ESTIMATING THE IMPACT OF FORECLOSURES ON HOUSING PRICES IN ORLANDO, FLORIDA: A HEDONIC MODELING APPROACH

By

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A THESIS PRESENTED TO THE GRADUATE SCHOOL
OF THE UNIVERSITY OF FLORIDA IN PARTIAL FULFILLMENT
OF THE REQUIREMENTS FOR THE DEGREE OF
MASTER OF SCIENCE

UNIVERSITY OF FLORIDA

2013

To my Mom and Dad, Fang Liu and Kang Xia

ACKNOWLEDGMENTS

I am deeply grateful to a number of people without whose encouragement and assistance this thesis would not have been completed. I am greatly indebted to my supervisor, Dr. Timothy Fik, for his constant encouragement and insightful guidance throughout my thesis process. In the preparation of the thesis, he has spent much time reading through each draft and provided me with inspiring advice. Without his consistent and illuminated instruction, the completion of this thesis could not have been possible. I would like to express my gratitude to Dr. Eric Keys for serving on my thesis committee and offering my valuable suggestions in the academic studies. I have learned much analysis skills and academic writing from him.I feel grateful to Dr. David Ling at Department of Finance Insurance and Real Estate for serving on my thesis committee. I have benefited a lot from his devoted teaching and enlightening lectures.

I am profoundly indebted to Dr. Steven Perz at Department of Sociology for supporting me to finish my two-year academic study. His broad and profound knowledge gave me great impression as well as great help. I would like to give my hearty thanks to Zhuojie Huang, Yang Yang, and Jing Sun for helping me work out my problems and for their valuable suggestions and critiques during the process of my thesis. Finally, I would like to thank my parents for their loving consideration and great confidence in me all through these years. They have always been helping me out of difficulties and supporting without a word of complaint.

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May 2013

Chair: Timothy Fik
Major: Geography

Foreclosures pose a significant threat to the market value of residential properties, and are partly responsible for driving down the sales price of units in areas where foreclosure density is relatively high. After the bust of housing bubble, there has been a profound increase in the number of foreclosures in certain geographic markets. The foreclosure phenomenon has negatively affected housing prices in the United States, and especially in the state of Florida.

This thesis uses data on single-family housing unit transactions in Orlando, FL for 2011 and 2012 to estimate the impact(s) of foreclosures on residential housing prices. A series of hedonic regression models are used to estimate the effects of foreclosures on market value. A foreclosure intensive index is also introduced, and estimates of the average loss of market value for foreclosed properties are obtained under various scenarios. The results suggest that, in the Orlando market, foreclosures have significant negative effects on the price of single-family housing units and nearby property values. Foreclosures also affect property value negatively when they are associated with other submarket factors, suggesting that the impact of foreclosures on market price is something that is not constant over various locations or submarkets. For

example, in housing submarkets with high median household income, the negative effects of foreclosures on the price of single-family housing units are significantly greater than the negative effect of foreclosures in the overall market (on average).

The approach adopted in this thesis can be applied to other urban housing markets to estimate the negative impact of foreclosures on average market price, and to explain variability in the impact of foreclosures in various housing submarkets.

CHAPTER 1
INTRODUCTION

The U.S. housing market was regarded to be prosperous over the past decade and began to decline in the middle of 2007. During the periods of housing market prosperity, the homeownership rate was approximately 70%, and more people than ever were able to purchase homes through various mortgage products, loose underwriting standards, and improved services (Cutts and Green 2004; LaCour-Little 2000). A growing credit risk was inevitable along with this achievement (Lin, Rosenblatt, and Yao 2009). For instance, subprime mortgages have grown to serve those with weak payment capacity and blemished credit who would not qualify for a mortgage in the prime market (Lin, Rosenblatt, and Yao 2009). $665 billion of such loans were originated in 2005, and the subprime's share of total mortgage originations reached 23% in 2006 (Lin, Rosenblatt, and Yao 2009). According to National and Twelfth District Developments (2007), a sharp increase in delinquencies and foreclosures took place in 2007 as the subprime market has captured the public spotlight. Due to the outbreak of the subprime credit collapse, the U.S. housing market was in a crisis through 2007 and 2008, which substantially increased foreclosures and largely declined the housing prices in over half of the states in the U.S. – especially in Arizona, California, Florida, Michigan, Ohio, and Nevada (Calomiris, Longhofer, and Miles 2008). According to Humphries (2012), foreclosure re-sales increased to a new high making up 20.5% of all sales in March 2012 (Figure 1-1). It is expected that foreclosure re-sales will continue their steady increase based on the status over the last several months (Humphries 2012).

In the 1990s, two theories of foreclosures were prevalent to model the factors associated with foreclosures (Grover, L. Smith, and Todd 2008). The options theory of foreclosures indicated that foreclosures occur when the value of the property falls far below the outstanding loan balance that the borrower finds it profitable to put the collateral to the lender instead of continuing payments. These foreclosures are often associated with homes whose market values have declined (Ambrose and Capone 1998). The trigger event theory indicated that foreclosures occur when the borrower experiences financial setbacks, such as job loss, which makes it difficult to continue making payments. These foreclosures are often associated with low credit scores or high unemployment rates (Ambrose and Capone 1998). Based on the report from RealtyTrac (2012), about 2 million homes are facing foreclosure process. According to the Mortgage Bankers Association, the number of mortgages in foreclosure or more than 90 days delinquent is at a record high of about 4.2 million (Hartley 2010). Highly leveraged borrowers tend to fall into a position of “negative equity” (Frame 2010). According to reports from CoreLogic, 11.3 million residential properties, which representing 24% of all residential properties with mortgages, were in a negative equity position as of year-end 2009 (Frame 2010). Foote, Gerardi, and Willen (2008) indicated that a negative equity position is necessary for a mortgage default and a trigger like a shock to the borrower’s monthly income is often required for a foreclosure.

Abundant researches suggested that foreclosures have negative effects on housing prices. Foreclosed properties tend to sell at discount because they are likely to be physically damaged during the foreclosure process or because lenders intend to sell them quickly to reduce their holding costs (Biswas 2012). Foreclosed properties also tend to lower the price of properties in the vicinity. According to Immergluck and Smith (2006), foreclosures of single-family homes have been regarded as a threat to neighborhood well-being. They argued that foreclosures, especially in lower-income neighborhoods, lead to vacant properties. These properties bring physical disorder and crime in a community, which then lead to lower housing values of nearby properties. After the bust of housing bubble, there has been a profound increase in the number of foreclosures in certain geographic markets. The foreclosure phenomenon has negatively affected housing prices in the U.S., and especially in the state of Florida. Florida Realtors (2012) estimated that about 600,000 houses in Florida remain in a "shadow inventory", which means that those properties are in the risk of default or foreclosure but not yet listed for sale. The Metropolitan Statistical Area (MSA) of Orlando-Kissimmee has the 7^{th} highest foreclosures rate (14.9%) in 2012 (FloridaRealtors 2012). Figure 1-2 shows the foreclosure rates in the U.S. as of August 2012, and Florida has one of the highest foreclosure rates as a percentage of all mortgaged homes (11.0%).

This thesis uses data on single-family housing unit transactions in Orlando, FL for 2011 and 2012 to estimate the impact(s) of foreclosures on residential housing prices and nearby property values. A series of hedonic regression models are used to estimate the effects of foreclosures on market value, and control for property, locational, and neighborhood characteristics. Based on the hedonic regressions, both foreclosure contagion model and foreclosure intensive index model show good performances. Foreclosure contagion model measures the foreclosure discount on housing prices and nearby property values. It also estimates the interactive nature between foreclosures and other attributes, such as property attributes, locational attributes, or neighborhood attributes. In addition, foreclosure intensive index model only includes foreclosure intensive index as foreclosure attributes to estimate the impact of foreclosure intensity on housing prices. It provides estimation of the average loss of market value for foreclosed properties under various scenarios. Moreover, this thesis intends to measure the effects of foreclosures on property values in the high-end housing submarket (i.e., in neighborhoods with relatively high income levels), given that effects of foreclosure tend to differ across submarkets.

The results suggest that, in the Orlando market, foreclosures have significant negative effects on the price of single-family housing units and nearby property values. In particular, a foreclosure property lowers tshe sale price by $49,105, and each additional foreclosure within 2000 feet of a subject sale is associated with an approximately $2,500 decrease of the sale price. The interactive approach suggests that foreclosures with larger living areas have larger negative effects on housing prices than those with smaller living areas. Foreclosures with population that has a higher percent of bachelor’s degree have larger negative effects on housing prices than those with a lower percent of bachelor’s degree. The foreclosure intensive index has a significant negative effect on the housing prices as expected, for a 0.01 unit increase of the foreclosure intensive index lowers the housing price by $1,563, which indicates that foreclosures are partly responsible for driving down the sales price of units in areas where foreclosure density is relatively high. Foreclosures also affect property value negatively when they are associated with other submarket factors, suggesting that the impact of foreclosures on market price is something that is not constant over various locations or submarkets. A foreclosure property lowers the sale price by $60,363, and each additional foreclosure within 2000 feet of a subject sale is associated with an approximately $3,300 decrease of the sale price. The interactive approach estimates that foreclosures with larger living areas have larger negative effects on housing prices than those with smaller living areas. The foreclosure intensive index has a significant negative effect on the housing prices as expected, for a 0.01 unit increase of foreclosure intensive index lowers the housing price by $2,330. Based on these statistics, in housing submarkets with high median household income, the negative effects of foreclosures on the price of single-family housing units are significantly greater than the negative effect of foreclosures in the overall market.

The organization of the thesis is shown as follows. Chapter 2 provides the literature reviews. Chapter 3 describes the study area and data/variables. Chapter 4 presents the hedonic regression methodology. Chapter 5 discusses the results and provides interpretations. Chapter 6 concludes the thesis and mentions the limitation and future research.

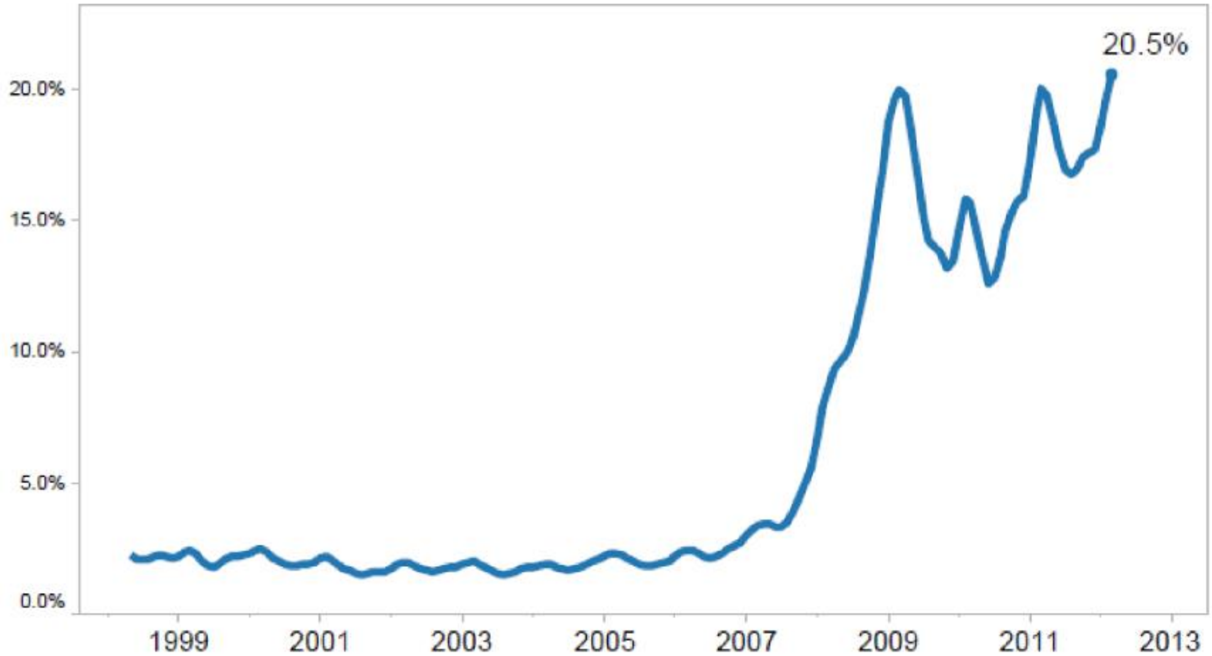

Figure 1-1. The United States foreclosure re-sales (Adapted from Zillow Real Estate Research: Humphries, S. 2012. Rentals Continue to Outshine Purchase Market, Home Values Still Plagued By Foreclosures. *Zillow Real Estate Research*. http://www.zillowblog.com/research/2012/04/09/rentals-continue-to-outshine-purchase-market-home-values-still-plagued-by-foreclosures/.)

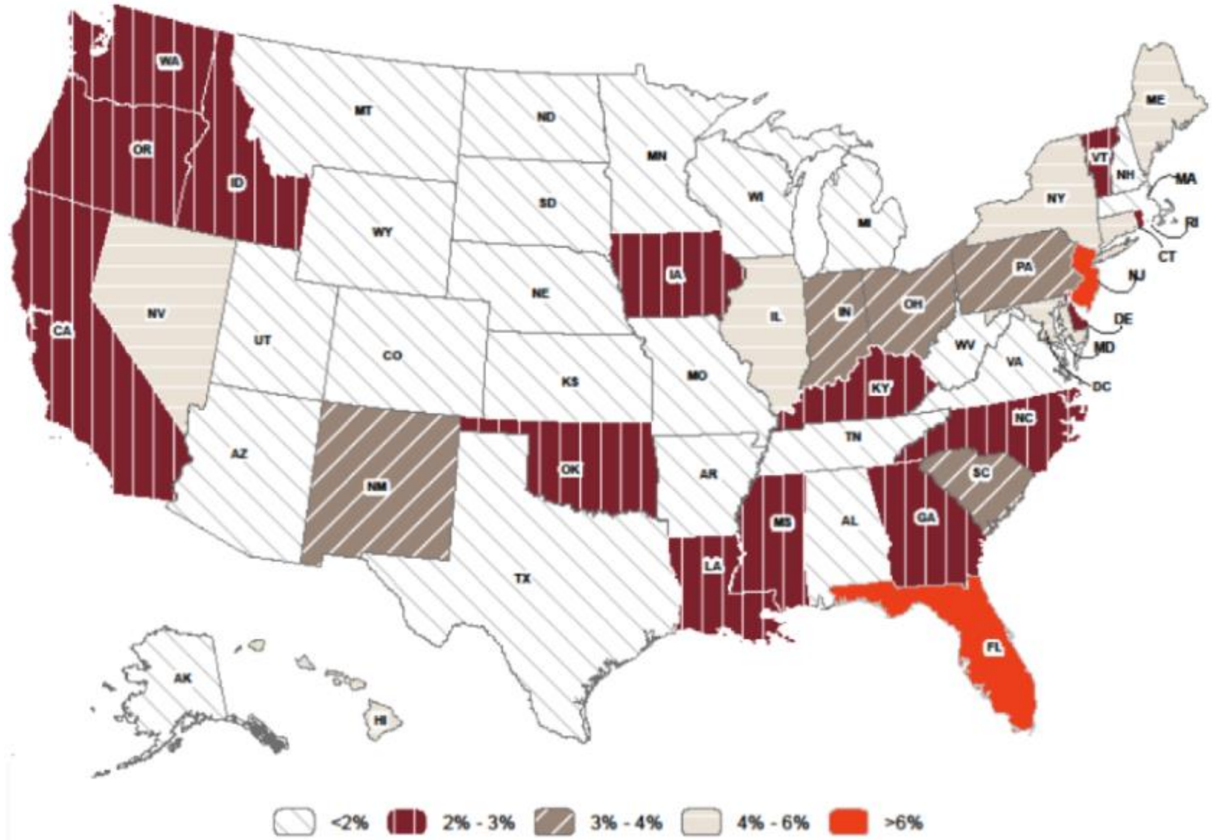

Figure 1-2. U.S. foreclosure rate as of August 2012 (Adapted from CoreLogic Market Trends: Norman, D. 2012. Foreclosures in May down almost 20% from year ago. *Real Estate Industry News*. http://www.realestateindustrynews.com/foreclosures/foreclosures-in-may-down-almost-20-percent-from-year-ago/.)

CHAPTER 2
LITERATURE REVIEW

Impact of Foreclosure on Housing Price

Over the past decade, numerous studies have examined the impact of foreclosures on property prices within affected neighborhoods and throughout the urban housing markets (Sumell 2009; Immergluck and G. Smith 2006; Mikelbank 2008; Leonard and Murdoch 2009). Hedonic models have been widely used to quantify the effects of foreclosures on real estate values using a large number of control variables such as property, location, and neighborhood characteristics to account for various price determinants (Schuetz, Been, and I. G. Ellen 2008). These studies vary significantly in terms of the location of the housing market, the period examined, the selection of control variables, and the model-building methodology.

To estimate the effects of foreclosures on housing prices, Sumell (2009) estimated that foreclosures lead to a 50% discount on property prices in Cuyahoga County, Ohio, between 2004 and 2006. Similarly, Campbell, Giglio, and Pathak (2009) found a 22% foreclosure discount for single-family properties in Massachusetts during 1987–2007. Both of these studies used hedonic price models with a larger sample size and sufficient control variables. Clauretie and Daneshvary (2009) estimated a foreclosure discount of less than 10% in Clark County, Nevada, from 2004 to 2007. This analysis controlled for various property and neighborhood characteristics, occupancy status, timing on the market, and cash sales. Several studies also indicated that larger foreclosure discounts are usually associated with homes in the lower quality range because financially distressed low-income homeowners are less likely to maintain their properties (Clauretie and Daneshvary 2009; Sumell 2009).

Given that foreclosed properties generally sell at discount, researchers began to concern about how foreclosures affect housing prices in surrounding neighborhoods, which is also called the “spillover” effect. Immergluck and Smith (2006) pointed out that foreclosures of conventional single-family homes in Chicago in 1999 had a significant impact on the housing values of surrounding properties after controlling for over 40 property and neighborhood characteristics. They indicated that each foreclosure associated with conventional loan within one-eight mile of a single-family home resulted in a 0.9% to 1.1% decline in the home value depending on whether or not the median house price in the census tract was controlled for. Foreclosures associated with conventional loans located between one-eighth and one-quarter mile away from a single-family home had less negative effects on the nearby housing prices. However, it was not clear why foreclosures associated with government-guaranteed loans appeared to have no effect on nearby sales prices.

Schuetz, Been, and Ellen (2008) studied single-family and multifamily property sales and foreclosures in New York City from 2000 to 2005 to identify the effects of foreclosures on housing prices in the nearby neighborhoods. Both physical distance (within 250 feet, 250–500 feet, and 50–1,000 feet) and time (less than and greater than eighteen months) were involved in this study. Their results suggested that the proximity to foreclosure properties is associated with lower sales prices. They also found that with the increase of the number of foreclosures, the magnitude of the negative effects on property prices increases over time.

Mikelbank (2008) examined the spillover effects of foreclosures and vacant/abandoned properties for Franklin County, Ohio in 2006. The author found out that the negative effect of a vacant property on a nearby house sale was more severe than foreclosure, but had a smaller “spillover” effect up to 500 feet. The effects of foreclosures, by contrast, were more moderate than vacancy, but had a significant impact up to 1,000 feet. Although this study is able to control for property quality, it has limited neighborhood control variables. Calomiris, Longhofer, and Miles (2008) developed a dynamic model of the housing market at the state level to measure the size of the effect that foreclosures have on the housing prices. Their results suggested that foreclosures had significant negative effects on housing prices. Surprisingly, the magnitude of this effect was small, which indicated that home prices are quite sticky even in the face of a high probability of foreclosure.

Leonard and Murdoch (2009) studied sales of single-family homes using hedonic price models in Dallas County, Texas, during 2006. They classified nearby foreclosures according to their physical space (250 feet, 500 feet, 1,000 feet, and 1,500 feet) of the sale, and indicated that the effects of nearby foreclosures on housing market were negative. They found evidence that each foreclosure within 250 feet negatively affected selling price by 0.5% or approximately $1,666. The results also suggested that there may be modest spillover effects even further out in the physical space. Rogers and Winter (2009) investigated the impact of foreclosures on sales prices of non-foreclosed homes in St. Louis County, Missouri, between 1998 and 2007. Foreclosure effects were measured involving both physical distance and time. The authors indicated that foreclosures lead to expected decline in the sales prices of nearby properties. One of the most notable findings is that the marginal impact of foreclosures on sales prices seems to decline as the number of foreclosures increases. The weaknesses of this analysis lie in the lack of temporal control variables and neighborhood control variables.

Lin, Rosenblatt, and Yao (2009) examined foreclosure spillover effects for the Chicago MSA in 2003 and 2006 based on a comparable properties theory. The authors indicated that the spillover effects of a foreclosure on the value of a neighborhood property depend on two factors: the discount of the foreclosure sale and the distance between the foreclosed property and the subject property. The results suggested that the spillover effects of foreclosures could lead to a decrease of nearby property values by 8.7% within a 0.9-kilometer radius and a 5-year period from liquidation in a bad market, such as that in 2006. The negative spillover effects reduce as the time and distance from the foreclosure increase. Moreover, the authors showed that the spillover effects of foreclosure were much less in a relatively good market, such as that in 2003, for the foreclosures decreased nearby property values only by 5%. The shortcomings of this study lie in that only ZIP code is utilized to indicate neighborhood characteristics and the control for local property price trends is not included.

Campbell, Giglio, and Pathak (2009) used single-family property transactions data in Massachusetts over the last 20 years to show foreclosures are sold at lower prices than regular houses (a 7–9% foreclosure discount). After using two different “differences-in-differences” approaches at a local level, the results suggested that foreclosures within 0.05 mile lower the price of houses by about 1%. Harding, Rosenblatt, and Yao (2009) used a repeat-sales approach to estimate the contagion effects of foreclosed properties. Both physical space (0–300 feet, 300–500 feet, 500–1,000 feet, and 1,000–2,000 feet) and time (the stage in the foreclosure process) attributes were involved in this study. The results confirmed that nearby foreclosed properties have significant negative contagion effects in house prices. A peak contagion effect from the closest foreclosure is approximately 1% and the negative contagion effect diminishes rapidly as the distance between the subject property and foreclosed property increases. The results also suggest that the largest negative contagion effect of a foreclosure on a nearby property occurs around the time of the foreclosure sale. A foreclosure decreases the value of a house within 300 feet of the foreclosure by approximately 1% at that point.

Biswas (2012) used a dataset of housing prices in the City of Worcester from 1991 to 2008 to examine the spillover effects of foreclosures. The author proposed a new approach which enables testing whether and how the impacts of nearby foreclosures may differ across types of housing. Their study focused on the effects of foreclosures of single- and multi-family houses on each single-family transaction within 660 feet (one-eighth of a mile) and within 1320 feet (one-quarter of a mile). One of the most preferred estimates suggested that each single-family foreclosure that occurs within 600 feet from a subject single-family house reduces the sale price by approximately 1%. Another preferred estimate suggested that between 660 and 1320 feet of a subject property, each multi-family foreclosure lowers the values of the nearby single-family properties by approximately 3%.

Foreclosure in Submarkets

Immergluck and Smith (2006) indicated that many cities have suffered a growth in foreclosures during the recent economic downturn. Particularly hard hit are low- and moderate- income and minority neighborhoods. The authors pointed out that the total number of foreclosures rose 238% from 1995 to 2002. There was an increase of 215%

in census tracts with less than 10% of minorities, while there was an increase of 544% in census tracts with more than 90% of minorities. One of the most notable findings is that there was an over 61% of increase in conventional foreclosures in census tracts with minority populations of 50% or more.

Hartley (2010) suggested that foreclosures affect housing prices differently in different neighborhoods (submarkets), so it may be necessary to use various sub-market specific strategies to reduce the unwanted negative effects caused by foreclosures. The author indicated that there are two different ways in which foreclosures can affect the nearby property values. First, foreclosures add the supply of homes to the market, and a large number of homes for sale may incur lower sale prices. Second, foreclosures have negative effects on nearby property values as foreclosures are viewed as a visible “negative externality”. That is to say, the presence of one or more foreclosed properties will reduce the well-being and the desirability of surrounding properties within the neighborhood, and drive down market value and prices. In short, there is a supply effect and a disamenity effect. Hartley (2010) also indicated that the supply effect and the disamenity effect vary across neighborhoods with different vacancy rates. It was found that foreclosures lower the nearby single-family properties prices via the supply effect in neighborhoods with low vacancy rates (i.e., in tight submarkets) and by the disamenity effect in neighborhoods with high vacancy rates (i.e., in loose submarket).

Biswas (2012) measured the spillover effects of foreclosures based on the characteristics of housing submarkets, which were defined on the basis of structural and neighborhood characteristics. A statistical clustering approach, which is based on the principle of minimizing the dissimilarities in housing characteristics within a cluster, and maximizing the across cluster heterogeneity, was applied to identify the various housing submarkets. The clustering approach resulted in three definable submarkets: high, medium, and low. The results suggested that foreclosures have substantial impact on the subject property values within the same submarket, for each distant foreclosure lowers a single-family sale price by approximately 0.1% within the same submarket.

Hedonic Price Model

Hedonic price models are most widely accepted as property valuation approaches in the real estate literatures. These hedonic models are applicable for illuminating the foreclosure impacts in various ways. Leonard and Murdoch (2009) estimated the hedonic price of an increase in foreclosures beginning with an ordinary least squares regression:

$$S_{06} = \zeta Z + \beta X + \delta D + \eta N + \varepsilon$$

The dependent variable S_{06} is the vector of home sale prices in 2006 (expressed as natural log). Z is a matrix of site-specific characteristics. X includes block group-level controls for percent African American, percent Hispanic, percent over 65 years of age, average household size, and percent owner occupied. D is a matrix of dummy variables to control for any fixed effects across school districts and time (month in which the sale took place). N , the target variable, is the counts of foreclosures at various distances.

Schuetz, Been and Ellen (2008) used a hedonic price model, controlling for property and neighborhood characteristics, to identify the effects of foreclosures that state on the neighboring property values. It is similar to the methodology used in the studies conducted by Ellen et al. (2002) and Voicu and Been (2008). The regression equation is shown below:

$$LPTICE_{ijt} = \beta_0 + \beta_1 LP_{ijt} + \beta_{22} PropChars_{ij} + ZIP_j + Boro * quarter * year + \varepsilon_{ijt}$$

in which LP_{ijt} is a vector of variables indicating the number of LP (a lis pendens is a notice of the intention to sue the property owner and reclaim the property if the loan is not repaid) filings within a given time and distance interval of property i; $PropChars_{ij}$ is a vector of characteristics describing property i, including square footage of the lot, building and unit age, structure types, and distance to the nearest subway stop; and ZIP_j is a set of ZIP code area fixed effects that control for time-invariant amenities and characteristics of the local neighborhood. $Boro * quarter * year$, a set of borough-quarter-year time fixed effects, is included to control for time-varying economic trends that may differ by borough. The dependent variable, $LPTICE_{ijt}$, is log per unit sales price of property i in ZIP code j in quarter t. The log transformation is commonly used in hedonic studies to reflect the non-linearity of related characteristics (Biswas 2012).

Lin, Rosenblatt, and Yao (2009) used a standard hedonic price model as the price equation to examine the spillover effects of foreclosures. The equation was defined as:

$$L_{price} = \beta_0 + \beta_1 * SF + \beta_2 * Lot + \beta_3 * No\_Bath + \beta_4 * Age + \beta_5 * Age^2 + \beta_6 * CNTY + \beta_7 * ZIP + Quarter\_dummy + \sum_{t=1,d=1}^{t=17,d=25} \beta_{t,d} * No\_Foreclosures_{t,d} + \varepsilon$$

The dependent variable is the logged sales price. Structural characteristics include area in square feet, lot size, and number of bathrooms. Age and the square of age are included to control the nonlinear effects of age on prices. County and zip code dummies are two important variables to control for neighborhood characteristics, which represent the locational differences in demography, median income, and other factors that might affect foreclosure rates. Quarterly dummies control for seasonal effects which have been found significant in property sale values (Goodman 1993). The number of foreclosures in the neighborhoods delineated by distance and time is the last set of hedonic factors. This variable measures the spillover effects of a foreclosure for a particular time and distance while controlling for foreclosures elsewhere. It is worth mentioning that the authors estimated three models with different assumptions on time/distance effects: (A) time effect only; (B) distance effect only; (C) time interactive with distance effects, where model (C) provides the best fit to the data.

Biswas (2012) used a hedonic regression model to estimate the negative impact of foreclosures on non-foreclosed housing prices:

$$Ln(Property\ Value_{ijt}) = \beta_0 + X_{ij}\beta_1 + F_{ijt}\beta_2 + T_{ij}\beta_3 + \varepsilon_{ijt}$$

The dependent variable is the natural log per unit sales prices of single-family non-foreclosed property i in Primary Statistical Area (PSA) j in year t. X_{ij} is a vector of structural characteristics of the subject property i, including lot size, living area, age, the number of rooms, etc. F_{ijt} is a vector of the number of foreclosures within a given time and distance interval of the subject property i. T_{ij}, a set of PSA-year fixed effects, allows for housing prices variation over time at the PSA level and controls for local neighborhood characteristics. Quarterly dummies are also included in the regression to account for the seasonality of housing prices. Finally, ε_{ijt} is the error term. To measure the effects of foreclosures in different submarkets, the author used a statistical clustering technique to identify housing submarkets, where the submarkets were defined on the basis of structural and neighborhood characteristics. The clustering approach was based on the principle of minimizing the dissimilarities of property characteristics within a cluster, and maximizing the heterogeneity across clusters. The clustering method resulted in three submarkets: high, medium, and low.

Immergluck and Smith (2006) used a hedonic regression model to estimate the impact of foreclosures on the values of nearby single-family properties and to control for other explanatory variables on property and location characteristics. They measured the foreclosures counts within a radius of eighth of a mile and between a radius of eight of a mile and a quarter of a mile. The hedonic price model was defined as:

$$Ln(p_i) = \alpha + \beta_1 X_i + \beta_2 Z_i + \beta_3 AC_i + \beta_4 BC_i + \beta_5 AG_i + \beta_6 BG_i + \beta_7 AO_i + \beta_8 BO_i + \varepsilon_i$$

$Ln(p_i)$ is the natural log of the price of the property. X_i is vector of property characteristics such as square footage, construction, etc. Z_i is vector of neighborhood characteristics including population density, income, race, etc., as well as locational characteristics such as latitude and longitude. The remaining variables are used for measuring foreclosures. The definition of each foreclosure variable is listed below:

- AC_i is the foreclosure counts of conventional single-family loans within an eighth of a mile from the property.
- BC_i is the foreclosure counts of conventional single-family loans between an eighth and a quarter of a mile from the property.
- AG_i is the foreclosure counts of government-insured single-family loans within an eighth of a mile from the property.
- BG_i is the foreclosure counts of government-insured single-family loans between an eighth and a quarter of a mile from the property.
- AO_i is the counts of other foreclosures (multifamily and commercial property) within an eighth of a mile from the property.

- BO_i is the counts of other foreclosures (multifamily and commercial property) between an eighth and a quarter of a mile from the property.

The authors classified submarkets based on neighborhoods income level, given that low- and moderate-income neighborhoods experience a relatively higher level of foreclosures which may lead to more vacant or abandoned properties than high-income neighborhoods. Thus, it is considered useful to test whether the effects of foreclosures in such neighborhoods differ from the effects of all transactions. To do so, the equation above is applied to only the property transactions in low- and moderate-income tracts.

CHAPTER 3
SURVEY OF STUDY AREA AND DATA

Research Statement and Objectives

This thesis is expected to illuminate how foreclosures affect housing prices after the bursting of the real estate bubble in the city of Orlando, Florida. As the real estate bubble busted, foreclosure rates increased dramatically in the U.S., which lead to a series of consequences such as high vacancy rate, and high crime rate. Additionally, foreclosures have lowered housing prices as both the supply of housing on the market has increased and as the rash of foreclosures has had a negative spillover effect on nearby property values. The state of Florida has one of the highest foreclosure rates as a percentage of all mortgaged homes in the United States. Thus, estimating the impacts of foreclosures in the state of Florida is necessary to better understand the implications of foreclosures on property valuation.

This thesis focuses on evaluating the impacts of foreclosures on single-family property values and the spillover effects of foreclosures on nearby properties in Orlando, FL in 2011 and 2012. It also aims to estimate the effects of foreclosures using an interactive variables approach (Fik, Ling, and Mulligan 2003). That is to say, foreclosures may affect property value when they are associated with other factors, such as property characteristics, locational characteristics, or neighborhood characteristics. In addition, this thesis introduces a new variable, Foreclosure Intensive Index (FII), to measure the intensity of foreclosures, and to estimate the impact of foreclosure intensity on housing prices. Moreover, this thesis intends to measure the effects of foreclosures on property values in the high-end housing submarket (i.e., in neighborhoods with relatively high income levels), given that effects of foreclosure tend to differ across submarkets.

This study has five major objectives:

- To test how foreclosures affect the prices of single-family properties after controlling for property attributes, locational attributes, and neighborhood attributes
- To determine the spillover effects of foreclosures on nearby single-family properties
- To evaluate how foreclosures affect housing prices when they are related to property characteristics, locational characteristics, and neighborhood characteristics, using an interactive approach
- To estimate how foreclosure intensity affects single-family housing prices using the Foreclosure Intensive Index, which describes the intensity of foreclosures within the nearby vicinity
- To assess the impacts of foreclosure on housing prices in higher median income neighborhoods

Study Area

The study area of this thesis is Orlando, Florida. Orlando is located in Central Florida and is northeast of Tampa. According to 2010 US Census, the total population of Orlando is 238,300, of which 28.1% is African-American and 25.4% is Hispanic. The percentage of population with bachelor's degrees or higher (percent of persons age 25 and over) is 31.9%. The number of total housing units in Orlando is 121,254 and the homeownership rate is 40.6%, which is about 18% lower than the state level. The median value of owner-occupied housing unites is $199,600 and the median household income for Orlando is $42,755, which is slightly lower than the state level. The percentage of persons below poverty level is 17.3%, which is about 3% higher than the state level. The unemployment rate was 8.6% in March 2012, which is about 3% lower than 2010. The main highway through Orlando is I-4, which connects to downtown, various attractions, and suburbs in Orlando. Amtrak, an US rail service, provides rail connections from Orlando to many of the surrounding towns, including Kissimmee, Sebring, Winter Haven, Sanford, and Ocala.

Orlando became a well-known vacation spot due to the Disney World Theme Park. The Disney World Theme Park, which includes Magic Kingdom, Epcot, Hollywood Studios, Animal Kingdom, and Downtown Disney, is one of the most famous attractions of Orlando. Additionally, there are a number of other attractions in Orlando such as Universal Studios and Sea World. As a famous holiday destination, Orlando receives about 52 million tourists ever year and is estimated as the fifth most popular US city for travelers visiting from overseas. It has more hotel rooms than any other US city except for Las Vegas. The accommodation industry stands for a major portion of the Orlando economy and employs a large amount of the local population. It is not surprising that tourism helps to bring in the largest revenues for city of Orlando. In addition to tourism, hi-tech industry such as electronics and aerospace are also main industries in Orlando as it is close to the NASA Kennedy Space Center. Central Florida Research Park is a large manufacturing facility for aeronautical crafts and related high tech research, which is home to over 120 companies and employs more than 8,500 people. This city is also home to the University of Central Florida – the second largest university in Florida. A base map of Orlando is shown in Figure 3-1.

According to the Orlando Regional Realtor Association, the median housing price was $125,000 in 2012, an increase of about 7% from 2011, which indicates a recovery period of Orlando housing market occurs from 2011 (Shanklin 2012b). According to the report from Clear Capital, Orlando was second in the country for home price increases in 2011, with a 6.7% increase in price. Dayton, Ohio enjoyed the largest gain with an 11.5% increase in price (Shanklin 2012c). The result of this report is based on the combination of several factors, such as resales of the same properties, unemployment rates, and the number of foreclosures on the target market. Although the overall trend of Orlando's median house prices increased, the median price decreased to $120,550 in August, 2012, from $126,000 in July, 2012, according to Orlando Regional Realtor Association (Shanklin 2012a). The decrease was caused by the large number of sales of both condos and single-family homes in lower price. Although the median price of the Orlando market was increased by 5.1% in August, 2012, compared to the year of 2011, it was the smallest increase in more than a year. There were two trends that continued to define the Orlando housing market during 2012: the supply of homes available for sale remained low, and distress sales (including foreclosures sales) still dominated the market. The Orlando Regional Realtor Association also reported that of all the closings during 2012, foreclosures made up 23.2%; short sales constituted 28.8%; and normal sales accounted for the rest of 48% (Shanklin 2012a).

The Florida Realtors (2012) estimated that about 600,000 houses in Florida remain in a "shadow inventory", which means that those properties are in the risk of default or foreclosure but not yet listed for sale. The Metropolitan Statistical Area (MSA) of Orlando-Kissimmee has the 7th highest foreclosures rate (14.9%) in 2012, in which the prime foreclosure rate is 10.9% and the subprime foreclosure rate is 36.4% (FloridaRealtors 2012). In May 2012, there were a total of 3,715 foreclosures fillings (including default notices, auction notices, and bank repossessions), reported in the Orlando MSA, which was an 80% jump from May 2011 (RealtyTrac 2012). RealtyTrac also reported that in March 2012, the average sale price of an Orlando home was $126,288 and the average sale price of a foreclosure home was $104,270, a $22,018 saving (Tisner 2012). When compared geographically, foreclosures in Orlando were 0.11% above the national statistics and 0.04% below the Florida statistics in March 2012 (Tisner 2012). However, increased foreclosures do not indicate that residents who are experiencing financial difficulties will necessarily lose their homes, because there are various ways to deal with foreclosures, such as loan modification or negotiating a short sale. Additionally, foreclosures are time consuming, for it takes about 24 months at minimum from start to finish on a foreclosure sale.

Although foreclosures have been a great concern to the Orlando housing market, few early studies on foreclosures were conducted on Orlando. Based on the above mentioned background information on foreclosures in Orlando, this thesis has sufficient reasons for investigating the effects of foreclosures on housing prices and nearby property values in Orlando.

Hypotheses

A large number of researches indicated that foreclosures cause discounts on housing prices (Sumell,2009; Campbell, Giglio, and Pathak, 2009; Clauretie and Daneshvary, 2009), which leads to the first hypothesis.

Hypothesis 1: Foreclosures affect single-family housing prices negatively.

Previous researches suggested that the spillover effect of foreclosures on nearby property values is negative, which leads to the second hypothesis.

Hypothesis 2: Foreclosures lower the prices of nearby single-family properties.

Although many studies focused on the negative effects of foreclosures on housing prices and surrounding property values, few of them addressed the impacts of foreclosures in an interactive approach. It is expected that the impacts of foreclosures are different when they are associated with different property characteristics and neighborhood characteristics. For instance, a foreclosure with larger living area is expected to have a higher discount on the property price comparing to a foreclosure with smaller living area. This expectation leads to the third hypothesis.

Hypothesis 3: Foreclosures affect single-family housing prices in an interactive way.

Foreclosure Intensive Index, a newly introduced variable, is utilized to estimate the impacts of foreclosure intensity on housing prices. It is expected that higher foreclosure intensive index can significantly lower the single-family housing prices. Thus, the fourth hypothesis is shown below:

Hypothesis 4: Higher Foreclosure Intensive Index can lower single-family housing prices significantly.

A number of studies estimated the effects of foreclosures in different submarkets. Many of them defined submarket based on geographic limit (such as census tract and ZIP code) or neighborhood characteristics (such as income level). This thesis defines submarkets based on median household income and focuses on the impacts of foreclosures on property values in neighborhoods with higher median household income. The fifth hypothesis is shown below:

Hypothesis 5: The way that foreclosures affect housing prices is different in submarkets or neighborhoods with higher median household income, compared to the global market.

Data Source

The data for this thesis were collected from the following sources:

- **Orange County Property Appraiser.** Single-family housing unit transactions (including foreclosure sales) data for Orlando in 2011 and 2012 were obtained from the Orange County Property Appraiser. This dataset contains sales price, property characteristics (living area, age, etc.), and X Y coordinates of each property location.
- **United States Census Bureau.** All socioeconomic data and the majority of GIS layers are obtained from the United States Census Bureau. Socioeconomic data, which is based on block group, contains median household income, poverty level, educational level, and etc. GIS layers contain major roads, which is used in the calculation of the distance between a subject property and the nearest major road.
- **City of Orlando.** This dataset contains GIS layers of Orlando downtown, which is used in the calculation of the distance between a subject property and downtown.
- **University of Florida GeoPlan Center.** This dataset contains GIS layers of public and private schools in Florida in 2012, which is used in the calculation of the distance between a subject property and the nearest school.
- **Federal Railroad Administration.** This dataset contains the Florida subset of the National Rail Network, which is used in the calculation of the distance between a subject property and the nearest railroad.

Data and Variables

The single-family property sales data for the city of Orlando in 2011 and 2012 were obtained from the Orange County Property Appraiser, which provides information on real estate transactions for Orange County (including Orlando). For each observed sale price in dollars (PRICE -- the dependent variable), the Orange County Property Appraiser records basic property characteristics, such as living area (feet), number of floors, number of bedrooms and bathrooms, year built, construction materials, as well as the {*x, y*} coordinates of each property. This dataset controls for property characteristics and absolute locations of properties. It also provides transaction information, including the sale price of each transaction, sale date, name of the seller and the buyer, and whether or not it is a foreclosure sale. The sales data are cleaned by removing transactions that have sale prices lower than $1,000, which are not viewed as real sales in this study. After cleaning the data, 1,543 single-family property transactions are selected, among which 137 are foreclosure sales. Figure 3-2 shows the distribution of single-family housing units, including both foreclosure and non-foreclosure sales in 2011 and 2012. Figure 3-3 and Figure 3-4 display the housing density surface and foreclosure density surface separately. Both density surfaces are calculated using Kernel Density function in ArcGIS. These figures show that the trends of the two density surface are similar to some extent, which is not surprising because the possibility of the occurrence of foreclosures increases as the number of housing units increase.

Foreclosures are measured by a dummy variable, FORECLOSURE, which equals to 1 if the single-family property is a foreclosure sale. In order to estimate the spillover effects of foreclosures on nearby properties, a number of measures of foreclosure proximity are created based on the distance intervals. The number of foreclosures within 1000 feet, 2000 feet, and 3000 feet of each target sale were calculated in ArcGIS. Three variables (F1000, F2000, and F3000) were added to each observation in the sales dataset, in which F1000 is the number of foreclosures within 1000 feet of the subject sale; F2000 is the number of foreclosures within 2000 feet of the subject sale; F3000 is the number of foreclosures within 3000 feet of the subject sale. It is important to notice that the number of foreclosures is measured by concentric circles extending from the subject sale but not measured by concentric rings. For instance, the number of foreclosures within 3000 feet of a sale contains the number of foreclosures within 2000 feet of a sale. Figure 3-5 provides a schematic representation of the hedonic model for property values and nearby foreclosures. Three buffer areas are drawn around each property (a radius of 1000 feet, 2000 feet, and 3000 feet). The number of foreclosures within 3000 feet of the subject property is eight in the example shown in Figure 3-5. FD_HD is a newly introduced variable called Foreclosure Intensive Index (FII), which is defined as following,

$$Foreclosure\ Intensive\ Index = \frac{Foreclosure\ Density}{Housing\ Density} \tag{3-1}$$

This index measures the intensity of foreclosures at any given location, taking into account housing unit density. It also indicates the possibility that units in the vicinity will be a foreclosure (as a probability density measure).

The second dataset includes socioeconomic and demographic variables for Orlando based on the 2010 U.S. Census, in which neighborhood characteristics were controlled. For all block groups in the study area, neighborhood characteristics were obtained, such as population to work using public transportation (RTAN_PUB), median household income (MEDHHINC), number of households with public assistance income (HH_PUBA), civilian employed population 16 years and over (LABOR_CIV), percent of population that has bachelor's degree (PCT_BACHLR), percent of renter occupied housing that moved in 2005 or later (PCT_RENT5), and percent of the population below poverty (PCT_POV). Additionally, locational characteristics are also controlled. For a subject property, distance to the nearest school (DIST_SCHOOL), to the nearest major road (DIST_MAJORROAD), to the nearest railroad (DIST_RAILROAD), and to downtown (DIST_DOWNTOWN) are calculated in ArcGIS. Note that all distance were measured in feet.

Table 3-1 provides definitions and descriptive statistics of variables in the global market. The mean sales price is approximately $152,872. The minimum and maximum sales price is $1,300 and $740,000, respectively. Figure 3-6 displays the distribution of single-family housing units along with sales price, which shows that housing prices are lower in northwest Orlando and higher in southeast Orlando. Visually, housing units around downtown area are not necessarily associated with lower prices as it is expected. The mean living area of the sample housing is approximately 1,687 square feet. The minimum and maximum living area is 480 and 4,631 square feet, respectively. The average median household income is $53,171; the mean percentage of population that has a bachelors' degree is 16.6%; the mean percentage below poverty is 12.4%. The average number of foreclosures within 1000, 2000, and 3000 feet of a subject sale is 0.69, 1.71, and 3.05, respectively. The mean Foreclosure Intensive Index (FD_HD) is 0.088.

Submarkets are defined based on median household income. This study uses the quantile method in ArcGIS and results three submarkets: low, medium, and high. Figure 3-7 displays the distribution of single-family housing units in each submarket. This thesis focuses on the high median household income submarkets, which are mostly located in the central Orlando (near downtown) and the southeast Orlando. Table 3-2 provides the descriptive statistics of variables in the high median household income submarkets. In that submarkets, 710 single-family housing transactions are selected, among which 58 are foreclosure sales. The mean sales price is approximately $196,600. The minimum and maximum sales price is $1,600 and $740,000, respectively. The mean living area is approximately 1,894 square feet. The mean number of population to work using public transportation is 8. The average number of foreclosures within 1000, 2000, and 3000 feet of a subject sale is 0.68, 1.69, and 3.05, respectively. The mean Foreclosure Intensive Index (FD_HD) is 0.088.

Table 3-1. Definition and descriptive statistics of variables in the global market

Variable Name	Definition	Mean	Std. Deviation	Minimum	Maximum
Dependent Variable:					
PRICE	Sale price of property	152871.920	90207.316	1300.000	740000.000
Property Attributes					
STYS	Number of floors	1.170	0.374	1.000	2.000
AREA	Living area (square feet)	1687.090	665.411	480.000	4631.000
POOL	Number of pools	0.190	0.389	0.000	1.000
AGE	Age of property	43.090	24.639	1.000	102.000
Locational Attributes					
X_COORD	X coordinate of property location	540749.580	19821.529	494665.000	580443.000
Y_COORD	Y coordinate of property location	1524622.090	15842.756	1483636.000	1554471.000
DIST_SCHOOL	Distance to the nearest school (feet)	1939.188	1302.016	146.840	8437.366
DIST_MAJORROAD	Distance to the nearest major road (feet)	2391.533	1939.724	57.880	9151.292
DIST_RAILROAD	Distance to the nearest railroad (feet)	12321.750	9069.451	10.734	35183.445
DIST_DOWNTOWN	Distance to downtown (feet)	17935.740	14824.252	0.000	60999.740
Neighborhood Attributes (Unit: block groups)					
TRAN_PUB	Population to work using public transportation	53.290	80.602	0.000	368.000
MEDHHINC	Median household income	53171.230	21892.678	9440.000	153381.000
HH_PUBA	Number of households with public assistance income	18.220	20.858	0.000	97.000
LABOR_CIV	Civilian employed population 16 years and over	1787.850	1681.506	129.000	7449.000
PCT_BACHLR	Percent of population that has a bachelor’s degree	16.608	9.135	0.000	44.200

Table 3-1. Continued.

Variable Name	Definition	Mean	Std. Deviation	Minimum	Maximum
PCT_RENT5	Percent of renter occupied housing that moved in 2005 or later	73.455	18.167	0.000	100.000
PCT_POV	Percent below poverty	12.418	9.709	0.000	63.820
Foreclosure Attributes					
FORECLOSURE	Dummy equal to 1 if the property is a foreclose sale	0.090	0.285	0.000	1.000
F1000	Number of foreclosures within 1000 feet of a subject sale	0.690	0.983	0.000	4.000
F2000	Number of foreclosures within 2000 feet of a subject sale	1.710	1.637	0.000	8.000
F3000	Number of foreclosures within 3000 feet of a subject sale	3.050	2.474	0.000	12.000
FD_HD	Foreclosure Intensive Index	0.088	0.070	0.000	1.000

Table 3-2. Descriptive statistics of variables in high median household income submarkets

Variable Name	Definition	Mean	Std. Deviation	Minimum	Maximum
Dependent Variable:					
PRICE	Sale price of property	196600.890	83575.628	1600.000	740000.000
Property Attributes					
STYS	Number of floors	1.240	0.430	1.000	2.000
AREA	Living area (square feet)	1893.700	739.868	612.000	4514.000
POOL	Number of pools	0.200	0.399	0.000	1.000
AGE	Age of property	43.390	28.978	2.000	98.000
Locational Attributes					
X_COORD	X coordinate of property location	547137.370	20238.177	494665.000	580443.000
Y_COORD	Y coordinate of property location	1520700.390	18746.571	1483636.000	1546816.000
DIST_SCHOOL	Distance to the nearest school (feet)	2119.298	1574.547	205.314	8437.366
DIST_MAJORROAD	Distance to the nearest major road (feet)	2310.093	2042.531	61.241	9151.292
DIST_RAILROAD	Distance to the nearest railroad (feet)	12190.140	10868.388	10.734	35183.445
DIST_DOWNTOWN	Distance to downtown (feet)	20519.670	19663.673	57.808	60999.740
Neighborhood Attributes (Unit: block groups)					
TRAN_PUB	Population to work using public transportation	8.090	13.284	0.000	47.000
MEDHHINC	Median household income	71150.120	18743.012	53922.000	153381.000
HH_PUBA	Number of households with public assistance income	10.030	12.401	0.000	34.000
LABOR_CIV	Civilian employed population 16 years and over	2001.960	2070.516	193.000	6228.000
PCT_BACHLR	Percent of population that has a bachelor’s degree	22.692	7.506	7.950	44.200

Table 3-2. Continued.

Variable Name	Definition	Mean	Std. Deviation	Minimum	Maximum
PCT_RENT5	Percent of renter occupied housing that moved in 2005 or later	76.241	18.804	0.000	100.000
PCT_POV	Percent below poverty	6.518	4.104	0.000	25.620
Foreclosure Attributes					
FORECLOSURE	Dummy equal to 1 if the property is a foreclose sale	0.080	0.274	0.000	1.000
F1000	Number of foreclosures within 1000 feet of a subject sale	0.680	1.025	0.000	4.000
F2000	Number of foreclosures within 2000 feet of a subject sale	1.690	1.587	0.000	8.000
F3000	Number of foreclosures within 3000 feet of a subject sale	3.050	2.362	0.000	11.000
FD_HD	Foreclosure Intensive Index	0.088	0.070	0.000	1.000

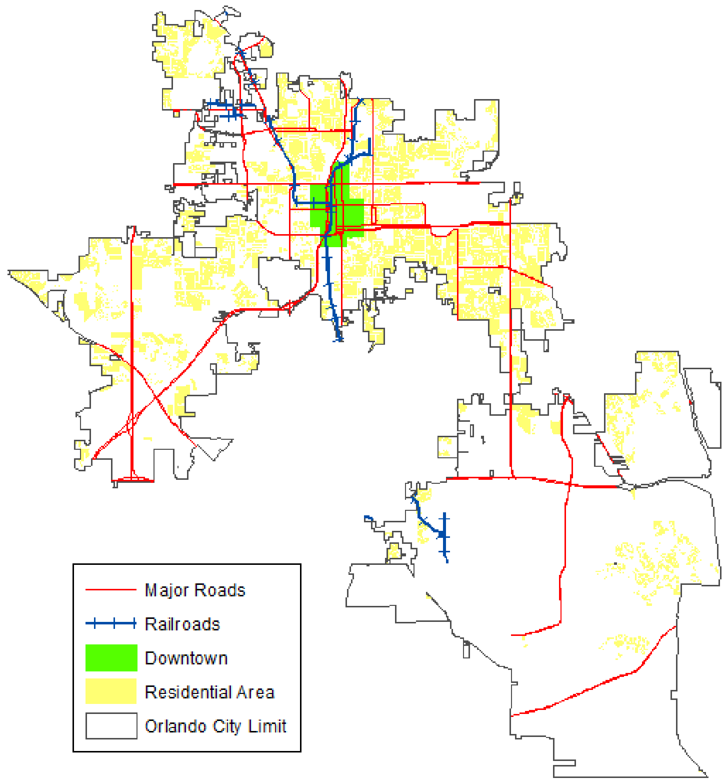

Figure 3-1. Orlando base map

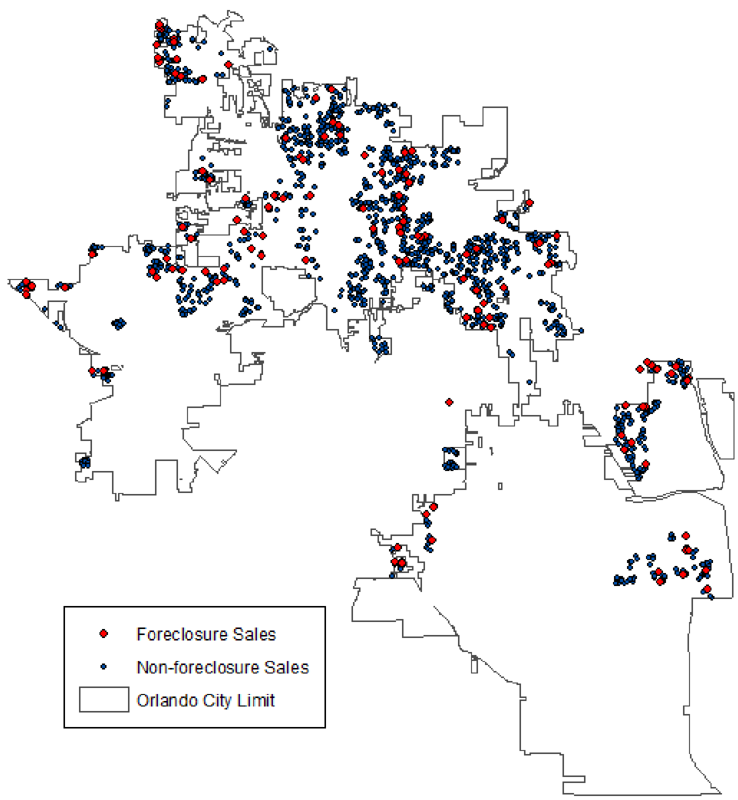

Figure 3-2. Distribution of single-family housing units

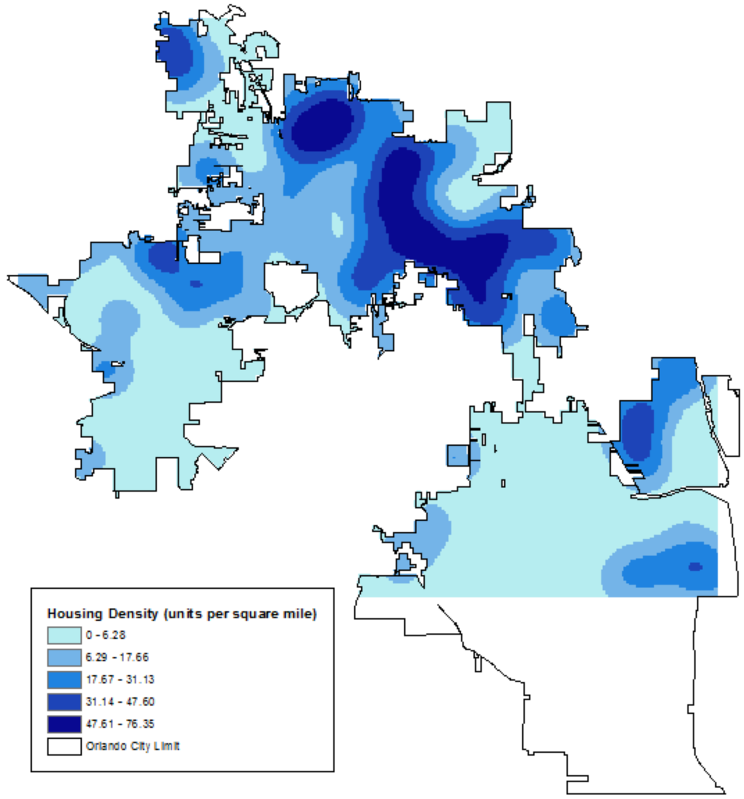

Figure 3-3. Housing density surface

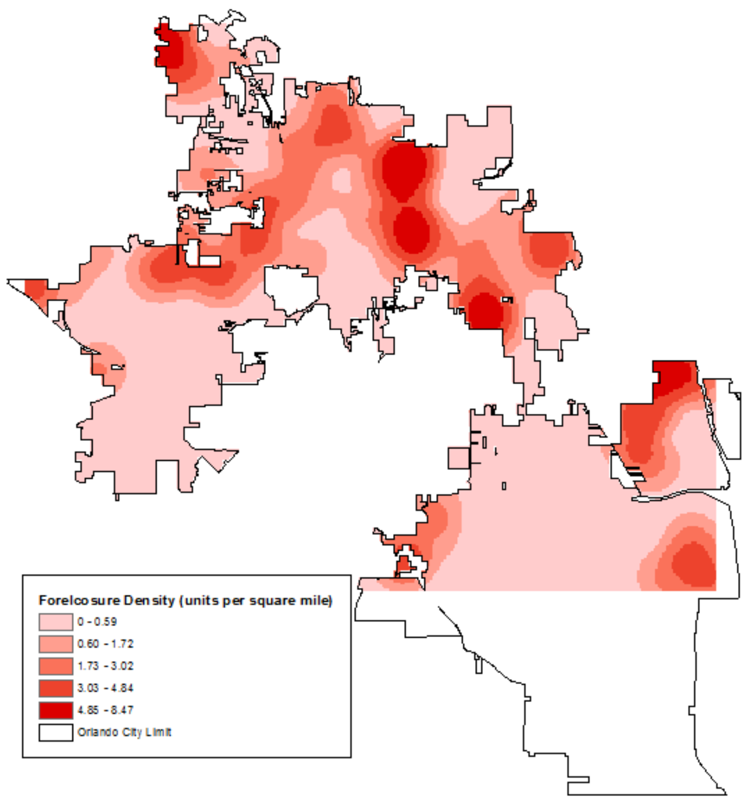

Figure 3-4. Foreclosure density surface

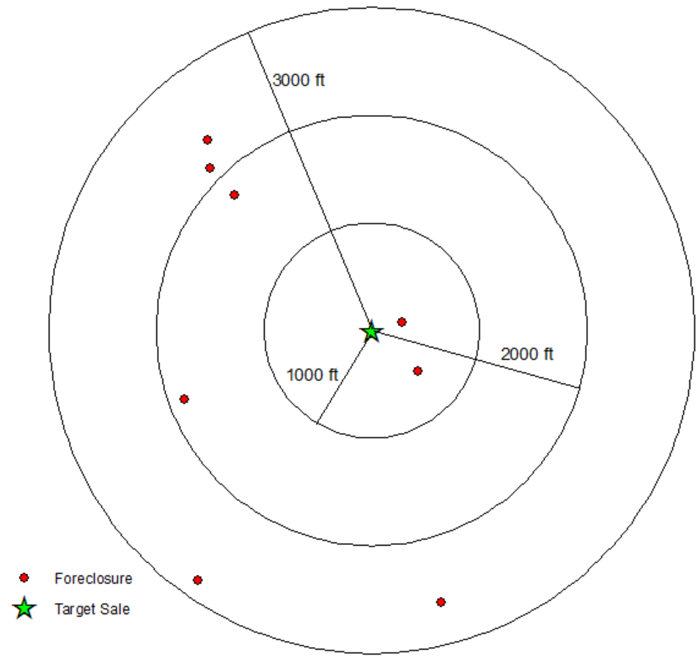

Figure 3-5. Modeling the impact of foreclosure on property value

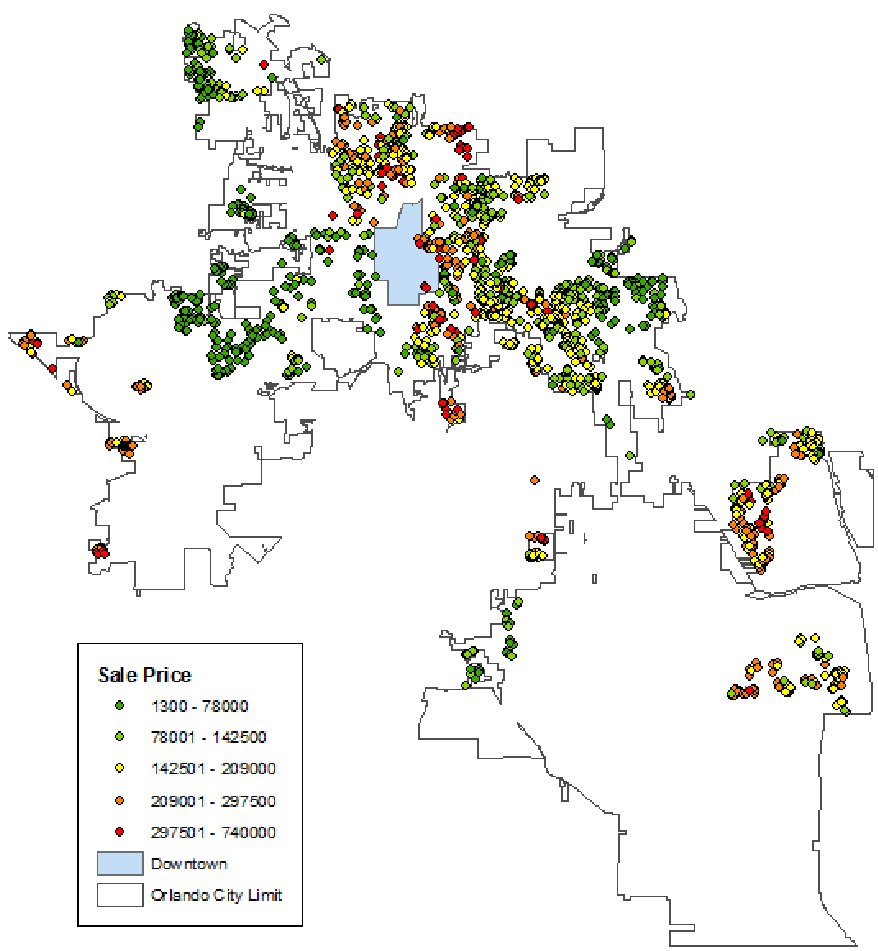

Figure 3-6. Distribution of single-family housing units along with sale price

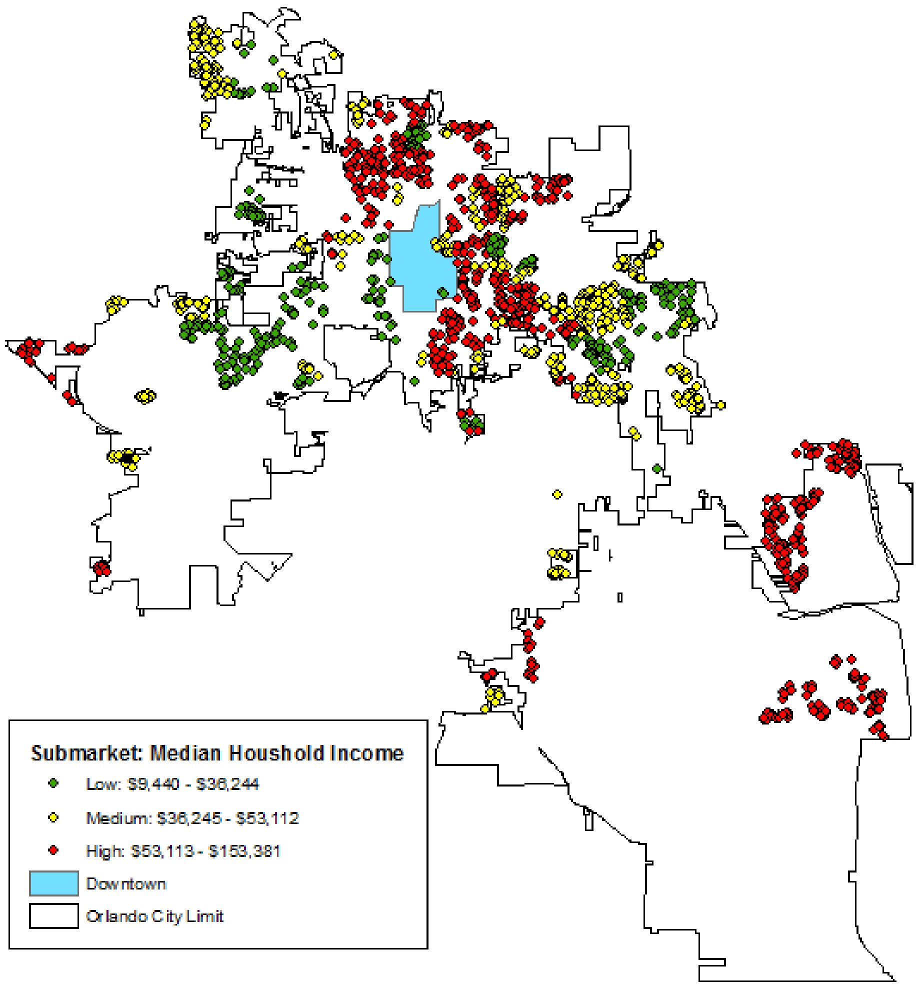

Figure 3-7. Single-family housing submarkets

CHAPTER 4
METHODOLOGY

Summary of Modeling Strategies

A series of hedonic regression models are used to estimate the effects of foreclosures on market value. The models are applied to both the global market and high median household income submarkets. This thesis intends to estimate the impacts of foreclosures on single-family housing prices by comparing the performance of two models: Foreclosures Contagion Model and Foreclosure Intensive Index Model. Figure 4-1 shows the flowchart of models for both the global market and high income submarkets. Property attributes, locational attributes, and neighborhood attributes are all included as control variables in both models. The differences of the two models lie in the selection of foreclosure attributes. In the foreclosure contagion model, foreclosure dummy (FORECLOSRUE), the number of foreclosures within 1000 feet (F1000), 2000 feet (F2000), and 3000 feet (F3000) are included. It is worth mentioning that the foreclosure contagion model contains two different approaches: non-interactive approach and interactive approach. The non-interactive approach intends to test the impacts of foreclosures and contagion effects of foreclosures, while the interactive approach intends to estimate the impacts of foreclosures when they are associated with property, locational, or neighborhood characteristics. In the foreclosure intensive index model, only the Foreclosure Intensive Index (FD_HD) is included to represent foreclosure attributes. This index indicates the possibility that units in the vicinity will be a foreclosure. The two models that contain three approaches are expected to provide a relatively comprehensive understanding of the effects of foreclosures on single-family housing prices.

Foreclosure Contagion Model

To identify the effects of foreclosures on single-family housing prices and nearby property values, a hedonic regression analysis was first conducted with a non-interactive approach, controlling for property, locational, and neighborhood characteristics. The regression equation is defined as follows:

$$Price = \beta_0 + \beta_1 X + \beta_2 Y + \beta_3 Z + \beta_4 F + \beta_5 C + \varepsilon \tag{4-1}$$

$Price$ is the sales price of a subject property. X is a vector of property characteristics of a subject property, including the number of floors, living area, number of pools, and age of the property. Y is a vector of locational characteristics of a subject property, including {*x, y*} coordinates, the 2nd order polynomial expansion of {*x, y*} coordinates, distance to the nearest school, distance to the nearest major road, distance to the nearest railroad, and distance to downtown. Z is a vector of neighborhood characteristics, including population to work using public transportation, median household income, civilian employed population 16 years and over, percent of population that has a bachelor's degree, percent of renter occupied housing that moved in 2005 or later, and percent below poverty. F is a foreclosure dummy, which equals to 1 if the subject property is a foreclosure. C is a vector of the counts of foreclosures within a given distance interval of a subject property. The distance intervals were defined as 1000 feet, 2000 feet, and 3000 feet. As it is mentioned in the previous chapter, the number of foreclosures is measured by concentric circles extending from the subject sale but not measured by concentric rings. Thus, for instance, the number of foreclosures within 3000 feet of a sale contains the number of foreclosures within 2000 feet of a sale. ε is an error term. It is worth mentioning that a 2nd order polynomial expansion of {*x, y*} coordinates produces 5 locational variables ($x, y, x^2, y^2, x*y$). The inclusion of the absolute location {*x, y*} enables us to obtain the geographic slope of housing price in the vicinity of some {*x, y*} locations (Fik, Ling, and Mulligan 2003).

The interactive approach is an expansion of the non-interactive approach. “Interactive” here indicates the product of the foreclosure dummy and all other independent variables. Instead of considering the foreclosure attributes alone, the interaction is superior to estimate the impacts of foreclosures when they are associated with other variables, such as property, location, or neighborhood characteristics. The regression equation is defined in the following:

$$Price = \beta_0 + \beta_1 X + \beta_2 Y + \beta_3 Z + \beta_4 F + \beta_5 C + \beta_6 FX + \beta_7 FY + \beta_8 FZ + \beta_9 FC + \varepsilon \qquad (4\text{-}2)$$

$Price$ is the sales price of a subject property. X, Y, Z, F, and C are defined exactly the same as the non-interactive model. FX is the interaction or production of the foreclosure dummy and a vector of property characteristics of a subject property. FY is the interaction or production of the foreclosure dummy and the vector of locational characteristics of a subject property. FZ is the interaction or production of the foreclosure dummy and the vector of neighborhood characteristics of a subject property. FC is the interaction or production of the foreclosure dummy and the vector of the counts of foreclosures within a given distance interval of a subject property. The foreclosure contagion model is expected to explain the effects of foreclosures on housing prices and nearby property values in both non-interactive and interactive ways.

Foreclosure Intensive Index Model

Foreclosure Intensive Index (FII) measures the intensity of foreclosures at any given location, taking into account housing unit density. It also indicates the possibility that units in the vicinity will be a foreclosure (as a probability density measure). FII is defined below,

$$Foreclosure\ Intensive\ Index = \frac{Foreclosure\ Density}{Housing\ Density} \tag{4-3}$$

This model uses only FII to represent foreclosure attributes, and also controls for property, locational, and neighborhoods characteristics. The hedonic regression equation is defined as follows:

$$Price = \beta_0 + \beta_1 X + \beta_2 Y + \beta_3 Z + \beta_4 FII + \varepsilon \tag{4-4}$$

$Price$ is the sales price of a subject property. X is a vector of property characteristics of a subject property, including number of floors, living area, number of pools, and age of the property. Y is a vector of locational characteristics of a subject property, including {*x, y*} coordinates, the 2nd order polynomial expansion of {*x, y*} coordinates, distance to the nearest school, distance to the nearest major roads, distance to the nearest railroad, and distance to downtown. Z is a vector of neighborhood characteristics, including population to work using public transportation, median household income, civilian employed population 16 years and over, percent of population that has a bachelor's degree, percent of renter occupied housing that moved in 2005 or later, and percent below poverty. FII is the Foreclosure Intensive Index. ε is an error term. The foreclosure intensive index model is expected to estimate the impact of the FII on single-family housing prices, given that FII is an indicator of foreclosure density.

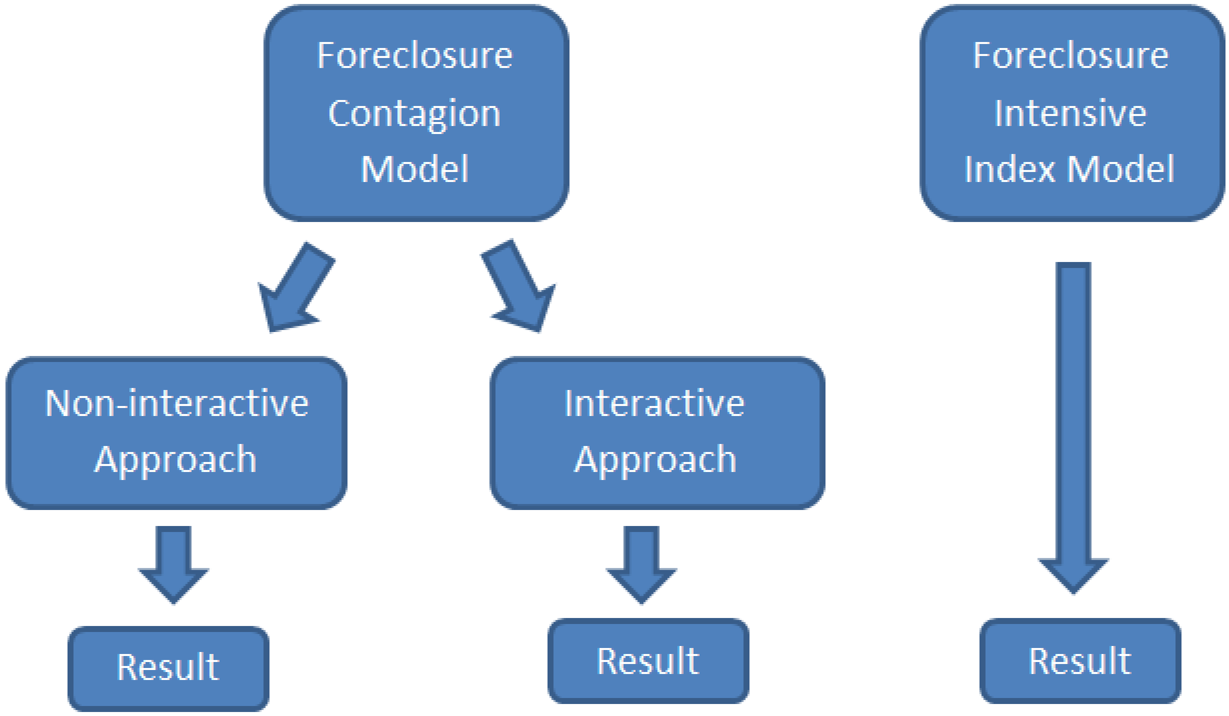

Figure 4-1. Flowchart of models for both global market and high income submarket

CHAPTER 5
RESULTS AND INTERPRETATION

Global market

This chapter presents the results of the previous hypotheses. Table 5-1 reports the regression results of the foreclosure contagion model with a non-interactive approach in the global market. The R-square of this model is 0.689, which indicates that 68.9% of the single-family housing prices can be explained by the independent variables in this model. All significant variables are displayed with expected signs and reasonable magnitudes in this table. For the property attributes, a larger living area and the inclusion of a pool increase the housing price, given that the coefficients are positive. One square foot increase in the living area leads to an $85 increase in the property value and the additional of a pool raises the housing price by $24,568.

For the locational attributes, an increase in the distance to the nearest major roads, to the nearest railroad, to downtown, and an increase in *y* coordinate lower the property value, given that the coefficients are all negative. An increase in the distance to the nearest major road by one thousand feet is associated with a $2,941 decrease of the housing price. The result satisfies our expectation because properties near major roads may suffer from noise and lower air quality, which then leads to lower property values. A thousand feet increase in the distance to the nearest railroad is associated with a $1,393 decrease of housing price. The vicinity of the railroad usually represents an older industrial area, where abandoned properties and lower quality communities are always located. Thus, it is not surprising that properties near railroads have lower sale prices. An increase in the distance to downtown by one thousand feet is associated with a $719 decrease of the housing price. There are several reasons that the downtown area is associated with lower housing prices. For instance, many renter occupied housing units are located near downtown, which increases the mobility of the population. This large mobility would cause many social problems, such as high crime rate, which then leads to lower housing prices. The negative coefficient of *y* coordinate indicates that property values decreases as houses move north. However, since the coefficient is small, we can say that the impact of direction on sale prices is small yet significant.

Two neighborhood attributes are shown to be significant in the table: the percent of population that has a bachelor’s degree and the percent of the population below poverty. With a positive coefficient, 1% increase of the population that has a bachelor’s degree raises the sale price by $2,917. The increase of the housing price is expected because a higher percent of population with bachelor’s degree indicates a higher education level and a higher income level. People with higher income levels tend to be able to afford properties with higher prices. Figure 5-1 shows the relationship between the sale prices of housing units and the percent of population that has a bachelor’s degree. Visually, higher percent of population with a bachelor’s degree is associated with higher sale prices. With a negative coefficient, 1% increase in the percent of the population below poverty lowers the sale price by $1,092. The result makes sense because people with lower income couldn’t afford housing with higher prices. Figure 5-2 shows the relationship between the sale prices of housing units and the percent of the population below poverty. Visually, a higher percent below poverty is associated with a lower sale price.

The two foreclosure attributes shown in the table are what we must give the most attention. The coefficient of the foreclosure dummy (FRECLOSURE) is -49,105, which indicates that a foreclosure property lowers the sale price by $49,105 compared to a non-foreclosure property, holding other control variables constant. The result satisfies our expectation of hypothesis1 that foreclosures affect single-family housing prices negatively. To estimate the effects of foreclosures on nearby property values, the number of foreclosures within 1000 feet, 2000 feet, and 3000 feet of a subject property are added into the model, in which the number of foreclosures within 2000 feet (F2000) is a significant variable. The coefficient of F2000 is -2,571, which indicates that each additional foreclosure within 2000 feet of a subject sale is associated with a $2,571 decrease in the sale price, holding other control variables constant. The result satisfies our expectation of hypothesis2 that foreclosures lower the prices of nearby single-family properties.

Table 5-2 presents the results of the foreclosure contagion model with an interactive approach in the global market. “Interactive” here indicates the product of the foreclosure dummy and all other independent variables. Instead of considering the foreclosure attributes alone, the interaction enables us to estimate the impact of foreclosures when they are associated with other variables, such as property, location, and neighborhood characteristics. The R-square of this model is 0.690, which indicates that 69.0% of the single-family housing prices can be explained by the independent variables in this model. All significant variables are displayed with expected signs and reasonable magnitudes in this table. Significant variables of property attributes, locational attributes, and neighborhood attributes are exactly the same as the previous model with a non-interactive approach. The coefficients change slightly while keeping the same signs. The number of foreclosures within 2000 feet (F2000) shows a significant variable with a negative sign.

Two new interactive variables demonstrate significant variables in this model: F_AREA and F_PCT_BACHLR. The interpretation of interactive variables is more difficult because the influence of one variable is dependent on the other variable that is interacted. F_AREA is the interaction of the foreclosure dummy and the living area, of which the coefficient is -20. Given that the coefficient of AREA is 86, we can calculate that for a non-foreclosed property, one square foot increase in living area leads to an $86 increase in the sale price, holding other control variables constant. However, for a foreclosed property, one square foot increase in living area only leads to a $66 ($66 = $86 – 1*$20) increase in the sale price, holding other control variables constant. The negative coefficient of F_AREA indicates that foreclosures with larger living areas decrease the sale price more when compared to foreclosures with smaller living areas, holding other control variables constant. That is also to say, foreclosures with larger living areas have a larger negative effect on housing prices than those with smaller living areas, holding other control variables constant. However, it doesn't mean that foreclosures with larger living areas have lower prices than those with smaller living areas because the living area (AREA) still has a positive coefficient whose absolute value is larger than that of F_AREA. For instance, the sale price of a 1000 square feet foreclosed property is $66,000 ($66,000 = $86*1,000 - $20*1,000), and the sale price of a 2000 square feet foreclosed property is $132,000 ($132,000 = $86*2,000 - $20*2,000). From this example, although the sale price of a 2000 sqft foreclosed property is higher than that of a 1000 sqft foreclosed property, the foreclosure discount of the 2000 sqft property ($40,000 = $20*2,000) is larger than that of the 1000 sqft property ($20,000 = $20*1,000). This result makes sense because properties with larger living areas tend to have higher sale prices as previously discussed. If such a property is a foreclosure, the foreclosure discount is expected to be larger than that of properties with lower prices or properties with smaller living areas.

Another interactive variable is F_PCT_BACHLR -- the interaction of the foreclosure dummy and the percent of population with bachelor's degree. The interpretation of this variable is similar to that of F_AREA. Given that the coefficient of PCT_BACHLR is 2,986 and the coefficient of F_PCT_BACHLR is -1,089, we can calculate that for a non-foreclosed property, 1% increase in the population with bachelor's degree leads to a $2,986 increase in the sale price, holding other control variables constant. However, for a foreclosed property, 1% increase in the population with bachelor's degree only leads to a $1,897 ($1,897 = $2,986 - $1,089) increase in the sale price, holding other control variables constant. The negative coefficient of F_PCT_BACHLR indicates that foreclosures with population that has a higher percent of bachelor's degree decrease the sale price more when compared to those with a lower percent of bachelor's degree, holding other control variables constant. That is to say, foreclosures with population that has a higher percent of bachelor's degree have a larger negative effect on housing prices than those with a lower percent of bachelor's degree, holding other control variables constant. However, it doesn't mean that foreclosures with population that has a higher percent of bachelor's degree have lower prices than those with a lower percent of bachelor's degree because PCT_BACHLR still has a positive coefficient whose absolute value is larger than that of F_PCT_BACHLR. For instance, the sale price of a foreclosed property with population that has 10% of bachelor's degree is $18,970 ($18,970 = $2,986*10 - $1,089*10), and the sale price of a foreclosed property with population that has 20% of bachelor's degree is $37,940 ($37,940 = $2,986*20 - $1,089*20). From this example, although the sale price of a foreclosed property with 20% of bachelor's degree is higher than those with 10% of bachelor's degree, the foreclosure discount of a foreclosed property with 20% of bachelor's degree ($21,780 = $1,089*20) is larger than those with 10% of bachelor's degree ($10,890 = $1,089*10). This result makes sense because properties with a higher percent of population that has a bachelor's degree tend to have higher sale prices as previously discussed. If such a property is a foreclosure, the foreclosure discount is expected to be larger than that of properties with lower prices or properties with a lower percent of population that has a bachelor's degree. The results of the interactive approach satisfy our expectation of hypothesis3 that foreclosures affect single-family housing prices in an interactive way. In particular, foreclosures affect housing prices significantly when they are associated with the living area and the percent of population that has a bachelor's degree.

The foreclosure intensive index model uses only the Foreclosure Intensive Index (FII) to represent foreclosure attributes, and also controls for property, locational, and neighborhoods characteristics. The definition of the Foreclosure Intensive Index has been previously discussed in methodology. Table 5-3 reports the regression results of the foreclosure intensive index model in the global market. The R-square of this model is 0.696, which indicates that 69.6% of the single-family housing prices can be explained by the independent variables in this model. Notice that the foreclosure intensive index model performs better than the foreclosure contagion model for it has a higher R-square. Most of the significant variables of property, locational, and neighborhood attributes are the same as the results of the foreclosure contagion models. The signs and magnitudes of the coefficients are also similar to the results of the foreclosure contagion models and are shown as expected.

The age of the property (AGE) is one of the new significant variables in this model. The coefficient of AGE is -607, which indicates that one year increase in the property age decreases the housing price by $607. This result satisfies our expectation because older properties tend to sell at lower prices. For the neighborhood attributes, two new variables are shown to be significant: the median household income (MEDHHINC) and the number of households with public assistance income (HH_PUBA). The coefficient of the median household income (MEDHHINC) is 0.657, which indicates that a $1,000 increase in the median household income raises the housing price by $657. The result makes sense because people with a high median household income tend to be able to afford properties with higher prices. Figure 5-3 shows the relationship between the sale prices of housing units and the median household income. Visually, higher median household income is associated with higher sale prices. The coefficient of the number of households with public assistance income (HH_PUBA) is -292, which indicates that an increase in the number of households with public assistance income lowers the housing price by $292. The result satisfies our expectation because a larger number of households with public assistance income indicate a higher poverty level, which then leads to lower housing prices as previously discussed. Figure 5-4 shows the relationship between the sale prices of housing units and the number of households with public assistance income. Visually, a larger number of households with public assistance income is associated with a lower sale price.

The Foreclosure Intensive Index (FII), shown as FD_HD in the table, has a large negative coefficient (-156,299), which indicates that a unit increase in the FII lowers the housing price by $156,299. Since the range of the FII is from 0 to 1, it is more appropriated to say that a 0.01 unit increase in the FII lowers the housing price by $1,563. The results satisfy our expectation of hypothesis4 that a higher Foreclosure Intensive Index lowers single-family housing prices significantly. It also proves that this index is a good indicator of foreclosure intensity and performs very well in predicting the single-family property values.

High Median Household Income Submarkets

After estimating the impact of foreclosures in the global market, this thesis also intends to measure the effects of foreclosures on single-family property values in the high-end housing submarket (i.e., in neighborhoods with relatively high income levels), given that effects of foreclosure tend to differ across submarkets. As it is previously mentioned, this thesis defines three submarkets (low, medium, and high) based on the median household income, and focuses on the impact of foreclosures on property values in submarkets with high median household income.

Table 5-4 reports the regression results of the foreclosure contagion model with a non-interactive approach in the submarkets with high median household income. The R-square of this model is 0.591, which indicates that 59.1% of the single-family housing prices can be explained by the independent variables in this model. All significant variables are displayed with expected signs and reasonable magnitudes in this table.

For the property attributes, a larger living area and the inclusion of a pool increase the housing price in the high-end submarkets, given that the coefficients are positive. One square foot increase in living area leads to a $90 increase in the property value and the addition of a pool raises the housing price by $16,896. For the locational attributes, a thousand feet increase in the distance to downtown is associated with a $1,504 decrease in the housing price, of which the rationale has been previously discussed. Compared to the global market, DIST_MAJORROAD and DIST_RAILROAD are not shown in Table 5-4. That is to say, distance to the nearest major road and to the nearest railroad do not affect the housing prices significantly in the high-end submarkets. The variable XY represents the product of x coordinate and y coordinate of each subject property. The coefficient of XY is negative but very small, which indicates that the property value decreases slightly as houses move northeast in the submarkets with high median household income. This variable highlights the interactive nature of the absolute location to explain the variations in sale prices, and indicates the presence of the non-linear relationship between the sale prices and {*x, y*} coordinates (Fik, Ling, and Mulligan 2003).

Three neighborhood attributes demonstrate significant variables: the population to work using public transportation (TRAN_PUB), the median household income (MEDHHINC), and the percent of population that has a bachelor’s degree (PCT_BACHLR). With a negative coefficient, an additional person using public transportation to work decreases the sale price by $534 in the high-end submarkets. The result is expected because a larger population using public transportation to work indicates a lower income level. People with lower income can only afford housing units with lower prices. The coefficient of the median household income is 0.815, which indicates that a $1,000 increase in the median household income raises the sale price by $815 in the high-end submarkets. This result makes sense because people with higher income tend to be able to afford properties with higher prices. With a positive coefficient, 1%increase in the population that has a bachelor's degree raises the sale price by $810, of which the rationale has been previously discussed.

Two significant foreclosure attributes are shown in the table, which are the same two attributes as that in the global market. The coefficient of the foreclosure dummy (FRECLOSURE) is -60,363, which indicates that, in the high-end submarkets, a foreclosure property lowers the sale price by $60,363 compared to a non-foreclosure property, holding other control variables constant. The coefficient of the number of foreclosures within 2000 feet (F2000) is -3,280, which indicates that, in the high-end submarkets, each additional foreclosure within 2000 feet of a subject sale is associated with a $3,280 decrease in the sale price, holding other control variables constant. Compared to the global market, both the foreclosure dummy and the number of foreclosures within 2000 feet have larger negative effects on property values in the submarkets with high median household income, given that the absolute value of the negative coefficients are larger.

Table 5-5 presents the results of the foreclosure contagion model with an interactive approach in the submarkets with high median household income. The R-square of this model is 0.591, which indicates that 59.1% of the single-family housing prices can be explained by the independent variables in this model. All significant variables are displayed with expected signs and reasonable magnitudes in this table.

Significant variables of property attributes, locational attributes, and neighborhood attributes are exactly the same as the results in the previous model with a non-interactive approach. The coefficients change slightly while keeping the same signs. The number of foreclosures within 2000 feet (F2000) still shows a significant variable with a negative sign.

As the only one significant interactive variable in this model, F_AREA, the interaction of the foreclosure dummy and the living area, has a negative coefficient of -29. As it is previously mentioned, the interpretation of interactive variables is more difficult because the influence of one variable is dependent on the other variable that is interacted. However, the rationale of this interactive term in the high-end submarkets is exactly the same as that in the global market. Given that the coefficient of AREA is 92, we can calculate that for a non-foreclosed property, one square foot increase in the living area leads to a $92 increase in the sale price, holding other control variables constant. However, for a foreclosed property, one square foot increase in the living area only leads to a $63 ($63 = $92 – 1*$29) increase in the sale price, holding other control variables constant. The negative coefficient of F_AREA indicates that foreclosures with larger living areas decrease the sale price more when compared to those with smaller living areas, holding other control variables constant. That is also to say, foreclosures with larger living areas have a larger negative effect on housing prices than those with smaller living areas, holding other control variables constant. However, it doesn't mean that foreclosures with larger living areas have lower prices than those with smaller living areas because the living area (AREA) still has a positive coefficient whose absolute value is larger than that of F_AREA. For instance, the sale price of a 1000 square feet foreclosed property is $63,000 ($63,000 = $92*1,000 - $29*1,000), and the sale price of a 2000 square feet foreclosed property is $126,000 ($126,000 = $92*2,000 - $29*2,000). From this example, although the sale price of a 2000 sqft foreclosed property is higher than that of a 1000 sqft foreclosed property, the foreclosure discount of the 2000 sqft property ($58,000 = $29*2,000) is larger than that of the 1000 sqft property ($29,000 = $29*1,000). This result makes sense because properties with larger living areas tend to have higher sale prices as previously discussed. If such a property is a foreclosure, the foreclosure discount is expected to be larger than properties with lower prices or properties with smaller living areas. Compared to the global market, F_PCT_BACHLR is not shown in the table. That is to say, the interaction of the foreclosure dummy and the percent of population that has a bachelor's degree does not affect the housing prices significantly in the submarkets with high median household income. In addition, both the number of foreclosures within 2000 feet and the interaction of the foreclosure dummy and the living area have larger negative effects on property values in the high-end submarkets, given that the absolute value of the negative coefficients are larger.

For the submarkets with high median household income, the foreclosure intensive index model, a model that uses only the Foreclosure Intensive Index (FII) to represent foreclosure attributes, and controls for property, locational, and neighborhoods characteristics, is also conducted. Table 5-6 reports the results of the foreclosure intensive index model in the high-end submarkets. The R-square of this model is 0.569, which indicates that 56.9% of the single-family housing prices can be explained by the independent variables in this model. Notice that the foreclosure contagion models perform better than the foreclosure intensive index model in the submarkets for they have higher R-squares (0.591 for both the non-interactive approach and the interactive approach). Most of the significant variables of property, locational, and neighborhood attributes are the same as the results in the foreclosure contagion models. The signs and magnitudes of the coefficients are also similar to the results in the foreclosure contagion models and are shown as expected. The rationales of most significant variables have been previously discussed. The foreclosure intensive index (FII), shown as FD_HD in the table, has a large negative coefficient (-233,010), which indicates that a unit increase of the FII lowers the housing price by $233,010. Since the range of the FII is from 0 to 1, it is more appropriated to say that a 0.01 unit increase of the FII lowers the housing price by $2,330. It also proves that this index is a good indicator of the foreclosure intensity and performs very well in predicting the single-family property values. Compared to the global market, the Foreclosure Intensive Index has a larger impact on single-family housing prices in the submarkets with high median household income, given that the absolute value of the negative coefficient is larger.

After comparing the results in both the global market and the high-end submarkets, it can be concluded that the results satisfy our expectation of hypothesis5 that the way that foreclosures affect single-family housing prices is different in submarkets or neighborhoods with higher median household income, compared to the global market.

Table 5-1. Regression results of foreclosure contagion model with non-interactive approach for the global market

Independent Variables	Coef.	Std. Error	t	Sig.	VIF
(Constant)	742802.284	204302.697	3.636	0.000	
AREA	84.735	2.485	34.100	0.000	1.654
POOL	24658.311	3475.339	7.095	0.000	1.107
DIST_MAJORROAD	-2.941	0.842	-3.492	0.000	1.614
DIST_RAILROAD	-1.393	0.225	-6.199	0.000	2.513
DIST_DOWNTOWN	-0.719	0.192	-3.743	0.000	4.901
Y_COORD	-0.477	0.132	-3.603	0.000	2.656
PCT_BACHLR	2917.004	204.344	14.275	0.000	2.108
PCT_POV	-1092.629	180.014	-6.070	0.000	1.848
FORECLOSURE	-49105.149	4630.614	-10.604	0.000	1.050
F2000	-2571.236	842.032	-3.054	0.002	1.149

Table 5-2. Regression results of foreclosure contagion model with interactive approach for the global market

Independent Variables	Coef.	Std. Error	t	Sig.	VIF
(Constant)	744775.042	204114.543	3.649	0.000	
AREA	86.054	2.512	34.251	0.000	1.699
POOL	24633.832	3467.307	7.105	0.000	1.107
DIST_MAJORROAD	-3.013	0.841	-3.585	0.000	1.616
DIST_RAILROAD	-1.336	0.224	-5.962	0.000	2.510
DIST_DOWNTOWN	-0.726	0.191	-3.793	0.000	4.899
Y_COORD	-0.480	0.132	-3.636	0.000	2.664
PCT_BACHLR	2986.239	206.259	14.478	0.000	2.158
PCT_POV	-1103.396	179.589	-6.144	0.000	1.848
F2000	-2416.170	842.588	-2.868	0.004	1.156
F_AREA	-19.718	4.592	-4.294	0.000	3.325
F_PCT_BACHLR	-1088.669	499.991	-2.177	0.030	3.307

Table 5-3. Regression results of foreclosure intensive index model for the global market

Independent Variables	Coef.	Std. Error	t	Sig.	VIF
(Constant)	548906.185	204435.953	2.685	0.007	
AREA	80.584	2.535	31.794	0.000	1.756
POOL	21945.231	3444.125	6.372	0.000	1.110
AGE	-607.198	94.582	-6.420	0.000	3.353
DIST_MAJORROAD	-3.445	0.844	-4.081	0.000	1.656
DIST_RAILROAD	-1.383	0.234	-5.909	0.000	2.783
DIST_DOWNTOWN	-1.290	0.220	-5.859	0.000	6.580
Y_COORD	-0.332	0.132	-2.507	0.012	2.710
MEDHHINC	0.657	0.094	6.989	0.000	2.617
HH_PUBA	-291.535	80.330	-3.629	0.000	1.733
PCT_BACHLR	2037.220	237.114	8.592	0.000	2.897
PCT_POV	-464.435	195.645	-2.374	0.018	2.228
FD_HD	-156298.936	20298.090	-7.700	0.000	1.239

Table 5-4. Regression results of foreclosure contagion model with non-interactive approach for the high income submarkets

Independent Variables	Coef.	Std. Error	t	Sig.	VIF
(Constant)	284103.506	76964.289	3.691	0.000	
AREA	89.853	3.728	24.103	0.000	1.864
POOL	16896.079	5443.525	3.104	0.002	1.157
DIST_DOWNTOWN	-1.504	0.160	-9.411	0.000	2.422
XY	-3.507E-07	0.000	-3.721	0.000	1.335
TRAN_PUB	-533.971	163.294	-3.270	0.001	1.153
MEDHHINC	0.815	0.130	6.248	0.000	1.464
PCT_BACHLR	810.441	354.900	2.284	0.023	1.739
FORECLOSURE	-60363.624	7638.766	-7.902	0.000	1.074
F2000	-3280.143	1440.679	-2.277	0.023	1.280

Table 5-5. Regression results of foreclosure contagion model with interactive approach for the high income submarkets

Independent Variables	Coef.	Std. Error	t	Sig.	VIF
(Constant)	275624.247	76927.267	3.583	0.000	
AREA	92.419	3.723	24.822	0.000	1.859
POOL	16526.386	5444.383	3.035	0.002	1.157
DIST_DOWNTOWN	-1.539	0.160	-9.648	0.000	2.411
XY	-3.452E-07	0.000	-3.663	0.000	1.334
TRAN_PUB	-521.732	163.315	-3.195	0.001	1.153
MEDHHINC	0.824	0.130	6.315	0.000	1.465
PCT_BACHLR	759.209	355.400	2.136	0.033	1.744
F2000	-3341.150	1439.480	-2.321	0.021	1.278
F_AREA	-28.805	3.650	-7.891	0.000	1.085

Table 5-6. Regression results of foreclosure intensive index model for the high income submarkets

Independent Variables	Coef.	Std. Error	t	Sig.	VIF
(Constant)	362433.648	78165.702	4.637	0.000	
AREA	90.822	3.809	23.843	0.000	1.851
POOL	15539.591	5535.232	2.807	0.005	1.138
DIST_DOWNTOWN	-1.418	0.162	-8.751	0.000	2.365
XY	-4.193E-07	0.000	-4.429	0.000	1.281
TRAN_PUB	-540.066	165.778	-3.258	0.001	1.130
MEDHHINC	0.866	0.121	7.165	0.000	1.196
FD_HD	-233010.214	34779.798	-6.700	0.000	1.413

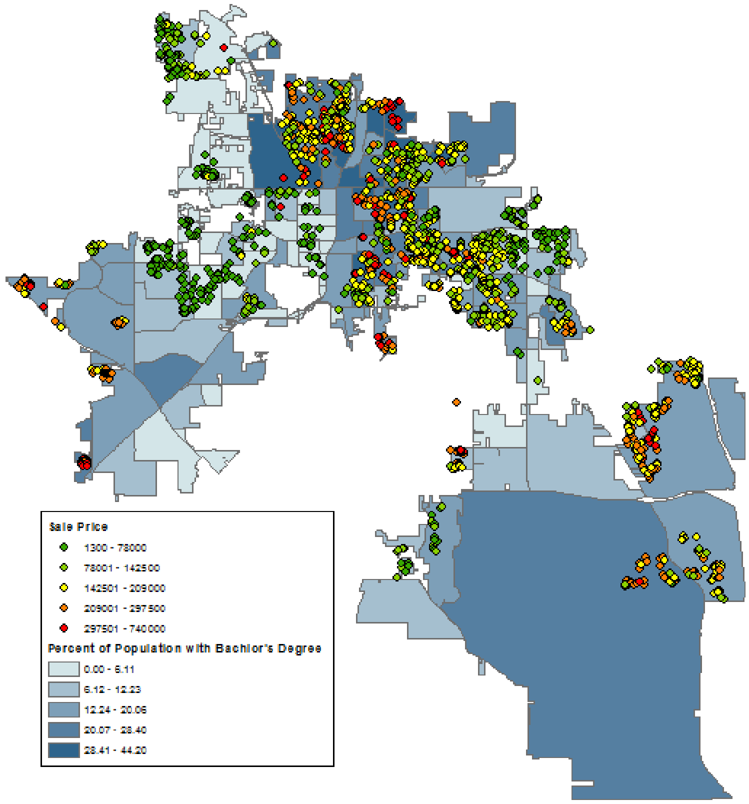

Figure 5-1. Percent of population with bachelor's degree

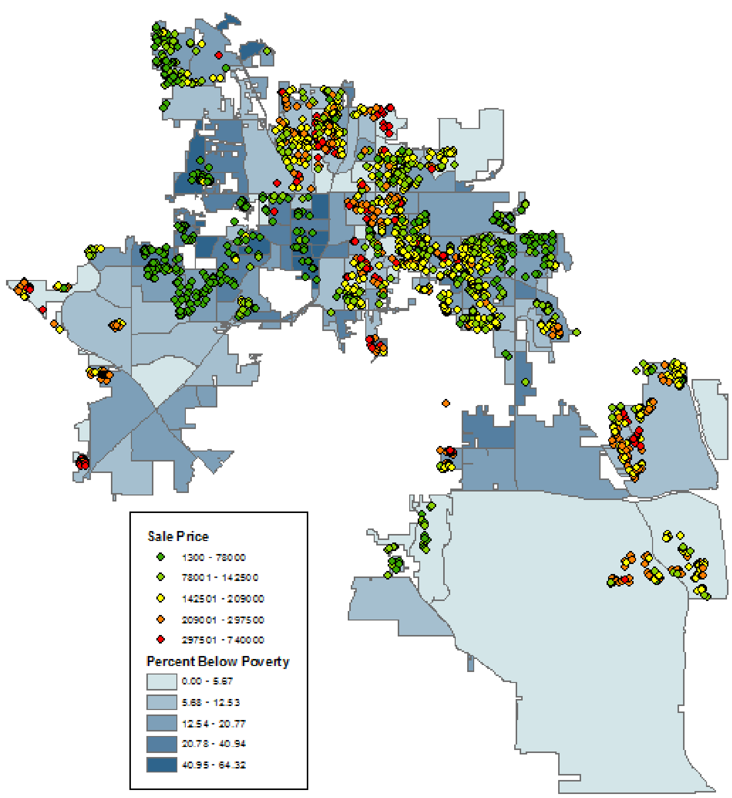

Figure 5-2. Percent below poverty

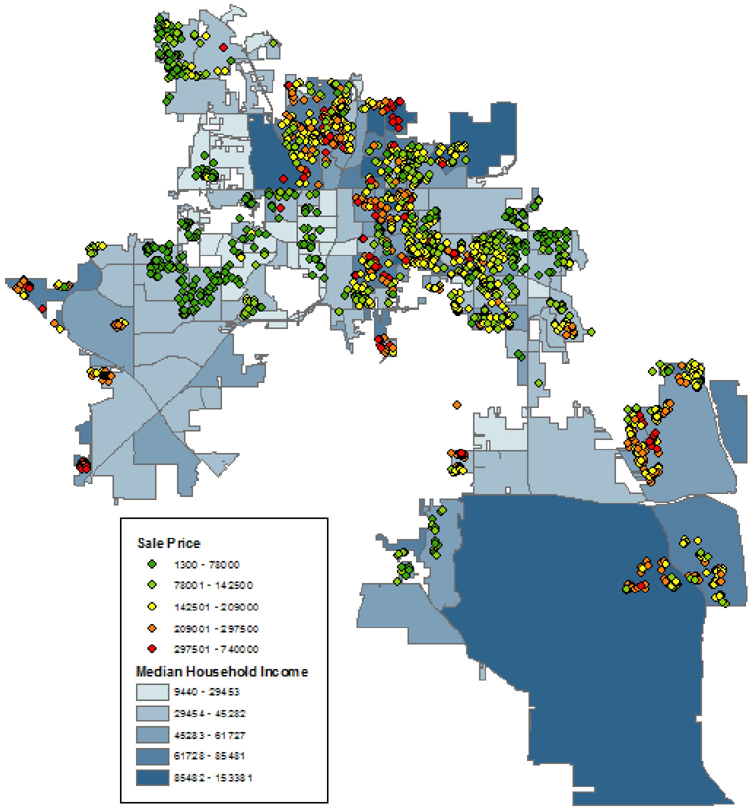

Figure 5-3. Median household income

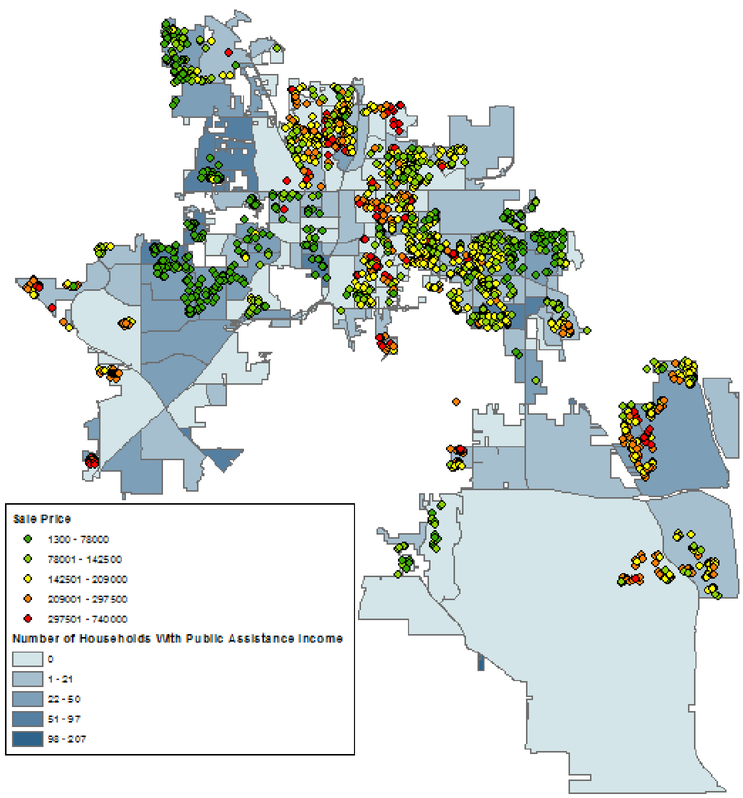

Figure 5-4. Number of households with public assistance income

CHAPTER 6
CONCLUSION AND DISCUSSION

Conclusion

This thesis uses a series of hedonic regression models to estimate the impacts of foreclosures on single-family property values and the spillover effects of foreclosures on nearby properties in Orlando, FL in 2011 and 2012. It also aims to estimate the effects of foreclosures using an interactive variables approach (Fik, Ling, and Mulligan 2003). Both the foreclosure contagion models and the foreclosure intensive index model show expected results in the global market and the submarkets with high median household income.

The impacts of foreclosures on housing prices and nearby property values are estimated in the global market. A foreclosed property lowers the sale price by $49,105. The contagion effects of foreclosures indicate that each additional foreclosure within 2000 feet of a subject sale is associated with an approximately $2,500 decrease in the sale price ($2,571 for the non-interactive approach and $2,416 for the interactive approach). Moreover, foreclosures affect property values when they are associated with other factors. For instance, foreclosures with larger living areas have larger negative effects on housing prices than those with smaller living areas, and foreclosures with population that has a higher percent of bachelor’s degree have larger negative effects on housing prices than those with a lower percent of bachelor’s degree. The Foreclosure Intensive Index has a significant negative effect on housing prices as expected, for a 0.01 unit increase of the Foreclosure Intensive Index lowers the housing price by $1,563. It also proves that this index is a good indicator of the foreclosure intensity and performs very well in predicting the single-family property values.

In the submarkets with high median household income, the effects of foreclosures on single-family property values are slightly different. A foreclosed property lowers the sale price by $60,363. The contagion effects of foreclosure indicate that each additional foreclosure within 2000 feet of a subject sale is associated with an approximately $3,300 decrease in the sale price ($3,280 for the non-interactive approach and $3,341 for the interactive approach). The interactive approach estimates that foreclosures with larger living areas have larger negative effects on housing prices than those with smaller living areas. The Foreclosure Intensive Index has a significant negative effect on housing prices as expected, for a 0.01 unit increase of the Foreclosure Intensive Index lowers the housing price by $2,330. Based on these conclusions, in the city of Orlando, the negative effects of foreclosures on single-family housing prices are larger in the high-end submarkets than in the global market.

Limitation and Future Research

There are several limitations in this thesis. First, hedonic regressions likely suffer from omitted variable problems because it is impossible to observe all property, location, and neighborhood characteristics (Frame 2010; Harding, Rosenblatt, and Yao 2009). Second, the reasons for the foreclosure discounts cannot be estimated due to data limitation. This thesis only measures the quantitative negative effects of foreclosures, but not other qualitative effects of the foreclosures process, such as property owner's finances, vacancy status, and property characteristics before and after foreclosure. Third, the hedonic regressions in this thesis do not control for temporal variables. It is widely believed that the effects of foreclosures on sale prices vary in different stages of the foreclosure process. Fourth, as Florida has one of the highest foreclosure rates in the country, the estimation of the impacts of foreclosures in Orlando may not be applied to other areas with lower foreclosure rates. Fifth, this thesis does not consider geographic submarkets. Foreclosures in different geographic submarkets may have different effects on housing prices. Finally, error terms are not examined in this thesis. The sample housing units are expected to have spatial autocorrelations given their spatial distribution.

In the future research, it would be helpful to control for occupancy status, property owner’s finances, as well as temporal variables when estimating the impacts of foreclosures on housing prices. For the interactive approach, it is possible to add more interactive variables into the hedonic regressions to estimate the non-linear relationship between the sale prices and other factors. For instance, the relationship between the sale prices and age may not be linear. In addition, it would be helpful to consider better data that related to foreclosures. For instance, the crime rates may be a good neighborhood variable, for the vicinity of foreclosures tend to have higher crime rates. It is also possible to consider adding locational dummy variables to examine the foreclosure effects in different geographic submarkets. For example, the effects of foreclosures in northwest Orlando may be different from that in southeast Orlando. Updated foreclosure notices and sales documents with more detailed transaction information are needed in future research. Moreover, more applications of GIS should be considered in the future real estate research, as GIS has become an increasing powerful tool in the recent years.

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