The American Nightmare: Exploring the Foreclosure Crisis in Boston

An honors thesis for the Economics Department

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Tufts University, 2009

Abstract:

Using site evaluation information and neighborhood characteristics from the 2000 Census, the following paper analyzes the impact of various factors on the maintenance of bank-owned properties after foreclosure. There are a number of significant variables, including the appearance of the property being occupied on the date of the site evaluation and the rating for the area surrounding the property. Contrary to expectations, the number of foreclosures within an eighth of a mile of the property also has a positive, significant value, but its low standardized coefficient decreases the importance of this finding. In addition, research was conducted using both quantitative and qualitative measurements to determine the location of high concentrations of foreclosures within Census block groups during the Boston foreclosure crisis in the early 1990s and the current foreclosure crisis. This research used two density mapping strategies, one that counted the number of foreclosures in each Census block group and one that examined the number of foreclosures within a quarter mile radius of all 100-square meter cells in each Census block group, to analyze the density of foreclosures and found a consistent relationship between higher minority populations and a greater concentration of foreclosures during both foreclosure crises.

Acknowledgments

This would not have been possible without the guidance and support of a number of people:

My primary advisor, Professor Jeffrey Zabel, has provided endless feedback and access to additional data sources through the Boston Federal Reserve Bank. The two other members of my thesis committee, Patricia Hanratty and Professor Rajeev Dehejia, also provided knowledge and support throughout the entire process.

In addition, I would like to thank the staff at Boston Community Capital, especially Elyse Cherry, for providing me with the invaluable opportunity to intern at their office. This experience sparked my interest in the current foreclosure crisis and provided me with the background information needed to pursue the topic further in a senior honors thesis. Thanks are also due to Sherman Teichman and Heather Barry at the Institute for Global Leadership for the Institute's financial support of my summer internship at Boston Community Capital.

Thanks to Paul Willen and Mary Burke at the Boston Federal Reserve Bank for taking the time to meet with me to help shape my project. Their expertise in the area was invaluable. Additional thanks to Paul Willen for allowing me to use data that he had collected.

Finally, I want to thank my family and friends for their endless support and encouragement as I researched and wrote this thesis.

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Chapter 1: Exploring the Impact of Neighborhood Characteristics on the Exterior Quality of Bank-Owned Properties

1.1 Introduction

The focus of this research is to explore the maintenance of foreclosed properties after ownership has been given to the bank. This research attempts to understand whether relationships exist between the bank's maintenance of a property and the property's location. In this model, the neighborhood characteristics, property characteristics, and surrounding foreclosures are all used to help to explain differences in property maintenance of bank-owned properties in Suffolk County, Massachusetts.

The central hypothesis of the research is that areas with larger minority populations or lower income residents will have bank-owned properties that are maintained at a lower level, which would then impact the values of surrounding properties and cause a possible decline in the community as a whole. The belief, as expressed in Gerardi and Willen (2008), is that minority and low-income communities were the areas most impacted by subprime lending. This is important because of the understanding that subprime lending was generally done without the necessary consideration of the borrower's ability to repay his or her debt. Because the banks were not originally concerned with the ability of customers in these areas to repay their debt, it would be assumed that the banks would also be less concerned with the upkeep of properties in these neighborhoods after foreclosure, when holding constant the number of foreclosures surrounding the property since this would impact the value of the property.

In addition, it is hypothesized that properties that appeared to be occupied on the day of the site visit will be in better condition because the inhabitant would care how the exterior condition of his or her home appears to others. It would be expected that a person living at the

property would be more inclined to maintain the property than a bank that has no personal connection to the home. If this is the case, there may be a policy implication in this finding, as it would be in the best interest of the banks to allow the residents to continue to live in the foreclosed properties. There is also an endogeneity problem that is associated with this variable since residents are more likely to stay in properties that are in better condition at the time of foreclosure.

It is important to note that this research is interested in the maintenance of the property between the time of foreclosure and the site evaluation. This would show the maintenance of the property during the time when the bank owned the home. Unfortunately, there is no exact measure for the quality of the property at the time of foreclosure so a proxy is being used to account for the condition of the property at the time of the foreclosure. This proxy is the assessed value of the property provided by The Warren Group.

If properties in low-income or minority neighborhoods are not being maintained by the banks, after controlling for property characteristics, these properties will result in lower property values for surrounding homes and could result in a swift downturn in the neighborhood. Low-income neighborhoods have fewer safety nets to keep them from quickly deteriorating as a result of poorly maintained, vacant properties. Vacant properties tend to be hotbeds of crime, vandalism and drug use. A prevalence of poorly maintained vacant properties in a low-income neighborhood could have a devastating impact. The condition of a property after it has been foreclosed upon by a bank could be important because it will impact the ease with which, and price at which, a bank can resell the home. This could, hypothetically, result in a higher maintenance of properties by banks with the hope of reclaiming losses that resulted from the previous owner not fully paying his or her mortgage. The negative impact on the community

will be greater for properties that remain vacant for extended periods of time and when the resale price of the property is significantly lower than its original value. These properties will impact the value of surrounding homes both as a result of their vacancy and because they sell for lower values, which will be used as comparable prices when other homes in the area are put on the market. Vacant and foreclosed properties have a direct spillover effect on the property values of surrounding homes and additional foreclosures will compound this negative impact on property value.

There has been a vast array of new research conducted on foreclosures as the current foreclosure crisis both continues and expands. Immergluck and Smith (2006) have found a direct connection between foreclosures and the value of surrounding properties. They have also identified a direct relationship between an increase in the number of foreclosures and higher crime rates in specific neighborhoods. Various work has been completed on the types of communities that have been impacted the greatest by the foreclosure crisis. The Woodstock Institute examined the location of subprime loans and found a prominence of these types of mortgages in minority communities.

This paper will add to previous research on foreclosures because it contains information on the actual condition of foreclosed properties in the Boston area. This is the first research that has been conducted where the researcher has visited the property and recorded the physical condition of the home. This adds a new dimension to the field of research by allowing an examination of the way that properties are cared for by the banks after they are foreclosed.

There are a number of notable findings from this work. The coefficient estimates for the rating of the area where the property is located, the property appearing to be occupied on the day of the site evaluation, and the assessed value of the property all have statistically significant,

positive values. It is also important to note that, contrary to the original expectations, the number of foreclosures within an eighth of a mile of the property had a consistently statistically significant, positive impact on the property rating. However, the standardized coefficient for this variable is very small, which indicates that this impact is not economically significant.

The remainder of this paper will continue as follows: Section 1.2 provides a short overview of the previous literature on the topic; the next section describes the data and examines the summary statistics and correlation between the regressors; Section 1.4 discusses the empirical model that was utilized in this analysis; the regression results are presented in Section 1.5; finally, the remaining section of the paper will provide a brief conclusion.

1.2 Literature Review:

Although there has been substantial research in the area of subprime mortgages and foreclosures in the past few years, the research on bank-owned properties and site condition has been non-existent. That being said, some of the previous literature can be significant in providing insight as to the impact of similar independent variables on subprime mortgages and foreclosure. The previous literature is also useful in understanding the main sources of data used in research in this field. In many of these previous studies the authors have also used data from both the Registry of Deeds and The Warren Group in order to understand similar aspects of the crisis.

Previous studies of the current crisis have investigated the impact of foreclosures on property values. Calomiris, Langhofer, and Miles (2008) find that the decline in house prices as a result of the current foreclosure shock will be low. They use house price data from the OFHEO home price index and information on the number of foreclosures and mortgages

available through the Mortgage Bankers Association to create a panel vector autoregressive model (PVAR). They conclude that average house prices will remain relatively flat over the course of the next two years, even with the predicted foreclosure shocks. This conclusion contradicts the common belief that there will be a significant decline in house prices.

Immergluck and Smith (2006) use Chicago-based data and a hedonic model to conclude that the impact of a foreclosure within an eighth of a mile and a quarter of a mile of a given property will cause a 0.9 percent decline in the property's value. This is a significant impact on the value of a property solely resulting from its proximity to a foreclosed property. The number of foreclosures within an eighth of a mile of the property has been included in this research to account for this direct impact between house value and foreclosures that are in a close proximity to the property.

Some research has also investigated the impact of property type on the likelihood of foreclosure. Gerardi, Shaprio, and Willen (2007) create a data set of homeownership experiences using data from the Registry of Deeds, The Warren Group, the 2000 Census, and the Bureau of Labor Statistics, which they use to determine that mortgages on single-family homes are less likely to end in default than mortgages on multi-family homes or condominiums. This is significant given that the vast majority of the bank-owned properties included in this paper's dataset are multi-family homes. The authors also explore the impact of the amount of equity in the home on the likelihood of loan default. The authors find that negative equity increases the probability of default on a mortgage, but it does not have enough of an impact to be the sole cause of default.

There has been previous work on the prevalence of subprime loans and foreclosures in specific types of communities, which can be used to consider the manner in which banks

maintain foreclosed properties in various types of communities. The Woodstock Institute (2008) study the prevalence of subprime loans in minority and low-income communities in Boston, Charlotte, Chicago, Cleveland, Los Angeles, New York City, and Rochester. Their research finds that communities with a higher proportion of minority groups have a greater number of subprime mortgages than communities with a lower proportion of minority groups. Nationally, communities of at least 80 percent people of color contain 3.6 times the number of high-risk loans as communities where less than 10 percent of the population are people of color. Calem, Hershaff, and Wachter (2004) find that racial composition of a community is an important determinant of whether a loan originated in the community will be subprime.

Grover, Smith, and Todd (2008) look to identify characteristics that are common in communities with high foreclosure rates using data from the Minneapolis-St. Paul area. The authors discover that the change in the percent of minorities in the population between 1990 and 2000 is an important variable in their regression**.** Mayer and Pence (2008) use a combination of data from three separate sources – LoanPerformance, United States Department of Housing and Urban Development (HUD), and the Federal Financial Institutions Examination Council's Home Mortgage Disclosure Act (HMDA)– to explore the geographical originations of subprime loans. They find that subprime mortgages are most heavily concentrated in areas with significant African-American and Hispanic populations. This paper builds off of this research to investigate whether the exterior condition of bank-owned properties differs depending on neighborhood variables, such as the racial composition of the community and the average income at the household level.

The data included in this paper contain information that has not been available to previous researchers, namely site evaluations of bank-owned properties. This research will

further explore the issue of community composition. However, instead of working to understand where subprime mortgages originated or where foreclosures occur, it will investigate the impact of community composition, specifically racial and economic, on the maintenance of properties by banks after foreclosure. By using site evaluations and exploring bank-owned properties, this research will expand upon previous literature in this area and provide new insight to the field.

1.3 Data Description:

The initial data were collected through work at Boston Community Capital during the summer of 2008 as a part of their effort to better understand the impact of the foreclosure crisis in Boston. The data are for properties that were bank-owned at some point during the period between December 1, 2007 and August 1, 2008. The original list of these properties is from a download provided by RealtyTrak, an online database of pre-foreclosure, auction and bank-owned properties. There are 92 observations included in the final data set used in this paper, although the download contained more properties not every site was visited and the decision was made to use only multi-family properties in this analysis. Information on the geographical location of the property, including the street address, zip code, and county, came from the original RealtyTrak download.

The data also include a variety of information from the Registry of Deeds, a public source of property information that includes online copies of mortgages, deeds, and various types of liens on the property. First, information was collected on the purchase date and purchase amount for the property. There is also information about the amount of, the lender for, and the date of the mortgage that was foreclosed on, as well as similar information for the foreclosure deed (the

foreclosing lender, the date on the foreclosure deed and the amount listed on the foreclosure deed).

Using The Warren Group, an online database of realty information that collects public records and compiles them by property address, information on the house type (single family, two family, three family, four to eight unit apartment and condominium) and the square footage of living space in the home were collected. These property variables are included because a property with a larger living space would be more difficult and costly to maintain than a smaller property that was valued at the same amount, and thus would be a consideration of the bank working to maintain the property. It is therefore important to account for the size of the property when looking at the impact of other characteristics on the property's maintenance.

For 108 of the properties on the bank-owned list, site visits were conducted where the exterior condition of the home was evaluated. For the site evaluations, the exterior condition of the home, the surrounding area, and a number of other aesthetic characteristics of the property were rated from one to six, with one being the worst and six being the best. These ratings have been included for all of the properties, as well as the amount of time between the foreclosure and the site evaluation. There is also a dummy variable included for whether the property appeared to be occupied on the day of the site evaluation. It has been previously stated that there is an inherent endogeneity problem with the occupied variable because properties that were in better condition at the time of foreclosure are more likely to maintain their residents than those in worse condition at the time of foreclosure. Although these are subjective evaluations, they were conducted by a small number of people and every person that worked in the evaluation of the properties was also a part of an informational meeting to explain what each rating meant. In

addition, all site evaluations were conducted by more than one person to allow for a discussion on the rating that each would receive.

Additionally, data from the 2000 Census was used to determine neighborhood characteristics for the areas where the properties were located. The Census data was configured to the data using GIS mapping software. The properties were mapped over layers that contained the Census block, Census block group, and Census tract maps. The maps were then used to determine the Census block, Census block broup, and Census tract numbers where each property is located. This data was then merged in with the original data set by generating the general Census identification number for each property. The Census information includes data on the median household income, the frequency of households in various income brackets, the number of residents in each community that is of a given race, and the total population. The Census data was aggregated to the Census block group level.

Finally, this data set of bank-owned properties was merged with Warren Group data from the Boston Federal Reserve Bank, which contained information on all foreclosures in the Boston area. This data set provided important new information on each property in the data set, including the latitude and longitude of the properties and information regarding the size and amenities of the property. Using the latitude and longitude for each of the properties, the distance between the properties in the original bank-owned data set and each of the foreclosures in the Boston Federal Reserve Bank data set were calculated. After the distance between the original properties and each foreclosure was determined, additional variables were generated which counted the number of foreclosures within a given radius of the bank-owned properties. These variables were created for radii of an eighth of a mile, a quarter of a mile, a half a mile,

three-quarters of a mile and a mile, although only the first of these was used in the final regressions shown in this paper.

Table 1 shows the summary statistics and detailed descriptions for the variables in this data set. There are a number of notable aspects to this table. First, the minimum value for square footage is zero. This is a result of the fact that this data was unavailable for five observations and when it was originally entered, instead of leaving the field empty, a value of zero was assigned to the property. In order to control for this, a dummy variable has been added that accounts for whether or not this data is provided for the property. Thirty seven percent of the properties in the data set appeared to be occupied on the day of the site evaluation. The vast majority, 89 percent, of the properties included in this data set are multi-family properties and, as a result of this fact, the decision was made to only use these properties.

Although the Census block groups are not overwhelmingly minority communities, the maximum percentage of African Americans in a block group is over 26 percent. This is twice the average percentage of African Americans in the United States, which is estimated by the American Community Survey to be 12.4 percent. However, the average percentage of whites in the block groups where these properties are located is over 75 percent. This is especially notable given that the majority of the writings on the foreclosure crisis have focused on its predominance in minority communities, but these properties are not located in Census block groups that are overwhelmingly occupied by minorities. It is, however, important to understand how these percentages compare to the city and nation as a whole. According to the American Community Survey's estimates for 2005-2007, Boston has a population that consists of 56.3 percent white residents and 23.5 percent African American residents. This means that the average percentage

of African American residents in the Census block groups where these properties were located is slightly higher than the average for the city.

The block groups where these properties are located are predominately low-income communities. The average percentage of households in these block groups that have incomes below $40,000 is 56.23 percent. In addition, 21 percent of the block groups where these properties are located have more than 50 percent of their residents with incomes under $25,000 a year. The average median income of all of the block groups where these properties are located is $37,500. Once again using the American Community Survey's estimates for Boston, these can be compared to the average values in the city. The median income in the city of Boston is $48,729, which is significantly higher than the average median household incomes for the Census block groups where these foreclosures were located. To gain a better understanding of the geographical location of these properties a map (Map 1) is included below.

Table 2 provides the same summary statistics as Table 1, except these are only for the multi-family properties. Because the majority of the properties are multi-family properties, the summary statistics in Table 2 are extremely similar to those in Table 1. The only notable differences are that the assessed values of the multi-family properties are higher than those for all of the properties and that the multi-family properties are slightly younger than the average age for the dataset that uses all of the properties.

Tables 3 and 4 show the distribution of ratings for various aspects of the property based on the site evaluations. As was earlier noted, the property rating was on a scale from one to six, with six being the highest possible rating. Looking first at the property ratings, which are an overall rating for the property based on the site evaluation, the majority of observations were given rankings that were integer values, a result of the fact that the site evaluation sheets used

during the visits listed only integer values. Only seven of the property ratings were non-integers. Over half of the properties were granted the "4" rating. This could be a sign of the individuals conducting the evaluations trending towards values in the middle of the rating rather than extremes. A similar distribution can be seen in the second column of ratings, which shows the area rating for the properties. This is a rating for the community surrounding the property. For the area rating over 60 percent of the properties received ratings of "4", but there are a greater number of non-integer ratings, with 14 properties receiving non-integer values. In addition, there is a broader range of ratings, with three properties receiving area ratings of "1".

For the other five rating variables there are not values provided for every property. This is a result of the fact that some of the aspects that were rated were not relevant to the property (such as rating the exterior paint of a property that is not painted, but rather has vinyl siding). The third column shows the rating of the exterior of the property. This is a rating for the general state of the exterior of the property. This distribution is also similar to the last two. Fifty percent of the properties received ratings of "4" and only 12 properties received non-integer ratings. The rating for the exterior paint on the property, shown in the fourth column, is only available for 79 of the observations. The vast majority, over 75 percent, of the properties received ratings of either "3" or "4" and only one property received a rating that was not an integer value. The ratings for the grounds on the property, the windows and doors of the property, and the sidewalk and street in front of the property, which can be found in Table 4, all show similar patterns to the distributions that have already been discussed, with the majority of observations receiving average ratings and very few receiving non-integer values.

Table 1 of the Appendix shows the correlation matrix between the variables in this model. There is a high correlation between the square footage and the multi-family variables

with the assessed value of the property. This is expected since larger properties are more likely to be multi-family properties and because a larger property is more likely to have a higher value. However, this is not a serious concern because the decision was made to only use the multi-family properties in this analysis.

1.4 Model

A linear regression model with robust standard errors was used for this analysis. It is notable that the dependent variable in these regressions is both discrete and bounded, which is important because the ordinary least squares regression may not be the best model for evaluating the data. The various ratings are bounded on the lower end at one and on the upper end at six and have a finite number of possible values. Equation 1.1 shows the basic form of the regressions in this analysis.

$$\text{PropertyRating} = ß_1 + ß_2\text{Neighborhood Characteristics} + ß_3\text{Property Characteristics} + ß_4\text{PropertyConditionProxy} + ß_5\text{Occupied} + € \quad (1.1)$$

The neighborhood characteristics include the percentage of residents in the Census block group that are African-American, which would be expected to have a negative sign, and the percentage that are a race other than African-American or Caucasian, as determined by the 2000 Census. There is also a dummy variable for whether the neighborhood is low-income, which is hypothesized to have a negative value. Here a neighborhood was defined as low-income if over 50 percent of the households had annual incomes below $25,000. With this definition, over 21 percent of the properties were in low-income neighborhoods. There is also a variable included in the neighborhood characteristics to account for the number of surrounding foreclosures. This is a count of the number of foreclosures within an eighth of a mile of the property.

The property characteristics originally included the square footage of the property, the age of the property, and a dummy variable for whether the property is a multi-family property; however, the multi-family property variable was removed because the decision was made to include only the multiple family properties in the final regressions, so this dummy variable was no longer necessary. There is also a proxy for the condition of the property at the time of foreclosure, namely the assessed value of the property. In addition, there is a variable included for the time between the foreclosure and the date of the visit to account for the time amount of time that the property was being maintained by the bank. The occupied variable is a dummy variable that is equal to one if the property appeared to be occupied on the day of the site evaluation and zero if it appeared to be vacant. This variable was anticipated to have a positive sign. Finally, there are dummy variables included for variables that are missing data for each observation in order to maintain the largest possible set of observations.

In later regressions there is also an interaction variable included in the model. It is an interaction included for the relationship between the low-income neighborhood variable and the number of foreclosures within an eighth of a mile of the property. This would account for whether an additional foreclosure within an eighth of a mile of a property in a low-income neighborhood would have a different impact on the property's maintenance than if the property were not located in a low-income community.

1.5 Results

Tables 5 and 6 show the regression results for this model. Table 5 provides results for the regressions that were run for only the multi-family properties using the property rating as the dependent variable. The first regression in Table 5 shows the baseline specification, which

includes the rating of the area where the property is located, the neighborhood and property condition variables, and whether or not the property appeared to be occupied on the day of the site evaluation. There are a number of significant variables in these results. First, there are a number of variables that follow the original hypotheses for their signs and significance. The rating of the area where the property is located is positive and statistically significant, as was originally predicted. Another variable whose results follow the original expectations is the dummy variable for whether the property appeared to be occupied on the day of the site evaluation. It is positive and statistically significant at the one percent level in this first set of results. It is also important to note that the assessed value of the property is also statistically significant at the one percent value.

However, there are also a number of statistically significant variables that do not follow the original hypotheses for their signs. This includes the positive sign associated with the number of foreclosures within an eighth of a mile of the property and the positive sign for the coefficient estimate of the variable that determines whether the property is in a low-income neighborhood. The coefficient estimate for this variable in the first set of results can be interpreted as meaning a property in a low-income neighborhood will have a rating value that is almost half a point higher than a property not located in a low-income neighborhood, holding all other variables constant.

In the second column of results in Table 5, the regression builds off of the first by adding the interaction variable between the number of foreclosures within an eighth of a mile and the low-income neighborhood dummy variable to the regression. This variable has a positive sign, but is not statistically significant. This implies that an additional foreclosure in a low-income neighborhood has an impact that is not statistically distinct from the impact of an additional

foreclosure in an area that is not defined to be low-income in this model. Another interesting finding is that the time between the foreclosure and the site visit has a positive sign, which means that the more time that the property is owned by the bank, the higher the maintenance of the property. It is positive in all of the regression results, but only significant at the ten percent level.

The third regression is the same as the second, except that the area rating variable is excluded because there is an endogeneity issue with the area rating variable since the same individuals who were determining the property rating were also rating the neighborhood where the property was located. It is also possible that the area rating variable could be picking up other aspects that are being considered in the regressions, such as the neighborhood demographics. The exclusion of this variable results in a slight increase in the magnitude of the occupied variable. It also causes the interaction term between the low-income neighborhood variable and the number of foreclosures within an eighth of a mile to gain significance at the ten percent level.

The fourth regression is the same as the second, except it removes the occupied variable. This change was made because of the previously discussed endogeneity issue associated with the occupied variable, since a property that is occupied may have been in better condition at the time of foreclosure causing the resident to stay in the property or it could be that the property is better maintained if there is someone living there. This variation in the regression, interestingly, decreases the magnitude of the coefficient estimate for the assessed value of the property. It also results in an increase in the magnitude of the coefficient estimate for the rating of the area around the property.

In order to understand the magnitude of the coefficient estimates in these results, the standardized coefficient has been calculated. The standardized coefficient describes the change

in the dependent variable, in standard deviations, resulting from a one standard deviation increase in a given independent variable. This is especially important in looking at the statistically significant independent variables to determine their economic significance. In looking at the results in Table 5, there are a number of independent variables that are both statistically and economically significant. The area where the property is located and the assessed value of the property both have standardized coefficients in the range of 0.3 to 0.39. These are economically significant, and some of the standardized coefficients with the largest magnitudes.

The standardized coefficient for the property being in a low-income neighborhood has a very large range of values, from .076 to .2454, which makes it more difficult to determine the economic significance of the variable, although in four of the five regressions in Table 5 the standardized coefficient for the low-income variable is in the range of .14-.24. This variable is economically significant in the first set of regression results, but once the interaction term is included, the economic significance of the low-income neighborhood variable declines. The variable that has the greatest economic and statistical significance in Table 5 is the assessed value of the property, which is statistically significant at the one percent level and has a standardized coefficient in the range of 0.249 to 0.590.

In addition, the occupied variable has a standardized coefficient with a value between 0.253 and 0.350. These values are economically significant and the variable is consistently statistically significant at the one percent level. Finally, the standardized coefficient for the number of foreclosures within an eighth of a mile of the property is not economically significant. It has a value in the range of 0.145 and 0.166 and given the magnitudes of the standardized

coefficients of the other variables these are not economically significant. Because the variable is not economically significant, its statistical significance is less concerning.

The second set of regression results are shown in Table 6. These use the same specification as the second column of Table 5, except instead of using the property rating as the dependent variable these regressions use ratings of more specific aspects of the exterior condition of the property as the dependent variables for the regressions. Again, these regressions were calculated using only the multiple family properties. These are interesting to look at because they show specific aspects of the property rating variable to determine if different elements are maintained at varying levels by the bank. It is possible that certain aspects of a property maintain their condition pre-foreclosure better than others and will remain at a high quality even without bank maintenance, while other aspects may quickly deteriorate or be expensive to maintain and therefore have a lower rating than the overall condition of the property.

The first of the dependent variables in this second set of regressions is the exterior condition of the property. An interesting aspect of this set of results is that the area rating is both not statistically significant in determining the exterior rating, but also has a significantly lower magnitude than the coefficient estimates for the area rating shown in Table 5. It is possible that this is a result of the fact that the exterior of the property is a variable less likely to be influenced by the neighborhood where the property is located. Once again, the variable for whether the property appeared to be occupied on the day of the site evaluation is statistically significant at the one percent level. Also similar to the previous results in Table 5 is that the assessed value of the property is statistically significant. There is also a positive and statistically significant relationship between the exterior condition of the property and the time between the foreclosure

and the site visit, which is contrary to the original hypothesis. Finally, the interaction term between the property being in a low-income neighborhood and the number of foreclosures within an eighth of a mile of the property is again positive and statistically significant, implying that a foreclosure in a low-income neighborhood actually has a positive impact on the maintenance of a property post-foreclosure compared to the impact of a foreclosure in a neighborhood not deemed to be low-income on the maintenance of a bank-owned property. This is again contradictory to the original predictions.

Overall, this set of regression results show a greater impact of the property being occupied on the exterior condition of the property, the exterior paint on the property and the grounds of the property, which are all the most easily maintained by a resident. This is an important finding since the direction of causality is shown to be that the property being occupied is influencing specific aspects of the property. This makes it less likely that the endogeniety problem that was originally considered in this discussion is an issue. That is, if reverse causality was an issue, we would expect that the area rating variable would be highly correlated with all aspects of the property. But while the area rating, which measures the general quality of the neighborhood, has a high magnitude and influence on the independent variable that shows the rating of the streets and sidewalks, it has a small magnitude and lower level of significance on the first floor independent variables. This is a result of the fact that the streets and sidewalks are maintained by the entire neighborhood and so less likely to be maintained by a bank that has no incentive to maintain the entire neighborhood.

It is important to once again consider the economic significance of these variables using their standardized coefficients. Because the dependent variables differ in each of the regressions in Table 6, it is even more important to use the standardized coefficients to determine the

differences in economic significance for the various independent variables. The standardized coefficients for this set of regression results show similar patterns to those in Table 5. The assessed value and the occupied variable are both economically significant in a majority of the regression results in Table 6 and have values with some of the largest magnitudes.

The rating for the area where the property is located is not economically significant in the first four regressions and only gains significance in the fifth regression, where the dependent variable is the rating for the sidewalks and streets. This follows the same pattern as the statistical significance of the area rating variable in these regressions. The assessed value has a standardized coefficient that is economically significant when the dependent variable is the exterior condition of the home or the windows and doors of the property, but it is not economically significant when the dependent variable is the rating of the streets and sidewalks. This, like the pattern of economic significance for the rating of the area where the properties are located, follows the same pattern as the statistical significance of the assessed value. Additionally, the number of foreclosures within an eighth of a mile has a standardized coefficient with a value that is approximately zero. This further supports the claim that although the value of the coefficient estimates for this variable are positive and statistically significant, they do not have the economic significance that would cause this to be a concerning result.

1.6 Conclusion

The analysis conducted through this study has revealed a number of significant variables in determining the change in the exterior condition of bank-owned properties from the time of foreclosure. The most important findings in this research include the significance of the coefficient estimates for the rating of the area where the property is located, for the property

appearing to be occupied on the day of the site evaluation and for the assessed value of the property. There is an important implication of the fact that a property being occupied has a positive, statistically significant impact on the maintenance of the property, in that banks should be encouraged to allow residents to stay in their homes post-foreclosure. This would help to keep the properties maintained at a higher level, which would then allow the banks to resell the properties at a higher value and would also assist the communities that are being negatively impacted by the vacant properties. The significant, positive relationship between the number of foreclosures within an eighth of a mile of the property and the property rating is less concerning because it is not economically significant.

Overall, this research shows that banks are not maintaining properties at varying levels in different neighborhoods based on the minority status and income of the residents in the community where the property is located. This is again contrary to the original expectations, but could be a positive sign as to the maintenance of properties. However, it is possible that the proxy used to account for the condition of the property at the time of foreclosure (the assessed value of the property) does not adequately portray this condition and that this research, therefore, does not directly account for the change in condition in the property's maintenance between the time of foreclosure and the site evaluation. It is also important to note that there were, unfortunately, very few observations in this research and that a better determination of the maintenance of bank-owned properties would require additional observations.

Map 1: Bank-Owned Properties

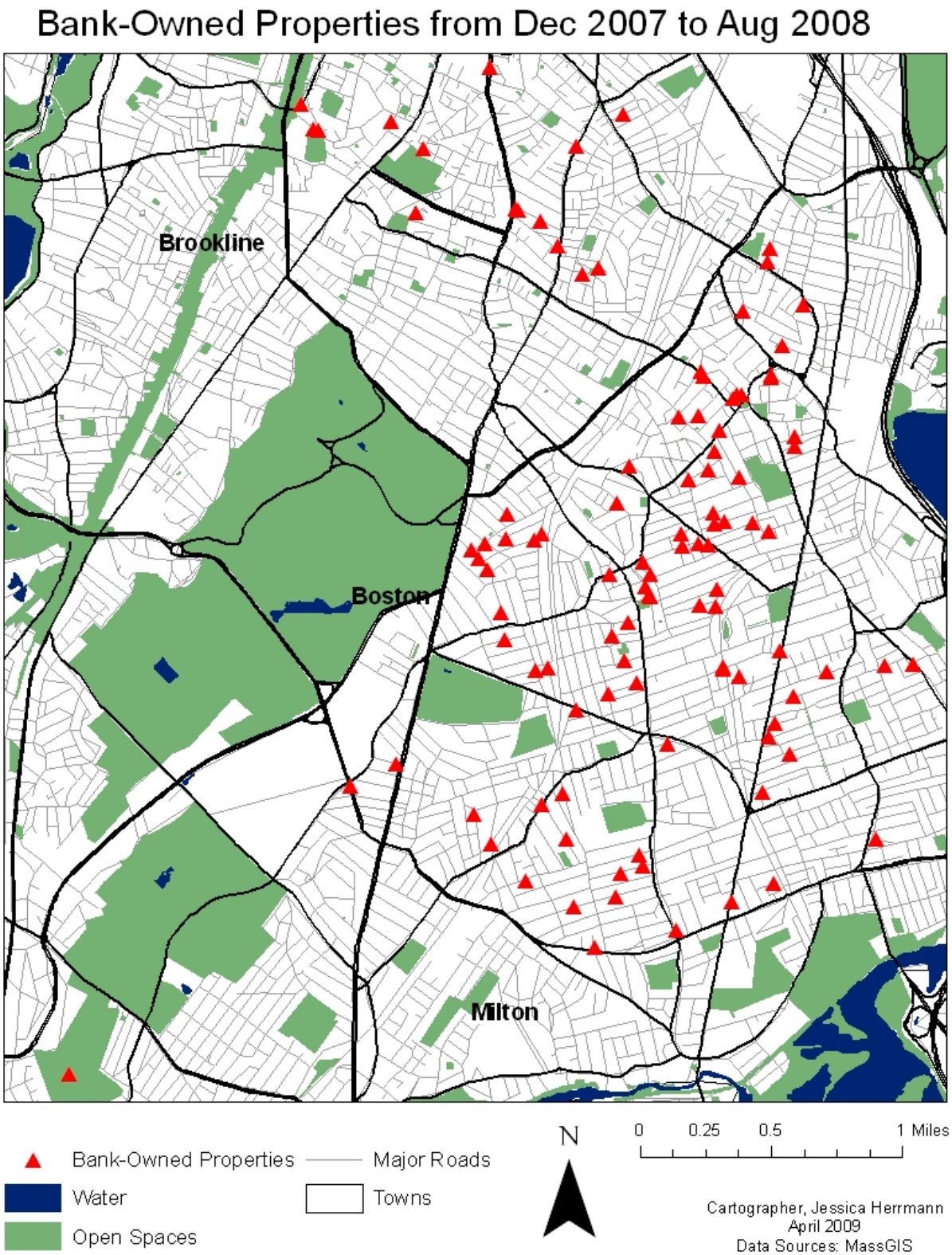

Table 1: Summary Statistics

Variable	Description	Obs	Mean	Std. Dev.	Min	Max
Number of Foreclosures within 1/8 Mile	=number of foreclosures within an eighth of a mile of the property	92	8.21	6.57	0	26
Percent African American	=percentage of the block group that is African American	89	4.64	5.13	0	26.98
Occupied	=1 if the property appeared to be occupied on the day of the site evaluation, 0 otherwise	92	0.37	0.49	0	1
Multifamily	=1 if the property is a two-family, three-family or 4-8 unit apartment, 0 otherwise	92	0.89	0.31	0	1
Single Family	=1 if the property is a single family, 0 otherwise	92	0.11	0.31	0	1
Percent White	=percentage of the block group that is white	89	76.52	11.64	30.21	97.56
Percent Other Race	=percentage of the block group that is a race other than African American or white	89	18.84	8.77	2.29	50
Time Between Foreclosure and Site Visit	=(number of days between site evaluation and foreclosure deed)/12	92	4.78	1.11	3.42	8.79
Low Income Neighborhood	=1 if the percentage of households that make an income under $25,000 in a Census Block Group is greater than 50, 0 otherwise	92	0.221	0.41	0	1
Square Footage	=square feet of living space/1,000	92	3.03	0.93	0	4.31
Assessed Value	=assessed value of the property/$100,000	92	4.28	0.99	0	6.48
Age of Property	=the age of the property in years	76	100.22	14.95	15	123

Table 2: Summary Statistics for Multifamily Properties Only

Variable	Observations	Mean	Std. Dev.	Min	Max
Number of Foreclosures within 1/8 Mile	82	8.82	6.55	0	26
Percent African American	82	4.49	5.37	0	26.98
Occupied	82	0.34	0.48	0	1
Percent Other Race	82	17.63	9.47	0	50
Time Between Foreclosure and Site Visit	82	4.78	1.08	3.58	8.56
Low Income Neighborhood	82	0.24	0.43	0	1
Square Footage	82	3.22	0.77	0	4.31
Assessed Value	82	4.44	0.83	0	6.48
Age of Property	82	83.13	40.40	0	123

Table 3: Rating Distribution

	Property Rating		Area Rating		Exterior Rating		Paint Rating	
Rating Value	Freq	Percent	Freq	Percent	Freq	Percent	Freq	Percent
1	0	0	3	3.26	1	1.19	1	1.27
2	4	4.35	1	1.09	3	3.57	6	7.59
2.5	1	1.09	1	1.09	1	1.19	0	0
3	13	14.13	7	7.61	12	14.29	27	34.18
3.5	5	5.43	9	9.78	9	10.71	1	1.27
4	48	52.17	56	60.87	42	50	37	46.84
4.5	1	1.09	4	4.35	2	2.38	0	0
5	18	19.57	10	10.87	11	13.1	4	5.06
6	2	2.17	1	1.09	3	3.57	3	3.8
TOTAL:	**92**		**92**		**84**		**79**	

Table 4: Rating Distribution

	Grounds Rating		Windows/Doors Rating		Sidewalks/Streets Rating	
Rating Value	Frequency	Percent	Frequency	Percent	Frequency	Percent
1	0	0	1	1.19	0	0
2	4	5.06	2	2.38	0	0
2.5	0	0	0	0	0	0
3	30	37.97	17	20.24	8	9.64
3.5	2	2.53	1	1.19	1	1.2
4	30	37.97	48	57.14	71	85.54
4.5	0	0	0	0	0	0
5	10	12.66	10	11.9	2	2.41
6	3	3.8	5	5.95	1	1.2
TOTAL:	**79**		**84**		**83**	

Table 5: Regression Results Using the Property Rating as the Dependent Variable

COEFFICIENT	Property Rating (1)	Property Rating (2)	Property Rating (3)	Property Rating (4)	Property Rating (5)
Area Rating	0.360***	0.343***		0.423***	
	(0.090)	(0.097)		(0.098)	
Foreclosures within 1/8 Mile	0.0220**	0.0182*	0.0194*	0.0189*	0.0208*
	(0.0097)	(0.010)	(0.010)	(0.011)	(0.011)
Percent African American	-0.0176	-0.0178	-0.0184	-0.0160	-0.0161
	(0.011)	(0.011)	(0.011)	(0.012)	(0.013)
Occupied	0.435***	0.464***	0.606***		
	(0.15)	(0.16)	(0.17)		
Percent Other Race	0.00555	0.00652	0.00906	0.00375	0.00599
	(0.0065)	(0.0065)	(0.0075)	(0.0064)	(0.0073)
Time between Foreclosure and Visit	0.0887	0.0956*	0.113*	0.0931*	0.115*
	(0.054)	(0.052)	(0.061)	(0.050)	(0.063)
Low-income Neighborhood	0.465**	0.218	0.0867	0.376	0.267
	(0.20)	(0.25)	(0.24)	(0.27)	(0.29)
Square Footage	-0.148	-0.141	-0.178	-0.113	-0.151
	(0.13)	(0.12)	(0.13)	(0.13)	(0.14)
No Square Footage Data	3.026***	2.918***	3.340***	2.907***	3.464***
	(0.89)	(0.79)	(0.76)	(0.83)	(0.80)
Assessed Value	0.400***	0.403***	0.532***	0.369***	0.526***
	(0.11)	(0.11)	(0.089)	(0.11)	(0.10)
Age of Property	0.0101	0.00914	0.00505	0.0119	0.00766
	(0.0099)	(0.0099)	(0.0100)	(0.010)	(0.011)
No Race Data	-0.830	-1.004*	-1.201**	-0.648	-0.764
	(0.69)	(0.60)	(0.54)	(0.65)	(0.59)
No Property Age Data	0.986	0.912	0.631	1.121	0.833
	(1.02)	(1.02)	(1.03)	(1.05)	(1.17)
Low-income*Number of Foreclosures		0.0345	0.0551**	0.0153	0.0347
		(0.029)	(0.028)	(0.031)	(0.033)
Constant	-0.337	-0.212	0.928	-0.548	0.827
	(1.17)	(1.18)	(1.16)	(1.22)	(1.32)
Observations	82	82	82	82	82
R-squared	0.5	0.5	0.42	0.44	0.31

Note: *, **, or ***: significant at .10, .05, or .01 level, respectively.

Table 6: Regression Results Using Ratings Other than the Property Rating for the Dependent Variables

COEFFICIENT	Exterior Condition (1)	Exterior Paint (2)	Grounds (3)	Windows and Doors (4)	Sidewalk and Street (5)
Area Rating	0.0923	0.0681	0.0862	0.0680	0.198***
	(0.12)	(0.15)	(0.15)	(0.097)	(0.059)
Foreclosures within 1/8 Mile	0.00427	0.0122	-0.00324	-0.00569	-0.00226
	(0.012)	(0.013)	(0.015)	(0.013)	(0.0064)
Percent African American	-0.0247	-0.0510**	-0.0189	-0.0504**	0.00609
	(0.015)	(0.020)	(0.020)	(0.024)	(0.0054)
Occupied	0.496***	0.404	0.421	0.157	0.0806
	(0.17)	(0.25)	(0.25)	(0.18)	(0.074)
Percent Other Race	0.0131	0.0158	0.00556	0.0250**	-0.00479
	(0.0079)	(0.014)	(0.013)	(0.010)	(0.0041)
Time between Foreclosure and Visit	0.130*	0.225	0.0141	0.0791	0.00649
	(0.067)	(0.21)	(0.15)	(0.12)	(0.031)
Low-income Neighborhood	-0.0505	-0.422	-0.0240	-0.127	-0.129
	(0.29)	(0.45)	(0.39)	(0.28)	(0.16)
Square Footage	-0.142	-0.00560	-0.155	-0.358***	-0.0817
	(0.16)	(0.19)	(0.13)	(0.13)	(0.071)
No Square Footage Data	2.907***	2.603**	2.689***	1.638**	-0.299
	(0.83)	(1.30)	(0.83)	(0.70)	(0.32)
Assessed Value	0.312**	0.139	0.196	0.398***	0.00672
	(0.14)	(0.16)	(0.14)	(0.10)	(0.075)
Age of Property	0.00416	0.0109	-0.00456	0.00252	-0.00208
	(0.012)	(0.013)	(0.012)	(0.010)	(0.0048)
No Race Data	-1.342***	-1.173	-1.011	-1.074***	-0.102
	(0.34)	(1.12)	(0.61)	(0.40)	(0.17)
No Property Age Data	0.947	1.494	-0.353	0.727	-0.422
	(1.26)	(1.35)	(1.29)	(1.07)	(0.51)
Low-income*Number of Foreclosures	0.0642**	0.0597	0.0558	0.0783**	0.0140
	(0.026)	(0.043)	(0.041)	(0.035)	(0.011)
Constant	1.514	1.062	3.126*	2.327*	3.658***
	(1.69)	(1.77)	(1.65)	(1.26)	(0.55)
Observations	74	70	69	74	73
R-squared	0.41	0.33	0.27	0.47	0.31

Note: *, **, or ***: significant at .10, .05, or .01 level, respectively.

Appendix Table 1: Correlation Matrix

	Property Rating	Area Rating	Number of Foreclosures	Black	Occupied	White	Other	Foreclosure to Visit	Low-Income	Sq.Ft.	Assessed Value
Area Rating	0.512										
Number of Foreclosures within 1/8 Mile	0.072	0.004									
Percent Black	-0.035	0.031	0.002								
Occupied	0.353	0.295	-0.142	0.001							
Percent White	-0.046	-0.037	0.017	-0.775	-0.013						
Percent Other	0.088	0.032	-0.025	0.437	0.018	-0.907					
Time Between Foreclosure and Site Visit	-0.024	-0.022	-0.085	0.235	-0.002	-0.067	-0.062				
Low-Income Neighborhood	0.116	-0.033	-0.067	0.064	-0.027	-0.065	0.050	-0.058			
Square Footage	-0.190	-0.131	0.305	0.158	-0.195	0.008	-0.116	0.080	0.060		
Assessed Value	0.040	0.049	0.286	0.107	-0.194	0.022	-0.102	0.021	-0.048	0.748	
Age of Property	-0.211	-0.293	0.104	0.091	-0.201	-0.113	0.100	-0.138	0.029	0.409	0.351

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Chapter 2: Using ArcGIS Software to Compare the Concentration of Foreclosures in Boston during the 1990s Foreclosure Crisis and the Current Foreclosure Crisis

2.1 Introduction

One of the major concerns regarding the current foreclosure crisis is the clustering of foreclosures in low-income and minority communities. A significant number of papers have investigated the vulnerability of neighborhoods during the current crisis and found a correlation between foreclosures and low-income and minority populations. However, the previous research has been independent of previous foreclosure crises. The research in this paper looks to compare the clustering of foreclosures in the current foreclosure crisis with that of the foreclosure crisis in the early 1990s in Boston, Massachusetts. This paper will provide a means to determine whether the current foreclosure crisis is actually more densely distributed in low-income and minority communities, whether both foreclosure crises occurred in predominately low-income and minority communities, or whether foreclosures are not clustered in these communities.

During the current foreclosure crisis, the majority of foreclosures have resulted from default on subprime loans. These loans have been predominately located in low-income and minorities communities, which could account for the high levels of clustering of foreclosures in these neighborhoods (Woodstock Institute, 2008). Because there has been substantial evidence that subprime mortgages were provided to these communities in significantly higher numbers and the number of foreclosures resulting from subprime mortgages is greater than foreclosures resulting from prime mortgages, it is a serious concern that minority and low income communities are being hit hardest by the current crisis, and that the current crisis is impacting these groups more than past crises. In addition, low-income communities are less likely to have the resources to protect themselves from the domino effect of multiple foreclosures and will

contain a greater proportion of individuals who are living closer to the edge, in terms of their ability to pay their mortgage payments (Woodstock Institute, 2008). These are the groups that are most likely to be susceptible to downturns in the economy and so it is important to understand if the current foreclosure is actually more heavily concentrated in these communities because they will likely require more financial resources to assist the neighborhoods.

This research uses a data set of all foreclosures in the greater Boston area (defined as Essex, Middlesex, Norfolk, Suffolk and Plymouth counties) from 1988 to January 2009. The foreclosure crisis of the early 1990s is defined by the years 1990 to 1995 and the current foreclosure crisis includes foreclosures from 2006 to January 2009. The foreclosures are then restricted to only residential properties. The analysis of these spatial questions is completed through the use of ArcGIS, a geographic information systems software. The paper also incorporates demographic information from the 1990 and 2000 Censuses, aggregated to the Census block group level. This includes the percentage of minority groups in the Census block groups and the median income of residents in these Census block groups.

The results of this research show a statistically and economically significant relationship between the percentage of African-American and Hispanic residents in a Census block group and the density of foreclosures for both methods of analysis and during both foreclosure crises. The economic significance of the coefficient estimates of the variables are consistently greater in the results using the mean density value (the average number of foreclosures within a quarter mile radius of all 100-square meter cells contained in the Census block group) than in the results using the percentage of housing units that were foreclosed as the dependent variable. This is true for both foreclosure crises. Finally, the evidence is inconclusive as to the impact of the median income in the Census block group on the concentration of foreclosures.

The remainder of this paper will continue as follows: Section 2.2 is a literature review of previous research on the topic, focusing on research conducted using ArcGIS; the following section provides information on the data being used for this analysis; Section 2.4 discusses the empirical strategy for the analysis; Section V reports the results of the spatial analysis; the final section will provide a brief conclusion.

2.2 Literature review:

Research on spatial analysis of the current foreclosure crisis has focused mainly on the clustering of foreclosures and determining which neighborhoods are facing the greatest distress as a result of the mortgage crisis. The research has generally focused on locating the foreclosures and then comparing the community characteristics of these neighborhoods. An example of this type of that research is of Grover and Lehnert (2008), who identify neighborhoods that are at the highest risk as a result of the current foreclosure crisis in Minnesota. They use data collected by the First American LoanPerformance from October 2007 on alt-A and subprime loans. Exploring the data at the zip code level throughout the state, the authors looked at the delinquency of loans, if loans were foreclosed, and if loans had resulted in the property being owned by the bank. Their analysis allows for a preliminary description of the geographic distribution of loans facing foreclosure, foreclosed loans and banked-owned loans. The authors' findings show that the inner-city has the highest rates of foreclosure and delinquency.

In addition, the Association of Community Organizations for Reform Now (2007) uses GIS to identify the geographic clustering of areas most likely to be impacted by the foreclosure crisis across the country. One of their projects focuses on Suffolk County and maps the Census

tracts with the greatest number of subprime loans, as provided by the Home Mortgage Disclosure Act (HMDA) data. They mapped where the high-risk, subprime loans were located and determined that these are the areas more likely to be impacted by the current crisis.

Jennings (2009) combines these tactics by developing a neighborhood distress score by Census tract in the greater Boston area. His distress variable is based on a variety of neighborhood characteristics, including the income of the residents, the crime rate in the area and the educational attainment of the residents. Jennings maps the distress variable for each Census tract and uses this as a background for other layers. He uses layers that show the density of minorities in the Census tracts (for African Americans, Latinos and Asians) as a means to determine the population of each group in the areas of distress. Jennings also geocodes neighborhood organizations, such as community development corporations and community centers, and schools and overlays these layers on the original neighborhood distress layer to visualize where they are located in association with the areas that need their assistance.

Finally, Sesay and O'Connor (2008) move beyond just the current foreclosures and explore the foreclosure trends in Denver. They map all foreclosure filings in the city between 1983 and September 2007 and find a concentration of foreclosures in the northeast and southwest sections of the city. They also map the standard deviation of foreclosure filings for these years and again they find a higher concentration of foreclosure filings in the northeast and southwest sectors of the city. In order to account for the density of residents in these areas, the authors then divide the number of foreclosure filings by the number of owner-occupied properties in each Census tract. Sesay and O'Connor also mapped the Census tracts by whether the tracts had an average number of foreclosures, above average number of foreclosures or below average number of foreclosures. Finally, the authors use these distinctions and look at the racial compositions of

the Census tracts with different levels of foreclosures and find that the Census tracts with extremely high levels of foreclosure also have populations that consist predominately of minorities. They use 2007 Claritas Estimates for the minority population in each Census tract.

The current research in the area stresses the need to determine the neighborhoods most likely to be impacted by the foreclosure crisis and where assistance may be necessary, but there has yet to be a published work that compares the current foreclosure crisis with the foreclosure crisis in the early 1990s in Boston. My research will fill this gap by exploring the differences in the clustering of foreclosures in the current and previous foreclosure crises in Boston and determining the income levels and minority distribution of these neighborhoods to determine if the current foreclosure crisis is more densely located in low-income, minority communities than the previous one.

2.3 Data Description

The data used in this analysis include a compilation of all foreclosures in the greater Boston area from 1988 until January 2009, which was provided by the Federal Reserve Bank of Boston as a part of The Warren Group database. It contains the 45,605 properties that were foreclosed during this period with a full address for each property. In addition, the dataset includes the assessed valued of the property, the year of the assessment, the date of the foreclosure, and the property type.

The properties were geocoded using the 2000 Census Tiger road lines dataset. Of the original 45,605 properties, 97 percent of the properties were matched to street addresses from the set of roads provided by the 2000 Census Tiger dataset. The remaining three percent included one percent which were completely unmatched. In this group of three percent that had not

matched, 266 properties had street numbers that had been listed in the Warren Group data as being "0". These properties were therefore impossible to match. Of the other properties that did not match, 118 properties were matched by hand. The newly matched properties were a result of a number of small errors in the original data set. These errors included a misspelling of the street name, the inclusion of numbers instead of letters in the street name, and the listing of incorrect zip codes. Once these mistakes were fixed, the properties were able to be accurately matched to their locations on the Tiger Census street data. This created a final data set of 44,257 foreclosed properties in the Boston area, which was defined as properties in Essex, Suffolk, Norfolk, Plymouth or Middlesex counties.

In addition to the foreclosure data, data from the 1990 and 2000 Censuses were used to determine the minority and income distributions within Census Block Groups in these counties. This dataset includes the median income of the population of the Census block group, the percentage of African Americans, Caucasians, and Hispanics living in the Census block groups, and the median home value.

Table 1 shows the summary statistics for the properties included in the GIS mapping that were classified as being a part of the foreclosure crisis in the early 1990s, defined as 1991 to 1995. There are 24,031 properties that were foreclosed in the greater Boston area during this period. First, it is notable that approximately 62 percent of the foreclosures in this period were residential properties. Of this 62 percent, over 60 percent were single family homes. In addition, the average assessed value, scaled using the Case-Shiller index, for all of the properties that foreclosed in the early 1990s is approximately $540,000; however, there is a distinct difference in the average values for the multiple and single family homes during this period. All of the single family properties that foreclosed in this foreclosure crisis in the greater Boston area had an

average assessed value of approximately $614,500, while the multiple family properties had a mean assessed value of approximately $655,000. It would be expected that the assessed values of the multiple family properties would be greater than those for the single family properties since they are typically larger. The disparity between the assessed values of single and multi-family homes is even greater when the median values, rather than the mean values, are observed. There is a difference of over $100,000 between the median value of the single-family property and the median value of the mutli-family properties that foreclosed in the 1990s foreclosure crisis. The final data set includes only these residential properties, but it is important to understand them in the context of all foreclosures during the period.

Table 2 shows the same summary statistics as Table 1, except they are for the properties that foreclosed in the greater Boston area during the current foreclosure crisis, defined as 2006 to January 2009. There are 12,088 foreclosures recorded during this time period for the data set. Of these properties, 82 percent are residential properties. And of the residential properties, approximately 61 percent are single family properties. The distribution of single and multi-family properties within the residential foreclosures is very similar to that in the previous foreclosure crisis; however in the current crisis a far greater number of the foreclosures were for residential properties than in the previous one. The assessed values for the current crisis are significantly lower than in the previous one, and this is true when observing both the mean and median values. For the properties foreclosed in the late 2000s, the average assessed value, scaled using the Case-Shiller index, was approximately $200,600. The mean assessed values for both the single and multi-family properties are larger than the overall value, they are approximately $201,000 and $235,000, respectively. This difference no longer holds true when considering the median values, which show the assessed values of the single-family properties to be below the

median value for all properties foreclosed during the current crisis. Once again, the final data set includes only those properties that were residential foreclosures.

Table 3 shows the distribution of foreclosures between 1988 and 2009. Here it can be seen that over fifty percent of the foreclosures that occurred in the greater Boston area between 1988 and 2009 were during the period between 1991 and 1995. In addition, it is clear that the greatest number of foreclosure in any year during this period was 2008, with 6,673 foreclosures, but that in 1992 the number of foreclosures was almost as high with 6,488 foreclosures during that year. It is also important to note that the foreclosures listed for 2009 are only for the month of January and that there were already over 250 foreclosures in the first month alone.

Tables 4 and 5 provide summary statistics for the Census block groups where the foreclosures are located. Looking first at Table 4, which shows the summary statistics for the 1990 Census block groups, it can be seen that the average percentage of African-American residents in the block groups was approximately 4.4, while the percentage of Hispanics in the block groups was 4.02. The total of the percentages of African-American, Caucasian and Hispanic residents does not add to one because there are other races that have not been accounted for in these three variables. Comparing these numbers to the percentage of various races in the Census block groups in 2000, shown in Table 5, there is a noticeable increase in the percentage of both Hispanic and African-American residents in this later period, as they increase to 7.07 and 5.79 percent, respectively.

In addition, the percent of the population that is low-income in the Census block groups decreases from approximately 33 percent to approximately 25 percent between the two Censuses. It is also important to note that both of the variables that determine the density of foreclosures, the mean density value from GIS and the percent of housing units that are

foreclosed, are both higher during the foreclosure crisis in the early 1990s than in the current foreclosure crisis. The mean density value was 40.19, which means that the average number of foreclosures within a quarter mile radius of all 100 square meter cells enclosed in the Census block group was 40.19 during the foreclosure crisis in the 1990s, but is only 21.41 in the current crisis. Additionally, the average percentage of housing units that were foreclosed in the 1990 Census block groups was 0.90 and this value decreased to 0.53 in the current foreclosure crisis. Part of this difference could be indicating that the magnitude of the current crisis, in terms of the absolute number of foreclosures, is not as great as the previous crisis, since the current crisis has not yet ended.

2.4 Empirical Strategy

As was previously stated, the original foreclosed properties were geocoded using the Census Tiger streets and those that did not match were rematched by hand. It is important to note that all of these properties were matched to the streetlines, but may not have positional accuracy. The Census Tiger streets are typically offset from their correct geographical locations by about 200 or 300 feet. However, because they are mapped as a means to determine their location within Census block groups and the block group data has the same positional inaccuracy, the properties will still be matched with the proper Census block groups, so this is not a concern. Selecting by attribute, all non-residential foreclosures were removed from the data set. This left only the properties defined as residential foreclosures (condominiums, single-family, two-family, three-family, four to eight family apartments and nine or more unit apartment buildings) for the analysis.

It is important to note that the Census block groups will be different for each of the time periods, as the boundaries for and number of Census block groups change for each Census. This means that any time the foreclosure crisis in the early 1990s is being analyzed, the Census block groups will be based off of the 1990 Census, and any time the current foreclosure crisis is being considered these Census block groups will be based on the 2000 Census.

This research will explore two separate methods to analyze the demographics of the Census block groups where the greatest number of foreclosures occurred. The first of these two methods is based on a count of the number of foreclosures that fall within the Census block group. Here, a spatial join was done between the Census block groups and the point data for the foreclosures during the given time period. Using the count of the number of foreclosures falling in the Census block groups, maps were generated that show the visual distribution of the number of foreclosures in each Census block group. This map was created for each of the foreclosure crises. The attribute table for this file will then be joined to the attribute tables for the desired Census demographics. Using the new attribute table, a comparison of the demographics of the Census block groups with the greatest number of foreclosures in each foreclosure crisis can be conducted. In order to understand the density of these foreclosures, the count of foreclosed properties in a given Census block group was then divided by the total number of housing units that exist in the Census block group.

The second method of analysis will involve a density map. Here a density file will be created for each of the foreclosure crises. In both density maps, a 100 square meter cell size will be used. In addition, the search radius for each cell will be 402 meters (approximately one quarter of a mile). This means that the raster file that is created will consist of cells that are 100 square meters each and that the density value for the number of foreclosures near any given cell

will be based off a radius of a quarter of a mile from the cell. Each of the cells will be given a density value based on the number of foreclosures in the surrounding area. After these two density files were created, the Zonal Statistics were used to determine the mean density value for each of the Census block groups. This means that it averages the density values for all of the cells in the Census block group. These Zonal Statistics are presented in a table and are then joined back to the Census block groups using a table join.

After the table join was completed for each of the foreclosure periods, new maps were created that show the average density value for each of the Census block groups during each of the foreclosure crises. A table join was then completed between the demographic information and the Census block groups in order to create a table with both the mean density values and the demographic information. This is the second basis of comparison of the demographics of the Census block groups during the crises.

In both of the analyses, the demographic information included in the table joins will be the 1990 and 2000 Census information on the percentage of African Americans, Caucasians, and Hispanics in the Census block groups and the median income of the households in the Census block groups. In addition, the median house values were included. For the 1990 Census these values are listed for all housing units, while for the 2000 Census they are only for occupied housing structures. The joined tables can be used to determine the demographic characteristics of the Census block groups that were most heavily impacted by each of the foreclosure crises. This will provide both an understanding of the differences between the current and previous foreclosure crises, in terms of the demographics of the areas most heavily impacted by the crisis, and a comparison between two methods of analysis using GIS: one that uses density mapping and the other that provides a count of the number of foreclosures in a specific area. This will be

especially important in this analysis because the influence of foreclosures is based on their proximity to other properties. This means that although the Census block group boundaries are concrete, the influence of the foreclosures within these areas is not. The density mapping will account for the impact that foreclosures will have across Census block group borders.

The differences between these two strategies can be best understood by looking at the maps for each strategy during the two foreclosure crises. Although many of the general trends are the same, the density for individual Census block groups greatly varies between the mapping of the two indicators. Maps using both strategies in both the greater Boston area and the city of Boston proper can be found under Maps 1-8. These provide both a large and small scale view of the distribution of foreclosures during each period and how they are displayed in each strategy. Comparisons 1 and 2 show two maps for the Boston area, each using a different analysis strategy. These provide a clearer understanding of the differences between the strategies. Comparison 1 shows the foreclosure crisis in the 1990s, using the percentage strategy on the left and the density values on the right. Some important differences to note are that the West Roxbury area shows a significantly greater density of foreclosures in the model using the percentage of housing units foreclosed than the map using the average number of foreclosures within a quarter of a mile. This shows a fundamental difference between the two strategies, since the map on the left counts the total number of foreclosures out of housing units in a Census block group, while the strategy on the right will count the number of foreclosures within a quarter mile radius of every 100 square meter cell and then average these values across the Census block group. As a result, larger Census block groups that could have a high percentage of foreclosures are not shown to have a high density in the map on the right.

This also works in the reverse, as can be seen in the Allston/Brighton area. Here there is a high concentration of foreclosures in the southeastern region, but the density is portrayed to be much greater in the map on the right because the Census block groups are small, so any foreclosure in the block group is more likely to be within a quarter mile of a 100 square meter cell in the Census block group. These differences cause a drastically different view of the 1990s foreclosure crisis in Boston.

The same differences can be seen in Comparison 2, which shows these two strategies for the current foreclosure crisis. The density map on the right shows a very high concentration of foreclosures in Dorchester, Roxbury and Mattapan. The strategy shown in the map on the left also shows a high concentration of foreclosures in these areas, but it is a less cohesive block of high concentration, with some Census block groups in these areas being shown with relatively low percentages of properties that were foreclosed. The map on the left also shows higher concentrations of foreclosures in Hyde Park and Roslindale than the density map on the right.

A linear regression model with robust standard errors was also used in this analysis as a means to examine the influence of the demographic characteristics of the Census block groups on the density of foreclosures. Equation 2.1 shows the basic form of the regressions.

$$\text{DensityIndicator} = ß_1 + ß_2\text{Race} + ß_3\text{Income} + ß_4\text{HouseValue} + € \qquad (2.1)$$

There are two density indicators, one for each of the analysis strategies, and each is used as the dependent variable during each time period. The race variables include both the percentage of Hispanics and the percentage of African-Americans in the Census block group. In addition, the income and house values are included as the logs of their real values. For the current foreclosure crisis, it was not possible to include overall housing values, but only those for occupied properties. Therefore, it is important to note that the results for the foreclosure crisis in the early

1990s have housing values for all properties, while the current crisis has housing values for only occupied properties. These should be fairly comparable and without them it would be impossible to account for differences in the property values across Census block groups. Following the general research on the topic, it is hypothesized that the race values will have positive signs while the income variable will have a negative sign. In addition, it is hypothesized that the house value will have a negative sign since income will be held constant and higher valued properties, when households have the same income, will be more susceptible to foreclosure.

2.5 Results

Comparing maps from the two foreclosure crises, which use the same analytical strategy, it is possible to gain a qualitative understanding of the change in the location of foreclosure clustering; however, this does not consider the shifting demographics of the Census block groups over time. In Comparison 3, both maps show the percentage of all housing units that were foreclosed upon. These percentages are mapped by the Census block groups appropriate to the years of the foreclosure crisis. This comparison shows a very distinct increase in the concentration of foreclosures in the Census block groups in Dorchester, Roxbury and Mattapan. The current foreclosure crisis has significantly fewer foreclosures in the northern regions of Boston, such as Allston/Brighton and Fenway/Kenmore.

Comparison 4 shows maps for each of the foreclosure crises using the strategy of displaying the average number of foreclosures within a quarter mile radius of a 100 square meter cell for all of the cells enclosed in the Census block group. Essentially, this provides a measure of density that accounts for the proximity of foreclosures both inside and outside of a given

Census block group. In a similar fashion to Comparison 3, Comparison 4 shows a very distinct movement of the center of the foreclosure crisis from the northern regions of Boston in the foreclosure crisis in the early 1990s to Roxbury, Mattapan and Dorchester in the current foreclosure crisis. It is important to remember that although this shows a shift in the geographical location of foreclosures, it does not provide any evidence of changes in the demographics of the Census block groups where the foreclosures are located. This requires a quantitative analysis.

To begin to understand the quantitative relationship between the two sets of foreclosures and the neighborhood characteristics of the Census block groups where they are located, it is important to first look at correlations. Table 6 provides correlations between the two foreclosure density indicators and the demographic characteristics of the Census block groups for each foreclosure crisis. The first important finding is that the signs for the correlations are the same in each foreclosure crisis. As anticipated, low-income neighborhoods have a positive correlation with foreclosure, higher incomes have a negative correlation with foreclosure, and higher percentage of minority populations (both African-Americans and Hispanics) have a positive correlation with foreclosure.

In addition, the differences in magnitude, both between the two indicators and the two crises are notable. Looking first at the difference between indicators of foreclosure, the mean density value has correlation values that are constantly larger than the values for the other indicator, the percent of housing units that were foreclosed upon in the Census block group. It is also important to note the difference in magnitudes of the same indicators across the two crises. The values for both indicators for the current foreclosure crisis are consistently greater in magnitude than their comparable values in the previous foreclosure crisis. This is the first piece

of plausible evidence that the current foreclosure crisis is more densely concentrated in low-income and minority communities than the Boston foreclosure crisis in the early 1990s.

Table 7 shows the regression results using the specification in Equation 1. The first two columns display the results for each of the density indicators during the early 1990s foreclosure crisis, while the third and fourth columns show the results using the same density values for the current foreclosure crisis. There are a few notable trends in all four regressions. First, the percent of African-Americans in the Census block group and the percent of Hispanics in the Census block group both have a positive, statistically significant relationship with the density of foreclosures during both time periods and with both density indicators. In both time periods, the density indicator for the mean density value (the average number of foreclosures within a quarter mile radius of all 100-square meter cells in the Census block group) has a value with a greater magnitude than the indicator for the percentage of housing units in the Census block group that were foreclosed during the foreclosure crisis. In order to determine whether the current foreclosure crisis is more densely concentrated in low-income communities, it is necessary to calculate the standardized coefficients for the two race variables during both time periods.

The standardized coefficients were calculated for each of the race variables. For both dependent variables, the coefficient estimates for the percent of African-Americans and the percent of Hispanic residents in the Census block group are economically significant. The percentage of African-Americans in the Census block group has a standardized coefficient that is consistently greater in magnitude than the standardized coefficients for the percentage of Hispanics in the Census block group, in both times periods and using both density values as the dependent variable.

The results for both foreclosure crises show that the standardized coefficients for the race variables are consistently greater in magnitude for the regressions where the dependent variable is the mean density value than when the dependent variable is the percentage of housing units that foreclosed. This is consistent with the pattern found in the differences in magnitude between the coefficient estimates of the same variable using the different density variables. When the mean density value is the dependent variable, the coefficient estimates on the independent variables always have coefficient estimates that are of a greater magnitude than when the percentage of housing units foreclosed is the dependent variable. In addition, the standardized coefficients are almost always larger for the same variables during the same foreclosure crisis when the dependent variable is the mean density value than when the dependent variable is the percentage of housing units that foreclosed.

The most significant finding from the standardized coefficients for the race variables is that the standardized coefficients are consistently higher in the current foreclosure crisis than in the previous foreclosure crisis, when comparing the results that use the same dependent variable. Looking at the percent of African-Americans in the Census block group when the dependent variable is the percentage of housing units that were foreclosed, the race variable has a standardized coefficient of 0.312 in the earlier foreclosure crisis and a value of 0.361 in the current foreclosure crisis. This is incredibly important because it addresses the original question of whether the current foreclosure crisis is more densely concentrated in minority communities. These results, which show a consistent pattern where the race variables have greater economic value in the current foreclosure crisis than in the previous one, are evidence that this is what is happening in Boston. Although the coefficient estimates for the race variables have lower values in the current crisis than in the foreclosure crisis in the early 1990s, the standardized coefficients

show that these race variables are more influential on the density of foreclosures today than they were in the early 1990s.

The log of the median house values has a coefficient estimate that is negative in both foreclosure crises when the dependent variable is the percent of housing units that were foreclosed, but is positive when the dependent variable is the mean density value. The standardized coefficients do not show these variables to be economically significant. The house value has standardized coefficients that range from -0.109 to 0.116, but given the magnitudes of the standardized coefficients of other variables in the regression, this does not show economic significance.

The variable with the greatest variation in its impact on foreclosures is the income variable. Using the first dependent variable, the coefficient estimates for this variable are positive and statistically significant in both time periods; however, when the second density indicator is the dependent variable, the coefficient estimate becomes negative in the early 1990s foreclosure crisis and loses its significance in the current foreclosure crisis. This makes it difficult to make any solid conclusion as to the impact of income on the density of foreclosures. It is possible that this shows that in the foreclosure crisis in the early 1990s the income of the residents had a greater impact on the density of foreclosures than it does in the current foreclosure crisis.

However, when the standardized coefficients are calculated for the income variable, the values are not economically significant. The standardized coefficients range in value from -0.126 to 0.153. As a result, it is not clear that the income of the residents in the Census block group has had an economically significant impact on the density of housing foreclosures in the greater Boston area in either of the foreclosure crises. This would be contrary to the literature in

the field, which has emphasized the high concentration of foreclosures in low-income communities in the current foreclosure crisis.

Overall, the regression results show a very distinct difference in the results of each of the methods and the differences between time periods. The mean density value showed significantly higher, more economically significant impacts of both race variables on the concentration of foreclosures in Census block groups during both foreclosure crises than the other density indicator. In addition, the results have shown that there has been a greater concentration of foreclosures in Census block groups that have greater minority populations, but it shows the income of residents in the Census block to not be economically significant. However, this research shows that the income variable is statistically significant in impacting the clustering of foreclosures during both foreclosure crises.

2.6 Conclusion

In conclusion, this research was able to provide conclusive evidence for the impact of a number of neighborhood variables on the concentration of foreclosures in Census block groups during both foreclosure crises in Boston. Using both analytical strategies, the results showed that a higher percentage of African-American or Hispanic residents in a Census block group resulted in a greater concentration of foreclosures in the Census block group during both foreclosure crises. In addition, this evidence showed a greater impact of minority residents on the concentration of foreclosures in the current foreclosure crisis than in the previous crisis. This supports the common understanding of the current foreclosure crisis, but the analysis is a new addition to the economic research in the field since it includes a comparison between the two foreclosure crises. It is important to note that findings related to the income levels in Census

block groups were inconclusive based on the extreme variation in these variables across time periods and analysis methods.

The research also shows that the spatial analysis that uses the mean density value, the average number of foreclosures within a quarter mile of all 100-meter cells within a Census block group, provides results with greater economic significance than the results using the percentage of housing units that were foreclosed as the dependent variable. This is consistent for all variables during both foreclosure crises.

Table 1: Summary Statistics for Foreclosures in the Foreclosure Crisis of the 1990s

Variable	Description	Observations	Median	Mean	Std. Dev.	Min	Max
Multifamily	=1 if the property is a multi-family home, 0 otherwise	24,031	N/A	0.2446	0.4299	0	1
Single family	=1 if the property is a single family home, 0 otherwise	24,031	N/A	0.379	0.4853	0	1
Assessed Value all Properties	=the assessed value of the property/Case-Shiller index	23,440	469,909.2	537,958.8	365,936.3	7,320.64	1.40E+07
Assessed Value for Single Family	=assessed value for only single family homes	9,050	511,273.8	611,4463	415,785.5	71,066.8	1.04E+07
Assessed Value for Multi-Family	=assessed value for only multi-family homes	5,699	635,644.2	654,635.2	268,091.9	11,079.46	1.40E+07

Table 2: Summary Statistics for Foreclosures in the Current Foreclosure Crisis

Variable	Description	Observations	Median	Mean	Std. Dev.	Min	Max
Multifamily	=1 if the property is a multi-family home, 0 otherwise	12,088	N/A	0.32	0.46	0	1
Single family	=1 if the property is a single family home, 0 otherwise	12,088	N/A	0.50	0.50	0	1
Assessed Value all Properties	=the assessed value of the property/Case-Shiller index	11,794	187,005.5	200,628.10	85,631.96	2,971.06	2,117,179
Assessed Value for Single Family	=assessed value for only single family homes	5,948	184,486.7	201,146.20	95,261.15	40,703.55	2,117,179
Assessed Value for Multi- Family	=assessed value for only multi-family homes	3,733	233,376.9	235,016.70	53,659.73	44,565.93	619,585.3

Table 3: Tabulation of the Year of Foreclosure

Year	Frequency	Percent	Cumulative
1988	93	0.2	0.2
1989	334	0.73	0.94
1990	1,201	2.63	3.57
1991	3,855	8.45	12.02
1992	6,488	14.23	26.25
1993	5,632	12.35	38.6
1994	4,714	10.34	48.94
1995	2,947	6.46	55.4
1996	2,462	5.4	60.8
1997	1,948	4.27	65.07
1998	1,138	2.5	67.56
1999	746	1.64	69.2
2000	435	0.95	70.15
2001	302	0.66	70.81
2002	220	0.48	71.3
2003	55	0.12	71.42
2004	86	0.19	71.61
2005	365	0.8	72.41
2006	1,425	3.12	75.53
2007	4,202	9.21	84.75
2008	6,673	14.63	99.38
2009	284	0.62	100
Total	45,605	100	

Table 4: Summary Statistics for 1990 Census Block Groups

Variable	Description	Obs	Mean	Std. Dev.	Min	Max
Mean Density	=mean density value for the Census block group	6,361	40.19	114.10	0	1,540.81
Percent Foreclosed	=number of foreclosures in Census block group/number of housing units in Census block group	6,256	0.90	1.78	0	25
Percent Black	=population African American/total population *100	6,361	4.43	13.69	0	100
Percent White	=population white/total population *100	6,361	88.96	20.72	0	100
Percent Hispanic	=population Hispanic/total population *100	6,361	4.02	10.37	0	101
Median Income	=lmedian household income for Census block group)	6,361	38,584.52	17,064.04	0	150,001
Ln(Income)	=ln(Median Income)	6,254	10.49	0.45	8.52	11.92
Percent Low-Income	=(number of households with incomes less than or equal to $25,000)/total number of households*100	6,254	32.87	17.93	0	100
House Value	=ln(median house value for all properties in the Census block group)	5,947	11.98	0.36	9.62	13.12

Table 5: Summary Statistics for 2000 Census Block Groups

Variable	Description	Obs	Mean	Std. Dev.	Min	Max
Mean Density	=mean density value for the Census block group	5,047	21.41	54.46	0	514.2
Percent Foreclosed	=number of foreclosures in Census block group/number of housing units in Census block group	5,035	0.53	0.98	0	8.67
Percent Black	=population African American/total population *100	5,038	5.79	13.69	0	102.48
Percent White	=population white/total population *100	5,038	83.75	21.59	0	125.76
Percent Hispanic	=population Hispanic/total population *100	5,038	7.07	13.51	0	110.22
Median Income	= median household income for Census block group	5,047	53,623.57	24,626.71	0	200,001
ln(income)	=ln(Median Income)	5,032	10.79	0.47	7.82	12.21
Percent Low-Income	=(number of households with incomes less than or equal to $25,000)/total number of households*100	5,032	24.81	16.19	0	100
House Value only Occupied	=ln(median house value for all occupied properties)	4,985	12.11	0.48	9.21	13.82

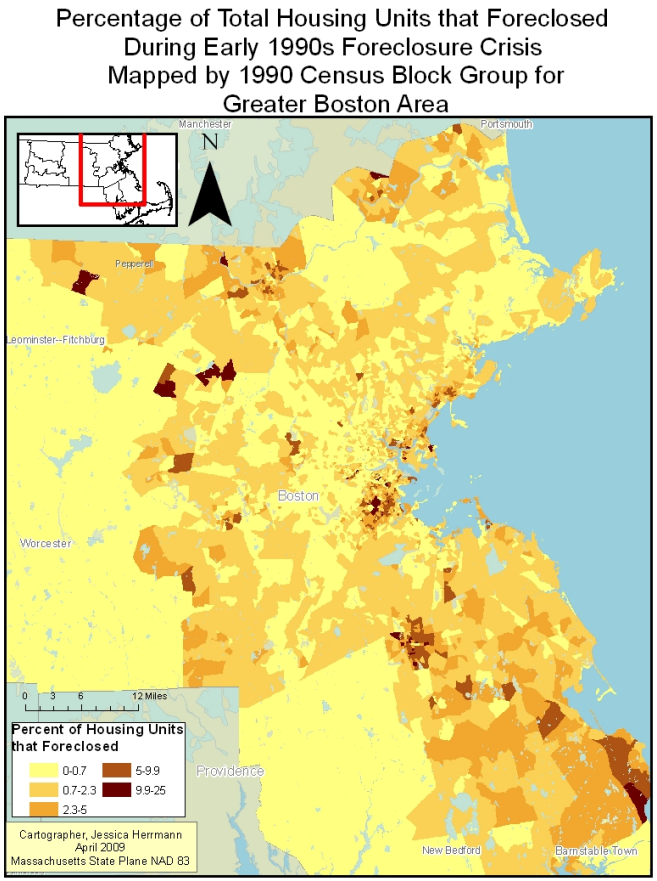
Table 6: Correlation between Foreclosure Density Variables and Neighborhood Characteristics for Both Methods of Analysis and Both Time Periods

Time Period:	Early 1990s Foreclosure Crisis		Current Foreclosure Crisis	
Foreclosure Density Variable:	Percent of Housing Units Foreclosed	Mean Density Value	Percent of Housing Units Foreclosed	Mean Density Value
ln(Income)	-0.0337	-0.1904	-0.1346	-0.2533
Percent Hispanic	0.1207	0.2039	0.2484	0.3976
Percent White	-0.3013	-0.3845	-0.4334	-0.5806
Percent Black	0.2988	0.3447	0.3751	0.4844
House Value	-0.0365	-0.0289	N/A	N/A
House Value Only Occupied	N/A	N/A	-0.1238	-0.0306

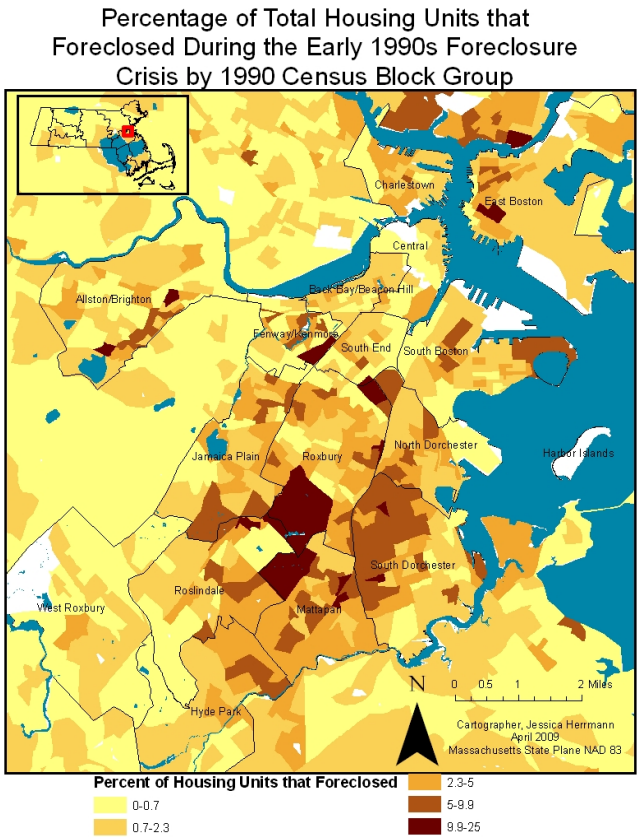
Table 7: Regression Results

	1990s Foreclosure Crisis		Current Foreclosure Crisis	
VARIABLES	Percent of Housing Units Foreclosed	Mean Density Value	Percent of Housing Units Foreclosed	Mean Density Value
Percent Black	0.0429***	2.622***	0.0260***	1.686***
	(0.00294)	(0.169)	(0.00180)	(0.109)
Percent Hispanic	0.0162***	1.352***	0.0150***	1.194***
	(0.00373)	(0.266)	(0.00181)	(0.124)
ln(Income)	0.390***	-29.66***	0.326***	1.943
	(0.0689)	(5.115)	(0.0367)	(1.590)
House Value	-0.153**	31.29***		
	(0.0756)	(6.404)		
House Value only Occupied			-0.224***	5.204***
			-0.0341	(1.355)
Constant	-1.610**	-42.45	-0.526*	-80.67***
	(0.718)	(45.41)	(0.307)	(18.34)
Observations	5947	5947	4985	4972
R-squared	0.108	0.183	0.183	0.320

Map 1: Percentage of Total Housing Units that Foreclosed During Early 1990s in Greater Boston

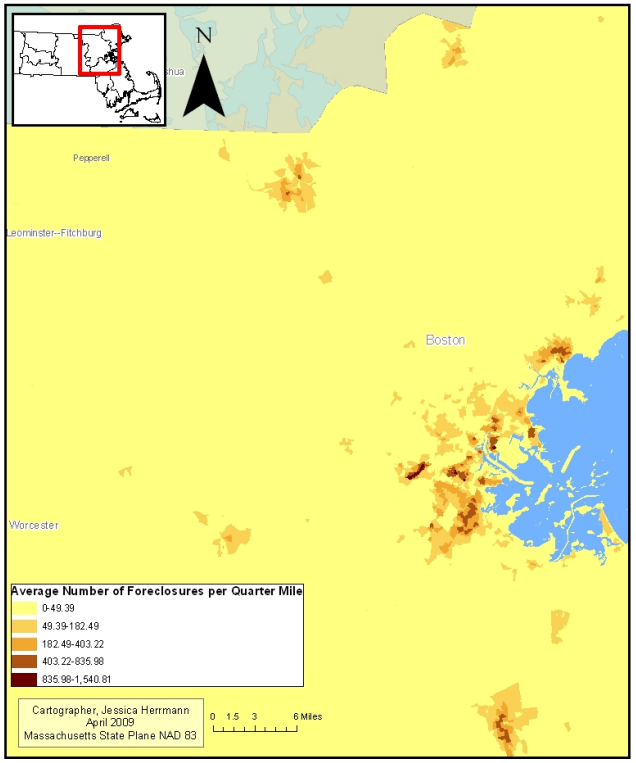


Map 2: Percentage of Total Housing Units that Foreclosed During Early 1990s in Boston



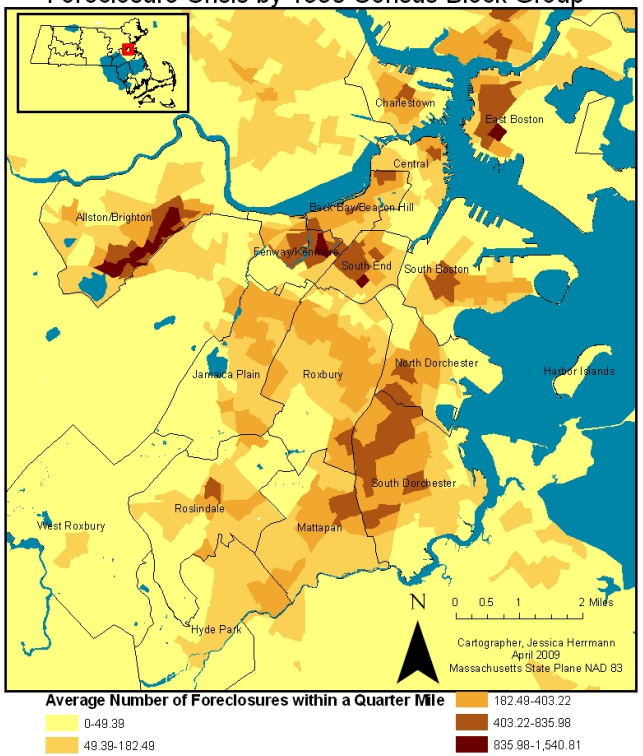
Map 3: Average Number of Foreclosures within a Quarter Mile of a 100-meter Cell for Early 1990s Crisis for the Greater Boston Area

Average Number of Foreclosures within a Quarter Mile Radius of Greater Boston for the Current Foreclosure Crisis by 2000 Census Block Group

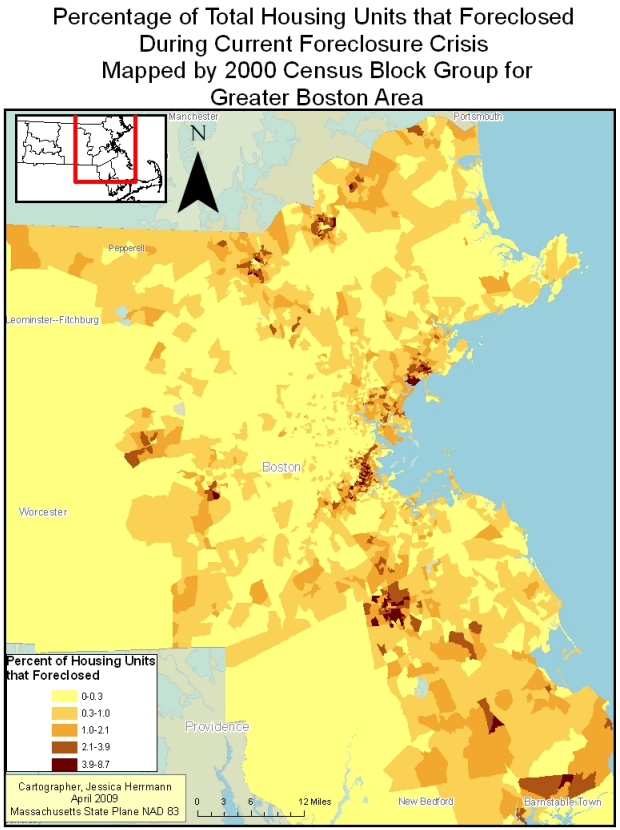


Map 4: Average Number of Foreclosures within a Quarter Mile of a 100-meter Cell for Early 1990s Crisis for Boston

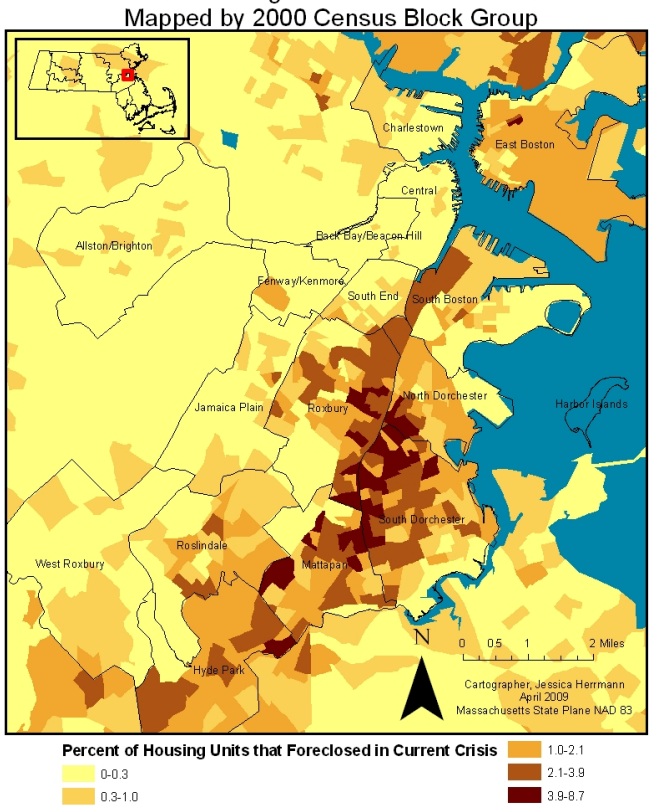
Average Number of Foreclosures within a Quarter Mile Radius in Boston for the Early 1990s Foreclosure Crisis by 1990 Census Block Group



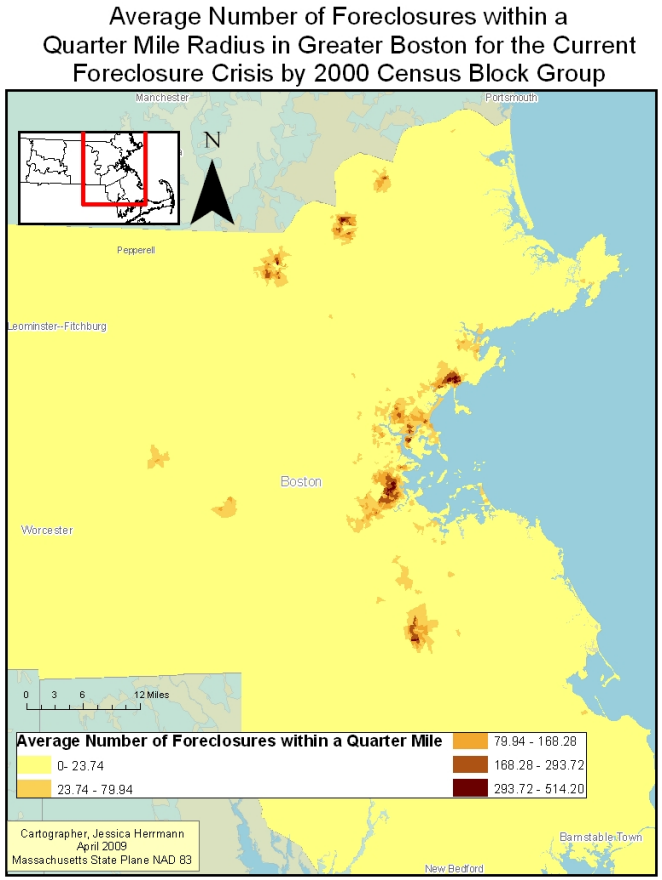
Map 5: Percentage of Total Housing Units that Foreclosed During Current Crisis in Greater Boston



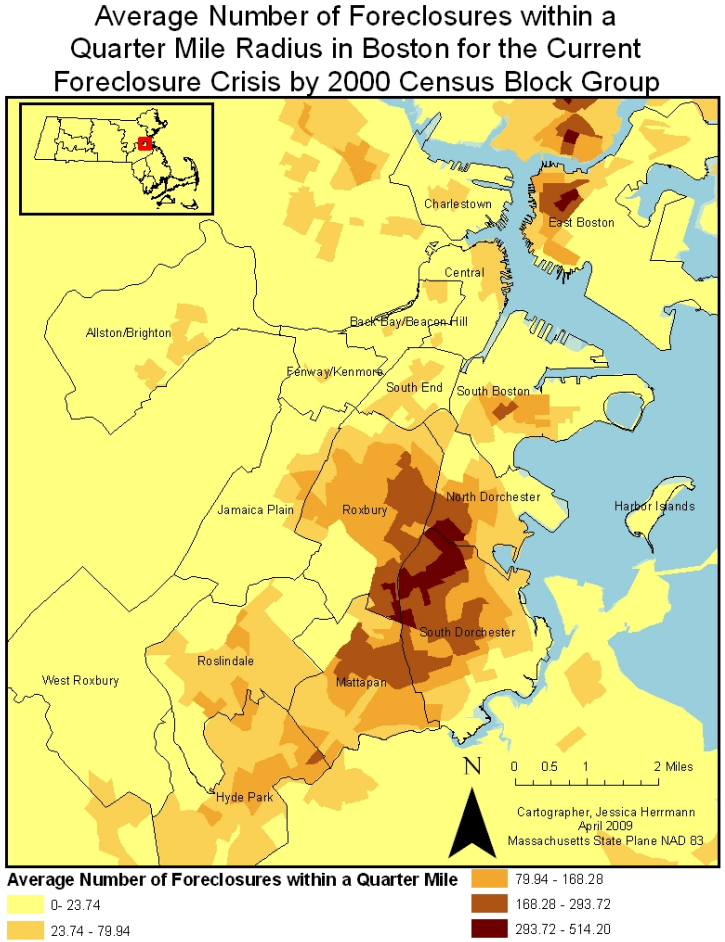
Map 6: Percentage of Total Housing Units that Foreclosed During Current Crisis in Boston



Map 7: Average Number of Foreclosures within a Quarter Mile of a 100-meter Cell for Current Crisis for the Greater Boston Area

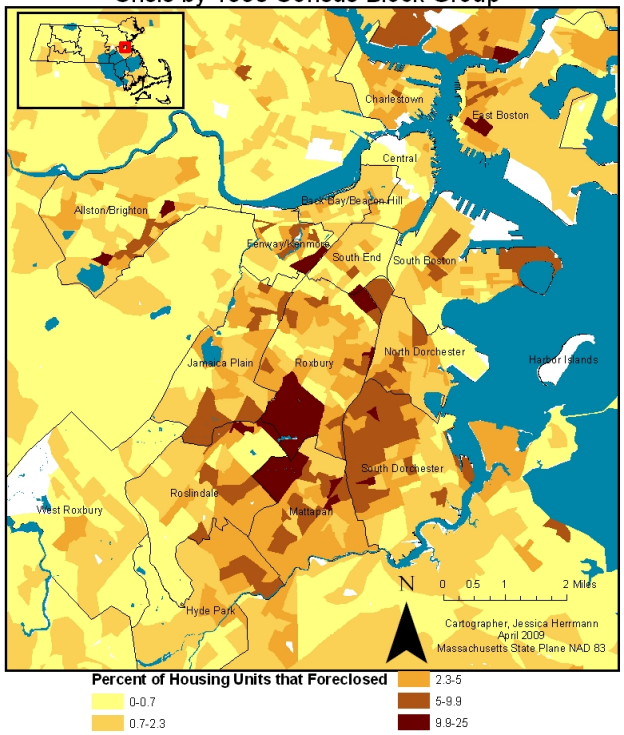


Map 8: Average Number of Foreclosures within a Quarter Mile of a 100-meter Cell for Current Crisis for Boston

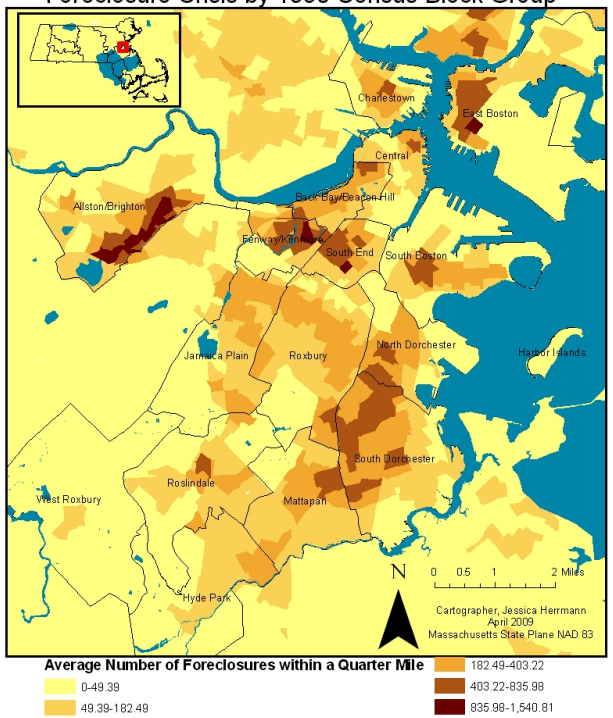


Comparison 1: Comparing Strategies for the Early 1990s Crisis

Percentage of Total Housing Units that Foreclosed During the Early 1990s Foreclosure Crisis by 1990 Census Block Group

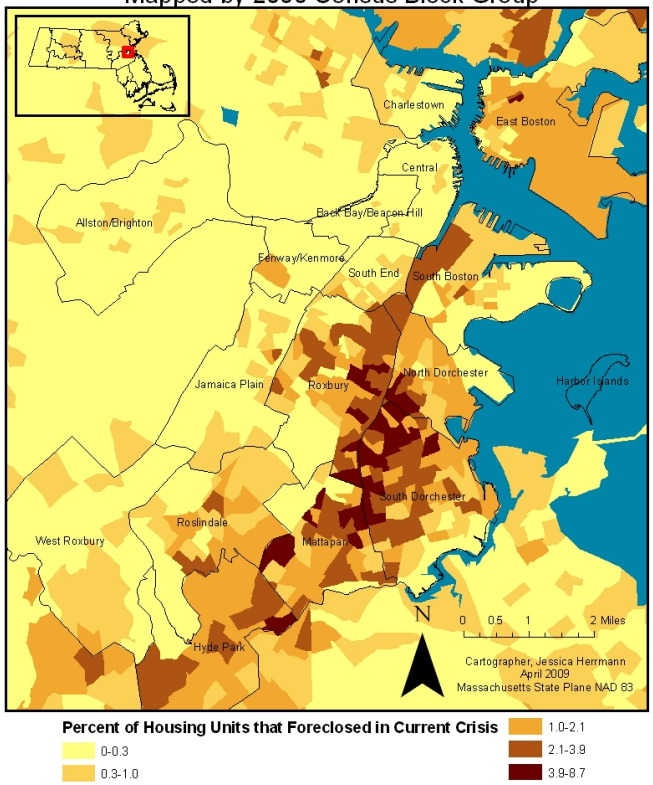


Average Number of Foreclosures within a Quarter Mile Radius in Boston for the Early 1990s Foreclosure Crisis by 1990 Census Block Group

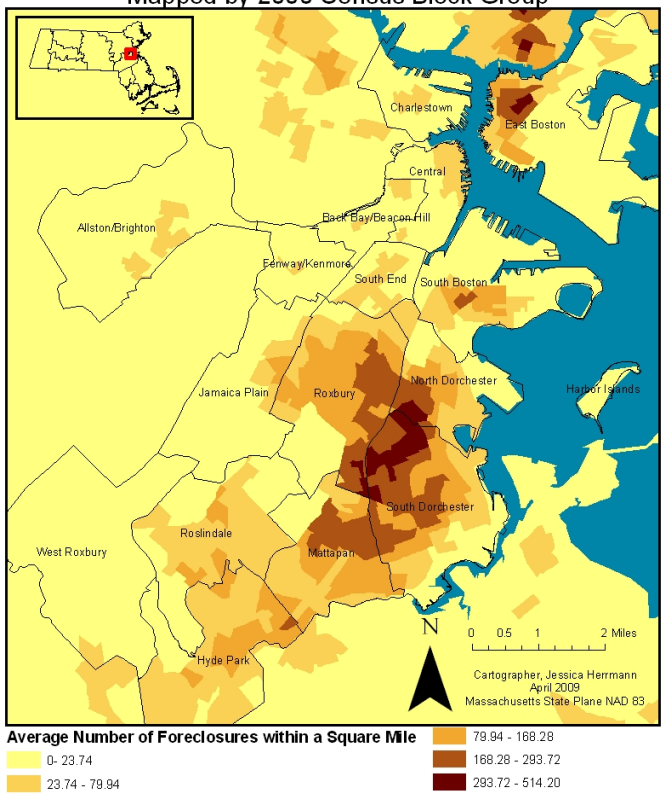


Comparison 2: Comparing Strategies for the Current Crisis

Percentage of Total Housing Units that Foreclosed During Current Foreclosure Crisis Mapped by 2000 Census Block Group

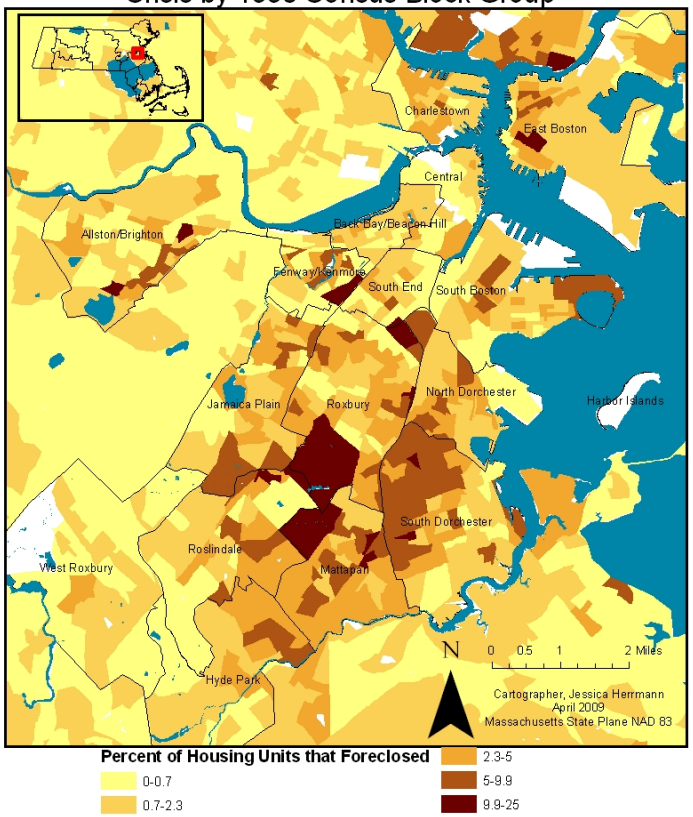


Average Number of Foreclosures within One Square Mile of a 100-Meter Cell during Current Foreclosure Crisis Mapped by 2000 Census Block Group

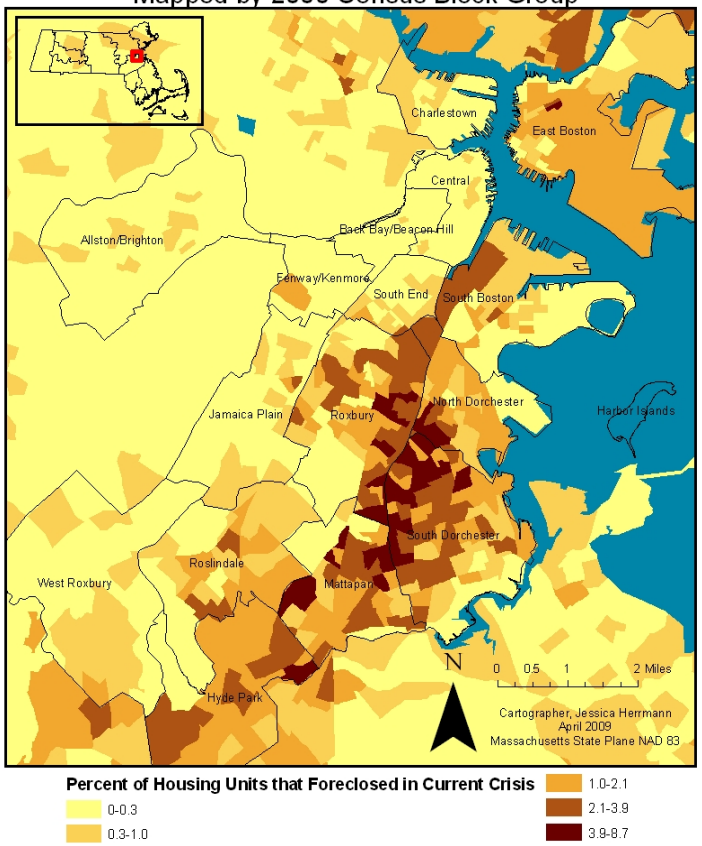


Comparison 3: Comparing the Crises Using the Percentage Strategy

Percentage of Total Housing Units that Foreclosed During the Early 1990s Foreclosure Crisis by 1990 Census Block Group

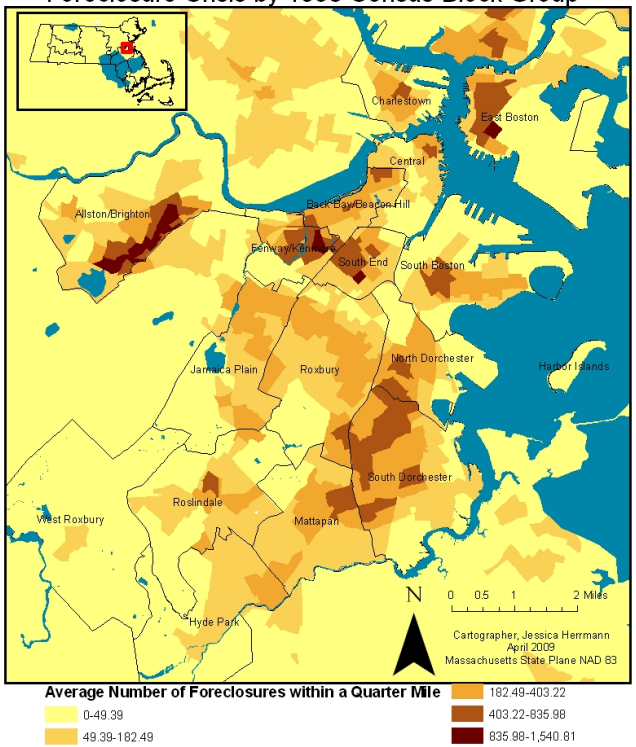


Percentage of Total Housing Units that Foreclosed During Current Foreclosure Crisis Mapped by 2000 Census Block Group

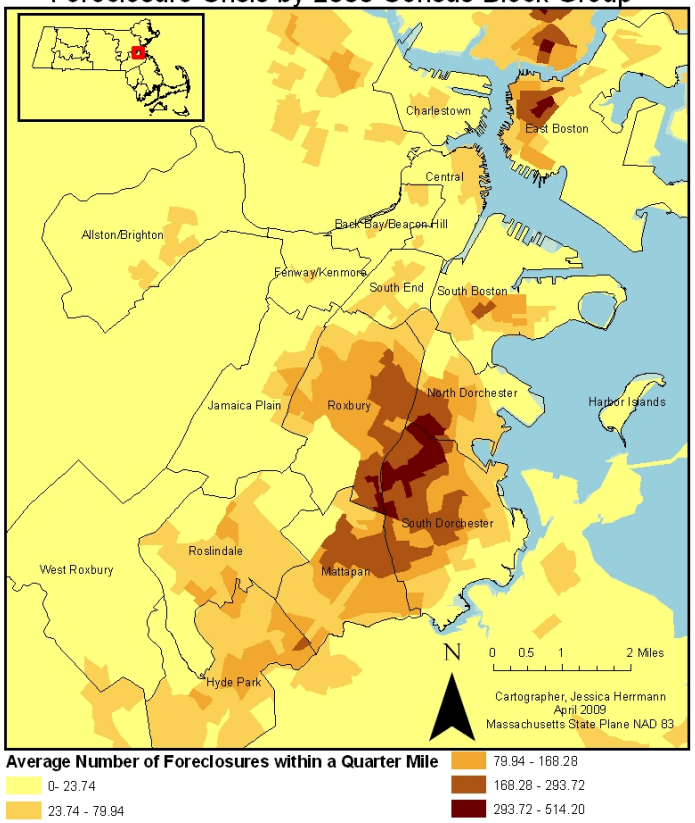


Comparison 4: Comparing the Crises Using the Average Number of Foreclosures per Quarter Mile

Average Number of Foreclosures within a Quarter Mile Radius in Boston for the Early 1990s Foreclosure Crisis by 1990 Census Block Group



Average Number of Foreclosures within a Quarter Mile Radius in Boston for the Current Foreclosure Crisis by 2000 Census Block Group



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