ABSTRACT

The purpose of this research is to effectively determine whether a home in Camden County, GA possesses a sale price premium for being elevated above the base flood elevation in flood zone A. Hedonic pricing is initially used to determine the significance of certain housing characteristics, but finds that elevation is insignificant in explaining the sale price of a home in the study area due to low observation numbers. Nearest neighbor propensity score matching is then used to estimate the property price differential between a treatment group of elevated homes, and control group of non-elevated homes, based on specified housing characteristics related to the probability of a home being elevated. The matching procedure concludes that an elevated home costs $35,756.94 more than a non-elevated home on average, consistent with a local appraiser’s analysis of elevation adjustments, and present value calculations based on FEMA insurance premium data.
ESTIMATING THE PROPERTY PRICE DIFFERENTIAL OF ELEVATION RETROFITTED HOUSES IN CAMDEN COUNTY

by

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CHAPTER 1
INTRODUCTION

Deep into the history of our earth, all forms of life have been dependent upon adaption in order to survive. Today, people residing in the coastal United States face the consequences of humanity's unsustainable choices. Climate change, an undeniably occurring anthropogenic phenomenon, brings with it increased tidal surges and flooded roads along coastlines, specifically in the state of Georgia. This forces approximately one hundred miles of Georgia coastline inhabitants to reconsider how they will adapt to their now rapidly changing environment (Galloway, 2015). The most feasible way flooding and storm hazard damages are currently being mitigated along the Georgia Coastline is elevation retrofitting, a costly but beneficial approach. Elevation retrofitting is done by altering a home's foundation in order to increase the first floors elevation above the expected level of a 100-year flood (FEMA, 2009), also known as the base flood elevation, or BFE. Despite the upfront costs of retrofitting, the many potential benefits such as increase in home value and lower paid insurance premiums provide a strong argument towards home owners investing more in plans to retrofit and become more resilient to natural disasters (FEMA, 2014). This information provokes the research question: How are home prices in Camden County, Georgia affected by being elevated above the base flood elevation? The following sections of this chapter serve to discuss the recent economic conditions in Camden county Georgia, relevant policy surrounding this question, the
strategies used to address this research question, and how changes in the environment are pushing the issue of elevation retrofitting.

A CLOSER LOOK AT COASTAL GROWTH

In the United States, 254 counties are located along the coastline, which contains approximately 29 percent of the US population. Census data shows us that among these counties, Georgia has seen a 78% increase in number of people per square mile of coastal land area from 1960 to 2008 (Wilson, Fischetti, 2010).

The Georgia coast is made up of six counties; Chatham, Bryan, Liberty, Glynn, McIntosh, and Camden (Figure 1). The focal point of this research is situated in Camden County, where the current population sits at just over 50,000 people. Upon the establishment of the Naval Submarine Base Kings Bay, Camden County saw its population jump from 10,000 people in 1978, to over 43,000 people by the year 2000 (Wilson, Fischetti, 2010). Original projections by the Georgia Institute of Technology's Center for Growth and Regional Development put Camden county at a population of around 60,000 by the year 2015, however these figures have since been revised due to the 2007-2009 housing market bust, and now expect to reach the 60,000 level by the year 2020.

It comes as no surprise that Camden County’s Naval Submarine Base at Kings Bay is the largest employer in the region, which gives rise to a large retiree population that has nearly doubled since the early 2000’s, and now accounts for 8,660 people living in the county (Lightsey, 2013). This demographic, along with population trends in the area, are important in understanding the current climate in which homeowners and buyers are exposed to.
TRENDS IN THE HOUSING MARKET

Beginning in the first quarter of the new millennium, home prices in the United States boomed 66 percent to their highest levels. On the South Georgia coast, these numbers were even more staggering, where home prices rose 80 percent from 2000 to 2005. In both Glynn and Camden counties, the valuation of new residential construction more than doubled over this time period, increasing 124 percent from $150 million in 2000 to $334 million in 2006. Permits for new residential buildings were up 67 percent (Mathews, 2012). The reason for such a boom was considered the result of easy monetary policy, too relaxed lending standards, and financial deregulation and innovation. However the housing market began to crack in 2006, and the bust that followed in 2007 was game changing.

By the second quarter of 2008, home prices on the South Georgia Coast had fallen 24 percent from their peak. From coast to coast residential building permits in the United States dropped 72 percent as a whole, and on the Georgia coast alone permits fell 76 percent. While financial institutions certainly felt their share of despair, it was the homeowners that were left close to hopeless. Mortgage debts rose higher than home values, homeowner wealth plummeted, and foreclosures started spreading like an epidemic. On top of that, the employment rate began to fall quickly in all South Georgia Coast sectors other than healthcare by more than 10 percent between 2007 and 2010. Construction was undoubtedly among the highest, seeing nearly a 40 percent decline.

The Georgia coast has entered a slow recovery following the housing market bust. Economists suggest the recovery will continue to be slow as a result of structural unemployment. The recession caused a significant shift in consumer demand for
construction and real estate industries, pushing the employees of those industries to find employment in other sectors (Mathews, 2012). This is contrary to cyclical employment, which allows for a faster recovery when employees can simply go back to their former jobs once the economy recovers. This short history of the housing market crisis is important to understand prior to delving into the current status of homeowner decisions and valuations in Camden.

**FLOOD RISK MITIGATION POLICY AND FINANCIALS**

The National Flood Insurance Program (NFIP) was established in 1968 enabling property owners the opportunity to purchase flood insurance if they resided in communities that adopted minimum building standards and other floodplain management ordinances (FEMA, 2014). Increased flooding frequency, and two disasters: Katrina (2005) and Sandy (2012) were the major causes for the NFIP to seek more financial stability. As a response, congress passed the Biggert-Waters Flood Insurance Reform Act of 2012 in order to reflect the true risk and cost of flood damages. This Act extended the NFIP for five years, while also phasing out subsidized rates and replacing them with “full risk rates,” or flood insurance rates that took into account factors such as elevation, foundation type, type of flood zone, etc. Since its enactment, the Consolidated Appropriations Act, as well as the Homeowner Flood Insurance Affordability Act, has repealed certain parts of the Biggert-Waters Flood Insurance Reform Act in order to address concerns regarding the rise in rates, and restore grandfathering.

The NFIP also implemented the Community Rating System (CRS) in 1990 to encourage homeowners to go above and beyond with floodplain management activities (FEMA, 2016). Under this system, communities are rewarded with discounted flood
insurance premium rates for meeting the three goals of CRS: (1) reduce flood damage to insurable property; (2) strengthen and support the insurance aspects of the NFIP; and (3) encourage a comprehensive approach to floodplain management (FEMA, 2016). Only 5 percent of the approximate 22,000 communities that participate in the NFIP are CRS communities, however 69 percent of all flood insurance policies stem from CRS communities. In order to achieve discounted premium rates up to 45 percent, communities can partake in four categories: (1) public information; (2) mapping and regulations; (3) flood damage reduction; and (4) flood preparedness. Elevation retrofitting falls into the third category.

Camden County entered the Community Rating System Program in 2013 with a Class 8 rating, but recently in 2015 improved to a Class 7 (Camden Chamber of Commerce, 2015). This provides residents residing in the flood plain who carry flood insurance the potential for 15% in savings on their insurance premiums, and 5% in savings for residents outside of the flood plain if they carry insurance. The estimated total savings in flood insurance premiums per year for Camden are now estimated at $113,005. Camden possesses 13,985 parcels of property with structures on them in the 100-year flood plain, but only 1,533 have flood insurance policies (Camdencountyga.gov, 2015).

The policy changes above have highlighted the benefits to being proactive in flood hazard mitigation, and more specifically the appeal of elevation retrofitting. Homebuyers in a flood zone are presumably aware of flood hazards, and are more than likely to be attracted to a house that has been elevated to prevent these risks. Elevated homes not only have more practicality in storage space, but also offer cheaper insurance rates, and comfort to the buyer that he/she will not be affected by storm surge or rising tides.
In the state of Georgia, special funding opportunities or subsidies (outside of lowering insurance premiums by 70-80%) do not exist to help cut the costs of retrofitting private homes. It is estimated that a post-FIRM residence in flood zone A who pays $1.78 premium per $100 dollars of coverage will see that premium fall to just $0.24 when elevating the residence four feet above the BFE (Kriesel, 2016). However, the choice to elevate a home is still largely a financial investment. Elevating a home takes on average 3 months, and ranges between $25,000 and $75,000, dependent on location, the material of the home, and size (Zhao, 2014). This price range does not include the additional cost of the homeowner to relocate during the elevating process. Due to this financial sacrifice, it is imperative that sufficient information is provided to these homeowners in order to effectively weigh their options.

**MOTHER NATURE CLOSING IN**

The research being conducted in this study comes just at the right time for coastal residents in Georgia, as the effects of climate change become more impeding. Many residents of Camden County’s neighbor, Chatham County, watched in awe during the month of October, 2015, when a super moon caused sea levels to rise to record breaking levels near Tybee Island and the Savanna coast. Tide gauges in the Savannah area reported sea level rise of 10.43 feet, the highest since multiple hurricanes rolled through the area in the 1940’s (Galloway, 2015).

In early October the following year, Hurricane Matthew skimmed along the Georgia coast, causing the evacuation of all residents East of I-95. The storm surge recorded at Ft. Pulaski, Georgia in Chatham clocked in at 8 feet, and the resulting floods left three dead (Carr, Valera, 2016). The police commissioner of Glynn County noted that the last hurricane
to have an impact of this magnitude was in 1898. It was not just the Georgia coast that felt the wrath of Matthew, but rather the Atlantic coastline from Florida up to South Carolina. Insured property losses for both residential and commercial areas were estimated between $4-6 billion dollars, of which $400-600 million dollars were related to storm surge (Rice, 2016).

The natural disasters mentioned above inflicted damage that can be almost completely avoided with elevation retrofitting. How crucial it has become for coastal residents to take some form of action will only continue to prove itself in time, as the future threatens larger tidal surges, flooded roads, and slowly rising risk for those who live a bit further inland. “If the dire predictions of state, federal and university scientists prove true, then billions of dollars of property in Brunswick, Darien, St. Mary’s and Savannah and on the islands of St. Simons, Sea and Tybee will be under water within a century,” (Chapman, 2016).

**METHOD**

Hedonic price analysis is a widely used method that estimates how the price of a good or service varies as attributes of the good or service change (Rosen, 1974, Freeman, 2003). In this research, the price of a house is being estimated based on its attributes: number of bathrooms, water access (dock), square footage, elevation, etc. To arrive at a price per foot relationship between sale price and house elevation, Camden county elevation certificates were originally incorporated into the hedonic to reflect the elevation attribute. Elevation certificates are important documentation of a building’s elevation in a flood zone, and are used to obtain flood insurance, and determine an appropriate premium
that reflects the home’s risk. However, upon further investigation, it turned out that the
certificates scanned by Camden County offices were not entirely representative of the true
elevation of the homes. For example, a certificate might show that a house is 3 feet above
BFE, but if the BFE is 5 feet above the surrounding grade, then the house is technically
elevated 8 feet. This disallowed the ability to derive a significant price per foot relationship
in the hedonic portion of the study, and provoked the use of a binomial elevation dummy
that will be explained in more detail in a later section. Due to this hiccup, a new technique
called hedonic matching is being applied to the dataset. In hedonic matching a sample of
elevated homes will be matched with a sample of non-elevated homes, both within Camden
County and of particularly similar attributes (example: each is a one story two bedroom
home with waterfront access). Using the propensity score matching procedure just recently
added to SAS in 2016, the Average Treatment Effect (ATE) can be estimated, which will
convey the price premium carried by elevated houses. By definition, this procedure
estimates the average causal effect of a binary treatment on a continuous or discrete
outcome (SAS, 2016). The ATE measures the difference in mean outcomes between units
assigned to the treatment and units assigned to the control. This procedure provides an
effective alternative to the hedonic model in determining a property price differential for
elevated homes.

LAYOUT

This thesis is organized as follows; a short discussion regarding previous literature
associated with hedonic pricing models, propensity score matching, the valuation of flood
hazards, and opposing viewpoints; a presentation of the data being used to conduct this
research; the theoretical basis and discussion of the statistical techniques being applied; an analysis of the results; and a final conclusion.
CHAPTER 2

LITERATURE REVIEW

Literature preceding this study has provided sound support regarding the use of valuation techniques in a variety of different environmental scenarios. In this study, the valuation of elevation retrofitting aligns closely with other hedonic price analysis done in the past regarding flood risk and the valuation of various environmental amenities.

ENVIRONMENTAL AMENITY VALUATION

Over decades of literature have provided conclusive evidence that amenities can be valued using non-market valuation techniques. This section intends to explain the different non-market valuation methods available to researchers, some of the constraints of these methods, and summarize literature that effectively applies the hedonic price method to amenity valuation.

Non-market valuation methods can be divided into two categories: stated preference and revealed preference (Pearce, 2002). Stated preference methods draw information from the stated responses of the consumers, most commonly in the form of a survey. The most popular method in this category is contingent valuation, which can be used to measure non-consumptive values such as existence and option values. While this method is widely used to collect information on consumer preferences, there are a few fundamental issues with it. For starters, contingent valuation can be a very expensive process. Collecting the data can take a lot of time and a great deal of funding, as well as time
spent organizing the data into a proper format for analysis. Many stated preference experiments also run into hypothetical bias, which can arise when respondents state a willingness to pay (WTP) in excess of what they would actually pay with their own money. Making sure that the survey responses are honest, and that the respondent is informed properly before responding, is a challenging process. Even after these considerations, the researcher may still find that once the collection process is over, the data isn’t telling the right story or cannot be used for the study. While there are always remedies for these types of issues, a more efficient and lower risk approach to estimating the effects of home elevation is using a revealed preference method.

Contrary to stated preference methods, revealed preference methods are based on the underlying theory that consumer behaviors in a market follow a natural desire to maximize utility (Pearce, 2002). As a result, the information used for welfare analysis is based on observations made about the consumer’s behaviors and preferences. This category of non-market valuation consists of the travel cost and hedonic price methods. Each of these methods can be used to estimate the consumptive value of a change in an environmental good.

The travel cost method is based on the premise that the price of accessing a good is equal to the opportunity cost of time and travel cost. This method uses the number of trips to an environmental amenity from different regions, as well as the estimated costs of the trips (inclusive of the opportunity cost of time spent traveling, and the monetary cost of traveling itself), to determine how valuable an environmental amenity is to consumers. Bin et al. (2005) employed this method successfully to estimate the consumer surplus of a beach day in North Carolina, and found estimates with considerably larger magnitudes
than previous findings based upon stated preference methods. Some biases that arise from this method are rooted in the assumption that individuals have the same opportunity and travel costs, and the assumption that all individuals and regions share equal willingness to pay. In this particular case, it would be tough to design a travel cost model that could capture the marginal value of a physical housing characteristics like its elevation, which prompted the choice of a hedonic approach.

In brief, a hedonic model regresses property prices on housing characteristics, neighborhood attributes, local public goods, environmental quality, and risk. If done correctly, the consumer willingness to pay for a characteristic of the property can be recovered, such as the willingness to pay for an elevated home. While the hedonic method will be expanded upon later, the following literature intends to present the different applications and successes the scholarly community has found using it.

In a widely known hedonic study, Lansford and Jones (1995) estimated that a home’s proximity to a water feature would have a positive effect on property prices. After using hedonic pricing methods, they were able to conclude that the recreational and aesthetic value of a Texas lake in the Colorado River Basin declined rapidly as a house’s distance from it increases. Mahan, Polasky, and Adams (2000) also used a hedonic to value wetland amenities in Portland Oregon. Their findings were that wetlands influenced property values both in their acreage and distance from a home. By increasing the size of the nearest wetland to a home by one acre, a residence’s value saw an increase of about $24. Additionally, for every 1,000 feet decrease in distance between a home and nearby wetland, residence’s value increased by $436 dollars. Wetlands are a significant influence
in the value of homes in Camden County, Georgia, due to its location on the Georgia coastline.

Another amenity valuation was done by Kriesel and Mullen (2009) that looked to determine the value of open space in marshland environments. The initial assumption was that home buyers in a heavily marshland dominated environment (such as Camden county) would view neighborhood common areas and marshland as substitutes. After modeling for impervious surface, common area in the neighborhood, water access, and distance to the marshland, they found that common area and proximity to marshland were significant positive influences on property prices. In several additional scenarios regarding the development of residential areas, Kriesel and Mullen investigated whether developers have market incentives to pursue low-impact residential subdivision designs. They concluded that by opting for higher density housing designs, the positive effect of increasing open space on sale price was larger than the negative effect that a small lot size had on the price.

A handful of studies have used hedonic pricing methods to value climate as an amenity in the housing market (eg. Maddison, 2010; Maddison and Bigano, 2003; Mueller, 2005; Mendelsohn, 2001). One in specific, Rehdanz and Maddison (2009), looked to measure climate as an amenity of households in Germany. Their findings were that climate had a significant impact in housing markets; in areas with higher January temperatures, lower July temperatures, and smaller rainfall, homes were far more expensive. These conclusions were used as evidence to predict how global climate change would affect housing markets.

Environmental disamenities can also be estimated in order to quantify negative property value impacts. For instance, Hite et al. (2001) was able to find that landfills had a
negative impact on residential real estate prices. The study showed that moving from a house within 3.25 miles of a landfill to a location that is 3.25 miles away from a landfill constituted a rise in property values and thus reflected a resident’s value for improved environmental quality. Davis (2010) found that power plants also behaved as a disamenity by comparing neighborhoods with similar housing and demographic characteristics located a variety of distances away from power plants. Neighborhoods within 2 miles of power plants saw a 3-7 percent decline in home values and rents. Toxic waste sites (Kohlhase, 1991) are yet another disamenity with a negative relationship to property values. The Environmental Protection Agency (EPA) is responsible for listing waste sites on something called a “Superfund list,” and upon doing so this observably creates a surrounding market for housing that is considered “safe” from these hazardous areas. In other words, a price premium becomes associated with housing that is located at greater distances from the waste sites, and remains until the site has been cleaned or removed from the list. Evaluating the effects of airport noise on residential property values is yet another example of disamenity valuation. Espey and Lopez (2000) approached this research question in the Reno-Sparks area of western Nevada, and found that a negative relationship existed between airport noise and property values. In areas where noise levels reached or exceeded 65 decibels, property values decreased by approximately $2400.

Amenity valuation is important in understanding the staggering effects that a property’s attributes can have on housing prices. In the above studies, we see direct examples of how consumers are taking into account not just the basic features of a home when determining to purchase a property, but the non-marketable amenities or disamenities as well. In this study, while there is a market price for elevating a home, the
benefits received from elevating a home are non-marketable in the same way as amenities and disamenities. These benefits can include increased headroom for parking cars, increased storage space, risk reduction, a better view of the marsh, etc.

**RISK AND CONSUMER BEHAVIORS IN THE HOUSING MARKET**

In an ideal world, full cooperation with flood risk mitigation efforts such as elevation retrofitting would result from perfect information amongst homeowners regarding their susceptibility to flood risk. If this were the case, home prices would also fully reflect the flood risk of the property. However, this is obviously not the case, therefore how consumers perceive flood risk is crucial to the decisions of a homeowner to undergo elevation retrofitting in the study area, and in estimating the true value of the home itself. Previous literature regarding risk perception and flood insurance helps us to understand these consumer behaviors and risk estimations more thoroughly.

One way to correctly portray how consumers in the housing market perceive flood risk is to look at changes in property prices during a period of flood events. In Bin and Landry (2008), flood zone price differentials in Pitt County, North Carolina during both Hurricane Fran and Hurricane Floyd observably reflect an immediate reaction in property prices after the flood events. While the study found no market risk premium on houses in the flood zone prior to Hurricane Fran, a 5.7% decrease in price arose after the event, along with an 8.8% decrease after Hurricane Floyd. The study concluded that between a 6.0% and 20.2% risk premium existed for homes sold in flood zones, but by approximately 6 years after Hurricane Floyd, the premiums had disappeared.

Atreya, Ferreira, Kriesel (2013) build on this notion that the housing market over time “forgets” about flood risk by using a difference-in-differences spatial hedonic model to
determine how property prices reacted to devastating flooding produced by Tropical Storm Alberto in 1994. While immediately following the flood event property prices fell drastically and flood risk discounts increased to between 25% and 44%, the study shows that the flood risk discounts for properties in the 100-year floodplain rapidly declined, and were completely erased by after about 4 years. This finding concluded that risk perceptions become heightened immediately following a major flood event, but taper off in the years that follow if no major flood events occur.

A more direct way of understanding consumer risk preferences is to look at the driving factors behind why homeowners purchase flood insurance. For instance, Brown and Hoyt (2000) found that a positive correlation exists between higher income households and the purchasing of flood insurance, as well as in the amount of insurance the household will purchase. The same conclusion was supported in Kriesel and Landry (2004), and Atreya et al. (2015). Kriesel and Landry (2004) also added that participation in National Flood Insurance Programs has a positive correlation with insurance demand. Despite this, their empirical analysis found that still only about 49 percent of eligible properties in coastal areas participate in them.

In Atreya et al. (2015), age was found to be a significant factor of flood insurance purchases. While a 1 percentage point increase in the age group 25-44 increases the policies in force per 1000-population by 2%, the same 1 percentage point increase in the age group for 65 and above sees a 6.7% increase. This is important information in coastal areas such as Camden County, which tend to see higher numbers of retirees living in the area on top of already high numbers of Navy retirees. A 1 percentage point increase in African Americans also saw a corresponding 1% increase in demand for flood insurance,
which could also affect the study area in Camden County where 19.6% of the population is African American (Census, 2015). This study also confirms findings from Zahran et al. (2009) that attributes such as experience with previous flood damage and having a mortgage on a home increases the probability of purchasing flood insurance.

In Dehring and Halek (2012), we can see how perceived risk could be an explanation for ineffectively mitigating flood risk. In this study, the goal in mind was to determine whether federal and state level building standard adjustments on coastlines effectively mitigated property losses. The study focused specifically on properties impacted by the occurrence of Hurricane Charley in Florida. Their findings were that properties built under the National Flood Insurance Program and located in A-Zone (a special flood hazard area lower than base flood elevation) sustained more damages relative to structures in a similar location built before regulatory changes. Why was this? One hypothesized reason is that homeowners abiding by NFIP building regulations view elevating their homes as a saving grace in mitigating their vulnerability to flooding and damages. This may cause a change in homeowner behaviors, for example not shuttering doors and windows before a major event like a hurricane. This argument is based on the premise that government regulation can cloud overall quality by causing purely visible factors to be in focus (Lindsay, 1976). An elevated home appears to be fool proof to homeowners worried about flooding damages, but still requires attention to detail in its construction to truly be effective. Elevation retrofits also tend to be expensive, and therefore can cause homeowners to make substitutes during constructing process such as opting to use less expensive labor, cheaper material, or less expensive technologies. This study does however make mention of Florida
being too lax with their enforcement of building codes, which is something to take into account when considering the above potential explanations.

Due to the fact that hedonic price methods in this study will rely heavily on housing market data, it is important to use the above literature regarding risk behaviors to try and draw a better understanding of consumer decisions that cannot be quantified by the data set. A better understanding of why residents in Camden might purchase flood insurance, or might not, will improve the overall ability to interpret the results of the regression, and draw conclusions about Camden residents’ preferences with regards to elevation retrofitting.

**RESEARCH SUPPORTING METHODS USED**

In the United States, a residence is often the most valuable single asset owned by Americans, and makes up a large share of income and total expenditure. Therefore, economists have dedicated considerable time to understanding how consumer demands in housing markets operate. The hedonic analysis of housing markets is widely applied in evaluating environmental amenities, the demand for housing attributes, and environmental policy. In fact, hedonic price functions are even a part of quality adjustment practices by the Bureau of Labor Statistics in developing indexes such as Consumer Price Index. While hedonic property value techniques are not seen as a direct source of designing environmental policy, they are important in supporting environmental policy decisions. Palmquist and Smith (2001), argue that hedonic value methods play a significant role in providing information to policy makers regarding air pollution, water pollution, and hazardous waste sites. Their argument draws upon examples such as Alder et al (1982), a situation in which the US Environmental Protection Agency funded research to determine
how hazardous waste site selection influenced surrounding property values using hedonic price analysis. By evaluating such a scenario one can arrive at consumers WTP for specific qualities in their environment (or lack thereof), providing policy makers with relatively significant information regarding the net impact of a decision, such as designating a waste site.

Sheppard (1999) states that one of the biggest difficulties in evaluating demand in the housing market is the heterogeneity of houses. For example, a Camden County home on the marsh cannot be drawn in direct comparison to a home that backs up to I-95, nor can the housing preferences of two Georgia residents with diverging income constraints. The choices made by two separate households can be contingent upon income, preferences, non-market constraints on choice, or differences in effective attributes that define each house (Sheppard, 1999). Housing is a differentiated good, meaning that there are a variety of different characteristics within it, all encompassed as one commodity in a consumer's mind. These attributes can consist of things such as number of bedrooms, bathrooms, square footage, or in this specific case whether the property has a house that is elevated on it, and how high it is elevated. In order to disassemble this bundle of characteristics, hedonic pricing models allow us to estimate marginal contributions or implicit prices for each of these housing attributes (Rosen, 1974). This is based on the underlying consumer theory in Lancaster (1966) that states it is the characteristic of a good that consumers draw utility from, or in other words the characteristics of a house that a homeowner draws utility from.

Monson (2009) does a good job at breaking down the characteristics that can be considered significant in a hedonic price valuation model, and providing real world
examples where a hedonic valuation method has been used. In the first case, a development near Jamaica Plain in Boston, Massachusetts, saw harsh economic times that called for a hedonic analysis to determine the quality of finishes in each condominium, as well as which community amenities to include. The results of the regression determined that the following attributes were statistically significant to the estimation; attached garage, swimming pool, private outdoors space, security systems, and extra storage space. The hedonic model was also able to predict a price for the condominiums within $3,000 of the actual asking price. By doing so, the condominium development could effectively determine what building attributes were desirable in construction of future phases.

The hedonic portion of this study will undoubtedly rely on support from the literature above in order to accurately represent the effects of homes’ specific characteristics on their sale prices in the Camden market. However, as mentioned earlier, in order to capture the true effect of elevating a home in Camden, the regression must be taken a step further. The propensity score matching procedure portion of the study, which allows for the estimation of average treatment effects, is relatively new but still supported by the literature that follows.

In the estimation of treatment effects using observational data, propensity score methods are being used more and more (Austin, 2007). There are three commonly used propensity-scoring methods: covariate adjustment using propensity score, stratification on propensity score, and propensity-score matching. For this study, propensity score matching will be used to eliminate selection bias in Camden county housing data and arrive at a more conclusive elevation effect on housing sale prices. Due to the fact that assigning treatments to a house are not completely random, matching pulls together a sample of
treatment houses that can be compared on all observed covariates to a sample of houses that are the control variables. The matching procedure employs a propensity score, or predicted probability of membership in either the treatment or control group.

Coca-Perraillon (2006) states that a good way to understand propensity scores is to think of them as profiling individuals who participated in a study, in order to select individuals who have similarities as the controls. Therefore, if the independent variables “include all factors related to participation and outcome” the treatment effect after matching the control and treatment groups should turn out to be the same as that of a random experiment. Propensity score is most often estimated using a logit regression with a dependent (dummy) variable indicating treatment participation. In a review of the different propensity score methods listed above, Austin (2007) found that the matching method eliminates more baseline differences between untreated and treated subjects than the others. More specifically, a type of matching procedure called ‘nearest neighbor matching’ (Rubin 1973) is considered among the top matching methods, and is effective at estimating the ATE. Nearest neighbor matching matches a treatment unit with its closest control match based on the absolute value of the difference between the logit of the propensity score of the selected treatment and that of the control (Coca Perraillon, 2006). This will be discussed further in Chapter 4 with more context.

Williams et al. (2014) were able to effectively implement propensity score matching with data collected from Oklahoma feeder calf auctions in fall 2010 to reduce potential self-selection bias. To do this, they matched value-added lots with non-value added lots that had close resemblance in order to simulate the random placement of feeder cattle lots into control and treatment groups. This random placement into the treatment group therefore
treats the treatment as an independent of the covariates. The study concluded that there were in fact selection biases in the hedonic model as a result of value-added management activities, and due to propensity score matching they were able to extract unbiased premium estimates for feeder cattle.

Likewise, Walls et al (2016) sought out to discover if energy efficiency is capitalized into home prices using hedonic regressions and some matching techniques. Propensity score matching procedures were used in this study due to the fact that Energy Star certified homes (the treatment group) were likely to differ from non-Energy Star certified homes (the control group) in characteristics additional to just certification status. The certification of homes were found to have a positive relationship with the sale prices of single family homes in both the Research Triangle region of North Carolina and Portland, Oregon. The effects of certification, however, were found to be much smaller from matched sample regressions than the unmatched sample in both North Carolina and Oregon. In a third city, Austin, Texas, the effects of certification proved to be insignificant after matching.

Abbott and Klaiber (2013) selected propensity-score matching methods to complement their research on the value of water as an urban club good. The flexibility of propensity score matching allowed the study to control for the selection of observable housing characteristics, and thus recover the average capitalized value of lakes in an area where lakes are an amenity to the surrounding community. The average capitalization effect of lake access was derived from matching non-adjacent properties within homeowners associations with properties outside of homeowners associations. Lake adjacent and non-adjacent properties within the same homeowners associations were also matched to determine the average additional value of lake adjacency. Similar to Abbott and
Klaiber, Metz (2017) used nearest neighbor propensity score matching to value the fundamental properties of open space. Several measures including adjacency to open space, and distance to the nearest tract of open space were used. These measures are comparable to parameters used in the Camden study such as adjacency to marshland and distance to nearest marsh adjacent parcel. Metz used propensity score matching to control for unobservable neighborhood effects, and therefore he matched houses that were in the same census tract. For example, a house adjacent to open space could be matched with a house across the street that shared similar structural characteristics. The study concluded that the small-scale value of open space is often overestimated due to neighborhood effects.

While the propensity score matching method is fairly new, empirical evidence shows that it is able assign both treatment and control groups very effectively. The above literature supports this evidence, and provides examples of how propensity score matching can complement hedonic regressions.
CHAPTER 3

STUDY AREA & DATA

STUDY AREA

Camden County is located in the southeastern corner of the state of Georgia along the coast of the Atlantic Ocean and border of Florida. It stretches approximately 782 square miles, leaving it as the 11th largest county in the state of Georgia (U.S. Census, 2010), of which approximately a fifth of the area is water. Three major rivers, the St. Mary's (north border), Satilla (south border), and Altamaha (south border), run through this very poorly drained area. Two major highways, I-95 and HWY 17, also stretch completely through Camden from North to South. Camden is characterized mostly by swamp/saltwater marsh to the east, and some poorly drained flat woods to the west. A large barrier island, Cumberland, also accompanies the coastline. This geographical description can be seen in more detail in Figure 2.

Kings Bay Naval base is the beating heart of Camden’s economy, making up for 35% of employment in federal civilian and military jobs. Following these sectors are the services, retail, and manufacturing industries. Cumberland Island National Shoreline carries the tourism industry on its shoulders, as it draws in about 40,000 visitors annually. The 2014 report from Georgia’s Department of Community Affairs writes that Camden’s economy is engaging in “low-risk, almost survival-mode activities, rather than visionary steps toward smart growth.” Home sales are described as flat, construction as non-existent, and moving forward the focus of the county seems to veer towards agriculture, forestry,
recreation, and conservation rather than residential, institutional, or industrial development (GDCA, 2014). Apart from the economic climate, development in Camden continues to be a struggle simply due to its geography. Tidal and stream flooding frequent the area due to the presence of large water features, and much of the land area faces poor drainage quality.

Camden’s coastal marshlands are currently protected under the Coastal Marshlands Protection Act (CMPA) enacted in 1970 by the state of Georgia. The Georgia Department of Natural Resources, Coastal Resources Division enforces these regulations regarding the estuarine area so residents and visitors of the area can fish, boat, use, and enjoy the marsh. Despite this, the Environmental Protection Department (2007) estimates that over the last two and a half centuries, approximately 20-25% of wetlands in the state of Georgia have been lost. Recently in 2015, lawmakers passed Senate Bill 101 in Georgia, which mandated the State Department of Natural Resources to write a set of rules to protect its coastal marshlands. It established (1) A 25-foot buffer “along coastal marshlands, as measured horizontally from the coastal marshland-upland interface, as determined in accordance with the Coastal Marshlands Protection Act,” and (2) “That no land disturbing activity is conducted within the buffer and that the buffer remain in its undisturbed state of vegetation.” Flood protection is a crucial ecosystem service wetlands can offer to Camden residents, as many residents see increased flooding recently due to sea level rise and more severe storm occurrences (EPA, 2017).
DATA

The dataset used in this study comes from the Camden County Tax Assessor’s office. It consists of residential home sales from 2013 thru second quarter of 2016, inclusive of their sale dates, prices, and physical characteristics. Elevation certificates compiled by the local floodplain manager were used to define the treatment group of residential homes that had been elevated, and parcel-level GIS data was used to capture amenity variables. The entirety of the dataset falls within flood zone A, which is the second most volatile of the Special Flood Hazard Areas determined by FEMA. In this zone, the lowest floor elevation must be at or above the BFE (Federal Alliance for Safe Homes, 2017). The dataset contains 830 total observations, of which 22 are elevated. The dataset is only inclusive of single-family residences sold after the year 2012, and that fall within 1,000 feet of the nearest marsh edge to ensure both the treatment and control group possesses some degree of marshland amenity value. Residences sold for under $50,000 were removed as outliers from the dataset to verify that all sales were arm’s length transactions. All bare lots and lot sizes less than one-tenth of an acre, or greater than ten acres, were also removed as outliers. The description of all variables can be found in Table 1.

HOME ATTRIBUTE VARIABLES

To effectively predict the sale price of homes in the study area, seventeen different variables (15 dummies) were hand selected that both agree with intuition and common literature. Variables representing the size of the household are supported by overwhelming evidence to explain the majority of variation in house prices. In this dataset, ‘Heated area’ represents the amount of heated square footage a home possesses, and the number of bathrooms in the household is also used to gauge the size of the home. These two variables
are predicted to have a positive effect on sale prices. Physical attributes that often increase the value of a home such as possession of a garage, a brick exterior, and fireplace are also all expected to have a positive effect on sale price. Shingle roofing is one physical feature that is expected to produce a negative effect on sale price due to how relatively inexpensive it is.

Features separate from the house itself, but associated with the property value, are also important to incorporate into the regression. The presence of a boat dock is predicted to have a strong positive effect on households in this data set due to the marshland nature of all the properties. Docks offer direct access to marshland amenities and are considered valuable for this reason. The presence of an outside deck, presence of a pool, and access to a paved road are all also hypothesized to have positive effects on sale prices. ‘Parcel size’ is a variable that captures the total acreage of the lot the home is built on, and intuitively should see a positive relationship with sale price. The age variable on homes should have a negative effect, due to older homes being more susceptible to wear and tear and maintenance costs.

To adjust for inflation and housing market shocks, three dummy variables are included in the regression for the years 2014, 2015, and 2016. The year 2013 is omitted from the regression to avoid perfect collinearity. Homes built in these respective years uphold a value of 1, and otherwise a value of 0. The Brunswick Housing Price Index was applied to the dataset to adjust for inflation by transforming sale prices into “real prices” for each fiscal quarter from Q1 2012 to Q4 2016. This did not significantly change the results, most likely due to the data set only covering 4 years, all of which are post 2007-2012 housing market bust. Had the dataset included sale transactions back through the
year 2000, a housing price index would be far more impactful. The market being analyzed is also specialized in marsh edge or near marsh edge properties. This market has not seen a great deal of sale transactions since the housing bust, making it a less sensitive area to general trends in the housing market. This rationale is based on comments from a consulting report compiled by James Hancock, an appraiser who worked with Camden housing data to help determine a property price differential between elevated and non-elevated homes. In his report, he stated that due to such limited sales in the market of marsh front homes, there was insufficient data to determine an effective market/time trend adjustment. His report will be detailed further in the matching procedure section.

AMENITY VARIABLES

Using GIS data techniques, each parcel’s distance to a handful of predominant features in Camden County could be measured and incorporated into the regression. The relevancy of Kings Bay Naval Base to the lives of residents in Camden prompted the creation of the “Nearest gate” variable, which is expected to have a positive effect on sale prices. This variable uses the shortest distance in miles between a property parcel and the closest of the three gates; Jackson, Stimson, or Franklin. The dummy variable “Marsh Edge” was created using GIS hand selection of parcels that were adjacent to marsh. Parcels that fall adjacent to the marsh feature are assigned a value of 1, or all otherwise are assigned a value of 0. In the GIS dataset, it was challenging to distinguish between marshland and an area that retains large amounts of water after flooding or high tide. Whether a house was on the marsh was therefore determined by best estimates. Residents actively use marshland on site by boating, kayaking, fishing, photography, and hunting, making this an important variable in estimating sale price variation. The effect of this variable is therefore
predicted to be positive. To further capture the importance of the marshland amenity, the “Nearest Distance” variable measures the distance of property parcels not on the marsh edge to the nearest property parcel that was previously identified to lie adjacent to the marshland. This is once again because the GIS data for the marshland feature occasionally classified non-marsh water features as marshland. This variable is also expected to have a positive effect.

**2010 CENSUS VARIABLES**

Different socio-economic and demographic characteristics of a neighborhood are important when attempting to capture all possible influences on a home’s sale price. In this study, the median household income in 2010 inflation adjusted dollars, as well as the race variable, were used to capture these effects. “Household Income” helps capture census block groups that may have a more affluent population, and therefore more desirable living conditions that one would expect to have a positive effect on home values. On the contrary, “Race” is a demographic variable that has been shown in previous literature (Kriesel and Mullen, 2009) to have a negative impact on home values. This variable consists of the percentage of residents that fall into a race category other than “white” in a block group.

**ELEVATION VARIABLE**

It was the initial plan to use 806 elevation certificates taken from the Community Rating System to determine a dummy variable representative of which of 753 property parcels from the original Tax Assessor’s dataset possessed an elevated home. From the certificates alone, 103 were reported as elevated. However, many elevation certificates turned out to misrepresent the true elevation of the homes, or not report any elevation at all. After using pictures and maps of the 753 property parcels (put forth by Camden
County’s website) it was found that 130 additional properties were elevated, of which 92 property parcels were elevated but did not have an elevation certificate filled out, and 13 could not be merged into the dataset by their parcel number. Of the 233 total elevated houses, 202 possessed waterfront access. After adding in the constraints to reach the 830 observations used in this study, the total number of elevated houses dropped to 22.

The elevation variable in this study is treated as a dummy variable, with houses taking on a value of 1 if they are elevated, and a value of 0 if they are not elevated. The major premise of this study is that elevation should have a positive effect on sale prices due to their reduction in the risk of potential flood damages, increase in storage space, and potential improvement to marsh view. However, due to the limited availability of observations containing an elevated home, it is quite possible that the resulting outcome could be insignificant.

**SUMMARY STATISTICS**

The averages for the 830 observations used in the best model of fit for the Camden County dataset can be observed in Table 2. To summarize, the average sale price of a home in the dataset was $180,728, and had about 1,959.94 square feet of heated area inside the home. The average lot size was .64 acres. As far as some additional characteristics of the homes, it possessed approximately 2 bathrooms, and the average age was around 19 years. While about 45% of homes had a fireplace present, and 85% had a garage present, only about 15% possessed an outdoor deck, and 12.9% had a pool on the property. A large majority of homes were built on a concrete slab (77.6%), had access to a paved road (96%), and had shingled roofs (96%). A miniscule percentage (.01) were found to be in bad
condition among the observations regressed. Additionally, 26.9% of houses were sold in 2014, 32.5% in 2015, and 18.8 in 2016.

In the group of amenity characteristics, the average distance to a parcel property bordering a marsh or water feature was 324.2 feet. The average distance to the Kings Bay Naval Base was about 7 miles. Only about 11% of the property parcels were determined to be bordering the marsh or a water feature, which provides very few observations that can be used to determine the value of flood proofing and elevation retrofitting. Of those homes, 15% were found to possess access to the water feature it bordered via a dock. To add to the challenge, elevated houses made up only 2.65 percent of the dataset, or 22 houses.

Among the two census variables, the average median household income (in 2010 inflation adjusted dollars) was around $62,953. The average home also resided in a census block group with about 15.82% non-white residents.
CHAPTER 4
MODEL ESTIMATION AND RESULTS

HEDONIC MODEL SPECIFICATION

Econometrically, the various housing characteristics selected to predict sale prices can be modeled by a hedonic price function. For simplicity, all seventeen variables in the model are categorized. The hedonic price function is expressed as:

\[ P_i = f(S_i, A_i, C_i, E_i) \]

In the above representation, physical and structural characteristics (heated area, fireplace, attached garage) are indicated as \( S \), amenity variables (nearest gate, marsh edge, nearest distance) are indicated as \( A \), census block variables (household income, race) are indicated as \( C \), and the single elevation variable is indicated as \( E \). The sale price of a home, indicated as \( P \), reflects a housing price index adjusted sale value, or “real price”. Yearly dummy variables were also included into the regression to control for inflation and all other time varying shocks to the properties.

In selecting a functional form, linear, semi-log, and log-log functional forms were all taken into consideration. While linear functional forms are most widely used, they do not always accurately capture the diminishing effect of continuous variables. For example, the effect of acreage on sale price may be substantial for the first acre, but begin to diminish as the acreage climbs towards 10 acres. It was quite evident after estimating the three models which result yielded the best model of fit. The log-log functional form returned a higher \( R^2 \), indicative of a higher explained variance in sale prices. More statistically significant
coefficients and theoretically consistent signs than the alternative functional forms were also gained from the log-log functional form. To transform the original hedonic price function into log-log functional form, the natural logarithm is taken of the sale price and all continuous independent variables (heated area, nearest gate, parcel size, etc.). The new log-log hedonic price function can now be expressed as:

\[
\ln Y_{it} = B_0 + B_x \ln X_{it} + e_{it}
\]

where the natural log of sale prices in Camden is represented by \(\ln Y_{it}\), \(\ln X_{it}\) is the vector of explanatory variables described in (1), \(B_0\) is the intercept, and \(e_{it}\) is the error term. The beta coefficients of a log-log regression can be interpreted as follows: if there is a change in \(x\) by one percentage point, there is a subsequent change in \(y\) by \(B_x\) percent. The corresponding implicit prices can be determined by dividing the mean sale price of the sample ($180,728.05) by the mean of the variable in focus, and multiplying by its respective beta coefficient. With regards to the dummy variable coefficients in the regression, the percentage effect of \(X\) on sale price can be given by \(e\) raised to the power of \(B_x\) and then subtracting 1.

**DIAGNOSIS OF HEDONIC MODEL ISSUES**

In order to obtain Best Linear Unbiased Estimates (BLUE) in the hedonic price model, a number of Ordinary Least Squares (OLS) assumptions must be upheld. Violations to these assumptions can bias the results of the regression, or decrease the efficiency of the model. To combat this problem, there are a number of ways to go about testing for assumption violations, and correcting them where necessary. In this section, violations of OLS assumption 4 (no multicollinearity) and assumption 5 (homoskedastic error term)
were determined to be the most threatening to the hedonic estimates, and were therefore tested below.

Multicollinearity is when two or more independent variables are highly correlated, making it difficult to determine if they have an individual effect on the dependent variable, and to what magnitude that effect may be. This occurs because the standard error associated with a specific OLS parameter estimate increases when the corresponding independent variable increases in correlation to the other independent variables in the model. The resulting effects can cause statistically insignificant t-tests on independent variables critical to explaining the dependent variable in the model, as well as lower the R², and change the magnitudes of the independent variable coefficients. A simple and effective way to test for this in the hedonic model is by calculating Variance Inflation Factors (VIF). VIF conducts a series of “artificial” regressions with the suspected independent variable as the “dependent” variable set equal to all other remaining independent variables. If zero multicollinearity exists, then the VIF will be equal to 1, and the standard errors will not be inflated. Contrarily, a VIF of 10 would show that the model is being affected by multicollinearity (Kennedy, 2013), and that the standard errors are inflated slightly more than 3x. Estimation for the hedonic model returned VIF’s around 2.5 for the heated area and distance to Kingsbay Naval Base variables. No other independent variables in the regression returned a VIF above 2. This result is evidence that there is no cause for concern that OLS assumption 4 was violated in this regression.

Heteroskedasticity is when the variance of the error term is not constant, and therefore OLS no longer provides estimates with minimum variance. This is an issue because with heteroskedasticity present, OLS will provide equal weight to all observations;
when in truth observations with larger disturbance variance possess less information than observations with smaller disturbance variance (Williams, 2015). Additional consequences of heteroskedasticity include biased standard error estimates, test statistics, and confidence intervals. In terms of the hedonic model’s data set, variables that are susceptible to heteroskedasticity include “distance to marsh edge parcel” and “distance to Kings Bay Naval Base”. At close distances to the naval base and marsh edge parcels, home prices will vary due to size of the house, ability to access the amenity, view of the amenity, and potential disamenity. Disamenity could include location near a shallow, unattractive marsh area, or noise from the naval base. The wide variance of home prices at these closer distances to the naval base and marsh edge is contrasted by a much narrower range of prices say a half mile away from the amenity as an example. A half-mile away, the amenity loses impact on the sale price.

White’s (1980) general test for heteroskedasticity was first used to test for nonlinear forms of heteroskedasticity, which regresses the squared residuals on all distinct regressors, cross products, and squares of regressors. The resulting chi square statistic (598.5) far exceeded its critical value and was highly significant, allowing rejection of the null hypothesis of homoskedasticity. The White test was followed up with a Breusch-Pagan/Cook-Weisberg test, which tests the null hypothesis that all error variances are equal. This resulting chi square statistic was 210.7, which also exceeded its critical value at a highly significant level, concluding that the error variances were a multiplicative function of one or more variables. While at first heteroskedasticity in the model may seem alarming, robust (also referred to as heteroskedastic consistent) standard errors can be calculated to remedy bias in standard errors. This is a far more popular method for dealing with
heteroskedasticity, as opposed to the use of Weighted Least Squares (WLS), which requires more assumptions and is more difficult to implement (Williams, 2015). In turn, the use of robust standard errors will not affect coefficient estimates, but will provide more accurate p-value estimates.

**SPATIAL CONSIDERATIONS**

By definition, spatial autocorrelation is the “presence of a spatial pattern in a mapped variable due to geographical proximity” (Heppel, 2000). Different from serial autocorrelation, which involves moving one dimensionally backwards into time, spatial autocorrelation can move two-dimensionally in any direction, making it a far more complex issue to deal with and less popular among researchers. Where positive spatial autocorrelation exists, similar values are occurring close to one another, whereas negative spatial autocorrelation represents dissimilar values occurring near each other.

In hedonic price modeling, the involvement of a wide array of structural, accessibility, and neighborhood variables can result in spatial autocorrelation. Imagining the current study area’s property characteristics, variables such as the heated area of the home, age, brick exterior, tend to be similar among properties in closer proximity due to the likelihood that the properties were developed around the same time (Gillen et al. 2001). Property prices also tend to be a function of the surrounding neighborhood’s property values. For instance, the sale price of a luxury home in a neighborhood of lower income housing will reflect a lower price than that of a luxury home in an upper class community. Variables such as household income and race attempt to control for these potential spatial effects, but do not always capture them entirely. Residents in the study area may also share a common place of employment, such as Kings Bay Naval Base in
Camden, resulting in commuter patterns. Brasington and Hite (2005) support the importance of incorporating spatial effects in hedonic studies, exemplified in their hedonic analysis of air, water, and soil contamination disamenities. In their model, environmental hazards’ effects on property values were determined by estimating distances to the nearest point specific pollution site. After estimating the implicit price of environmental quality using both a spatial Durbin model and OLS, they found “relatively large” differences in the resulting coefficients, and a statistically significant spatial lag parameter in each. While again spatial variables can attempt to mitigate the potential for spatial autocorrelation here such as “distance to Navy base”, there can still be smaller accessibility patterns that go undetected.

Estimating OLS with spatial autocorrelation can have consequences on the resulting parameter estimates. Spatial error autocorrelation, which arises from the error term of an observation affecting its neighboring observations, can result in parameter estimates that are still unbiased, but inefficient. This would include something like omitting variables such as noise pollution coming from Kings Bay Naval Base, or spatial correlation amongst other latent variables. Spatial lag, on the other hand, is a more severe form of autocorrelation that can render parameter estimates biased and inefficient. Spatial lag assumes that the correlated errors are occurring between dependent variables, for example spatial spillover effects such as sale prices of a property in the dataset having an impact on neighboring sale prices or property value. If this type of spatial autocorrelation affects the OLS estimates, the issue becomes harder to ignore. Yet, studies have found that spatially corrected estimates of implicit prices do not always vary much at all from estimates using OLS. Mueller and Loomis (2008) reached this conclusion with hedonic property models using a comparison
between OLS estimates of the implicit price of wildfire risk and three separate spatial weight matrices. Donovan, Champ, and Butry (2007) also determined that the specification of different spatial weight matrices can be arbitrary.

In this study, semi-variance analysis was used to dictate if spatial dependence is present in the hedonic model. As stated in Kriesel (2015), “[Semi-variance] measures the association between pairs of properties that are within specified distance intervals.” This geostatistical technique was first employed in mining exploration, but has since been used in a variety of environmental studies (Atreya, Ferreira, and Kriesel, 2013). Cressie (1993) provides us with a mathematical representation of semi variance for pairs of parcels in the following equation:

$$\hat{y}(h) = \frac{1}{2n(h)} \sum_{i=1}^{n(h)} (z(x_i + h) - z(x_i))^2$$

Each property’s residual from OLS is represented by the $z$-value, $h$ corresponds with a distance interval between pairs of property parcels (100 feet), $x$ is the latitude-longitude coordinates of $z$, and $n(h)$ is the number of parcel pairs within the given interval. If spatial dependence is present, the semi-variance will increase in correspondence with an increase in the distance between pairs of parcels. This makes intuitive sense, because an increase in distance between parcel pairs indicates a wider variety of neighborhoods and amenities.

The variogram procedure in SAS was used to derive a graph of the semi-variance of observed logarithmic sale prices (top line) and OLS residuals (bottom line). Its results can be seen in Figure 3. According to Figure 3, the spatial and neighborhood variables used in this hedonic regression succeeded fairly well in minimizing spatial dependence for parcel pairs with distances larger than 300 feet. This can be put into perspective by the assumption that neighboring properties are usually separated by about 150 feet in
distance. At distances greater than 300 feet, the semivariance of the OLS residuals begin to level off as the property prices continue to increase. From this result, it can be concluded that the issue of spatial dependence is not severe enough to require further analysis or correction methods. The OLS estimates provided by the hedonic should allow for sufficient and economically significant estimates.

**HEDONIC MODEL RESULTS**

The log-log model estimation of the hedonic resulted in almost all theoretically consistent coefficients on the housing characteristic variables, and was mostly significant at the 5% level or better. These results can be seen in Table 3. The following is a brief discussion of the variables that succeeded most at explaining sale price, and some potential explanations for those variables that did not turn out as hypothesized.

As was to be expected, heated area, parcel size, and age were among those that resulted in very significant coefficients. Their implicit prices were $76.44 dollars per square foot and $28,238.76 per acre of land. Joining these coefficients with significance at the 1% level was boat dock, which increased the sale price of a home in the sample by about $92,687.67 when present. The boat dock variable was expected to be very important in an area such as Camden, where residents seek recreational use and aesthetic pleasure from the surrounding water/marsh features. The high significance of boat dock proved valuable in the matching procedure, which will be detailed in a later section. Unlike boat dock, the marsh edge variable was only significant at the 5% level, but still positive. This could be the result of boat dock absorbing most of the sale price effect, but still reinforces the claim that marsh edge property parcels possess a premium.
Amid the neighborhood variables in the regression, household income resulted in a positive and very significant coefficient of 0.208. This means that a 1% increase in the median household income of a census block group increases the sale price of a home by 0.208%. The significance of the household income variable is vital to this regression because it effectively absorbs much of the “neighborhood effect” discussed in the spatial considerations section. The variable controlling for race was found insignificant, and is most likely a sign that the observations used in the model did not possess a large variability in race. Had the data stretched across a broader area of neighborhoods in Camden County, there would likely be a more significant race effect.

The two additional spatial variables calculated using GIS, distance to Kingsbay Naval Base and distance to the nearest marsh edge parcel, were also found insignificant. The distance to marsh variable did reflect the hypothesized negative sign, indicating that at greater distances from marshland the sale price of a home should slightly depreciate. This result agrees with theory that homeowners value marshland amenities (Lansford and Jones, 1995, Mahan et. Al, 2000). The insignificance of the distance to marsh variable is mostly due to the constraint put on the data set that disallowed including observations with a greater distance to marsh than 1000 feet. In alternative models that lifted this constraint, the distance to marsh variable was found very significant. However, in order to obtain the best estimates across all variables, the current data sample containing heavier constraints was chosen. The insignificance and incorrect sign of Kingsbay Naval Base was unexpected, but can be rationalized. The initial assumption was that residents in the data set would be represented by a large number of employees, or people who frequently travel to the base. Instead, this result showed that the base might act as a disamenity to nearby
properties, perhaps due to noise or the non-aesthetic appearance of the base. The Naval Base also draws in a large amount of businesses and fast food restaurants that could be considered a nuisance. This could explain the positive sign on the Naval Base variable, which represents a positive increase in sale price when distance from the base increases.

Other variables that were significant in the hedonic were fireplace, brick exterior, concrete slab, and number of bathrooms. A house possessing a fireplace cost approximately $14,465.85 more, and a house with a brick exterior was about $15,052.31 more. These estimates are both consistent with theory, as they are often considered “luxury” attributes. The negative coefficient on the concrete slab variable was also consistent with theory, providing on average an $18,825.69 dollar decrease in the price of a home. Concrete is a relatively cheap foundation, and can be vulnerable to erosion, especially in a flood zone. It also makes the process of detaching a home in order to elevate it much harder, and disallows placement of plumbing and electrical wiring under the home. The number of bathrooms variable was most likely insignificant and negative because the total heated area variable in the model is already accounting for the majority of the difference in home prices.

The elevation variable was by far the most crucial variable that did not turn out to be significant. As mentioned in multiple prior sections, this is most likely due to the low amount of observations that possessed an elevated home. While the elevation variable did reflect a positive sign, indicating a higher sale price if the home was elevated, the result still did not provide strong enough evidence to answer the research question. In order to cope with this dilemma, different strategies needed to be explored to determine an elevation effect, which leads in to the following chapters regarding the matching procedure.
MATCHING PROCEDURE

In order to find conclusive evidence that elevating a home in Camden County adds a premium to sale prices, a propensity score matching method was estimated using a set of confounding variables related to both the treatment assignment and the sale price. A propensity score can be best defined as the probability that a treatment is chosen by a participant with certain unique characteristics (Rosenbaum and Rubin, 1983), or in this case,

(4) \[ L(s) = P(T=1 | V=v) \]

Where \( L(s) \) is the propensity score, \( T=1 \) is the treatment when a home is elevated, and \( V=v \) is the set of variables found to be most occurring in an elevated home. Using this set of variables, a logistical regression model can be used to compute the propensity scores. These propensity scores provide the probability of assignment to treatment group \( T=1 \), or homes that are elevated, for each observation in the dataset.

In order to match the propensity scores of these observations in both the treated \( (T=1) \) and control \( (T=0) \) groups, three potential strategies exist; greedy nearest neighbor, optimal matching, and replacement. Greedy nearest neighbor was used in this procedure with \( K=2 \) nearest control units, which means two control units nearest to each one treatment unit were selected. By stating \( K=2 \), this means 2 separate loops of matching are done per one treatment observation, therefore increasing the number of potential matches. This is important to specify given the small amount of elevation observations. Higher values of \( K \) (from 3 to 5) were also investigated in this study, but were not found to produce as significant of a property price differential as a value of 2.
In order to set a boundary on the range of potentially matched propensity scores in each group, a caliper must be applied in the procedure. A caliper of .50 (as used in this procedure) implies that the difference in the logit of the propensity scores of two observations is less than or equal to .50 times the common standard deviation of the logits of the propensity scores (SAS 2016). Having so few elevated properties in the data set did not allow for the tougher constraint of a caliper closer to .2, as most of propensity score literature suggests (Austin, 2010, Lunt, 2013). It also makes intuitive sense that both observations in a match between the treatment and control group originate from the same type of characteristics in Camden County. To do this, the “exact” specification in the procedure exists so it can be determined that both observations share the same value of a variable. In this procedure, boat dock is used after the exact statement so that households on the marsh edge, and therefore in the most flood prone areas, are matched.

When multiple control units are being matched to one specific treatment unit, it is recommended that the “match weight” option also be used in the matching procedure. Here, the weight will be equal to “none”. When specifying the match statement, each treated unit is given a weight of 1, while each control unit also possesses a weight of 1 divided by the number of control units in that matched set. This ensures that the total weight of matched control units equals the total number of the treated units in a matched set, and in total. This is necessary in order to acquire the average treatment effect, which in other terms is the mean price differential (MPD) in the sale price of elevated homes versus non-elevated homes. The MPD can be expressed as:

\[
\text{MPD} = E[Y(1)|T=1] - E[Y(0)|T=0],
\]
where $E[Y(1)|T=1]$ is the expected value in dollars of homes that have been elevated and assigned to the treatment group, and $E[Y(0)|T=0]$ is the expected value in dollars of homes that are not elevated and assigned to the control group.

To further guarantee similarity between the homes being analyzed by the propensity score method, certain housing characteristics that are related to the probability of a home being elevated, and the resulting price differential, must be specified. The specified dummy variables that resulted in the most significant treatment effect were dock and multistory. Dock, as mentioned earlier under the “exact” statement, was chosen because of how highly significant it was in estimating sale price, and its representation of a house that borders the marsh where flooding is most probable. Multi-story was chosen because it represented a nicer class of homes. Multi-story homes tend to be of higher value, and therefore have more to gain from elevating. Multi-story homes also have a better chance of obtaining a marsh view from elevating than a single-story home would. Additional to these dummy variables, heated area and age were specified in the procedure to ensure that the selection of houses shared similar square footages and ages. These variables were previously determined to be highly significant in predicting sale price in the hedonic portion, and also make intuitive sense. Elevation for houses with a larger footprint are presumably more expensive, and the opportunity costs are potentially lower for elevating older houses that are more likely to be renovated already. Much like the specification of the hedonic model, the sale prices in the matching portion were adjusted to real prices using the Brunswick housing price index.
MATCHING PROCEDURE RESULTS

The matching procedure used to analyze the effect of elevation using dock, multistory, heated area, and age, resulted in 44 matches between the treatment and control groups. The average treatment effect came out to be 35,756.94, and was statistically significant at less than the 1% level. These results can be seen in Table 4. What this conveys is that on average, an elevated home in the data set sold for approximately $35,756.94 more than a non-elevated home when possessing similar physical and spatial characteristics.

To better understand the distribution of the observations used to obtain these results, a series of box plots and frequency distributions are available below. In Figure 4 the distribution of the logit of propensity scores can be seen for homes in the treated and control groups based on all observations, observations in the support region, and matched observations (SAS, 2016). The two distributions appear to be very well balanced for matched observations in this graphic. Figure 5 displays a box plot that compares distributions of the heated area characteristic. The median heated area among the matches of both the control group and treatment group falls right near 2,000 square feet. The interquartile range (or middle 50% of homes) in the matched group was between 1,500 square feet and 2,500 square feet. To put this into perspective, the average size of an American home built in 2013 was about 2,598 square feet (CNN, 2014), and a “small” American home is considered to be less than 1,400 square feet. In Figure 6, a box plot that compares distributions of the age of properties in the data set is displayed. Although the distributions are not as balanced as the heated area distribution, the median age of the control and treatment groups still fall within 10 years of each other. The interquartile range of homes
in the treatment group is approximately 10-25 years old, and the range of homes in the control group is about 15-30 years old.

The frequency distributions reflect the amount of homes in the treatment and control group that possess a characteristics, or do not possess a characteristic. Dummy variables are binomial, and therefore cannot be represented in a box plot. In Figure 7 the frequency of docks in each group can be observed. Of the matched observations, it is evident that very few houses that possessed a dock met the criteria of the data set. The handful of houses in the treatment and control group that did possess a dock can be seen in blue. It was a very similar story in Figure 8 with the multistory variable. Here, slightly more homes in the control group were multiple stories, and the treatment group had about the same distribution of multistory homes as it did with docks. Although the number of homes is low for both of these distributions, they do fit tight restrictions that were set out to guarantee similarities between the properties being estimated. For this reason, even with a small amount of observations, a significant property price differential could still be obtained.

Having so few elevated observations in the dataset can still cause for concern regarding the reliability of the resulting treatment effect. While the estimate was significant, the procedure is highly sensitive to different variables, and changes in different procedural constraints. For that reason, an appraiser (James Hancock) was hired to determine if the results of this study had validity to them. In order to focus on the elevation adjustment, he used properties that were on the marsh edge, and that had similar times of sale, size, quality, and other attributes. He tried to keep sale dates in consideration to eliminate the interference of market trends, but did note that the low amount of marsh
front property sales in Camden made controlling for the time of sale a challenge. There were 4 elevated homes that James looked at which had a crawl space, and fell into the price range of about $200,000+-/. There were 3 elevated homes that had sufficient headroom to park cars, and fell into the price range of around $300,000+-/. In cases where an attribute was not present across all homes, James made adjustments to maintain similarity in sale prices. For instance, among the 3 homes that had sufficient headroom to park cars, James made adjustments for 2 of the 3 homes that did not possess a fireplace, one home which had an inferior view, and one home which had a superior location in a gated community. His evaluation concluded elevated homes with a crawl space (in the price group of around $200,000+-/) had a +6% adjustment, and that elevated homes with sufficient headroom to park cars (in the price group of around $300,000+-/) had a +15% adjustment when elevated. This is equivalent to a range of between $12,000 and $45,000 of added value to elevated homes. The price differential estimated in the matching procedure of this study falls towards the higher end of this estimate, but still well within the range that Hancock concluded.

In addition, research compiled by FEMA (2013) regarding elevation costs and benefits further supports this study’s results. In their own comparison, FEMA looked at a 1-story home built at BFE, and a 1-story home built at 3 feet above BFE, each with the same flood insurance coverage under the NFIP. For a home meeting the current federal building requirements, flood insurance premiums were $143 per month, or $1,716 per year. A home elevated 3 feet above BFE saw a decrease in those premiums to only $46 a month, or $552 a year. By calculating the difference in yearly insurance premiums between these two homes ($1,164 in savings) and dividing by an interest rate of .03, it can be shown that the
present value of elevating a home in flood zone AE is $38,800. The home is calculated as an
infinite annuity due to the fact that a person purchases a home not just with his or her own
personal timeline in mind, but also the value that the next buyer will purchase the home at,
and so on. While not exact, the result of this calculation is quite comparable to the property
price differential that resulted from the matching procedure. The same comparison
conducted by FEMA in flood zone AE was also conducted in flood zone VE. This time, a
building at current federal standards possessed a flood insurance premium at $10,536 a
year, as compared to $3,780 a year for a building 3 feet above the current federal
requirements. Using the same calculation from above, the present value of elevating a
home in the higher risk flood zone VE is a staggering $225,200.

Supplementary to those calculations, a graphical comparison of insurance premiums
between 2007 and 2017 (Figure 9) warns that the financial costs of waiting to elevate will
likely only grow higher. The detailed numbers of this comparison are shown in Table 5 and
Table 6, and were taken from NFIP rating manuals. Before the Biggert Waters Flood
Insurance Reform Act of 2012, raising a house to 4 feet above BFE when freeboard was
initially at 0 feet provided insurance premium cost savings of about $567.78. Now, in 2017,
this same amount of elevation saves homeowners more than double ($1,277.56). It is
important to remember that on top of the insurance premium savings conveyed by these
calculations, a number of remaining benefits to elevating homes located in these flood
zones exist that are not being valued. These include a vast increase of storage space, an
improvement to views of the marshland or water feature, and most importantly the ability
to completely prevent flooding from affecting the homeowner. This is all evidence to
support the positive treatment effect drawn from the matching procedure, and suggest that
the true benefit of elevating a home is likely even larger than what is portrayed in by the
average treatment effect and insurance premium calculations.

The results of the matching procedure succeeded at providing a strong argument
that positive price effects exists when elevating a home in flood zone AE. The premium of
$35,756.94 is not a fully reliable estimate, but it certainly suggests that a hefty premium
exists on elevated houses, and that elevation retrofitting should be thoroughly explored as
a primary method for flood protection. In future studies regarding the benefits of
elevating, more reliable real estate data with a higher number of sale transactions should
be acquired.
CHAPTER 5
SUMMARY AND CONCLUSION

Flood risk and flood protection methods are two profoundly important topics to homeowners in coastal Georgia given their vulnerable position to rapidly changing climate conditions. This study conducted in Camden County, GA set out to be one of the pioneers in determining an answer to the important research question: how are home prices affected by being elevated above the base flood elevation? First, this paper showed a quick look into the environmental, real estate, and policy conditions of Camden County, GA. After, a number of literature and valuation techniques were discussed to solidify the foundation of the methods used in this study to answer the research question. Finally, the hedonic and propensity score matching procedures used in this study were explained in full detail, and their results were reported and interpreted.

In the hedonic price method that followed previous amenity value research, an estimation of the effects of a variety of housing characteristics on sale price determined a number of significant and theoretically consistent coefficients. From these it was possible to draw conclusions about the large importance of marshland proximity, and how including spatial variables can greatly reduce spatial autocorrelation (household income, race, distance to marsh, etc.). While many coefficients turned out as expected, the elevation coefficient was insignificant in explaining sale prices. This disqualified the hedonic from contributing an authentic answer to the research question, and opened the door for the matching procedure.
In the matching procedure, greedy nearest neighbor propensity scores were used to sort out a treatment of elevated houses and control group of non-elevated house. Homes in the data set were also matched according to their possession of a boat dock, how many stories the home was, the year it was built, and its size. The average property price differential turned out to be $35,756.94 and was significant at less than the 1% level. This result, complemented by an appraisal by James Hancock and research by FEMA, supported the initial hypothesis that elevating a home causes a positive sale price effect, and provided an answer to the research question.

Though data constraints did not allow this research to reach the most robust results, there are still some takeaways that are of considerable importance: (1) Elevating a home is found to increase its market value significantly; (2) Elevating a home severely decreases its insurance premiums, along with adding a number of benefits (storage space, marsh view, etc.); (3) Water feature proximity and access (boat dock) in Camden county places a significant premium on sale prices.

Elevation retrofitting is not a topic that is set to soon go away. As the frequency of a major flood event occurring along the coastline increases, research such as this needs to be taken further in determining how homeowners can benefit from precautions such as elevation retrofitting. The more available quality information becomes to homeowners facing the decision whether to elevate, the more cost savings they will be able to obtain, and less consequences they will have to endure in the long run.
REFERENCES


Kriesel, W. "How was a Real Estate Market’s Response to a Natural Amenity Affected During the Housing Bust." Prepared for Annual Meetings of the Western Regional Science Association (2015).


Table 1 - Variable Descriptions

<table>
<thead>
<tr>
<th>Variable</th>
<th>Description</th>
<th>Hypothesized Sign</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sale Price</td>
<td>Property sale price, the dependent variable</td>
<td>+</td>
</tr>
<tr>
<td>Heated Area</td>
<td>Total heated square footage of home</td>
<td>+</td>
</tr>
<tr>
<td>Parcel Size</td>
<td>Total acreage of property parcel</td>
<td>+</td>
</tr>
<tr>
<td>Baths</td>
<td>Number of bathrooms</td>
<td>+</td>
</tr>
<tr>
<td>Age</td>
<td>How long ago the house was first constructed</td>
<td>-</td>
</tr>
<tr>
<td>Fireplace</td>
<td>Presence of fireplace inside the home, yes = 1</td>
<td>+</td>
</tr>
<tr>
<td>Bad Condition</td>
<td>Whether the house was reported as below average condition, yes = 1</td>
<td>-</td>
</tr>
<tr>
<td>Garage</td>
<td>Presence of an attached or detached garage, yes = 1</td>
<td>+</td>
</tr>
<tr>
<td>Deck</td>
<td>Presence of an outdoor deck attached to house, yes = 1</td>
<td>+</td>
</tr>
<tr>
<td>Brick</td>
<td>Exterior of house is brick material, yes = 1</td>
<td>+</td>
</tr>
<tr>
<td>Slab</td>
<td>Foundation of house is concrete slab, yes = 1</td>
<td>-</td>
</tr>
<tr>
<td>Pool</td>
<td>Presence of pool on property, yes = 1</td>
<td>+</td>
</tr>
<tr>
<td>Paved</td>
<td>House has access to a paved/city road, yes = 1</td>
<td>+</td>
</tr>
<tr>
<td>Shingles</td>
<td>Houses possesses a shingle roof, yes = 1</td>
<td>-</td>
</tr>
<tr>
<td>Elevated</td>
<td>House has been elevated above BFE, yes = 1</td>
<td>+</td>
</tr>
<tr>
<td>Dock</td>
<td>Dock access on property, yes = 1</td>
<td>+</td>
</tr>
<tr>
<td>Marsh Edge</td>
<td>Property borders marsh or other water feature, yes = 1</td>
<td>+</td>
</tr>
<tr>
<td>Nearest Distance</td>
<td>Distance (feet) to nearest property parcel that borders marsh or other water feature</td>
<td>-</td>
</tr>
<tr>
<td>Nearest Gate</td>
<td>Distance (miles) to nearest Kings Bay Naval base gate</td>
<td>-</td>
</tr>
<tr>
<td>Percent Non-White</td>
<td>Percentage of non-white residents in a Census block group</td>
<td>-</td>
</tr>
<tr>
<td>HH Income</td>
<td>Median household income in 2010 inflation adjusted dollars within Census block group</td>
<td>+</td>
</tr>
<tr>
<td>Y14, Y15, Y16</td>
<td>Sale year dummy variable, yes = 1 if sold in respective year</td>
<td>+</td>
</tr>
</tbody>
</table>
Table 2-Summary Statistics

<table>
<thead>
<tr>
<th>Variable</th>
<th>Mean</th>
<th>Standard Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sale Price</td>
<td>$180,728.05</td>
<td>92,216.97</td>
</tr>
<tr>
<td>Heated Area</td>
<td>1,959.94</td>
<td>678.11</td>
</tr>
<tr>
<td>Parcel Size</td>
<td>.64</td>
<td>.77</td>
</tr>
<tr>
<td>Baths</td>
<td>2.21</td>
<td>.59</td>
</tr>
<tr>
<td>Age</td>
<td>19.33</td>
<td>9.07</td>
</tr>
<tr>
<td>Fireplace</td>
<td>.45</td>
<td>.5</td>
</tr>
<tr>
<td>Bad Condition</td>
<td>.0096</td>
<td>.098</td>
</tr>
<tr>
<td>Garage</td>
<td>.86</td>
<td>.35</td>
</tr>
<tr>
<td>Deck</td>
<td>.15</td>
<td>.36</td>
</tr>
<tr>
<td>Brick</td>
<td>.13</td>
<td>.33</td>
</tr>
<tr>
<td>Slab</td>
<td>.78</td>
<td>.42</td>
</tr>
<tr>
<td>Pool</td>
<td>.13</td>
<td>.34</td>
</tr>
<tr>
<td>Paved</td>
<td>.96</td>
<td>.20</td>
</tr>
<tr>
<td>Shingles</td>
<td>.96</td>
<td>.19</td>
</tr>
<tr>
<td>Elevated</td>
<td>.03</td>
<td>.16</td>
</tr>
<tr>
<td>Dock</td>
<td>.05</td>
<td>.22</td>
</tr>
<tr>
<td>Maybe Marsh</td>
<td>.11</td>
<td>.31</td>
</tr>
<tr>
<td>Nearest Distance</td>
<td>324.20</td>
<td>305.32</td>
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<tr>
<td>Nearest Gate</td>
<td>7.02</td>
<td>7.11</td>
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<tr>
<td>Percent Non-White</td>
<td>15.82</td>
<td>8.60</td>
</tr>
<tr>
<td>Household Income</td>
<td>$62,953.59</td>
<td>11,784.02</td>
</tr>
<tr>
<td>Y14 Dummy</td>
<td>.27</td>
<td>.44</td>
</tr>
<tr>
<td>Y15 Dummy</td>
<td>.33</td>
<td>.47</td>
</tr>
<tr>
<td>Y16 Dummy</td>
<td>.19</td>
<td>.39</td>
</tr>
</tbody>
</table>
Table 3- Hedonic Model Results

P-Values: * ≤0.05  **≤0.01  ***≤0.001  \( R^2 = .7178 \)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient</th>
<th>Marginal Implicit Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intercept</td>
<td>-34.599</td>
<td>--</td>
</tr>
<tr>
<td>Heated Area</td>
<td>.829</td>
<td>$76.44</td>
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<tr>
<td>Parcel Size</td>
<td>.100</td>
<td>$28.238.76</td>
</tr>
<tr>
<td>Baths</td>
<td>-.024</td>
<td>-$1,962.66</td>
</tr>
<tr>
<td>Age</td>
<td>-.019</td>
<td>-$177.64</td>
</tr>
<tr>
<td>Fireplace</td>
<td>.077</td>
<td>$14,465.85</td>
</tr>
<tr>
<td>Bad Condition</td>
<td>-.080</td>
<td>$13,895.03</td>
</tr>
<tr>
<td>Garage</td>
<td>.044</td>
<td>$8,129.57</td>
</tr>
<tr>
<td>Outdoor Deck</td>
<td>-.024</td>
<td>-$4,285.84</td>
</tr>
<tr>
<td>Brick</td>
<td>.080</td>
<td>$15,052.31</td>
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<tr>
<td>Slab</td>
<td>-.110</td>
<td>-$18,825.69</td>
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<tr>
<td>Pool</td>
<td>.107</td>
<td>$20,410.39</td>
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<tr>
<td>Shingles</td>
<td>-.141</td>
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<td>$905.90</td>
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<td>Dock</td>
<td>.414</td>
<td>$92,687.67</td>
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<tr>
<td>Maybe Marsh</td>
<td>.098</td>
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<td>Nearest Gate</td>
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<td>Percent Non-White</td>
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<td>$102.82</td>
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<td>Household Income</td>
<td>.020</td>
<td>$.06</td>
</tr>
<tr>
<td>Y14 Dummy</td>
<td>.021</td>
<td>$3,835.42</td>
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<tr>
<td>Y15 Dummy</td>
<td>.014</td>
<td>$2,547.99</td>
</tr>
<tr>
<td>Y16 Dummy</td>
<td>-.041</td>
<td>-$7,260</td>
</tr>
</tbody>
</table>

\( p-values: * ≤0.05  **≤0.01  ***≤0.001 \)

\( R^2 = .7178 \)
Table 4- Matching Procedure Results

| N  | Mean    | Standard Error | t Value | Pr > |t| |
|----|---------|----------------|---------|------|---|
| 44 | 35756.94| 12572.19       | 2.84    | 0.0068 |
Table 5- Savings from Elevating to 4 Feet above BFE when Freeboard is X (2007)

<table>
<thead>
<tr>
<th>Freeboard</th>
<th>Premium</th>
<th>Savings</th>
<th>Capitalized Savings</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>$379.38</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>3</td>
<td>$379.38</td>
<td>-0.62</td>
<td>$-17.71</td>
</tr>
<tr>
<td>2</td>
<td>$429.11</td>
<td>$49.11</td>
<td>$1,403.00</td>
</tr>
<tr>
<td>1</td>
<td>$563.75</td>
<td>$183.75</td>
<td>$5,249.86</td>
</tr>
<tr>
<td>0</td>
<td>$947.78</td>
<td>$567.78</td>
<td>$16,222.14</td>
</tr>
<tr>
<td>-1</td>
<td>$3,989.42</td>
<td>$3,609.42</td>
<td>$103,126.14</td>
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</tbody>
</table>
Table 6- Savings from Elevating to 4 Feet above BFE When Freeboard is X (2017)

<table>
<thead>
<tr>
<th>Freeboard</th>
<th>Premium</th>
<th>Savings</th>
<th>Capitalized Savings</th>
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<td>$533.99</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>3</td>
<td>$555.63</td>
<td>$21.63</td>
<td>$617.90</td>
</tr>
<tr>
<td>2</td>
<td>$653.90</td>
<td>$119.90</td>
<td>$3,425.74</td>
</tr>
<tr>
<td>1</td>
<td>$963.60</td>
<td>$429.60</td>
<td>$12,274.30</td>
</tr>
<tr>
<td>0</td>
<td>$1,811.56</td>
<td>$1,277.56</td>
<td>$36,501.58</td>
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<tr>
<td>-1</td>
<td>$3,965.48</td>
<td>$3,431.48</td>
<td>$98,042.22</td>
</tr>
<tr>
<td>-2</td>
<td>$6,046.37</td>
<td>$5,512.37</td>
<td>$157,496.30</td>
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<tr>
<td>-3</td>
<td>$7,978.05</td>
<td>$7,444.05</td>
<td>$212,687.10</td>
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<tr>
<td>-4</td>
<td>$10,167.13</td>
<td>$9,633.13</td>
<td>$275,232.38</td>
</tr>
<tr>
<td>-5</td>
<td>$12,158.77</td>
<td>$11,624.77</td>
<td>$332,136.22</td>
</tr>
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</table>
Figure 1- Map of Camden County’s Location
Figure 2 - Map of Camden County
Figure 3-Graph of Semi-variances for Real Property Price and OLS Residuals
Figure 4- Box Plot of Logit of Propensity Scores
Figure 5- Box Plot of Heated Area

Figure 6- Box Plot of Property Ages
Figure 7 - Frequency Distribution of Dock

Figure 8 - Frequency Distribution of Multistory
Figure 9- Insurance Premiums Comparison between 2007 and 2017