06330	-1.03	0.21
HSQ	0.00029*	5.76	1,729.82

AGE	-0.00161	-1.216	46.49
F-value	21.967		
Adjusted R^2	0.6199		
Durbin-Watson statistic	1.917		

* Significant at α=0.01.
** Significant at α=0.05.
*** Significant at α=0.10.

Table 5. Elasticities of statistically significant variables and effect of dummy variables in the semi-log model of the house selling price in Athens-Clarke County.

Variable	Elasticity
IMPSP	0.00000109
LCPLA	-0.00000107
LC	0.00000331
RMS	0.00000359
HSQ	0.00000407
	Effects of dummy variables
PLAM2	0.12939
PLAM4	-0.28617
OPSQ1	0.00025
DSQ1	0.12538
ZOYS	0.19242
FES	-0.18062

Note: For formulas used to calculate elasticities in this study and other functional forms see Yang (2001).

CHAPTER 5

CONCLUSIONS AND IMPLICATIONS

The purpose of this study was to estimate the effect of the potential lawn area (PLA) on the selling price of a home. The study, which was conducted in Athens-Clarke County, Georgia, used the hedonic pricing method as its theoretical framework. The hedonic method was used because the selling price of a home is an implicit price affected by certain characteristics or attributes that are house and landscape specific. In addition, the study also wanted to find if there was a relationship between turf species, turf quality, and turf color and the selling price of a home. In order to examine these effects individual house assessments were conducted during the months of May and June 2005 to identify each of the dominant turfgrass species and turf quality and color scores for each of the 271 observations in the dataset.

The ordinary least squares (OLS) method was applied to estimation of the semi-log model. Results confirmed the expectation that the PLA, within limits, had a positive and statistically significant effect on the home's selling price. The positive effect on the selling price of a home was associated with the PLA from 10,001 to 15,000 square feet instead of less than 10,001 square feet. Almost 37 percent of the properties in the sample had lawn area that was less than 10,001 square feet and this category was used as the base variable. The results also concluded that when compared to the base variable a PLA greater than 25,001 square feet had a negative and statistically significant effect on the home selling price.

The results indicated that two of the turfgrass species dummy variables were statistically significant. When compared to the base lawns seeded with bermudagrass, having a zoysiagrass lawn would increase the home's selling price. However, lawn seeded with tall fescue instead of bermudagrass would cause the selling price of the home to decrease.

Homeowners, real estate agents, and landscapers should all be able to understand and interpret the results from this study and utilize the knowledge for their respected purposes. Homeowners and real estate agents will be able to place the proper emphasis on a home's lawn area and turfgrass species in preparation of selling the home. Real estate agents could also use the results to inform potential buyers of the value of the landscape attributes, which may increase the probability of a successful sales transaction. Landscape installation and maintenance companies and turfgrass producers can use the results as an illustration of how maintaining and developing a lawn may increase the price homeowners could expect for their house at the time of sale. The value associated with lawn area and turfgrass species could also be used by landscapers and turfgrass companies as a means to solicit new business.

Limitations of the study

The results of this study, although in line with most expectations, should be taken with caution because of several limitations. The PLA measurement is an approximation. It is possible that errors were inadvertently made in some of the measurements, because of the constant value of the multiplier applied to each property. It is likely that some properties had flower beds, which would restrict lawn area. Limitations also involved the individual turfgrass assessments. The observation of the dominant turfgrass species only took place in the home's front yard. Not being able to observe the backyard could have posed a problem because turfgrass species used in the front yard may differ from that in the backyard.

Another limitation was that the turfgrass assessments were conducted during a single visit. The TQ and TC scores of the warm-season turfgrass species would have been much lower if the assessments were conducted during the winter months. The season of the year is relevant because the house sale record and the turfgrass assessments were five to seven years apart. This difference in timing of the sale and the evaluation of the lawn forced the assumption that the same turfgrass species was still present five to seven years after the house had been sold. Although, this assumption is probably true because lawn renovation and replacement is expensive and time consuming, some homes may have undergone a lawn renovation.

The model did not include an explicit neighborhood affect which may limit the explanatory power of the results. Athens-Clarke County, like most urban areas, has neighborhoods where the value of land is higher than in other parts of town. However, a suitable neighborhood variable was not placed in the model. Further studies could include some form of a neighborhood affect.

In spite of numerous studies empirical applications of the hedonic pricing method to real estate prices, little research has been conducted with respect to the values of turfgrass. This study attempted to explore the effect of lawn area and quality on the house selling price and, hopefully, will lead to further, more advanced studies on the relationship between the value of potential lawn area and the selling price of residential properties.

REFERENCES

Anderson, L. and H. Cordell. “Influence of Trees on Residential Property Values in Athens, Georgia (U.S.A): A Survey based on Actual Sales Price.” *Landscape and Urban Planning* 15 (1988):153-164.

Craig, L., R. Palmquist, and T. Weiss. “Transportation Improvements and Land Values in the Antebellum United States: A Hedonic Approach.” *Journal of Real EstateFinance and Economics* 16 (1998):173-189.

Do, A. and G. Grudnitski. “Golf Courses and Residential House Prices: An Empirical Examination.” *Journal of Real Estate Finance and Economics* 10 (1995):261-270.

Dubin, R. “Predicting House Prices Using Multiple Listings Data.” *Journal of Real Estate Finance and Economics* 17 (1998):35-59.

Geoghegan, J., L. Wainger, and N. Bockstael. “Spatial Landscape Indices in a Hedonic Framework: An Ecological Economics Analysis Using GIS.” *Ecological Economics* 23 (1997):251-264.

Goodman, A. “Andrew Court and the Invention of Hedonic Price Analysis.” *Journal of Urban Economics* 44 (1998):291-298.

Hayden, T. “Could the Grass be Greener?” *U.S. News and World Report*, May 16, 2005, pg. 57.

Karipidis, P., E. Tsakiridou, N. Tabakis, and K. Mattas. “Hedonic Analysis of Retail Egg Prices.” *Journal of Food Distribution Research* 36 (2005):68-73.

Kennedy, P. *A Guide to Econometrics*. Cambridge, Massachusetts: The MIT Press, 2003.

Kim, Y. and A. Wells. “The Impact of Forest Density on Property Values.” *Journal of Forestry* 103 (April/May 2005):146-151.

Kmenta, J. *Elements of Econometrics*, 2nd. ed. Ann Arbor, Michigan: The University of Michigan Press, 1997.

Le Goffe, P. “Hedonic Pricing of Agriculture and Forestry Externalities.” *Environmental and Resource Economics* 15 (2000):397-401.

Luttik, J. “The Value of Trees, Water and Open Space as Reflected by House Prices in the Netherlands.” *Landscape and Urban Planning* 48 (2000):161-167.

National Turfgrass Evaluation Program. “A Guide to NTEP Turfgrass Ratings.” April 17, 2005. http://www.ntep.org/reports/ratings.htm

Nicholson, W. *Intermediate Microeconomics and Its Application*, 8th. ed. Orlando: Harcourt Inc., 2000.

Pagourtzi, E., V. Assimakopoulos, T. Hatzichristos, and N. French. “Real Estate Appraisal: A Review of Valuation Methods.” *Journal of Property Investment and Finance* 21 (2003): 383-401.

Paterson, R. and K. Boyle. “Out of Sight, Out of Mind? Using GIS to Incorporate Visibility in Hedonic Property Value Models.” *Land Economics* 78 (2002):417-425.

Payne, B. “The Twenty-nine Tree Home Improvement Plan.” *Natural History* 82 (1973):74-75.

Robbins, P. and T. Birkenholtz. “Turfgrass Revolution: Measuring the Expansion of the American Lawn.” *Land Use Policy* 20 (2003):181-194.

Rosen, S. “Hedonic Prices and Implicit Markets: Product Differentiation in Pure Competition.” *Journal of Political Economy* 82 (1974):34-55.

Rosiers, F., M. Thériault, Y. Kestens, and P. Villeneuve. “Landscaping and House Values: An Empirical Investigation.” *Journal of Real Estate Research* 23 (2002):139-159.

Selia, A. and L. Anderson. “Estimating Costs of Tree Preservation on Residential Lots.” *Journal of Arboriculture* 8 (1982):182-185.

Shonkwiler, J. and J. Reynolds. “A Note on the Use of Hedonic Price Models in the Analysis of Land Prices at the Urban Fringe.” *Land Economics* 62(1986): 58-63.

Shultz, S. and D. King. “The Use of Census Data for Hedonic Price Estimates of Open-Space Amenities and Land Use.” *Journal of Real Estate Finance and Economics* 22 (2001): 239-252.

Sirmans, G., D. Macpherson, and E. Zietz. “The Composition of Hedonic Pricing Models.” *Journal of Real Estate Literature* 13 (2005):3-43.

Sydor, T. “Three Essays on the Economics of Forest Investments.” Ph. D. dissertation, University of Georgia, 2005.

Tryväinen, L. “The Amenity Value of the Urban Forest: An Application of the Hedonic Pricing Method.” *Landscape and Urban Planning* 37 (1997):211-222.

U.S. Census Bureau, “Census 2000 Data for the State of Georgia.” March 21, 2005. http://www.census.gov/census2000/states/ga.html

U.S. Census Bureau, Census of Housing, "Historical Census of Housing Tables, Homeownership." March 21, 2005. http://www.census.gov/hhes/www/housing/census/historic/owner.html

U.S. Census Bureau, Census of Housing, "Historical Census of Housing Tables, Home Values." March 21, 2005. http://www.census.gov/hhes/www/housing/census/historic/values.html

U.S. Census Bureau, *Statistical Abstract of the United States*. Washington DC, 2001.

Yang, S. "Is Bigger Better? A Re-examination of the Scale of Economies of REITs." *Journal of Real Estate Portfolio Management* 7 (2001):67-77.

APPENDIX

Table 6 shows an example of turfgrass species identification and the equivalent of turf quality and turf color scores.

Table 6. Example of turfgrass species identification and turfgrass quality and color score.

Address	BERM	CENT	ZOYS	FES	STAUG	OTH	TQ	TC
12 Main	X						7	6
450 Elm			X				8	8

An X indicated the turfgrass species that dominated the front yard as viewed from the sidewalk or curb. A blank entry indicated the absence of a given species.

Scores reflecting the turf quality and turf color ranged from 1, i.e., very poor quality or very poor color, to 9, i.e., very high quality or very high color. The combined score or the turf quality and color index could theoretically range from 2 to 19. From the 271 assessed properties, 23 received scores of 0 because they did not have any lawn area in the front of the house or because turfgrass was not present.