THE EFFECT OF RESIDENTIAL MORTGAGE FORECLOSURE ON RESIDENTIAL INCOME SEGREGATION

By

YOUNG SUN KWON

A DISSERTATION PRESENTED TO THE GRADUATE SCHOOL
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To the memory of my late Father

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Young Sun Kwon

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This study examines the effect of foreclosures on residential income segregation and identifies appropriate policies which can contribute to less segregated communities in the context of the recent subprime mortgage foreclosure crisis. It is based on the theoretical framework that foreclosures play a role in structuring geographical distribution of residents, specifically by income, because low- and median-income households, who are primary targets of high-risk subprime lending, are the most vulnerable groups for these foreclosures. Using the threshold effect theory, this study hypothesizes that foreclosures, especially when they are concentrated in economically distressed neighborhoods, can exacerbate income segregation, and at a certain point, the foreclosure effect will grow rapidly when more homes are entering foreclosure in a neighborhood.

To determine what impact the foreclosure effect will have and how it varies due to different neighborhood characteristics, an empirical analysis is applied, targeted at the Miami Metropolitan Area. This area was chosen due to the significant number of foreclosures that occurred during the recent recession. The results of the analysis show

that the concentrated foreclosures have an effect on income segregation; the more the foreclosure activities are generated, the deeper the income segregation is. However, though this study assumes that higher-income neighborhoods might be able to manage the foreclosure problem without significant changes during the early stages, the spline regression, conducted by neighborhood type, reveals a different pattern. In fact, the spatial isolation of low-income households triggered by foreclosures is more rapid and distinct in the Economically Strong neighborhoods; out-migration of high-income households is more likely to occur. In addition, the foreclosure effect is also significant in the Moderate and Economically Distressed neighborhoods, though the initial pace of segregation is slower than in the Economically Strong neighborhoods. The results imply that programs that mitigate the foreclosure effect should be applied as soon as possible in all three types of neighborhoods, though different policy approaches are needed for different neighborhood types. The Economically Strong neighborhoods will need programs to impede outflows of higher-income households, and the Moderate and Economically Distressed neighborhoods should focus on preventing further delinquency and foreclosures and potential property abandonment.

CHAPTER 1
INTRODUCTION

Background and Justification

Residential mortgage foreclosure continues to be significant issue in a number of U.S. cities. Between 1986 and 2010 the rate of mortgage foreclosures in the U.S. increased from 0.26% to 1.27% with a significant increase since 2006 (Department of Housing and Urban Development, 2011). According to the U.S. Foreclosure Market Report, about 2.3 million U.S. properties faced foreclosure proceedings in 2008, a 225 percent increase in total properties foreclosed since 2006 (RealtyTrac, 2009). Florida represents one of the most serious cases, experiencing the second highest number of foreclosures in the U.S. (Neighborhood Stabilization Program, 2009)[1].

Given the strong relationship between the recent foreclosure crisis and subprime lending (Engel and McCoy, 2011),[2] the foreclosed homes tend to be concentrated in lower income communities (Immergluck & Smith, 2006a, 2006b; Simkovic, 2013). Concentrated foreclosures, especially when they are in economically distressed neighborhoods, not only harm those who lose their homes through foreclosure, but also have negative impacts on nearby property owners, who see their homes depreciating (Schuetz, Been & Ellen, 2008). In turn, mortgage foreclosures can exacerbate the segregation of low-income households through the process of out-migration of higher income residents, potential housing abandonment, and/or in-migration of lower-income households (Li & Morrow-Jones, 2010). In this regard, two research questions will be

[1] Approximate number of foreclosure starts for all of 2007 and the first six months of 2008 was 58,188 (Neighborhood Stabilization Program, 2009).

[2] Subprime lending consists of loans to those with low-income, few- or no-assets, and/or troubled credit histories, and requires little or no down-payment.

addressed in this dissertation: (1) do foreclosures drive further income segregation in these communities, and (2) how does the effect vary based on initial economic characteristics of these neighborhoods? This study empirically tests whether the negative effect of foreclosures is heightened in lower income neighborhoods where foreclosures are severely concentrated and where housing demand is low.

Research Design

This study applies an empirical analysis targeted at selected areas that have been heavily hit by the residential mortgage foreclosure crisis in Miami Metropolitan Area in order to determine (1) the effect of mortgage foreclosures on income segregation in theses neighborhoods, and (2) different aspects of these effects based on neighborhood characteristics. Because the Miami Metropolitan Area has the highest level of foreclosures in Florida, both in terms of the rate and the total number (Neighborhood Stabilization Program, 2009), it offers a particularly rich test case.

Specifically, this study follows four phases as illustrated in Figure 1-1. First, the literature on neighborhood change in terms of residential income segregation, the foreclosure effect, and neighborhood change theory—both the concept and methodology—will be reviewed, and the theoretical framework of this study will be established. Based on this framework, during the second phase, the relationship between residential mortgage foreclosures and income segregation in neighborhoods will be examined using spline regression analysis. Spline regression, a non-linear regression model, is used to measure the threshold effects of foreclosures on income segregation. In this study, the threshold effect is defined as a dynamic process in which the magnitude of the foreclosure effect varies significantly as the mass of foreclosures exceeds some critical value (Quercia & Galster, 1997). After investigating the overall

foreclosure effect in neighborhoods in the Miami Metropolitan Area, the neighborhoods in the study area will be classified according to their economic characteristics, which are directly associated with foreclosures, based on data at the Census Tract level (2000-2011), from the American Community Survey, the U.S. Department of Commerce, and the U.S. Department of Housing and Urban Development's (HUD) Neighborhood Stabilization Program (NSP); each neighborhood will be assigned to specific neighborhood types. Then, based on the neighborhood types, the foreclosure effect on income segregation will be estimated again using spline regression analysis to identify the different threshold effects of foreclosures among these neighborhood types.

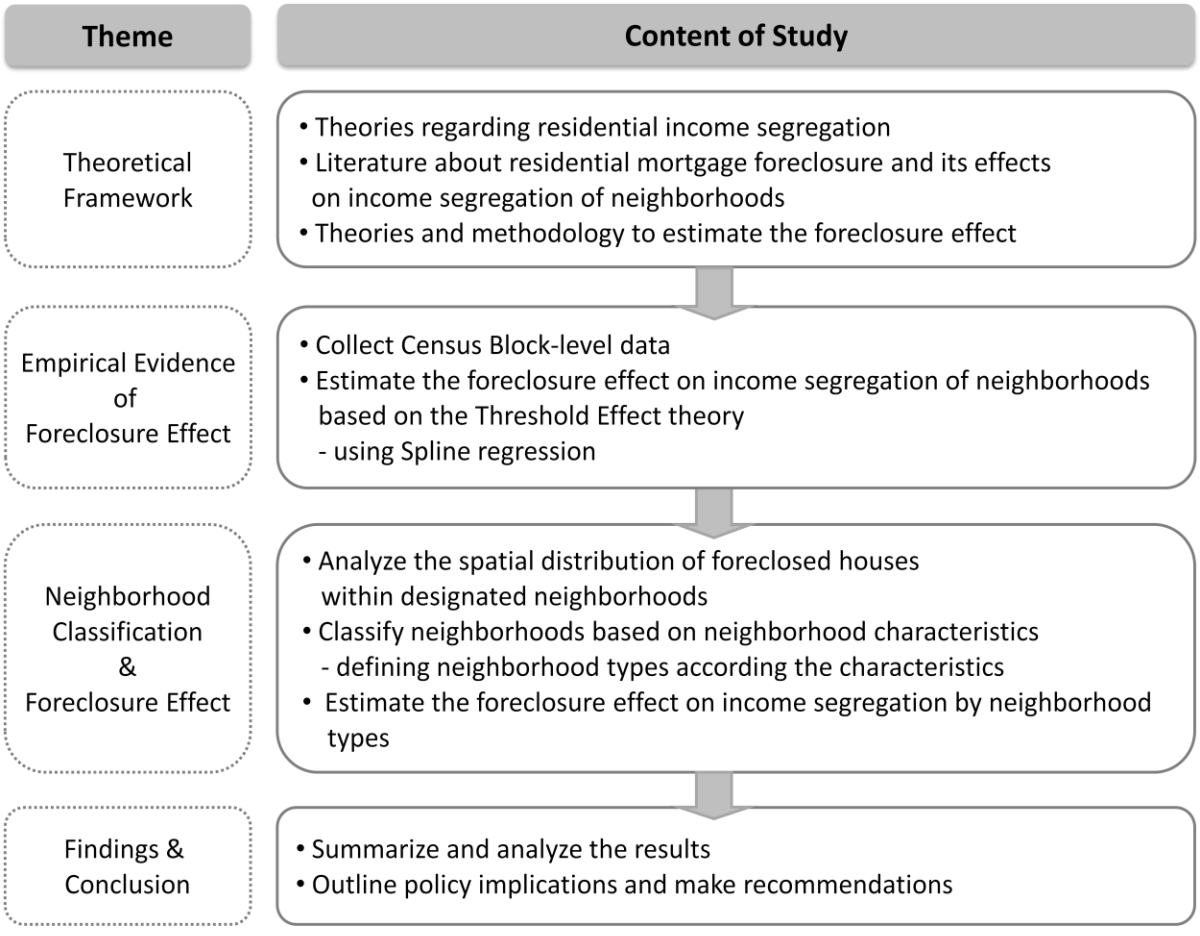


Figure 1-1. Content of study.

This study offers empirical evidence that informs planning initiatives regarding the impact of foreclosures in terms of neighborhood composition based on income. Specifically, neighborhood classification allows the introduction of a geographical feature of foreclosures at the neighborhood level, and provides information about economic characteristics in neighborhoods with high frequencies of foreclosures. From this, we can re-examine the mortgage lending system, including the lending decision process, lending standards, and/or supervision of lenders, and can devise protections for borrowers that reduce the probability of foreclosures such as the Hope Now Alliance,[3] the federal Home Affordable Modification Program,[4] and/or the Home Affordable Refinance Program.[5] Also, spline regression analysis, threshold-theory-based analysis, can provide the empirical basis with reference to the relationship between the number of foreclosed homes and the foreclosure effect. For example, neighborhoods having foreclosure problems might be able to manage the foreclosure problem without any significant changes in spatial income composition until the size (number or rate) of foreclosures reaches a critical value. However, when a neighborhood reaches a critical value in the size (number or rate) of foreclosures, the neighborhood may experience more rapid low-income segregation. The result of spline regression would show which neighborhoods have the greatest needs and/or when the

[3] The Hope Now Alliance consists of the U.S. Department of the Treasury, the U.S. Department of Housing and Urban Development, mortgage servicers, and counselors. It was created in 2007 for the purpose of helping homeowners who may not be able to pay their mortgages through counseling in response to the subprime crisis (Hope Now Alliance, 2007).

[4] The Home Affordable Modification Program (HAMP), part of the Making Home Affordable Program in 2009, was designed to help eligible home owners with loan modification on their home mortgage debt in the context of the subprime mortgage crisis (Freddie Mac-Home Affordable Modification Program).

[5] The Home Affordable Refinance Program (HARP) was established by the Federal Housing Finance Agency in 2009 in order to help underwriter and near-underwriter homeowners refinance their mortgages (MakingHomeAffordable.com).

time is appropriate for funding to rehabilitate or redevelop foreclosed properties. Based on these results, some planning interventions, such as application of the Neighborhood Stabilization Program (NSP)[6] operated by the U.S. Department of Housing and Urban Development (HUD), can be proposed to relieve the foreclosure effect.

Ultimately, this study investigates the effect of foreclosures on residential income segregation in the context of the subprime mortgage crisis and seeks to identify appropriate policies that can contribute to less segregated communities. Its premise is that reducing foreclosure activities and alleviating the foreclosure effect will lead to less economically segregated neighborhoods. To date, the current federal policies addressing the recent foreclosure crisis have often been criticized for some design and implementation problems, even though long-term outcomes remain to be seen (Immergluck, 2013). Moreover the local governments in the Miami Metropolitan Area, Miami-Dade, Palm Beach, and Broward counties, do not have their own foreclosure policies or strategies except applying for federal programs, mainly the Neighborhood Stabilization Program (NSP). Thus, it is expected that some improvements in policy direction and localized strategies for communities suffering from foreclosure damages in the Miami Metropolitan Area will be suggested based on the results of the empirical analysis undertaken in this study.

[6] The Neighborhood Stabilization Program, a federal response to the foreclosure crisis, was established under Division B, Title III of the Housing and Economic Recovery Act (HERA) of 2008 to stabilize communities that have suffered from foreclosures. It offers funding to states and local governments for the purpose of purchasing or redeveloping foreclosed and abandoned homes and residential properties (Government Accountability Office, 2010).

CHAPTER 2
THEORETICAL FRAMEWORK

Literature Review

Academics began to examine the recent foreclosure crisis as the number of foreclosed homes increased starting in 2007. Several studies have investigated historical aspects of the residential mortgage market, the cause of the subprime mortgage lending boom and surging growth in foreclosures, the direct and indirect effect of foreclosed properties on households and their communities, and the policies and programs adopted to respond to the crisis. This research shows that the risk associated with subprime mortgages is high, and low- and median-income borrowers, who are primary targets of subprime lending, are the most vulnerable groups for these foreclosures. Based on this literature, this study establishes a theoretical framework that links residential mortgage foreclosures and residential income segregation. To understand the relationship, this study looks at how the recent foreclosure crisis has developed, and the role of foreclosures in structuring geographical distribution of households, specifically by income.

Development of Foreclosure Crisis

The recent residential mortgage foreclosure crisis, so called subprime mortgage crisis, is characterized by an unusually large proportion of subprime mortgages entering into delinquencies or foreclosures. Although a subprime mortgage loan is not clearly defined, the term subprime has been used to describe certain characteristics of the individual borrowers (e.g. with blemished or limited credit histories), lenders (e.g. who specialize in high-cost loans), or mortgage contract types (e.g., no down-payment, and an adjustable-rate mortgage (ARM)) (Demyanyk & Hemert, 2011). The common factor

throughout the definitions of a subprime loan is a higher risk of default than a prime loan, because the subprime loan has been made to people who may have difficulties in maintaining the repayment schedule by providing loans to those with low incomes and few or no assets, with little or no down-payment, and with troubled credit histories (U.S. Department of Housing and Urban Development). It extends credit to those who might not have access to the loan market otherwise, and for that reason imposes a higher interest rate than a prime loan in order to make up for the increased risk. Specifically, the Office of the Comptroller of the Currency, the Board of Governors of the Federal Reserve System, the Federal Deposit Insurance Corporation, and the Office of Thrift Supervision define the subprime mortgage loan based on the credit histories of individual borrowers in the Expanded Guidance for Subprime Lending Programs as follows (Federal Deposit Insurance Corporation, 2001), these borrowers:

- Typically have weakened credit histories including payment delinquencies, or more severe problems such as charge-offs, judgments and bankruptcies.
- Reveal reduced repayment capacity through credit scores, or debt-to-income ratios; a credit bureau risk score (FICO) of 600 or below, or other bureau or proprietary scores with an equivalent default probability likelihood; and/or debt service-to-income ratio of 50% or greater, or otherwise limited ability to cover family living expenses after deducting total monthly debt-service requirements from monthly income (p.2).

The subprime mortgage loans—high-default-risk loans—have been producing a large part of the payment delinquencies or foreclosures that are directly related to the recent foreclosure crisis. Although the crisis became obvious in 2007, it is rooted in the banking system of the early 1990s, and has revealed the weaknesses of the banking system and industry regulation (Engel & McCoy, 2011). In the 1970s, mortgage lending was a demanding process both to lenders and borrowers. Banks required fixed-rate loans with 20 percent down-payment, thus mortgage borrowers needed to prove

whether they could afford the loans based on loan-to-value and debt-to-income ratios; because if borrowers defaulted on the loan, banks would absorb the loss (Engel & McCoy, 2011). Consequently, customers who had bad payment records and/or gaps in employment history were likely to be refused a mortgage, because their incomes were too low to cover the initial down-payment and monthly loan payment. Moreover, at that time, regulations associated with mortgage lending were also conservative (Engel & McCoy, 2011). For example, interest rates on home mortgages were capped by the government, and some states prohibited adjusted rate mortgages (ARMs), balloon payments, and prepayment penalties for loan refinancing.

This conservative mortgage lending environment produced distortions in the banking industry and real estate businesses. The restrictions on interest rates and some mortgage types could not be continued because of the inflation in the late 1960s and 1970s, and new savings vehicles; the inflation forced up market interest rates, and consequently, depositors withdrew their money from the banks to invest in other savings vehicles such as money market funds, mutual funds and pension funds, which served higher interest rates without interest rate caps than the banks (Engel & McCoy, 2011; Green & Wachter, 2005). In these circumstances, as the banks faced the limitation of the ability to fund long-term, fixed rate mortgages due to the cash outflows, some changes occurred such as the Depository Institution Deregulation and Monetary Control Act (passed in 1980), and the Alternative Mortgage Transaction Parity Act (passed in 1982). Specifically, in 1980, Congress eliminated the interest rate cap on first mortgages, and then in 1982 lending products other than fixed rate loans, including adjustable-rate mortgages (ARMs), balloon payment mortgages, and interest-only

mortgages, were permitted (Engel & McCoy, 2011; Green & Wachter, 2005). Banks not only can charge market-rate interest, but also broaden the types of loans available to their customers; home mortgage borrowers with low- or moderate-income might prefer a lower rate of interest with a balloon payment when their homes are sold.

The deregulation of mortgage lending and preempting states' lending regulations facilitated the increased securitization of residential mortgages in the 1980s. It was initially driven by Fannie Mae[1] and Freddie Mac,[2] the major government-sponsored enterprises (GSEs),[3] and generated a subprime mortgage boom. The GSEs, Fannie Mae and Freddie Mac, are "shareholder-owned corporations chartered by congress to create a stable flow of funds to mortgage lenders in support of homeownership and rental housing" (Gates et al., 2002, p.370). They do not originate mortgages, but purchase mortgages of lenders, mainly by packaging mortgages into securities and dealing in them to investors (Gates et al., 2002). The securitization allowed lenders to reinvest their assets for more loans, and to spread the risk of long-term mortgages with secondary mortgage market investors (Immergluck, 2009a; Piskorski et al., 2010); by

[1] In 1938, the US Congress established the Federal National Mortgage Association (Fannie Mae), and in 1968, it became a government-sponsored enterprise (GSE) (Federal National Mortgage Association, 2008).

[2] In 1970, the Federal Home Loan Mortgage Corporation (Freddie Mac) was created by the US Congress as a public government-sponsored enterprise (Federal Home Loan Mortgage Corporation Act, approved 1970, amended 2010).

[3] As a type of quasi-governmental organization created by a law of the United States, they

- "Have a Federal charter authorized by law;
- Are privately owned, as evidenced by capital stock owned by private entities or individuals;
- Is under the direction of a board of directors, a majority of which is elected by private owners;
- Make loans or loan guarantee for limited purposes such as to provide credit for specific borrowers or one sector;
- Raise funds by borrowing which does not carry the full faith and credit of the Federal Government, or guarantee the debt of others in unlimited amounts" (Kosar, 2007, p.1).

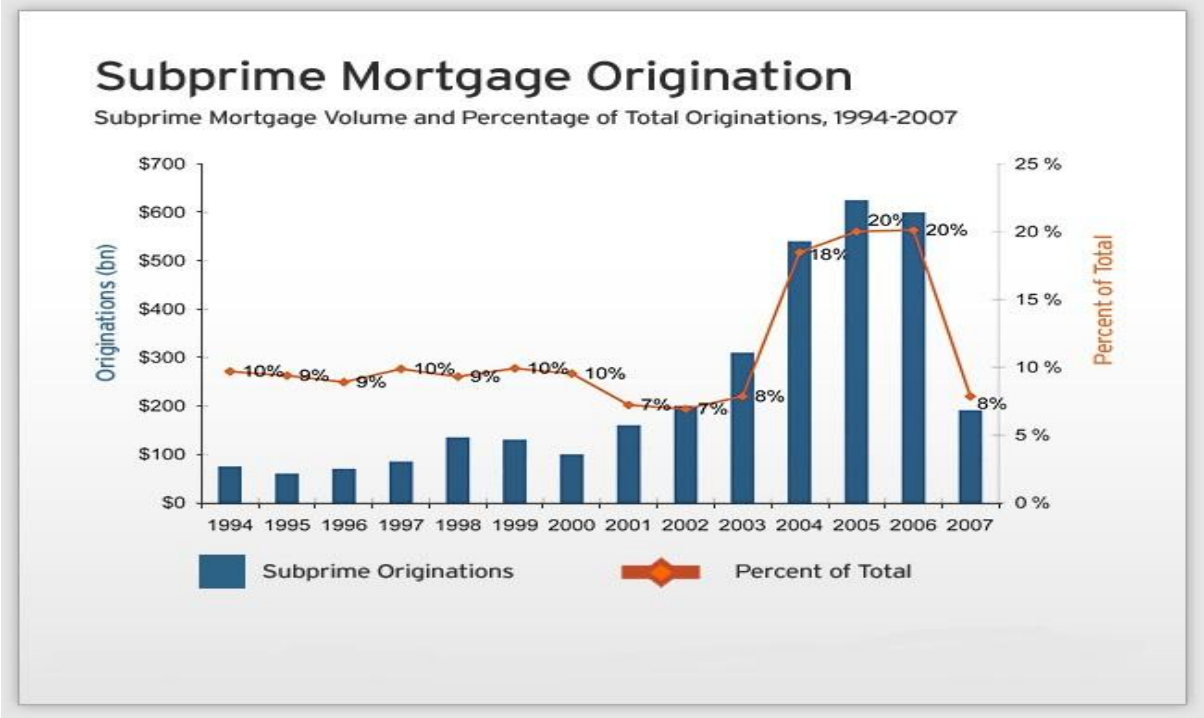
"bundling loans, selling them to a trust, and carving the cash flows from the mortgages into bonds sold to investors that are backed by the collateral underlying the mortgages" (McCoy & Renuart, 2008, p.8).[4] In the 1980s, the securitization of mortgages became widespread, and Fannie Mae and Freddie Mac could expand the subprime mortgage market by securitizing mortgages in the form of mortgage-backed securities (MBS) (Engel & McCoy, 2011; Federal National Mortgage Association). Subsequently, other investment banks, and financial institutions along with GSEs also started to get into the subprime mortgage market;[5] securities backed by subprime mortgages rapidly increased from $11 billion in 1994 to $83 billion (55 percent of subprime mortgages) in 1998 (Department of Housing and Urban Development and U.S. Department of Treasury, 2000).

In the late 1990s subprime lending surged, and it increased rapidly after 2001 (Immergluck, 2009a; Simkovic, 2013). As of 2005, subprime originations had shot up abruptly to about $663 billion (2007 Dollars) which was up from $187 billion (2007 Dollars) of 2001, and approximately 20 percent of the mortgage originations were

[4] As nominal interest rates rose, depository institutions were concerned about lending at a fixed rate. If a homebuyer took out a mortgage loan at an adjustable rate, the depository institution typically held on to the mortgage because the homebuyer (borrower) would absorb the risk of the interest rate. However, if the homebuyer chose to get a fixed-rate mortgage, the lender typically sold it to GSEs such as Fannie Mae, Freddie Mac or Ginnie Mae, and then the GSEs resold the loans to individual investors and institutions, "whose balance sheets were more compatible with holding a long-term asset with a fixed nominal rate," by packaging them into mortgage-backed securities. Funds for mortgage loans began to be obtained from mortgage-backed securities instead of traditional savings, loans and commercial banks, and the securities backed by mortgages were traded in a secondary mortgage market. Consequently, "securitization became a dominant source of funds for long-term residential mortgages" (Green and Wachter, 2005, p.99).

[5] "The Secondary Mortgage Market Enhancement Act of 1984 (SMMEA) made it easier for private entities to issue private mortgage-backed securities and for banks and thrifts to buy these securities" (McCoy and Renuart, 2008, p.8).

subprime in each year from 2005 to 2006, up from 5 percent of 2000 (Joint Center for Housing Studies of Harvard University, 2008).



Source: Inside Mortgage Finance, published by Inside Mortgage Finance Publications. Inc., 2009.

Figure 2-1. U.S. subprime mortgage origination.

More than 80 percent of subprime mortgages were securitized (Schumer & Maloney, 2007; Simkovic, 2013). As mentioned above, mortgage lenders could make and sell securitized mortgages simultaneously, which made the mortgage system more complex and made investors depend on appreciation by the large credit rating agencies such as Standard & Poors, Moody's, and Fitch Ratings who had underestimated the risks of mortgage-backed securities (Mason & Rosner, 2007). Among securitized mortgages, low quality securities in the subprime mortgage market contributed to the current foreclosure crisis beginning in 2007. In addition, based on the federal affordable housing goals and the promotion of homeownership, government-sponsored enterprises, Fannie Mae and Freddie Mac used tax exemptions from state and local

government to expand mortgage financing to low- and modest-income households and racial minorities by purchasing subprime mortgage-backed securities under the new requirements of the Community Reinvestment Act of 1992[6] (Department of Housing and Urban Development, 2001; Engel & McCoy, 2011).

Along with deregulation, technological innovation, so called automated underwriting (AU),[7] paved the way for the expansion of securitization to the subprime mortgage market in the 1990s. Automated underwriting (AU), a tool for mortgage lending decisions, evaluates the mortgage applicants' riskiness, and has been widely adopted by major mortgage market participants from government-sponsored enterprises (GSEs) to large banking institutions (Gates et al., 2002). In fact, before the introduction of AU in the mortgage market, lenders tended to be conservative about borrowing decisions since they did not know how to predict the risk that borrowers would default; "when underwriting loans, they had used rules of thumb to help ensure repayment such as a total debt-to-income ratio of 36 percent, a 20 percent down payment, and three months of savings in the bank" (Engel & McCoy, 2011, p.16). The AU system provided the statistical basis of mortgage lending decisions by incorporating applicants' credit histories with mortgage loan application data into the scoring models and gave lenders confidence that mortgage defaults could now be estimated with greater certainty by considering a multiplicity of risk factors (Gates et al., 2002). More

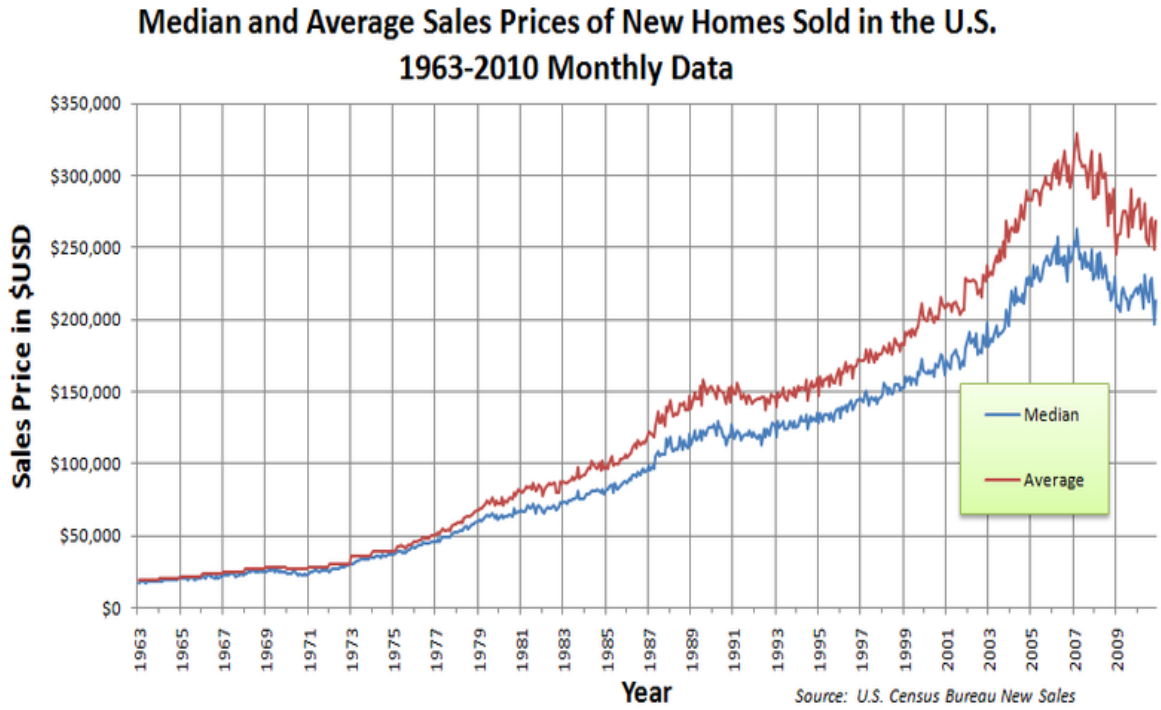
[6] The Community Reinvestment Act changed in 1992 requiring Fannie Mae and Freddie Mac to devote a minimum percentage of their business activity—purchasing and securitizing mortgages—to meeting affordable housing goals in order to assist lending to low- and moderate-income households and lending in underserved geographic areas such as low-income and high-minority neighborhoods (Department of Housing and Urban Development, 2001, p.1).

[7] "In 1995, Freddie Mac introduced Loan Prospector, its statistically based AU system" (Gates et al., 2002, p.372).

importantly, this model assumed that U.S. housing prices would rise consistently based on the short-run analysis of economic trends, including the U.S. housing bubble, which peaked in early 2006 (Anderson, et al., 2011; Engel & McCoy, 2011). Thus, using this model enabled mortgage lenders to now assess borrowers who could not afford a down-payment, or who had damaged credit histories. However, this underwriting system did not consider changing economic conditions such as the sharp decline in home prices, that began in late 2006 and 2007; accordingly, the AU system became a key factor in the foreclosure crisis (Anderson, et al., 2011). In sum, less restricted mortgage lending standards, securitization, loan technology innovation, and increasing housing prices were the foundation of subprime mortgage growth, which is directly connected to the foreclosure crisis (Doms et al., 2007; Zandi, 2008).

Due to the proliferation of subprime mortgages, the mortgage market was characterized by higher rates of interest to compensate for increased credit risk (Department of Housing and Urban Development; Federal Deposit Insurance Corporation, 2001). In order to avoid initial mortgage payments, a high percentage of subprime borrowers—90% in 2006—chose adjustable-rate mortgages (ARMs) characterized by low initial interest rates that could increase during an adjustment period (Zandi, 2008). Namely, the borrowers took out their loans with low initial interest rates, and planned to adjust the monthly loan payment during the future adjustment period. Characteristics of the mortgage loan, such as little or no down-payment and low initial payment, and a rising trend of housing prices encouraged the borrowers to believe that they could later refinance the loan at a lower rate interest. However, U.S. housing prices reached their peak in 2005-2006 and then began to decline sharply in

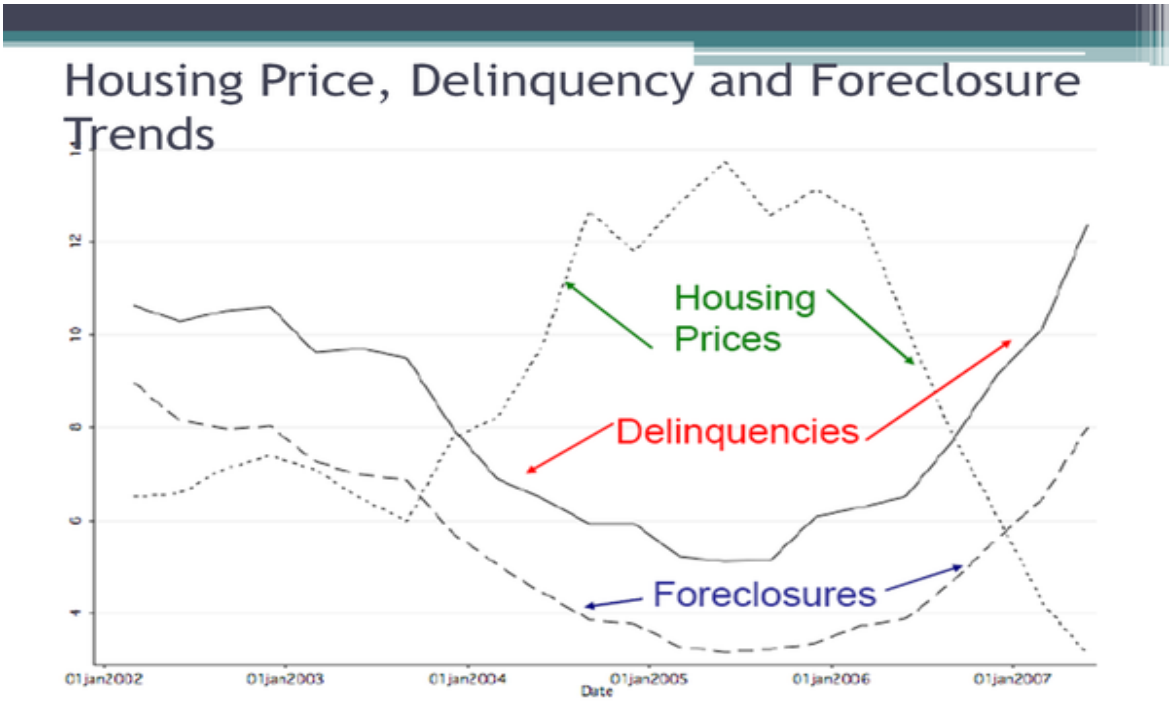
the second half of 2006 due to overbuilding (See Figure 2-2) (Chatterjee & Eyigungor, 2009; Immergluck, 2009a; U.S. Census, 2010; Zandi, 2008).



Source: U.S. Census Bureau (2010)

Figure 2-2. U.S. housing prices.

Once housing prices began to drop, the subprime borrowers, who mostly carried high interest mortgages, had difficulties refinancing for a more favorable loan. Consequently, defaults and foreclosures dramatically increased as the initial terms expired. According to the Center for Responsible Lending (CRL) (2011), 23 percent of subprime loans originated between 2000 and 2008 were non-current as of February 2011, more than 90 days delinquent or foreclosed (Center for responsible Lending, 2011). RealTrac shows that about 450,000 homes were in foreclosure during the third quarter of 2007, two times the number of foreclosed homes during the same period the prior year (Yoon 2007); housing prices did not continue to increase, and interest rates on adjusted-rate mortgages (ARMs) were set at higher levels (Foote et al., 2012).



Source: National Institute of Justice (2009)
Figure 2-3. U.S. housing price, delinquency and foreclosure trend.

The foreclosures impoverished individual consumers and weakened community stability. According to The Economist (2008), households in the U.S. were increasingly in debt. The ratio of debt to disposable personal income had been rising from 77% in 1990 to 127% in 2007, and much of this rise could be explained by mortgage lending (The Economist, 2008). Also, according to Schumer and Maloney (2007), about $71 billion in housing wealth will be lost directly through these foreclosures, and "more than $32 billion in housing wealth will be indirectly destroyed by the spillover effect of foreclosures, which reduce the value of neighboring properties" (Schumer & Maloney, 2007, p.12). The direct and indirect effect of foreclosures on households and their communities are discussed further in the next section.

The Foreclosure Effect on Residential Income Segregation

The foreclosure crisis and community stability

Large numbers of foreclosed properties have posed a particular problem when they are highly concentrated in certain neighborhoods (Immergluck, 2009b). They are strongly related to housing vacancy, poverty concentration, increases in crime rates, and/or housing price depreciation (Baxter & Lauria, 1999, 2000; Immergluck & Smith, 2006a, 2006b; Li & Morrow-Jones, 2010). Earlier studies paid attention to more direct effects, such as the relationship between foreclosures and housing prices (Forgey et al., 1994; Carroll et al., 1997). Foregey et al. (1994) empirically test whether foreclosed homes are likely to be sold at a discount, using a sample of 2,482 real estate transactions in Arlington, Texas. This study uses a hedonic price model to examine the that houses in foreclosure status do sell at a reduced price, and the result shows that "the foreclosed properties in the sample sold for an average of 23% less than other houses in the sample", which has statistical significance (Foregey et al., 1994, p.317). Since then, Carroll et al. (1997) have assessed the results of Foregey et al. (1994)'s study by reviewing 1,974 residential properties in Las Vegas, Nevada. The main reason the authors examine the results of the earlier work is that Foregey et al. (1994)'s analysis does not take into account neighborhood conditions where these properties are located. Thus, they include dummy variables based on the proximity to the foreclosed properties for controlling location in their model, and the result with these location control variables indicates that the discount rate of foreclosed-house prices fall to between 8.45% and 9.72%, compared to a random sample of properties not within one block of the foreclosed properties (Carroll et al., 1997).

Baxter and Lauria (1999, 2000) empirically examined the relationship between foreclosures and racial transition; in these studies, the foreclosure rate is the exogenous variable that affects racial transition in neighborhoods. The authors propose that mortgage foreclosures can catalyze the ongoing racial transitions in neighborhoods; "the higher the percentage of units foreclosed in a block group, the larger the percentage black population in 1990 at New Orleans" (Baxter & Lauria, 1999, p.772). In 2000, Baxter and Lauria developed their analysis by using a structural equation model to test the following hypotheses:

- Hypothesis 1. Employment decline reduces median block group income and the mean value of owner-occupied housing.
- Hypothesis 2. Decline in employment and income are concentrated in block groups with the largest proportion of low-income black residents.
- Hypothesis 3. Lower employment and lower median block group income reduce home values and increase residential mortgage foreclosure rates; higher foreclosure rates are associated with higher vacancy rates, increases in the proportion of black residents, and lower levels of owner-occupied housing.
- Hypothesis 4. The prior racial composition of a block group has significant net effects on median block group income, mean house value, foreclosure rates, and subsequent changes in neighborhood racial composition (Baxter & Lauria, 2000, p.677-680).

The results of the New Orleans case study indicate that characteristics of economically distressed neighborhoods such as low housing prices and low incomes are the primary causes of mortgage foreclosures, and in turn foreclosures, especially concentrated foreclosures in certain areas, affect the socioeconomic characteristics of the neighborhood, resulting in increased vacancy rates, racial transition, changes in aggregate income, and in housing tenure status. These results indicate that the foreclosures not only impact the neighborhood's vacancy rate, home ownership, and/or racial transition, but also a relationship exists between the prior characteristics of the

neighborhood, such as the employment rate, income and/or racial composition, and the resulting foreclosure rates.

Immergluck and Smith (2006a, 2006b) investigate the impact of single-family mortgage foreclosures on neighborhoods in Chicago in terms of property value and crime by using a regression model. They find that single-family mortgage foreclosures have a great influence on nearby property values. In fact, within a radius of an eighth of a mile around the foreclosed properties, the property value is reduced by 0.9 %. The literature on the effects of "proximate phenomena on property values" finds that "significant impacts of foreclosures on property values will occur within a quarter of a mile or less" (Immergluck & Smith, 2006, p.64). Some later studies also examine the foreclosure effect on the overall property values of neighborhoods, using hedonic regression analysis. They commonly show that foreclosures have a large influence not only on the mortgage borrowers unable to make their payments, but also on their communities by depreciating property values around the foreclosed homes (Been, 2008; Leonard and Murdoch, 2009; Lin et al., 2009; Harding et al., 2009). According to the results suggested by Been (2008), Leonard and Murdoch(2009), Lin et al.(2009), Harding et al. (2009), the nearby foreclosures generate negative externalities that discount the selling price of all properties, and the discounting effect diminishes rapidly as the distance from the foreclosed properties increases.

More recently, Li and Morrow-Jones (2010) assess the behavioral pattern of individual households. Namely, foreclosures usually cause out-migration of current residents, and the out-migration of individuals may generate socioeconomic change in the neighborhoods, specifically in the percentage of African-Americans, female

headship rates, median household income, and unemployment rates. However, according to this study, these changes can vary depending on neighborhood status. If the foreclosed homes and their surroundings are not “attractive enough for potential homebuyers or investors” (Li & Morrow-Jones, 2010, p.24), the house might be unoccupied for a long time. On the other hand, if the house and neighborhood are “relatively attractive or on the revitalization agenda of the local community” (Li & Morrow-Jones, 2010, p.24), the foreclosed homes might attract potential homebuyers or investors to the neighborhood. The authors conclude that mortgage foreclosures would accelerate housing filtering, and racial and economic turnover of residents by expediting the process of residential migration and reoccupation. As we can see in the literature, residential mortgage foreclosures can have a substantial effect, often negative, on the socioeconomic status of neighborhoods, from reductions in the selling price or value of the foreclosed properties and surroundings to increased crime, to increased concentrations of lower income residents.

The foreclosure effect on residential income segregation

Based on the strong relationship between the recent foreclosure crisis and subprime lending, foreclosed homes are likely to be disproportionately concentrated in lower-income communities (Dymski, 2005, 2010; Engel & McCoy, 2011; Immergluck & Smith, 2006b; Immergluck, 2009a, 2009b; Simkovic, 2013). The Department of Housing and Urban Development (2000) provides a research analysis based on approximately one million mortgages reported nationwide in calendar year 1998 under the Home Mortgage Disclosure Act (HMDA). This study clearly indicates that subprime lending continued to grow at a rapid pace during the 1990s and disproportionately concentrated in low-income minority communities. Also, Calem et al.(2004) tested the

distribution of subprime mortgage loans by using a regression model, over time (1997 to 2002) and across 7 cities: Atlanta, Baltimore, Chicago, Dallas, Los Angeles, New York City, and Philadelphia. They found that neighborhood median income and borrowers' incomes are inversely related to subprime borrowing activities.

These concentrated foreclosures have caused a specific problem, especially when they are in economically-distressed neighborhoods (Immergluck, 2009b). They not only harm those who lose their homes through foreclosure, but also have negative impacts on nearby property owners, who see their property values depreciate (Immergluck, 2010; Schuetz, Been & Ellen, 2008). In fact, these foreclosures caused many of these homes to be worth less than the mortgage loan. According to Wells Fargo Economic Research (2010), 23% of U.S. homes became less valuable than the mortgage loan by September 2010. However, one difference is that concentrated foreclosures, when they are in middle- or upper-income neighborhoods, may not deleteriously affect the property value or other economic status of the neighborhoods; foreclosures may create opportunities for homebuyers to purchase at lower prices. Still, in economically distressed neighborhoods they may cause long-term vacancies— potential abandonment— which tend to be the targets of property value depreciation, vandalism, criminal behavior, etc. (Immergluck, 2009b). Consequently, the geographic concentration of foreclosed homes can aggravate residential income segregation through the process of out-migration of higher income residents, potential housing abandonment, and/or in-migration of lower-income households (Immergluck, 2009b; Mallach, 2009; Li & Morrow-Jones, 2010).

The Threshold Effect of Neighborhood Change

Many studies examine the patterns of neighborhood change, describing how neighborhood change occurs, and what factors affect the neighborhood change process (Girgsby, et al., 1987). Some use the Invasion-Succession model of the Chicago School, tracking the neighborhood change processes by "which one population supplanted another and one social system replaced its predecessor" (Schwirian, 1983, p.85). Others use the Demographic/Ecological model, explaining neighborhood change through "adaptation of the population to its environment", which reflects the durability of social organizations as population migration occurs in residential areas. While the Demographic/Ecological model focuses on "the extent to which neighborhoods maintain their social organization in the face of continued population turnover" (Schwirian, 1983, p.93), the Threshold Effect model defines neighborhood change as "a dynamic process in which the magnitude of the response changes significantly as the triggering stimulus exceeds some critical value" (Schwirian, 1983; Quercia & Galster, 1997, p.409). The Threshold Effect model assumes that "once begun, the process of change from one equilibrium state to another is often non-linear, even discontinuous" (Galster, 2001, p.2119).

A relatively new theory of neighborhood change, the Threshold Effect model, has been attracting practical and academic interest (Quercia & Galster, 2000). According to this theory, "when a neighborhood reaches a critical value of a certain indicator, it may trigger more rapid changes in that neighborhood's environment" (Galster et al., 2000, p.703). To test threshold effects associated with neighborhood change indicators empirically, most research has used non-linear regression models—spline, categorical, or quadratic regressions. For instance, Galster et al. (2000) empirically tested the

theory of the threshold effect through the spline specification model by using neighborhood quality-of-life indicators in census tracts of U.S. metropolitan area. These indicators include the poverty rate, non-employment rate, female headship rate for families with children, and secondary dropout rate, and show some evidence of highly non-linear effects in incidence of poverty rate and female headship rate. This significant study explores how the main indicators change after they reach their critical values in terms of both endo-dynamic and exo-dynamic relationships. When neighborhood quality-of-life of indicators surpass a tipping point, they can subsequently result in a much more rapid change in themselves (endo-dynamic relationship). Alternatively, when an exogenous factor, which can affect neighborhood quality-of-life indicators, reaches its tipping point, it subsequently can cause a much more rapid change in the neighborhood quality-of-life indicators (exo-dynamic relationship) (Galster et al., 2000).

This study assumes that the threshold, characterizing a critical mass of foreclosures, effectively describes the relationship between foreclosure and income segregation in the neighborhood; the foreclosure effect on income segregation is characterized by a non-linear relationship or a threshold effect (Galster et al., 2010). For example, if negative conditions in a neighborhood —in this study, concentrated foreclosed homes—reach a critical point “where they become intolerable to better-off residents who have the wherewithal to move to a superior residential environment”, the wealthy residents might move out of their neighborhood far more rapidly; meanwhile, the visible negative conditions, once the threshold of concentrated foreclosures is passed, become an impediment to higher-income in-movers (Quercia & Galster, 2000, p.146). Consequently, segregation may intensify as those who do not have the

wherewithal to choose a better place to live remain behind. When the threshold points are estimated, we can draw implications for potential mechanisms of the foreclosure effect, suggesting policy to address economically distressed places. If rapid segregation of low-income households occurs after the number of foreclosed homes reaches a critical point, the foreclosure effect is consistent with the threshold effect theory, and some planning interventions can be made depending on where this tipping point is located. Provided that the number of foreclosed homes has not yet gone over the threshold, preventive interventions can be applied; by contrast, if the foreclosure status of neighborhoods stands above the tipping point, remedial programs can be suggested (Galster et al., 2000).

Residential Segregation

Dimension of residential segregation

Defining or measuring segregation can be controversial. Little agreement exists regarding what constitutes the best measurement. Massy and Denton (1988) attempt to evaluate 20 potential measures of residential segregation, and suggest five dimensions of residential segregation: evenness, exposure, concentration, centralization, and clustering. According to them, when a group is “highly centralized, spatially concentrated, unevenly distributed, tightly clustered, and minimally exposed to majority members”, the group can be called “residentially segregated” (Massy & Denton, 1988, p.283).

The root of residential segregation can be understood based on the concept of “the geography of opportunity”. Galster and Killen (1995) introduced the term, referring to the ways in which geographic context affects an individual’s opportunity. According to the authors, settlement options are restricted by social and economic conditions; low-

income minorities experience the strictest limit on the opportunity of housing choices (Galster & Killen, 1995). Historically, poor minorities have been concentrated in certain communities due to institutional racism. Further, although low-income individuals need access to their jobs, they are much less likely to have their own personal means of transport because they set aside a greater portion of their income for shelter and food (Murakami & Young, 1997). According to the National Personal Transportation Survey (1995), twenty-six percent of low-income households did not have their own car, compared to four percent of other households in the U.S. (Department of Transportation, 1995). Consequently, the poor tend to gather around the jobs that are generally located in traditional inner-city neighborhoods to minimize commuting distance (Murakami & Young, 1997; Stoll, 2005). During the latter half of the 20th century, as the location of job opportunities in metropolitan areas changed, the distance between segregated neighborhoods—low income-dominated—and employment centers increased as the latter continued to decentralize towards new suburban areas (Stoll, 2005). Although some federal and local programs offered alternatives to the inner city, low income residents "remain[ed] fairly centralized and concentrated in older urban and suburban neighborhoods of the nation's metropolitan areas" (Stoll, 2005, p.2; Landis & McClure, 2010). This trend of job suburbanization, coupled with the low proportion of car ownership among the poor, disconnected these residents from many job opportunities, exacerbating their employment difficulties and residential isolation (Stoll, 2005).

Another determinant of neighborhood residential segregation is a historically discriminatory housing market, creating racial residential segregation throughout U.S.

cities. “The message is clear that blacks are not welcome in most non-minority neighborhoods” because non-minorities believe that racial minorities, especially the low-income minorities, will make the neighborhood a less desirable place to live (Peterson & Krivo, 1999, p.466; Bobo & Zubrinsky, 1996; Farley et al., 1994). Many studies have recognized racial discrimination in housing choice as a cornerstone of segregated neighborhoods (Alba & Logan, 1993; Farley & Frey, 1994, 1996). The discriminatory practices in the housing market are strongly rooted in the legally enforced segregation of earlier time periods that implemented Jim Crow laws between 1876 and 1965, mortgage lending practices, particularly redlining, and in the policies and programs of the Department of Housing and Urban Development that deliberately assigned public housing for low-income minorities to isolated and segregated places in a city (Yinger, 1995). Also, realtors contributed to racial segregation by intentionally guiding African American and Whites into separate communities. The wide range of institutional discrimination established and implemented by government officials, bankers, realtors, and insurers concentrated African Americans in neighborhoods that were predominantly African American (Galster, 1992; Peterson & Krivo, 1999).

Residential segregation

Racial prejudices and stereotypes. Racial discrimination in the housing market is still a major problem, and “it may also affect residential sorting”, which reinforces segregation of affluence and/or poverty (Reardon & Bischoff, 2011, p.1093). Though today’s forms of discrimination are more subtle, racial discrimination violates neighborhood stability in already vulnerable communities; “whites continue to adhere to negative racial stereotypes, deny the persistence of pervasive racial prejudice and discrimination, and are quite likely to oppose race-based social policies” (Briggs, 2005,

p.74). Guest and Weed (1976) trace pattern changes in ethnic residential segregation for some U.S. cities, and find that cross-sectional or differences over time in residential segregation among ethnic groups are highly related to differences in social status. On the other hand, ethnic segregation tends to continue to exist even if the income differences among ethnic groups disappear. In addition, according to Crowder (2000), the size of the minority population in the neighborhood significantly affects the annual likelihood of leaving the neighborhood—Whites especially tend to leave neighborhoods experiencing increases in minority population, and predominantly White neighborhoods often serve as their potential destinations.

Income inequality and income segregation. Income segregation can be described by spatially concentrated poverty or affluence; lower-income households will live, on average, in neighborhoods with lower average income than higher-income households do (Reardon & Bischoff, 2011). Neighborhoods of concentrated poverty can create impediments to upward housing mobility (Galster et al., 2008). Carter et al. (1998) recognized an increasing concentration of poor households, disproportionately composed of racial and ethnic minorities in public housing mostly located in central cities, as negative characteristics of U.S. cities. The authors find that the poor and minorities are overrepresented in public housing, and they investigate the effect of the location of public housing on changes in neighborhood poverty rates in four large cities, Boston, Cleveland, Detroit, and Philadelphia. The results of their analysis show that the location of public housing usually exacerbates poverty concentration in these neighborhoods (Carter et al., 1998).

Also, according to Galster et al. (2010), the mixture of low-, middle- and high-income individuals in neighborhoods can affect the subsequent income in these areas, and this effect can vary according to the income mixture. This income-mix indicator, percent of low-income and percent of high-income in their study, not only is the dominant focus in the scholarly literature, but also is the focal point of several public policy initiatives promoting mixed income communities, or poverty deconcentration in both the U.S. and Western Europe (Galster et al., 2010). Based on their analysis, they maintain, "the income mix of a neighborhood matters, and in extreme concentrations of low-income groups, it matters a great deal" to residents in the neighborhood; it affects their subsequent earning prospects, which forms the subsequent income mix of the neighborhood (Galster et al., 2010, p.47). Thus public policy may focus on areas of concentrated low income residence.

Housing Policy

Housing policies addressing residential segregation

Concern about the negative consequences for low-income minorities of living in isolated, economically distressed areas ranges from lack of adequate services to negative impacts on individual motivation; "positive role models are scarce, and service providers such as schools are often underfunded and of inferior quality" (Abramson & Tobin, 1995, p.45; Galater & Killen, 1995). In this regard, Title VIII of the Civil Rights Act of 1968, commonly known as the Fair Housing Act, reinforced the Civil Rights Act of 1964 by prohibiting discrimination on the grounds of race, religion, and national origin in the sale or rental of housing. Under the Fair Housing Act, numerous charges of discrimination have been made based on race or ethnicity in the provision of affordable housing. For example, the Huntington Branch of the National Association for the

Advancement of Colored People (NAACP), Housing Help, Inc. (HHI), and two low-income African American residents of the Town of Huntington appealed an adverse judgment of the United States District Court for the Eastern District of New York. The appellants tried to construct a multi-family subsidized apartment in Greenlawn/East Northport, a White neighborhood. According to the appellants, the Town of Huntington violated Title VIII of the Civil Rights Act of 1968 by adhering to the Town's zoning ordinance that prohibited private construction of multi-family housing in all areas except a small urban renewal zone in the Huntington Station neighborhood, a predominantly minority area. Thus, the appellants requested to amend the town's zoning code.

In a similar case, the Metropolitan Housing Development Corp. (MHDC) proposed a racially integrated low- and moderate-income housing project in the Village of Arlington Heights. To develop this project, the nonprofit requested revisions to the zoning codes from a single-family housing district to multi-family housing district. However, the Arlington Heights City Planning Commission denied the request. The MHDC appealed an adverse district court decision. The Fair Housing Act provides a solid basis to challenge racial segregation in the housing market. However, there are difficulties in proving deliberate intention based on the Fair Housing Act. For example, although the MHDC alleged that the decision of Arlington Heights resulted in racially disproportionate impacts on low-and moderate-income African Americans, it could not present the evidence that the city had had racially biased intent. Consequently, the Supreme Court reversed the lower court's decision and remanded the case to the court of appeals to further consider whether the Fair Housing Act had been violated; the court upheld the zoning ordinance, and the City designated the location for multi-family

housing at the neighborhood boundaries adjacent to commercial areas, based on the court decision in 1977.

Additional remedies for low-income minorities with limited housing choice include a range of housing mobility programs. Before discussing housing mobility programs, it is imperative to briefly mention the history of public housing. Public housing is a form of subsidized low-income housing in the United States that was established to supply "decent and safe rental housing" for low-income households, the elderly, and persons with disabilities (HUD). The question of reality aside, public housing has created many negative images in the popular imagination, such as concentrations of poverty and minorities, grim architecture, lack of environmental management systems, and high crime rates (Schwartz, 2010). Thus, the federal government has generated new policies as remedies for real problems and negative perceptions of public housing such as: housing choice vouchers and HOPE VI redevelopment.

An early example of a voucher solution, the Gautreaux Program targeted racial discrimination in the Chicago public housing system. According to Hills v. Gautreaux 425 U.S. 284 (1976), the Chicago Housing Authority (CHA) had built public housing in areas with high concentrations of low-income minorities. The American Civil Liberties Union (ACLU) brought class action suits against the CHA and the Department of Housing and Urban Development (HUD) on behalf of African-American tenants and applicants for public housing in Chicago. This lawsuit alleged that the CHA had chosen public housing sites in order to deliberately prohibit African-American low-income families from locating in White neighborhoods and that HUD had supported CHA's discriminatory housing process by providing financial assistance. The outcome of this

lawsuit was to supply scattered public housing sites that were not located in areas of concentrated poverty. The CHA awarded Section 8 vouchers[8] to a number of African-American families in Chicago's housing projects in order to enable them to move to new locations for a better quality of life. The results of this program, the effects of residing in higher income communities, varied depending on where the participants moved (DeLuca & Rosenbaum, 2003); a large portion of low-income black families that were placed in suburban areas, which had higher incomes and lower composition of African Americans, did not move back to their original city. The "suburban movers had higher employment than city movers" despite the fact that the program did not provide employment services, while the urban movers tended to remain on the welfare rolls (DeLuca & Rosenbaum, 2003, p.308). Moreover, the Gautreaux young adults who moved to the suburbs were more likely than those who moved to urban areas to graduate from high school, attend college, and secure jobs with better pay and benefits (DeLuca & Rosenbaum, 2003). Consequently, the Gautreaux Program was a qualified success, and became a model for other housing mobility programs, especially following Section 8.[9]

In the 1990s, HUD initiated the HOPE VI housing program to alleviate the problems associated with concentrated poverty in public housing. The goal is to

[8] The Section 8 voucher was authorized under the Housing and Community Development Act of 1974 (amending the U.S. Housing Act of 1937) and operated by the U.S. Department of Housing and Urban Development to assist the rental housing payment for very low-income families, the elderly, and the disabled. Currently, it continues as the Housing Choice Voucher program (HUD Office of Housing Choice Vouchers, n.d.)

[9] The Gautreaux program also inspired the Moving to Opportunity (MTO) program, which operated in five large cities, Baltimore, Boston, Chicago, Los Angeles, and New York by the Department of Housing and Urban Development (HUD) during 1994 and 1998. It assisted very low-income families living in public housing or Section 8 project-based housing by providing opportunities to relocate to more affluent neighborhoods (HUD Moving to Opportunity for Fair Housing, n.d.).

promote mixed-income housing and prevent poverty concentration by renovating and modernizing public housing and distributing housing vouchers. Although HUD has been working to transform the public housing environment through the HOPE VI program, it has been criticized for failing to provide enough housing to accommodate all residents who lived in public housing prior to redevelopment. The HOPE VI housing redevelopment programs do not require a "one-for-one" replacement of the existing public housing units, thus the renovated projects do not need to house the same number of tenants. For example, a HOPE VI grant was awarded to the Miami-Dade Public Housing Agency (MDPHA) by HUD in 1999 for the redevelopment of Scott-Carver Homes, a project located in Liberty City, Miami. At the time, Scott-Carver had 826 public housing units, and the majority of its residents were African-American (Miami News and Announcements, 2010). However, Phase I of the HOPE VI Redevelopment Project, completed in 2008, had only 57 single-family homes with 41 of these homes purchased by former residents of Scott-Carver Homes (Miami News and Announcements, 2010). Phase II planned to supply 354 rental units; 177 public housing units, 107 low- and moderate-income units, and 79 market-rate units. In other words, even if the new houses and apartments were assigned exclusively to the former residents of Scott-Carver, the HOPE VI Redevelopment Project could accommodate less than 50% of the previous residents, resulting in a net loss of housing for them. This significant displacement of former residents can do more harm than good (Clampet-Lundquist, 2010; Popkin et al., 2004). As we can see in these cases, though public housing and other alternatives (Section 8 and HOPE VI) set desirable goals, such as the de-concentration of poverty, improvement of the housing environment, and

abolishing discrimination, they can have considerable problems that should be addressed. Therefore, more careful consideration is required to protect low-income, elderly, and disabled households.

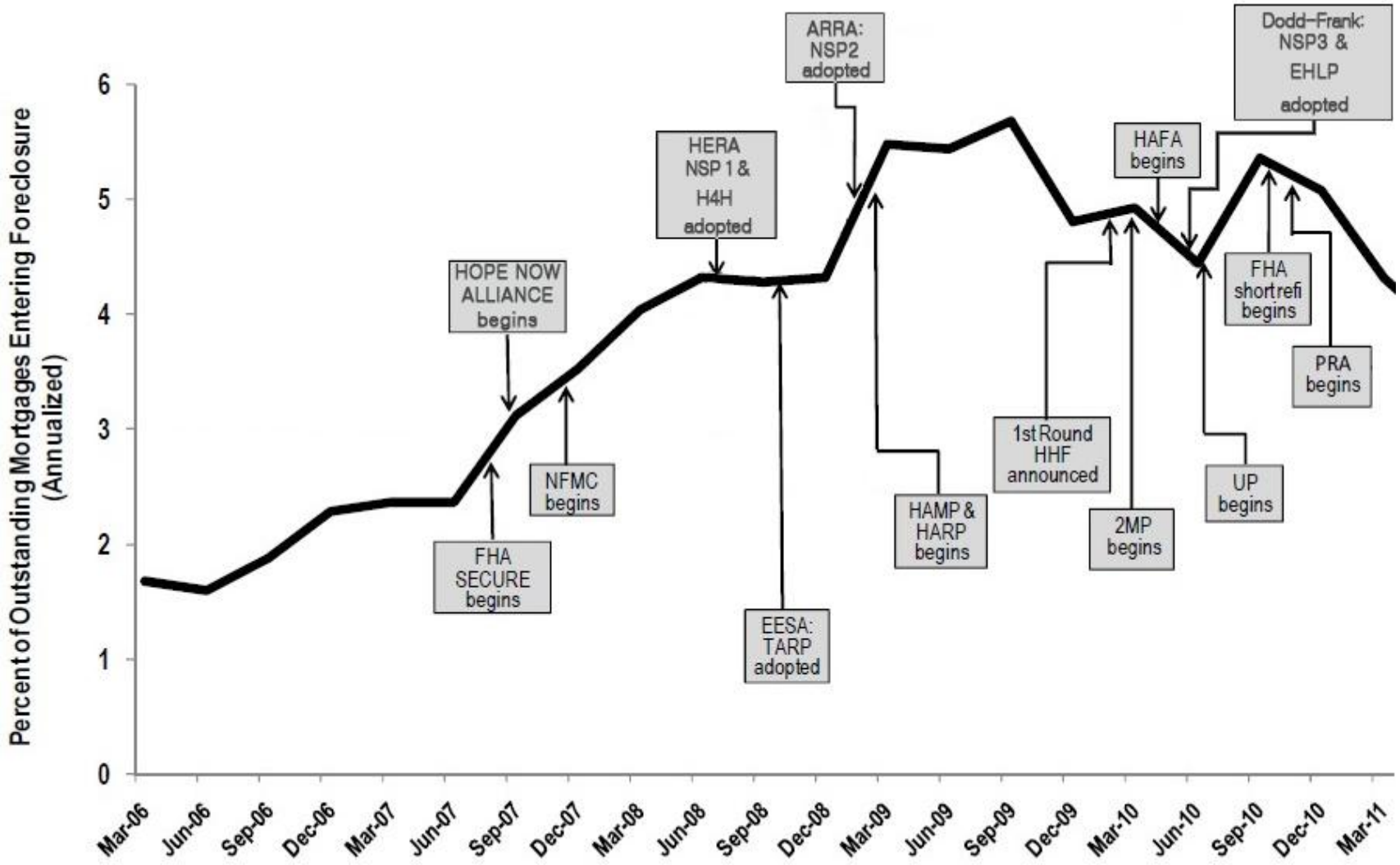
Housing policies addressing the foreclosure crisis

Since the U.S foreclosure crisis emerged in 2007, the federal government has implemented policies to prevent foreclosures and to alleviate the impacts of foreclosures on the households and communities in which the foreclosed properties are concentrated as shown in Figure 2-4 (Immergluck, 2013). This section summarizes the major policies and programs established in response to the recent foreclosure crisis. Although there are policies that may have an indirect influence on foreclosure status, this study examines these policies and programs that directly address the foreclosure crisis and housing problem.

Policies and programs for preventing foreclosures. Federal responses to prevent foreclosures have been highly focused on generating opportunities for modification of troubled mortgages (Mallach, 2009). First, in August 2007, the Federal Housing Administration (FHA) announced the Secure Program to refinance the loans of delinquent homeowners to more affordable loans to prevent or reduce foreclosures. Next, Hope Now Alliance was initiated by a collaborative of credit and homeowners' counselors, mortgage servicers, and mortgage market participants with participation by the Department of the Treasury and the Department of Housing and Urban Development (Hope Now Alliance, 2007). The Alliance offered counseling and information service to at-risk homeowners for facilitating loan modifications to avoid foreclosures; it operated a national twenty-four hour toll-free telephone line named as the Homeowner's HOPE Hotline and encouraged homeowners at risk of foreclosures to

contact their lender or provided other contact information that could help homeowners' refinancing (HOPE NOW-Support & Guidance for Homeowners). Many subsequent programs assisted at-risk homeowners in refinancing their loans through borrower-counseling, loan payment adjustment, and/or expanding capacity of lenders or local governments as seen in Table 2-1.

The Troubled Assets Relief Program (TARP) begun in 2008 includes succeeding programs such as Making Home Affordable (MHA), Hardest Hit Fund (HHF), and Home Affordable Unemployment Program (UP). Initiated under the Emergency Economic Stabilization Act (EESA) of 2008 (Division A of Public Law 110-343), TARP enabled the Department of the Treasury to purchase and warrant $700 billion of "troubled assets"—defined by the EESA of 2008 as "a) residential or commercial mortgages and any securities, obligations, or other instruments that are based on or related to such mortgages, that in each case was originated or issued on or before March 14, 2008, the purchase of which the Secretary determines promotes financial market stability; and b) any other financial instrument that the Secretary, after consultation with the Chairman of the Board of Governors of the Federal Reserve System, determines the purchase of which is necessary to promote financial market stability, but only upon transmittal of such determination, in writing, to the appropriate committees of Congress" (Congressional Budget Office, 2012; Emergency Economic Stabilization Act of 2008, p.5-6).



Note: adapted from Immergluck, 2013. Housing Policy Debate 23(1) (P. 203, Figure 1).

Figure 2-4. Federal policies that address the foreclosure crisis.

Major transaction of the TARP can be categorized into four parts: capital purchase and support for financial institutions, financial assistance for the automotive industry, investment partnership to increase liquidity in securitization markets, and mortgage programs. Based on the final category, mortgage programs, the federal government initially allocated $75 billion—of the total, $50 billion was from TARP and $25 billion was from Fannie Mae and Freddie Mac—to the Home Affordable Modification Program (HAMP) that provided direct payments to help homeowners avoid foreclosures through mortgage modification (Congressional Budget Office, 2012). In addition, programs supporting state governments (Hardest Hit Fund (HHF)), the unemployed borrowers assistance program (Home Affordable Unemployment Program (UP)), and junior mortgage modification program (Second Lien Modification Program (2MP) among others are operated under the Troubled Assets Relief Program (TARP).

In addition, the Department of the Treasury and the Department of Housing and Urban Development assist the mortgage programs in TARP through the Home Affordable Foreclosure Alternatives (HAFA) and Emergency Homeowners Loan Program (EHLP). If the borrowers cannot afford their mortgage payment with the Home Affordable Modification Program (HAMP), the Home Affordable Foreclosure Alternative (HAFA) suggests two options for transitioning out of the mortgages: a short sale or a Deed-in-Lieu (DIL) of foreclosure. In a short sale, the mortgage companies allow the borrowers to sell their houses for an amount that fall “short” of the amount they still owe, and in Deed-in Lieu, the mortgage companies let the borrowers transfer ownership back to them (Department of Housing and Urban Development and U.S. Department of Treasury). The HAFA short sales completely release the borrowers from mortgage debt

responsibility after selling their houses, and offer relocation assistance. The Emergency Homeowners Loan Program (EHLP) provides $1 billon emergency mortgage relief funding to assist mortgage borrowers who are unemployed or underemployed and at risk of foreclosures (Department of Housing and Urban Development). It is authorized under the Dodd-Frank Wall Street Reform and Consumer Protection Act (Dodd-Frank Act) of 2010, and targeted at only Puerto Rico and the 32 states that are not funded by the Hardest Hit Fund (HHF) program.

Although many homeowners have received assistance from these federal programs, the consensus is that their full potential has not been realized as a means to prevent or reduce foreclosures (Mallach, 2009). For example, although as of July 2012, more than one million homeowners had received permanent modification of their mortgages through the Home Affordable Modification Program (HAMP), over 230,000 of those modifications were subsequently canceled, mainly because the homeowners later defaulted (Congressional Budget Office, 2012). Also, some programs such as Federal Housing Administration's (FHA) Secure or Home Affordable Foreclosure Alternatives (HAFA) programs operated temporarily. Thus, distressed homeowners need more effective and continuous program implementation.

Table 2-1. Federal policies to prevent foreclosures.

Policy	Time	Note
Federal Housing Administration (FHA) Secure	2007 August	Refinancing the loans of delinquent homeowners to more affordable loans to prevent or reduce foreclosures.
Hope Now Alliance	2007 October	Offering foreclosure prevention counseling to homeowners.

Table 2-1. Continued.

Policy	Time	Note
National Foreclosure Mitigation Counseling (NFMC)	2007 December	Providing funds to local housing counseling organizations to counsel homeowners at risk of foreclosures.
Hope for Homeowners (H4H)	2008 July	Run by the FHA to refinance distressed borrowers out of unaffordable mortgages and to support long-term sustainable homeownership through smaller, more affordable, fixed rate loans.
Troubled Asset Relief Program (TARP)	2008 October	Allowing the Department of the Treasury to purchase or insure troubled assets—illiquid, difficult-to-value—from banks and other financial institutions under the Emergency Economic Stabilization Act (EESA) of 2008.
	2009 March	Home Affordable Modification Program (HAMP): Under Making Home Affordable (MHA), it provides opportunity to modify loans for mortgage payment reduction.
	2009 March	Home Affordable Refinancing Program (HARP): Under Making Home Affordable (MHA), it expands refinancing capabilities through the GSEs.
	2010 February	Hardest Hit Fund (HHF): Funding to state housing finance agencies (HFAs) for implementing foreclosure prevention programs in their states.
	2010 March	Home Affordable Unemployment Program (UP): As a supplemental program to the HAMP, it provides assistance to unemployed borrowers by reducing (31 percent of borrower's income) or suspending (12 months or more) their monthly mortgage payments.
	2010 July	Second Lien Modification Program (2MP): Modifying the borrower's junior mortgages.
	2010 October	Principal Reduction Alternative (PRA): If the borrower's home is currently worth significantly less than owed on it, as a supplemental program to the HAMP, it offers incentives to mortgage servicers and investors to apply the flexibility to reduce the amount the borrower owes on the home.

Table 2-1. Continued.

Policy	Time	Note
Home Affordable Foreclosure Alternatives (HAFA)	2010 April	Providing option of short sales and deeds-in-lieu of foreclosure for homeowners who are unable to keep their homes despite HAMP. Providing for incentives to mortgage servicers to execute short sales or deeds-in-lieu of foreclosure.
Emergency Homeowners Loan Program (EHLP)	2010 July	By the Dodd-Frank Wall Street Reform and Consumer Protection Act of 2010, EHLP offers $1 billion of emergency mortgage relief to HUD in order to assist unemployed mortgage borrowers. - This relief is provided to Puerto Rico and the 32 states not funded by HHF program.

Source: HUD Federal Housing Administration (FHA) (http://portal.hud.gov/hudportal/HUD?src=/program_offices/housing/fhahistory); Congressional Budget Office (2012) Report on the Troubled Asset Relief Program-October 2012; HOPENOW-Support & Guidance for Homeowners (http://www.hopenow.com/); NeighborWorksAmerica National Foreclosure Mitigation Counseling Program (http://www.nw.org); Hope for Homeowners (http://www.hopeforhomeownersprogram.org); MakingHomeAffordable.com-An Official Program of the Department of the Treasury & Housing and Urban Development (http://www.makinghomeaffordable.gov)

Policies for minimizing the foreclosure effect. As we can see above, policies addressing the foreclosure crisis have focused on preventing foreclosures. However, the Neighborhood Stabilization Program (NSP), as the leading governmental response to the accumulation of foreclosed properties, aims to alleviate the negative effect of foreclosures that have already occurred in neighborhoods by awarding grants to states and local governments, which can be used for purchasing and redeveloping foreclosed and abandoned homes and residential properties. This program operated by the U.S. Department of Housing and Urban Development (HUD) includes the three phases of the Neighborhood Stabilization Program (NSP), and each program is authorized by different sections of the act; NSP 1 authorized under Division B, Title III of the Housing and

Economic Recovery Act (HERA) of 2008, NSP 2 authorized under the American Recovery and Reinvestment Act (ARRA) of 2009, and NSP 3 authorized under the Dodd–Frank Wall Street Reform and Consumer Protection Act (Dodd-Frank Act) of 2010. The NSP funds may be used for activities that include, but are not limited to:

- Establish financing mechanisms for purchase and redevelopment of foreclosed homes and residential properties;
- Purchase and rehabilitate homes and residential properties abandoned or foreclosed;
- Establish land banks for foreclosed homes;
- Demolish blighted structures; and
- Redevelop demolished or vacant properties (HUD Neighborhood Stabilization Program Grants, n.d.).

Table 2-2. Three phases of the neighborhood stabilization program.

Phase	Substance
NSP1	Grants ($3.92 billion) to all states and selected local governments on a formula basis to stabilize communities hardest hit by foreclosures and delinquencies (under Division B, Title III of the Housing and Economic Recovery Act (HERA) of 2008) - Each of the 50 states and Puerto Rico received a minimum award of $19.6 million. - The other grantees are decided on the basis of greatest need factors such as the highest rate of foreclosures, subprime mortgages, abandoned homes, etc. with a minimum grant level of approximately $2 million.
NSP2	Grants ($2 billion) to states, local governments, nonprofits and a consortium of nonprofit entities on a competitive basis for communities whose viability has been and continues to be damaged by the economic effects of foreclosed and abandoned properties (under Title XII of Division A of the American Recovery and Reinvestment Act of 2009).

Table 2-2. Continued.

Phase	Substance
NSP-TA	$50 million allocation made available to national and local technical assistance providers to support NSP grantees (under Title XII of Division A of the American Recovery and Reinvestment Act of 2009). The grants are intended to: - Help NSP grantees to implement sound underwriting, management, and fiscal controls; - Measure outcomes in the use of public funds through accurate and timely reporting; - Build the capacity of public-private partnerships; - Develop strategies to serve low-income households; - Incorporate energy efficiency into State and local NSP programs; - Provide support, technical assistance, and training on the operation and management of land banks; - Train grantees and their sub-grantees on HUD program rules and financial management requirements; and - Assist grantees and their sub-grantees to develop materials on energy conservation or other Department or programmatic priorities.
NSP3	Grants ($1 billion) to all states and select governments on a formula basis (under the Dodd–Frank Wall Street Reform and Consumer Protection Act of 2010) targeting communities with the most severe neighborhood problems associated with the foreclosure crisis. - Allocated by a formula based on the number of foreclosures and vacancies in the 20 percent of U.S. neighborhoods (Census Tracts) with the highest rates of homes financed by a subprime mortgage that are delinquent or are in foreclosure. - The grant minimums for non-state grantees and state grantees are $1 million and $5 million respectively.

Source: HUD Neighborhood Stabilization Program Grants (http://portal.hud.gov/hudportal/HUD?src=/program_offices/comm_planning/communitydevelopment/programs/neighborhoodspg)

The three phases of NSP programs have been implemented by addressing some problems associated with the earlier NSP 1 program. For example, given the shortage of administrative resources in the early stages of the NSP program, the technical assistance funding (NSP Technical Assistance) was initiated in the NSP 2 phase to help NSP grantees in managing funds (Immergluck, 2013; U.S. Government Accountability Office, 2010). Because some local governments and/or nonprofits who received NSP 1 grants had difficulties in implementing the program efficiently enough to obligate all the funds by the program's deadline (18 months), the NSP-TA could contribute to facilitating funding applications. Also, the NSP 2 program was designed as a competitive one unlike the formula-based NSP 1, out of consideration of the capacity of grantee and operational effectiveness (U.S. House of Representatives, 2009); NSP 3 turned back to a formula basis focused on the highest rates of homes financed by a subprime mortgage that are delinquent or are in foreclosure. At present, little information is available for judging whether the formula basis or the competitive basis is better or whether the NSP program has effectively reduced the negative effect of foreclosed properties on neighborhoods. However, given the number of foreclosed properties and the scale of the problem, the NSP funds, by themselves, are too small to make a substantial contribution toward mitigating the negative effect of foreclosures (Immergluck, 2013). The Department of Housing and Urban Development expected that the three NSP programs might impact 100,000 properties, and as of March 2011, approximately 36,000 homes had been or were being purchased or rehabilitated. Clearly, the NSP programs, "even if highly effective, will be very limited in scale

compared to the aggregate flow of foreclosed properties" (Department of Housing and Urban Development, 2011; Immergluck, 2013, p.222).

This chapter reviewed the literature on the recent foreclosure crisis, its effect on community stability, and the relationship with residential income segregation. Also, neighborhood change theories and existing housing policies and programs related to the foreclosure crisis and residential income segregation are summarized to estimate the foreclosure effect on neighborhood income segregation, and to draw suggestions by linking the estimated foreclosure effect and existing housing policies and programs. The recent foreclosure crisis, which emerged in 2007, involved an unusually large percentage of subprime mortgages entering into delinquencies or foreclosures.[16] Given the characteristics of subprime loans, people may have difficulties in maintaining the repayment schedule (Department of Housing and Urban Development), the foreclosed homes tends to be disproportionately concentrated in lower-income communities (Dymski, 2005, 2010; Engel & McCoy, 2011; Immergluck & Smith, 2006a, 2006b; Immergluck, 2009a, 2009b; Simkovic, 2013); and consequently, they exacerbate the residential income segregation through the process of out-migration of higher income residents, potential housing abandonment, and/or in-migration of lower-income households (Immergluck, 2009b; Mallach, 2009; Li & Morrow-Jones, 2010).

According the Threshold Effect theory, one of the major theories of neighborhood change, income segregation triggered by concentrated foreclosures varies depending on the extent of the geographic concentration of foreclosures. If the size (number or

[16] The subprime share of the entire mortgage market rose from 10.1% in 2000 to 23.5% in 2006. Over 90% of subprime mortgages in 2006 were adjustable-rate mortgages (ARM), and the subprime ARMs stared to show increase in serious delinquency of 90 days or more past due and those in foreclosure; the delinquency rate for subprime ARMs increased from approximately 20% in 2007 to 40% in late 2009 (The Financial Crisis Inquiry Commission, 2011).

rate) of foreclosed homes in a neighborhood reaches a critical point, it might accelerate out-migration of higher-income households who become intolerant of their residential environment depreciating; it can intensify segregation of low-income households who do not have the wherewithal to choose a better place to live. Also, accumulation of foreclosed homes in a neighborhood may act as an impediment to in-migration of higher-income households and result in long-term vacancies because it is not likely to be attractive to homebuyers, especially when the threshold of concentrated foreclosures is passed. In the next chapter, Chapter 3, the methodology for estimating the foreclosure effect on income segregation will be explained based on the Threshold Effect Theory.

CHAPTER 3
METHODOLOGY

Hypothesis

This study begins with the assumption that residential mortgage foreclosures can drive increases in residential income segregation of neighborhoods in the context of the recent subprime mortgage foreclosure crisis. Mortgage payment delinquency and foreclosures are highly related to home buyers' incomes. If displaced as a result of foreclosure, their housing choice options will likely be constrained, leading to a certain degree of segregation by income (Reardon & Bischoff, 2011). Based on this premise, this study hypothesizes that the foreclosure effect on income segregation occurs differently according to neighborhood characteristics such as the foreclosure status (number or rate of foreclosures), median household income, employment status, and the percentage of owner-occupied homes as seen in Figure 3-1. To be specific, the foreclosed homes, especially when they are severely concentrated in economically distressed neighborhoods, can exacerbate low income segregation by depriving the households of their homes as well as by depreciating nearby properties, which can trigger out-migration of higher income residents, potential housing abandonment, and/or in-migration of lower-income households; whereas when they are in middle- or upper-income neighborhoods, foreclosures may create opportunities for homebuyers to purchase at lower prices instead of deleteriously affecting the property value or other economic status of neighborhoods (Immergluck & Smith, 2006a, 2006b; Li & Morrow-Jones, 2010; Schuetz, Been & Ellen, 2008; Simkovic, 2013). Thus, this study empirically tests whether a specific effect of foreclosure, low income segregation, is

heightened in lower income neighborhoods where foreclosures are severely concentrated and where housing demand is low.

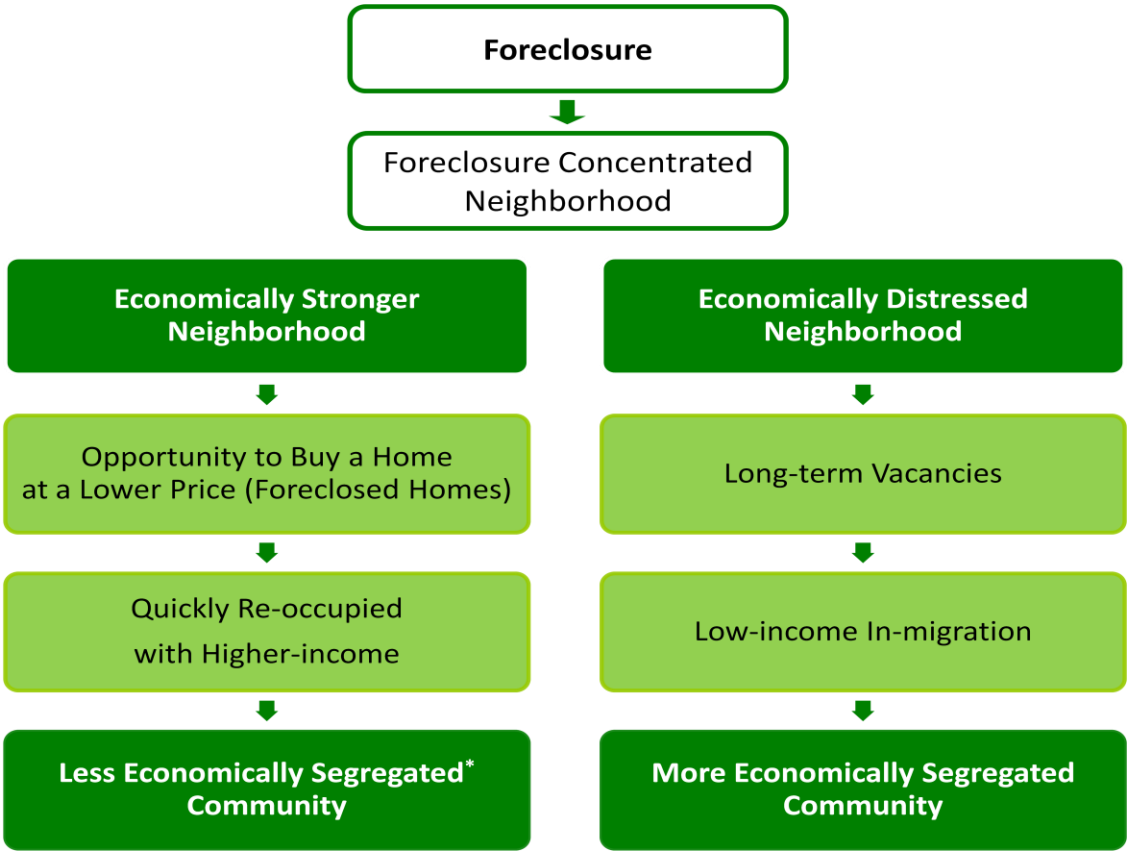
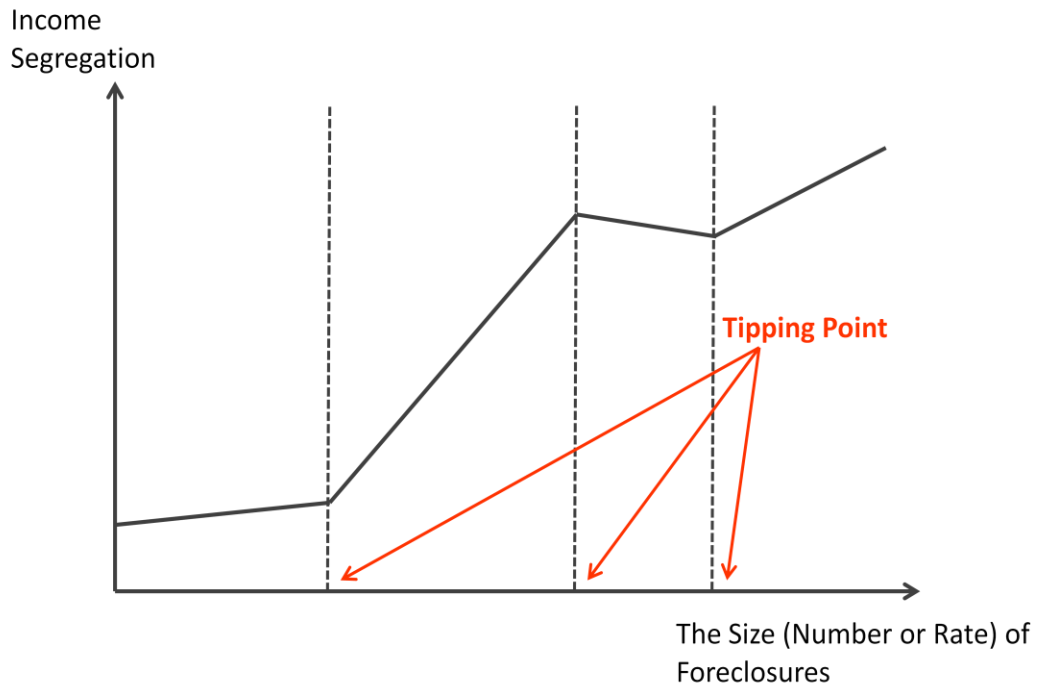


Figure 3-1. Conceptual diagram.

* In this study, residential income segregation is measured by the degree of possible interaction of low-income households with non-low-income households based on Massey and Denton (1988). Thus, when more higher-income households move into a neighborhood, the neighborhood becomes less economically segregated.

Considering the premise that the negative effect foreclosures might increase if more homes are entering into foreclosure in a neighborhood, this dissertation also hypothesizes that neighborhood status tends to change based on the "Threshold Effect Theory", which estimates the foreclosure effect on neighborhood income segregation. According to this theory, the size (number or rate) of foreclosures in a neighborhood determines the tipping point as seen in Figure 3-2 below. For example, a neighborhood

might be able to manage the foreclosure problem without any significant changes in spatial income composition, or might undergo a slight change in its initial level of income segregation until the size (number or rate) of foreclosures reaches a critical value. However, when a neighborhood reaches a critical value in the size (number or rate) of foreclosures, the neighborhood may experience sudden and rapid low-income segregation. And the "critical" point—threshold, or tipping point—might vary with neighborhood type based on the neighborhoods' economic characteristics. This study calculates the threshold effect of mortgage foreclosures on residential income segregation at the neighborhood level. Also, if it appears that the neighborhood threshold (tipping point) exists, the number and the locations of the tipping point are estimated based on neighborhood type, which are classified based on neighborhood characteristics.



Note: adapted from Marsh and Cornier, 2002. Spline Regression Models (P. 8, Figure 2.2).

Figure 3-2. Change in neighborhood indicators by the size of foreclosures.

- Hypothesis 1: Foreclosures, especially when they are concentrated in a certain neighborhood, can exacerbate income segregation of neighborhoods, and the relationship between the concentrated foreclosures and income segregation can be well explained by the “Threshold Effect” theory.
- Hypothesis 2: the foreclosure effect on residential segregation occurs differently in different neighborhoods.

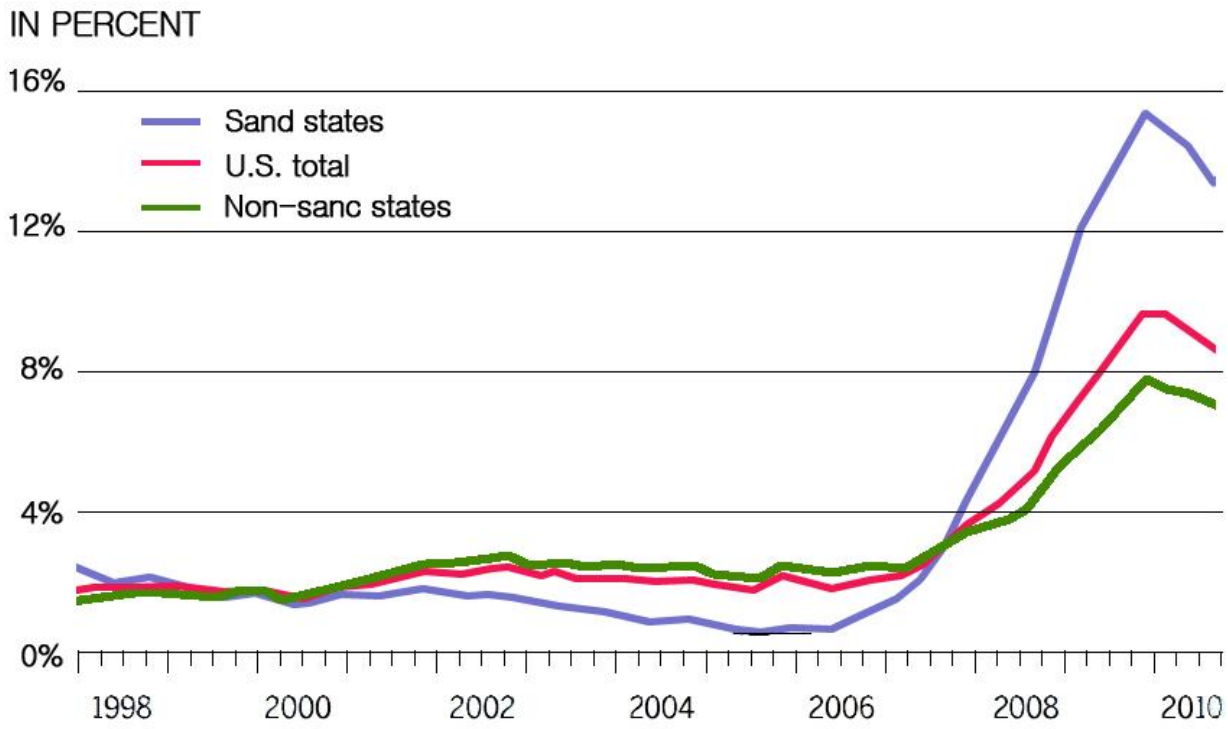
This chapter explains the methodology to empirically prove the hypothesis of this study, which examines these conditions in neighborhoods in the Miami Metropolitan Area. The definite increasing trend of foreclosures in the U.S. and the study areas’ relatively high proportion of U.S. foreclosures provide justification to investigate the foreclosure effect in this area. First, some socio-economic conditions of the study areas are outlined, including foreclosure distribution and the areas’ demographic and economic profile. It then introduces the geographical patterns of foreclosures at the neighborhood level, and the economic characteristics in neighborhoods with high frequencies of foreclosures. Further, regional characteristics are taken into consideration using the demographic and economic characteristics of the Miami Metropolitan Area. After understanding the foreclosure status and the study areas’ profile, methods for empirical analysis are illustrated; the neighborhoods in the Miami Metropolitan Area are classified depending on their socio-economic characteristics, and then classified by neighborhood types. The threshold effect of foreclosures on income segregation is estimated using spline regression analysis with reference to the relationship with the size (number or rate) of foreclosed homes.

Study Areas

Distribution of Foreclosures and Case Selection

The U.S. Foreclosure Market Report shows that about 2.3 million U.S. properties faced foreclosure proceedings in 2008, a 225 percent increase in total properties

foreclosed since 2006 (RealtyTrac, 2009). Also, according to the Financial Crisis Inquiry Commission (2011), mortgage loans in the state of serious delinquency, which means those 90 or more days past due or in foreclosure, had maintained around 1% since 1998, however, jumped in 2006 and kept rising as shown in Figure 3-3. In 2009, seriously delinquent mortgage loans reached to 9.7% of the entire mortgage loans.



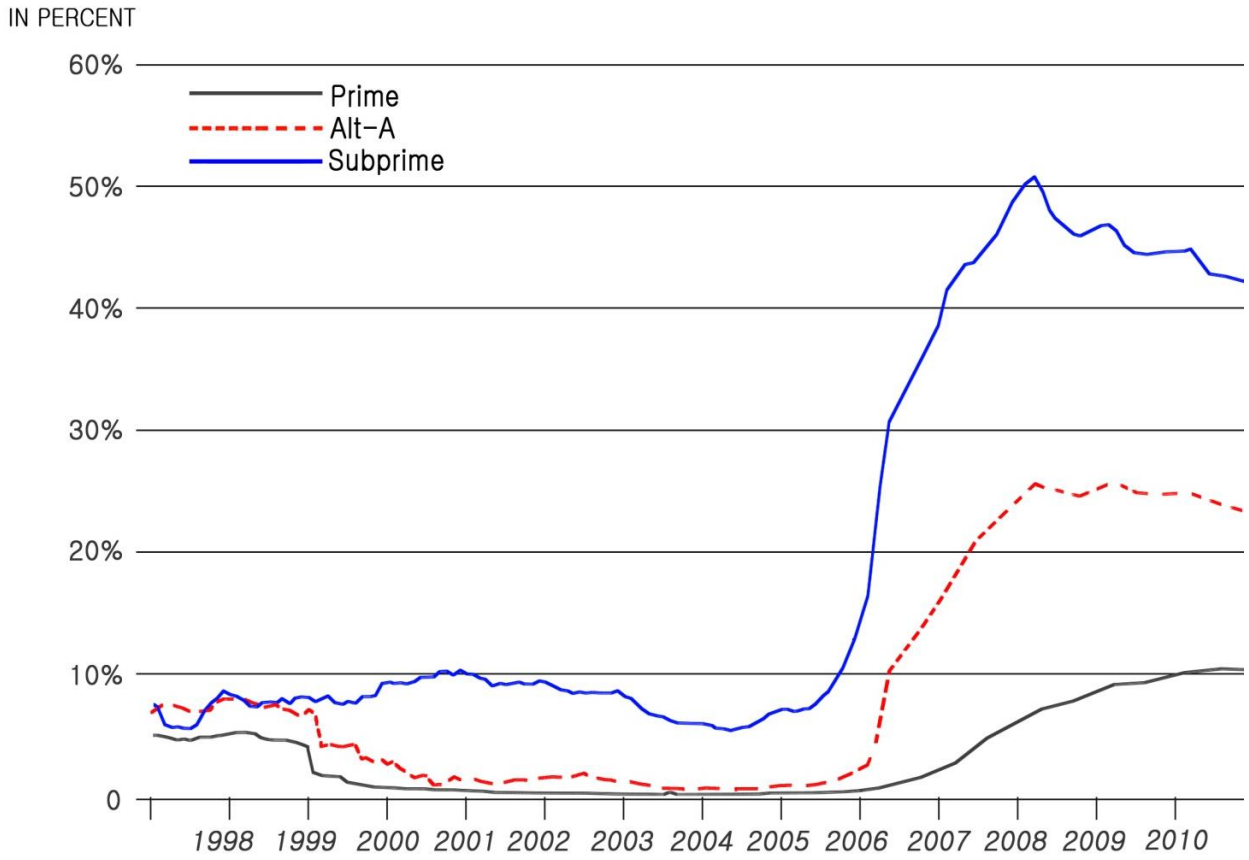
Note 1. Serious delinquencies include mortgages 90 days or more past due and those in foreclosures.
2. Sand states: Arizona, California, Florida, and Nevada (Financial Crisis Inquiry Commission, 2011).

Source: Mortgage Bankers Association National Delinquency Survey (several years)

Figure 3-3. U.S. mortgages in foreclosure.

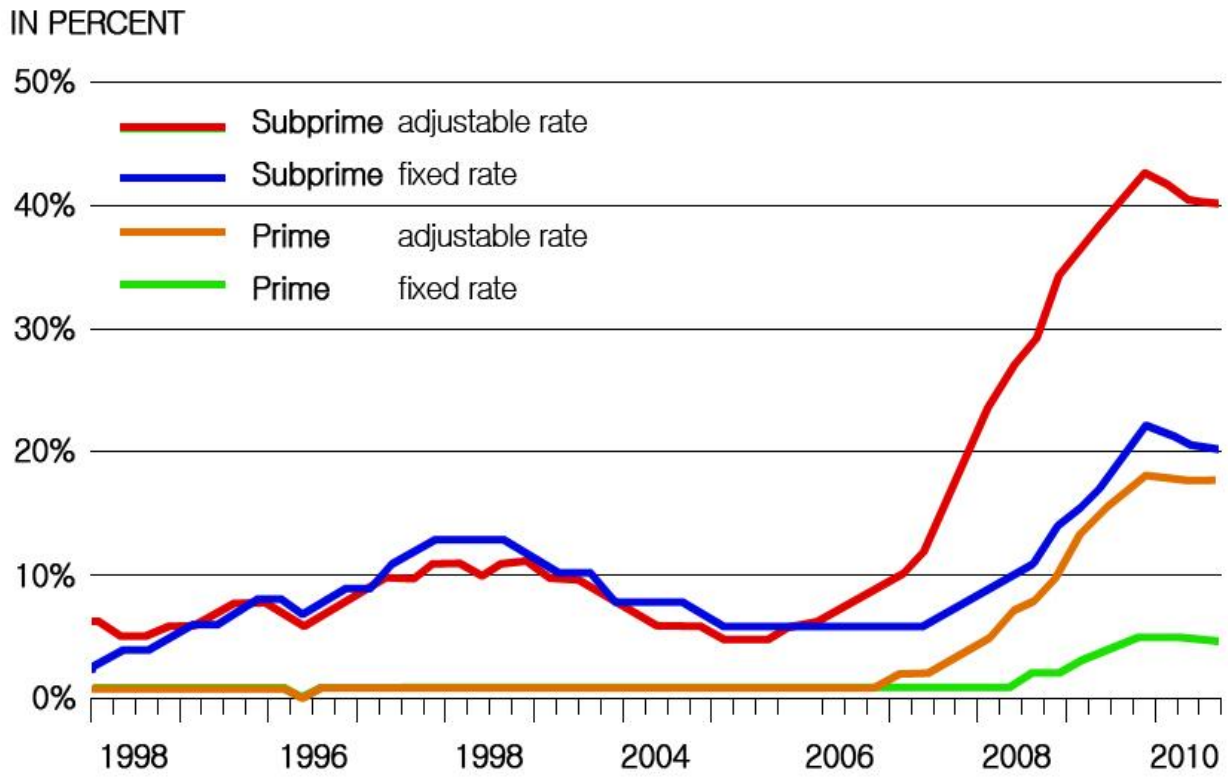
This dramatic increase in foreclosures comes from a large portion of subprime mortgages entering into delinquency or foreclosure. Subprime loans extend credit for those who might not have access to the loan market otherwise, and instead, takes a higher interest rate than a prime loan in order to accommodate the increased risk. A high percentage of subprime borrowers (90% in 2006) take adjustable-rate mortgages

(ARMs) because they can choose low initial mortgage payments with the plan to adjust their monthly loan payment during the future adjustment period. The borrowers believe that they can refinance the loan with more favorable terms based on a rising trend of housing prices (Cole & Mishler, 1997; Zandi, 2008). However, during the recent housing crisis, the subprime borrowers had difficulties refinancing their loans under the declining trend of housing prices, and delinquencies and defaults on subprime mortgages originated in 2006 have skyrocketed as shown in Figure 3-4 (Kiff & Mills, 2007). Also, we can see adjustable rate mortgages (ARMs) have been more distressed than fixed-rate mortgages (FRMs) in the Figure 3-5.



Note: Outstanding loans in 60 days or more past due and those in foreclosures (Kiff & Mills, 2007).
Source: Mortgage Bankers Association National Delinquency Survey (several years)

Figure 3-4. ARM delinquencies and foreclosures in the U.S.



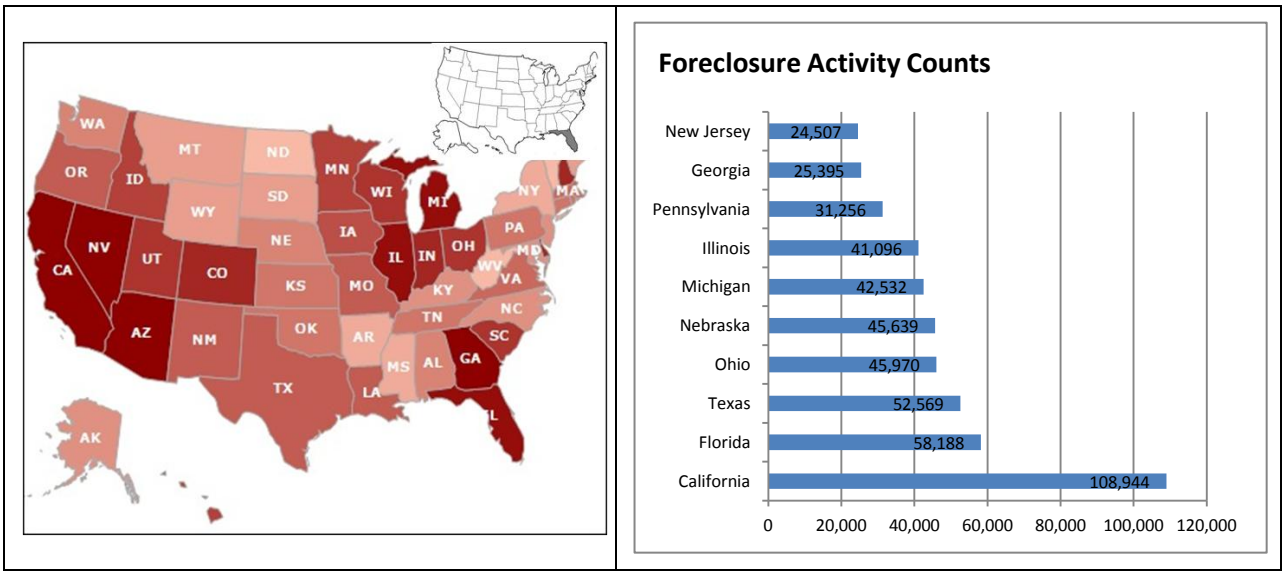
Note: Serious delinquencies include mortgages 90 days or more past due and those in foreclosures (Financial Crisis Inquiry Commission, 2011).

Source: Mortgage Bankers Association National Delinquency Survey (several years)

Figure 3-5. U.S. mortgage delinquency rates by loan type.

In this context, Florida represents one of the most serious cases in the U.S., experiencing the second highest number of foreclosures[1] (Neighborhood Stability Program, 2009). Because the Miami Metropolitan Area includes the top three counties in Florida, in terms of the total number of foreclosures (Neighborhood Stability Program, 2009), it is analyzed as the case study area. The Miami Metropolitan Statistical Area (Miami Metropolitan Area, Miami MSA) is located in the southeastern part of Florida, and consists of Miami-Dade, Palm Beach, and Broward counties.

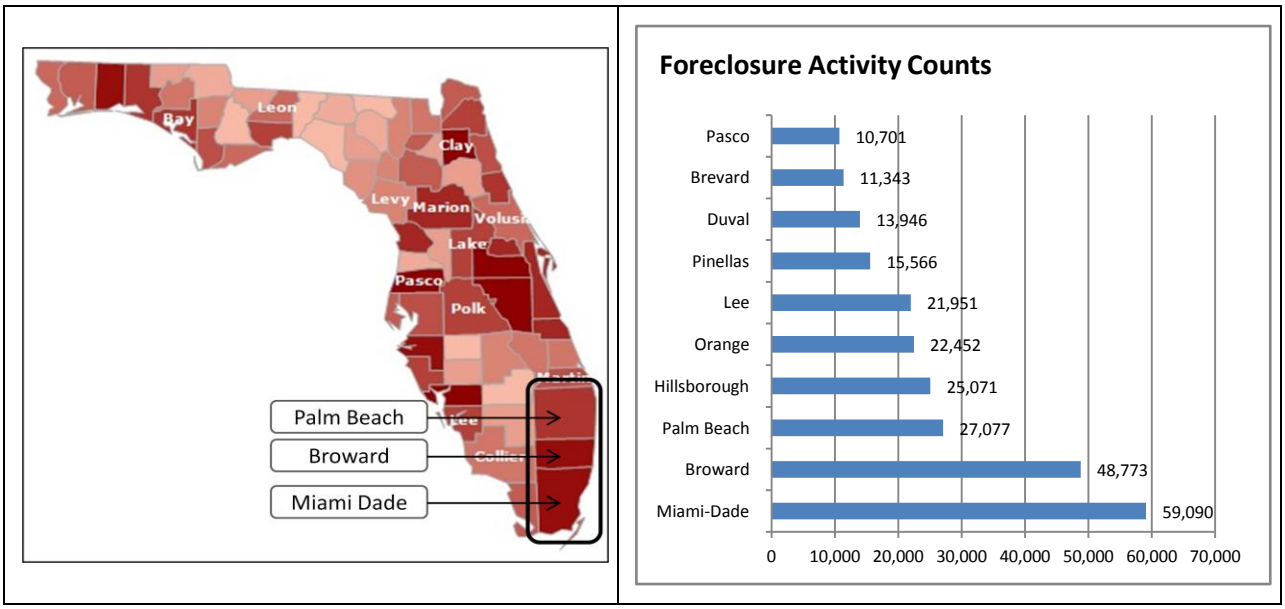
[1] The approximate number of foreclosure starts for all of 2007 and the first six months of 2008: 58,188 (Neighborhood Stability Program, 2009).



Note: Approximate number of foreclosure starts for all of 2007 and the first six months of 2008, based on the Mortgage Bankers Association National Delinquency Survey (based on a sample of approximately 41.6 million mortgage loans serviced by mortgage companies, commercial banks, thrifts, credit unions and others)

Source: HUD Neighborhood Stabilization Program (2009)

Figure 3-6. Foreclosure activities in the U.S.



Note: Approximate number of foreclosure starts for all of 2007 and the first six months of 2008, based on the Mortgage Bankers Association National Delinquency Survey (based on a sample of approximately 41.6 million mortgage loans serviced by mortgage companies, commercial banks, thrifts, credit unions and others)

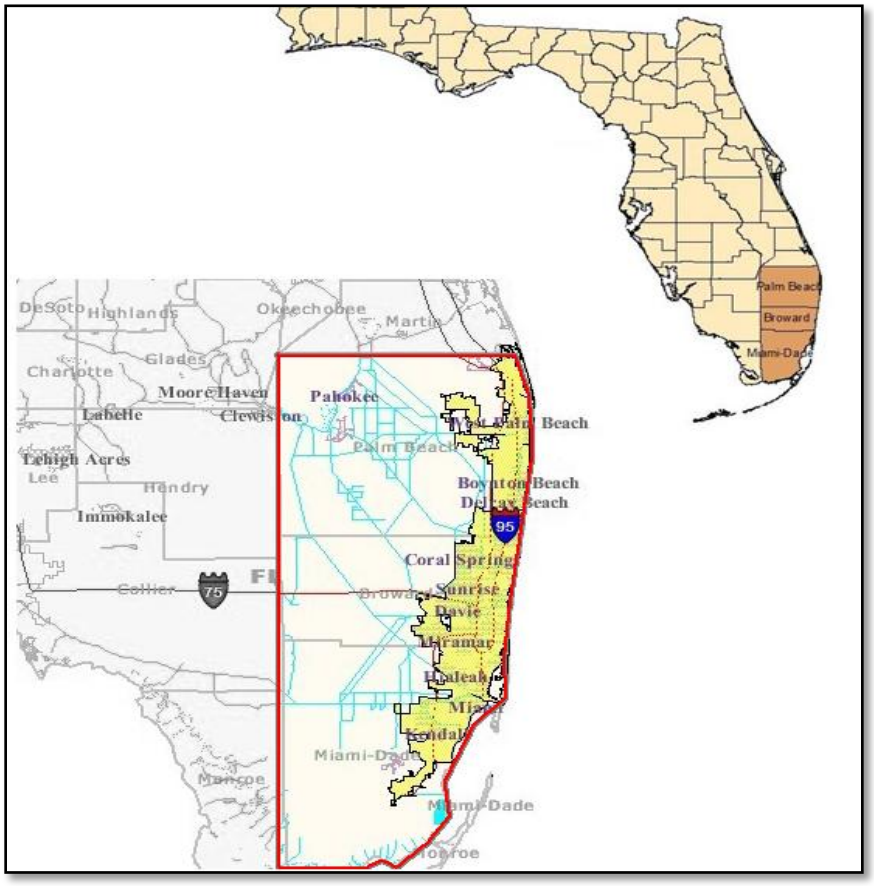
Source: HUD Neighborhood Stabilization Program (2009)

Figure 3-7. Foreclosure activities in the Florida State.

Profile of the Study Areas

General conditions

The Miami Metropolitan Statistical Area is composed of the three most populous counties in Florida. With over 5.5 million residents (5,564,635) (2010 U.S. Census), it is the eighth most populous metropolitan area of 381 Metropolitan Statistical Areas in the United States.[2] This population accounts for approximately one third of the Florida population (18,801,310), and includes several principal cities such as Miami, Fort Lauderdale, Pompano Beach, West Palm Beach, and Boca Raton (2010 U.S. Census).



Source: U.S. Census Bureau, Geography Division (2010)

Figure 3-8. Miami Metropolitan Area.

[2] The United States Office of Management and Budget (OMB) defines 381 Metropolitan Statistical Areas (MSAs) for the United States and seven for Puerto Rico by designating one or more adjacent counties or county equivalents (U.S. Office of Management and Budget, 2013).

In addition, according to the 2010 data from the U.S. Department of Commerce (2011), the Miami Metropolitan Area's GDP ranks 11th in the U.S., and comprises 34.2% ($257.6 Billion) of Florida's GDP ($754 Billion). However, the overall economy of the Miami Metropolitan Area is in decline. For example, per capita income in 2010 (ACS) stood at $41,838, down 4.8% from 2007 after inflation adjustment (Department of Commerce, Bureau of Economic Analysis, 2011). Moreover, the poverty rate (all households) increased from 13.3% in 2000 to 13.6% in 2010, and the number of households living in poverty has risen by 28,635 since 2000. Examining these current conditions in the Miami Metropolitan Area can contribute to understanding the reasons for this economic decline and their relation to the recent foreclosure crisis, which may help in determining policy and program recommendations and other solutions to relieve the negative effect of foreclosures.

Demographics

According to the 2000 U.S. Census, the population of the Miami Metropolitan Area is 5,007,564 and increased to about 5,564,635 in 2010 (U.S. Census 2000; 2010). As we can see in Table 3-1, the population in the Miami Metropolitan Area has increased by about 55,707 every year since 2000. One noticeable characteristic is that the population is primarily confined to the Miami urbanized area, the strip-shaped area between the Atlantic Ocean and the Everglades as seen in Figure 3-8. In 2000, the population of the urbanized area was 4,919,036 (98.23% of total population in the Miami MSA), and the urbanized area's population in 2010 was 5,502,379 (98.88% of the total population in the Miami MSA) (U.S. Census 2000; 2010).[3]

[3] Although the entire Miami Metropolitan Area is discussed here, the un-urbanized areas (the Everglades, agricultural areas, and water conservation areas) are excluded from the study area. This is because the

Table 3-1. Miami Metropolitan Area population: 2000-2010.

County	2000	2010	Change
Miami-Dade County (Miami-Miami Beach-Kendall)	2,253,362	2,496,435	243,073
Broward County (Fort Lauderdale-Pompano Beach-Deerfield Beach)	1,623,018	1,748,066	125,048
Palm Beach County (West Palm Beach-Boca Raton-Boynton Beach)	1,131,184	1,320,134	188,950
Miami MSA	5,007,564	5,564,635	557,071
Miami	362,470	408,568	46,098
Fort Lauderdale	152,397	165,521	13,124
Hollywood	139,357	140,768	1,411
West Palm Beach	82,103	101,043	18,940
Pompano Beach	78,191	99,845	21,654
Miami Beach	87,933	87,779	-154

Source: 2000 · 2010 U.S. Census Bureau Decennial Census

As of the 2010 U.S. Census, there are 2.69 million (48.4%) males and 2.87 million (51.6%) females among 5,564,635 people. The percentage of the Hispanic/Latino population is 41.6%, increasing from 34.0% in 2000. The percentage of the overall U.S. population was 16.4% in 2010 (U.S. Census 2000, 2010). Also, this Metropolitan Area's population is older than the U.S. average (U.S. Census 2010), as measured by the percentage of the population that is over-65 (15.9% versus 12.8%).

urbanized area includes the largest concentration of population (more than 95%) of the Miami Metropolitan Area. A large section of the un-urbanized area with a small portion of population can distort the results of this analysis.

Table 3-2. Miami Metropolitan Area demographic characteristics.

Characteristics		2000		2010	
		Population	Ratio (%)	Population	Ratio (%)
Hispanic or Latino Origin	Hispanic or Latino	1,704,064	34.0	2,312,929	41.6
	Non Hispanic or Latino	3,303,500	66.0	3,251,706	58.4
Race	White	3,610,052	72.1	3,914,239	70.3
	Black or African American	946,573	18.9	1,169,185	21.0
	Asian	85,461	1.7	125,564	2.3
	American Indian & Alaska Native	10,698	0.2	16,108	0.3
	Hawaiian & Pacific Islander	2,407	0.0	2,356	0.0
	Others	185,602	3.7	197,183	3.5
	Multi-Race	166,771	3.3	140,000	2.5
Sex	Male	2,418,866	48.3	2,693,823	48.4
	Female	2,588,698	51.7	2,870,812	51.6
Age	Under 5 years	311,706	6.2	324,045	5.8
	5 to 21 years	1,098,406	21.9	1,167,819	21.0
	22 to 39 years	1,292,197	25.8	1,309,333	23.5
	40 to 64 years	1,481,518	29.6	1,876,846	33.7
	65 years and over	823,737	16.4	886,592	15.9
	Total	5,007,564	100.0	5,564,635	100.0

Source: 2000 · 2010 U.S. Census Bureau Decennial Census

A total of 14.2% of the Miami Metropolitan Area's population is without a college education or even a high school diploma. This percentage is higher than the U.S. average of 12.9% (2010 U.S. Census Bureau).

Table 3-3. Miami Metropolitan Area educational attainment (2010).

Educational Attainment	Population	Distribution Ratio
Less than high school graduate	414,560	14.2%
High school graduate, incl. equivalency	792,450	27.2%
Some college or Associate's degree	823,842	28.2%
Bachelor's degree or higher	887,210	30.4%
Percent high school graduate or higher	2,503,502	85.8%
Percent bachelor's or higher	887,210	30.4%
Total (Population 25years and over)	2,918,062	100.0%

Source: 2010 American Community Survey

Employment and income

Table 3-4 shows employment numbers for Miami Metropolitan Area by industry. The Educational Services /Health Care and Social Assistance sector has the largest employment, and the fastest increase in employment from 2000 to 2010. This increase appears to be related to greater demand generated by a high percentage of elderly persons. On the other hand, the Finance and Insurance/ Real Estate and Rental and Leasing sector, the Information sector, and the Manufacturing sector have rapidly declining employment numbers. The rapid decline after 2008 in the Finance and Insurance/ Real Estate and Rental and Leasing sector and the Construction sector appears to be the result of the foreclosure crisis that emerged in 2007.

Table 3-4. Miami Metropolitan Area employment by industry.

Industry	Employment (Estimate)			Change (%)		
	2000	2008	2010	00-08	08-10	00-10
Agriculture, forestry, fishing and hunting, and mining	14,562	12,075	15,661	-17.08	29.70	7.55
Construction	159,783	225,904	206,712	41.38	-8.50	29.37
Manufacturing	146,236	134,744	132,362	-7.86	-1.77	-9.49
Wholesale trade	107,778	110,676	106,032	2.69	-4.20	-1.62
Retail trade	283,863	317,442	325,799	11.83	2.63	14.77
Transportation and warehousing, and utilities	133,841	162,642	156,212	21.52	-3.95	16.71
Information	73,474	66,689	63,673	-9.23	-4.52	-13.34
Finance and insurance, and real estate and leasing	187,409	228,729	220,286	22.05	-3.69	17.54
Professional, scientific, and management services	255,550	319,030	326,845	24.84	2.45	27.90
Educational services, and health care and social assistance	385,805	477,510	499,657	23.77	4.64	29.51
Arts, entertainment, and recreation, and accommodation, and food services	203,353	243,392	255,340	19.69	4.91	25.56
Other services, except public administration	119,890	146,146	151,927	21.90	3.96	26.72
Public administration	93,363	102,493	103,304	9.78	0.79	10.65
Total (16 years and over)	2,164,907	2,547,472	2,563,810	17.67	0.64	18.43

Source: 2000 U.S. Census; 2008, 2010 American Community Survey

The Miami Metropolitan Area's median household income had been rising steadily for most of the previous decade, but the growth in median household income started to fall in 2008; the average annual growth rate of the median household income between 2000 and 2008 was 2.97 percent, however, between 2008 and 2010, a decline occurred (minus 1.11 percent). Since that time, the number of households in the median- and low-income levels increased, while the number of households in the high-income level declined as seen in Table 3-5. This change in the income level in 2008 might stem from the foreclosure crisis beginning in 2007. This study will look at the foreclosure effect by income level of households.

Table 3-5. Miami Metropolitan Area income.

Income	Households (Estimate)			Average Annual Growth (%)		
	2000	2008	2010	00-08	08-10	00-10
Less than $10,000	203,075	155,031	161,437	-2.96	2.07	-2.05
$10,000 to $14,999	128,533	115,233	118,409	-1.29	1.38	-0.79
$15,000 to $19,999	125,749	114,887	115,985	-1.08	0.48	-0.78
$20,000 to $24,999	131,402	114,929	117,700	-1.57	1.21	-1.04
$25,000 to $29,999	125,973	109,149	111,754	-1.67	1.19	-1.13
$30,000 to $34,999	120,726	108,764	112,300	-1.24	1.63	-0.70
$35,000 to $39,999	110,955	100,883	102,383	-1.13	0.74	-0.77
$40,000 to $44,999	106,367	100,618	103,574	-0.68	1.47	-0.26
$45,000 to $49,999	88,421	84,509	86,292	-0.55	1.05	-0.24
$50,000 to $59,999	161,841	161,739	161,753	-0.01	0.00	-0.01
$60,000 to $74,999	181,412	194,713	197,111	0.92	0.62	0.87
$75,000 to $99,999	177,100	229,516	224,532	3.70	-1.09	2.68
$100,000 to $124,999	94,967	146,868	144,949	6.83	-0.65	5.26
$125,000 to $149,999	46,428	86,464	84,250	10.78	-1.28	8.15
$150,000 to $199,999	44,303	86,556	82,854	11.92	-2.14	8.70
$200,000 or more	59,208	96,959	94,321	7.97	-1.36	5.93
Total Households	1,906,460	2,006,818	2,019,604	0.66	0.32	0.59
Median household income (dollars)	40,906	50,634	49,514	2.97	-1.11	2.10

Source: 2000 U.S. Census; 2008, 2010 American Community Survey

Miami metropolitan area home ownership and occupancy status

According to the U.S Census Bureau data (2000, 2010), the homeownership rate[4] in the Miami Metropolitan Area decreased from 66.05% in 2000 to 63.48% in 2010, though the total number of housing units increased by 308,910 from 2,148,455 in 2000 to 2,457,365 in 2010 as shown in Table 3-6. The decrease in homeownership despite the increase in housing units might be related to the growing proportion of renter occupied housing units and vacant housing units; the proportion of renter occupied housing units increased from 30.09% in 2000 to 31.07% in 2010, and the housing vacancy rate increased from 11.37% in 2000 to 14.90% in 2010. Moreover, the increased vacancy rate and renter-occupied housing rate can be attributed to the recent foreclosure crisis, which resulted in owners losing their homes and being displaced. To better assess the foreclosure effect on neighborhoods, this study examines certain socio-economic characteristics with the goal of identifying tipping points that may vary by neighborhood type.

Table 3-6. Miami Metropolitan Area home-ownership status.

(Unit: number, %)

2000	Housing Unit	Home-ownership Rate	Vacancy Rate	Owner Occupied		Renter Occupied	
				Number	Rate	Number	Rate
Broward	739,749	69.56	11.69	454,403	61.43	198,877	26.88
Miami-Dade	852,278	57.85	8.86	449,325	52.72	327,449	38.42
Palm Beach	556,428	74.66	14.79	354,026	63.62	120,149	21.59
Total	2,148,455	66.05	11.37	1,257,754	58.54	646,475	30.09

[4] The homeownership rate is calculated by dividing the number of owner occupied housing units by the total number of occupied housing units (U.S. Census Bureau, Housing Vacancies and Homeownership).

Table 3-6. Continued.

2010	Housing Unit	Home-ownership Rate	Vacancy Rate	Owner Occupied		Renter Occupied	
				Number	Rate	Number	Rate
Broward	802,245	67.15	15.45	455,536	56.78	222,820	27.77
Miami-Dade	989,435	55.77	12.32	483,874	48.90	383,735	38.78
Palm Beach	665,685	71.19	18.10	388,144	58.31	157,063	23.59
Total	2,457,365	63.48	14.90	1,327,554	54.02	763,618	31.07

Source: 2000 U.S. Census; 2010 American Community Survey

Method of Analysis

In this study, two statistical methods are applied to examine the foreclosure effect at the Census Tract level[5]; cluster analysis for classifying neighborhoods and spline regression analysis for determining the threshold effect of foreclosures. The spline regression analysis is conducted twice, once before and once after neighborhood classification to assess both the overall foreclosure effect and the effect based on neighborhood types as shown in Figure 3-9. It uses secondary data from the U.S. Census Bureau and the U.S. Department of Housing and Urban Development. The analysis period is from 2000 to 2011 (2007-2011 American Community Survey (ACS) samples[6] are used for 2011 data). To classify neighborhoods, the data for 2000 is used to look at the initial status of neighborhoods before the foreclosure crisis; after

[5] Empirical studies addressing neighborhood issues have been usually conducted at a census tract level or census block group level, if data is available. Analysis at a more subdivided geographical unit level (i.e. census block group) can offer more detailed and specific results. However, because the foreclosure data, the independent variable for spline regression analysis, is provided at the census tract level, neighborhoods are designated as census tracts in this study.

[6] This 5-year public use micro-data sample (PUMS) for 2007-2011 contains the combined PUMS 1-year files for 2007, 2008, 2009, 2010 and 2011 of American Community Survey (ACS) and Puerto Rico Community Survey (PRCS) samples. It contains five years of data for housing units and the population from households and the group quarters (GQ) population (U.S. Census Bureau, American Community Survey).

classifying neighborhoods based on their economic characteristics, foreclosure data is compared by classified neighborhood types. Also, because the foreclosure data from the U.S. Department of Housing and Urban Development's (HUD) Neighborhood Stabilization Program (NSP) is collected in the year 2007 and the first six months of 2008 (foreclosure starts of 18 months), this study investigates the foreclosure effect shortly after the foreclosure crisis began based on the 2007-2011 American Community Survey (ACS).

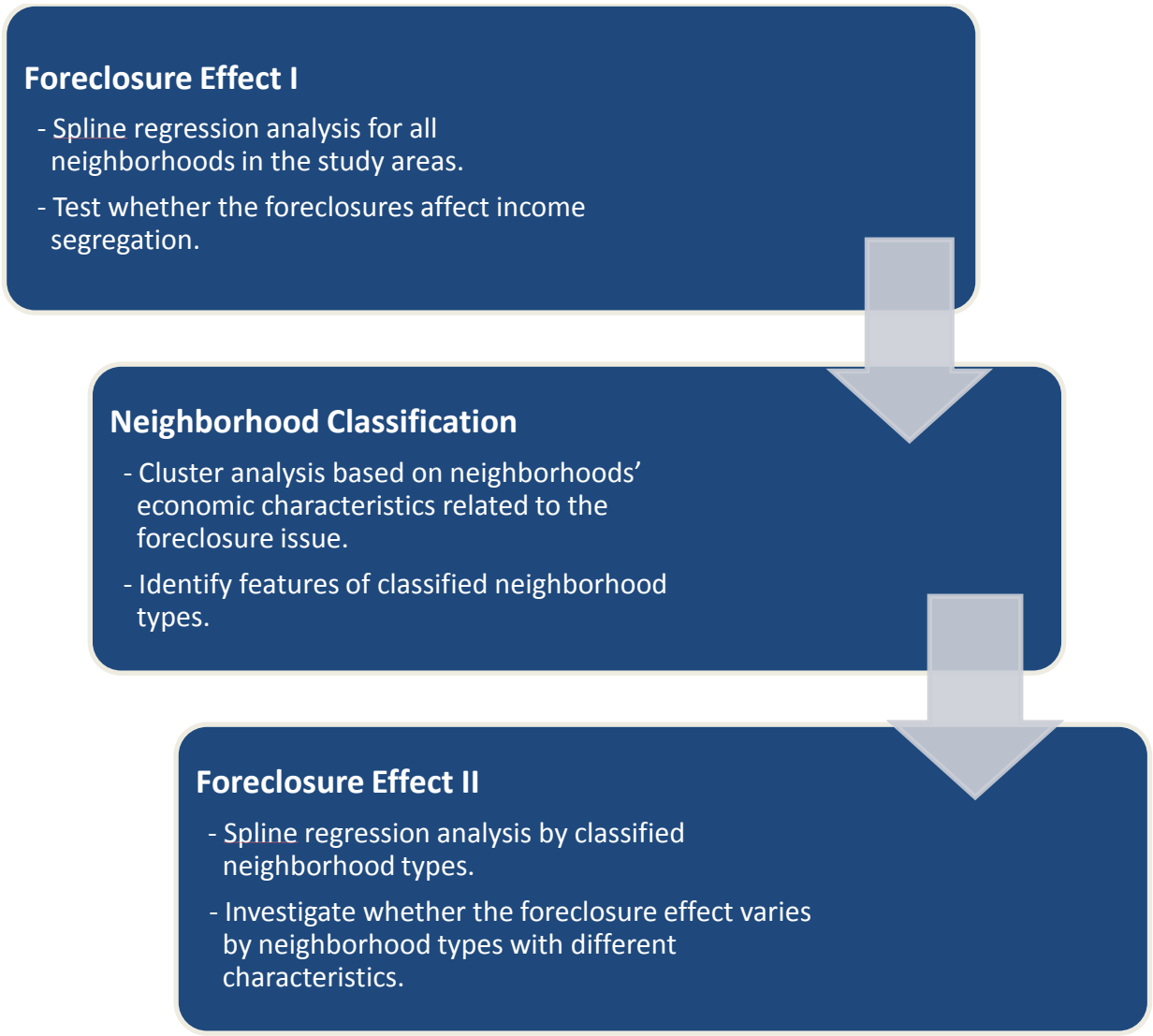
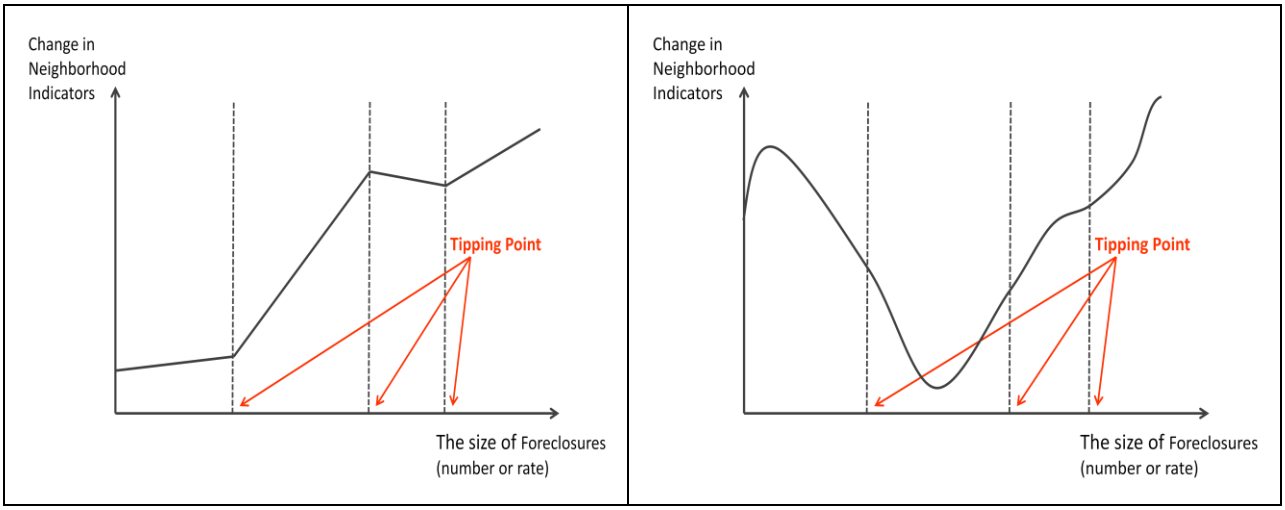


Figure 3-9. The process of analysis: application of methodology.

Foreclosure Effect on Income Segregation

Spline regression

The Threshold Effect theory assumes that neighborhood characteristics vary based on their thresholds, and this trend cannot be estimated through a simple linear regression. This study will use spline regression to test the threshold effects of mortgage foreclosure on income segregation. Spline regression estimates different linear slopes for different ranges of the independent variables. It is used when a regression line is broken into a number of line segments separated by special join points known as spline knots, or tipping points. It elegantly and effectively captures non-linearity of variables by simply joining some regression lines. Moreover, the joined regression lines can come in many different forms from linear lines to quadratic or higher order functions as shown in Figure 3-10.

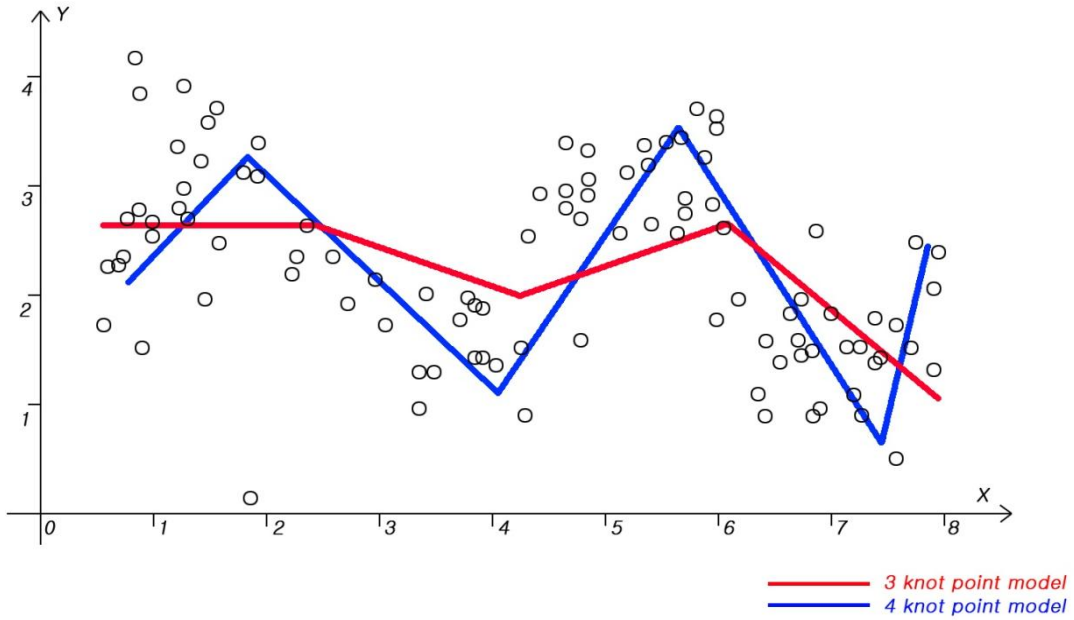


Note: adapted from Marsh and Cornier, 2002. Spline Regression Models (P. 8, Figure 2.2 & P. 25, Figure 3.4).

Figure 3-10. Form of spline regression.

The regression line changes direction at these points. Thus, “in applying spline methods, three features of splines play a key role: 1) the number of distinct spline segments into which the independent variable falls, 2) the degree of the polynomial

used to represent each segment, and 3) the location of the segment tipping points" (Marsh & Cornier, 2002, p.14). Namely, the number and the location of the segment tipping points determine the statistical significance of the spline regression model. However, the weakness of the model also exists in the process of deciding the tipping points; there is no theoretical direction to set the tipping points. The process of choosing the tipping points is "typically arbitrary, and the results are often sensitive to this choice" (Galster et al. 2000. p. 710). Therefore, the tipping points 1) can be set beforehand by researchers according to the data distribution as shown in Figure 3-11, or 2) can be automatically selected by computational model such as Multivariate Adaptive Regression Splines (MARS).[7] For more objective and accurate analysis, this study applies a computational model and tests statistical significance.



Note: adapted from Marsh and Cornier, 2002. Spline Regression Models (P. 18, Figure 2.2 & P. 25, Figure 3.4).

Figure 3-11. Choice of the number and the location of knot points.

[7] Multivariate Adaptive Regression Spline, introduced by Friedman in 1991, is a non-parametric regression statistical method for discovering the unknown number, locations and degree of the spline knots (Friedman, 1991).

Specifying tipping points beforehand. To explain the spline regression formula, suppose the model has three-tipping points arbitrarily selected by researchers based on data distribution (see Figure 3-11), the piecewise linear function can be specified as follows (Johnston, 1984):

$$Y = \theta + \alpha W_1 + \beta W_2 + \gamma W_3 + \varepsilon D_2 + \varphi D_3 + \varepsilon, \quad (3\text{-}1)$$

$$W_1 = X,$$

$$W_2 = 0 \text{ if } X \leq a; X - a \text{ if } a < X,$$

$$W_3 = 0 \text{ if } X \leq b; X - b \text{ if } b < X.$$

Where θ, α, β, and γ represent parameters to be estimated, D2 and D3 are dummy variables, and ε represents a random error term with the usual assumed statistical properties.

Selected by computational model. To discover the unknown number, locations, and degree of the spline knots, Friedman introduced Multivariate Adaptive Regression Splines (MARS) in 1991. It is a non-parametric regression statistical method and can automatically produce knot points from data based on hinge functions, partitioning the independent variables into their own regression lines (Friedman, 1991). To be specific, according to Friedman (1991), MARS follows the function as follows: it can be understood as a weighted sum of the basis functions B_m.

$$\hat{f}(x) = \sum_{m=1}^{M} a_m B_m(x) \quad (3\text{-}2)$$

And the basis functions B_m take the form

$$B_m(x) = I[x \in R_m] \quad (3\text{-}3)$$

"where *I* is an indicator function having the value one if its argument is true and zero otherwise. The $\{a_m\}_1^M$ are the coefficients of the expansion whose values are jointly adjusted to give the best fit to the data" (Friedman, 1991, p.10). Thus, the basis functions can have one of the following three forms:

- A constant one.
- A hinge function, *max(0, x-constant(knot)) or max(0, constant(knot)-x)*
- A function combining two or more hinge functions, which models interaction between two or more variables.

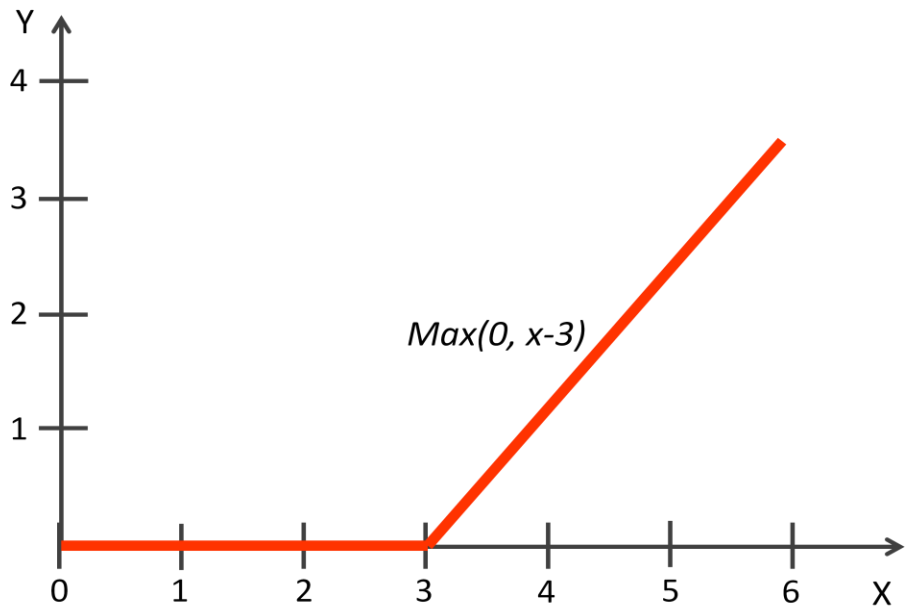


Figure 3-12. Hinge function with a knot at x=3.

The hinge function "consists of two hyperplanes continuously joined together at a hinge" (Breiman, 1993, p.999), and it suggests subregions of the covariate space (see Figure 3-12). Through the MARS, variable values for knots of the hinge functions are automatically taken.

Data for Spline regression analysis

In the model, a residential mortgage foreclosure is set as an independent variable (X: the number of foreclosures), and income segregation is set as a dependant variable (Y: income segregation index over five years from 2007 to 2011).

Table 3-7. Variable for spline regression analysis.

Variable	Data	Measurement
Independent Variable	Foreclosure Distribution	Number of Foreclosures by Census Tract
Dependent Variable	Income Segregation	Income Segregation Index - Dissimilarity Index - Isolation Index

Foreclosure Data. As an indicator distribution of foreclosures by census tracts, projected estimates from the Department of Housing and Urban Development (HUD)'s Neighborhood Stabilization Program (NSP) will be used. While foreclosure data at the neighborhood level is generally not available, HUD needed this data to allocate NSP funds on a priority basis to communities suffering from foreclosures. The federal agency provides its data of estimated foreclosures based on risk and vacancy data to assist state and local governments in their efforts to target the communities and neighborhoods with the greatest needs. This foreclosure data is based on the Mortgage Bankers Association National Delinquency Survey as of June 2008, and the approximate number of foreclosure starts for all of 2007 and the first six months of 2008 (foreclosure starts over 18 months).[8] Because foreclosure data is not estimated

[8] HUD elected to use this measure of "foreclosure starts" over a period of time rather than "currently in foreclosure" because the agency wanted to capture the volume of foreclosures independent of state laws and other actions locally that may affect how long a property is in the foreclosure process.

longitudinally, this study cannot cover the entire period from 2007-2011 consistent with the American Community Survey, which is used to measure income segregation. Thus in this study the foreclosure effect is examined as the influence of foreclosures during 2007 and the first six months of 2008 on income segregation during 2007 and 2011, which reflects the foreclosure effect after the recent foreclosure crisis.

Methodology for Allocation of $3.92 billion of Emergency Assistance for the Redevelopment of Abandoned and Foreclosed Homes (NSP 1)*

Section 2301 of the Housing and Economic Recovery Act of 2008 calls for allocating $3.92 billion for state and local governments (42 U.S.C. 5302) for emergency assistance with redeveloping abandoned and foreclosed homes.

The statute directs that the funds be allocated to "States and units of general local government with the greatest need, as such need is determined in the discretion of the Secretary based on

(A) the number and percentage of home foreclosures in each State or unit of general local government;

(B) the number and percentage of homes financed by a subprime mortgage related loan in each State or unit of general local government; and

(C) the number and percentage of homes in default or delinquency in each State or unit of general local government." (2301(b)(3))

The statute also provides direction to grantees that they should give priority emphasis in targeting the funds that they receive to "those metropolitan areas, metropolitan cities, urban areas, rural areas, low- and moderate-income areas, and other areas with the greatest need, including those--

(A) with the greatest percentage of home foreclosures;

(B) with the highest percentage of homes financed by a subprime mortgage related loan;

(C) identified by the State or unit of general local government as likely to face a significant rise in the rate of home foreclosures." (2301(c)(2))

Source: HUD Neighborhood Stabilization Program Data (http://www.huduser.org/portal/datasets/nsp.html)

* A summary of NSP 1 allocation formula

Figure 3-13. Methodology for NSP funding allocation.

Income segregation index

Massy and Denton (1988) evaluated twenty potential measures of residential segregation, and categorized them into five dimensions of residential segregation: evenness, exposure, concentration, centralization, and clustering. Massey et al. (1996) suggest the best five indicators to represent each segregation dimension based on Massey and Denton's (1988) original study by analyzing twenty segregation indices of 318 metropolitan areas in the US; the dissimilarity index (D; evenness), the isolation index (xP*x; exposure), the relative concentration index (RCO; concentration); the absolute centralisation index (ACE; centralisation) and White's index of spatial proximity (SP; clustering). However, considering data availability and the need to conduct analysis at the neighborhood (Census Tract) level, this study measures income segregation by using two indices among these distilled indices, the dissimilarity index and the isolation index. The dissimilarity index (Duncan & Duncan, 1955) in particular "served as the standard segregation index, routinely employed to measure spatial separation between social groups", because it can be easily calculated and interpreted, and can be applied to any group size or composition simply by calculating the percentage of minority members and comparing the minority percentage within residential areas to that in the entire urban area (Robinson, 1980; Ross et al., 2004, p.437). Not only the number of empirical studies applying the dissimilarity index, but also the availability of comparative data supports its reputation and provides a ground for the continued employment of the dissimilarity index (Robinson, 1980). Also the isolation index (Liberson, 1981) can help complement the income segregation measurement by emphasizing the spatial isolation of minority group members, on which the dissimilarity index (D) does not focus (Massey & Denton, 1988, p.287). Thus this

study applies these two measurements[9] to quantify income segregation, since they are widely used, convenient to test empirically, and helpful for deeper understanding of segregation trends through mutual supplementation[10] (Robinson, 1980).

Evenness: the Dissimilarity Index (D). Evenness means the extent to which minority members "share a common area of residence" with others (Massey & Denton, 1988, p. 284). As the most widely used measure, the dissimilarity index (Duncan & Duncan, 1955) measures the degree to which the percentage of low-income households[11] within neighborhoods approaches the minority percentage of the entire region (the entire analysis area).[12]

$$D = \sum_{i=1}^{n} \left[\frac{t_i \times |p_i - P|}{2TP(1-P)}\right] \quad (3\text{-}4)$$

[9] Within the context of this study, the concentration index can offer information about areas occupied by a critical mass of low-income households. Also, the centralization index measures the degree to which low-income households are located in and around the urban core which generally includes old and substandard housing. Finally, the index for measuring clustering refers to the extent to which low-income areas (census tracts) are spatially contiguous to each other. It is maximized if adjacent low-income areas cluster to form a contiguous area of low income residents. For this index, it is required to estimate the average proximity between members of the same group and between members of different groups (Massey et al., 1996)

[10] The dissimilarity index focuses on the proportion of low-income households in neighborhoods and the isolation index concentrates upon the total population of the low-income households. Thus together these two indices can effectively inform our understanding of income segregation. This is called mutual supplementation.

[11] Neighborhoods in the Miami Metropolitan Area will be categorized as low-income, middle-income, and high-income neighborhoods based on the HUD standard (HUD, 1996):

- Low-income: Median household income in a census block not in excess of 80 percent of area median household income of a region (county);
- Middle-income: Median household income in a census block between 81 and 120 percent of area median household income of a region (county);
- High-income: Median household income in a census block above 120 percent of area median household income of a region (county).

[12] The entire analysis area is the urbanized area in the Miami MSA.

This index has a value between 0 and 1.0 where t_i and p_i represent the total population and proportion of low-income households in census $tract_i$ respectively. And T and P are the population size and proportion of low income of the whole analysis area, which is subdivided into n census tracts.

Exposure: the Isolation Index (xP*x). Exposure represents "the degree of potential contact, or the possibility of interaction between minority and majority group members within geographic areas" (Massey & Denton, 1988, p.287). The isolation index (Liberson, 1981) measures the extent to which members share common residential areas with one another; it is calculated as the minority-weighted average of each neighborhoods' minority share (Massey & Denton, 1988). When X is the minority group,

$$xP^*x = \sum_{i=1}^{n} [x_i/X]\,[x_i/t_i] \qquad (3\text{-}5)$$

where x_i, and t_i are the numbers of X members, and the total population of census $tract_i$ respectively, and X represents the number of X members in the whole Metropolitan Area. It has a value between 0 and 1.0, and can be understood as the probability that one minority member (x_i) shares the area with another minority member.

Neighborhood Classification

Cluster analysis

To identify the clustering pattern of neighborhood indicators, a cluster analysis will be used. Cluster analysis is a statistical method used to form groups by assigning observed values with common characteristics into the same cluster. Consequently, the values of data in the same group are more similar to each other than those in the other groups.

The main factors that determine clustering results are 1) the data used, 2) the measurement taken to estimate similarity, and 3) group formation based on estimated values. The cluster analysis can be conducted in different ways based on what data comprises the cluster and how we can identify them efficiently using such methods as low-distance among objectives, intervals or statistical distribution, or area density in the case of spatial data. Based on the research question and the clustering notion, the clustering model may use a distance function, density model, or centroid model, and if necessary, multiple notions can be applied. The results of clustering can be modified by adjusting parameters or through a trial-and-error process.

Table 3-8. Algorithms of cluster analysis.

Clustering Algorithm		Manner of Analysis
Hierarchical Clustering	Divisive Method	▪ A top-down approach. ▪ All observations are assigned into one group. ▪ Then the cluster is split recursively as one moves down to lower hierarchies.
	Agglomerative Method	▪ A bottom-up approach. ▪ Start with each variable as individual clusters. ▪ Then at each step, merge the closest pair of clusters. · This method requires the definition of cluster proximity. · The number of clusters are set in advance of clustering.
K-means Algorithm (Partitioning)		▪ Applied when the number of clusters is decided in advance. ▪ Allocates observations into K clusters according to specific standards.

Source: Tan et al. (2006)

This study will use neighborhoods' economic data, which is highly related to foreclosures based on literature, such as area median income, the home ownership rate, housing prices by neighborhoods (census tracts).[13] In order to rearrange the data into some clusters, an appropriate measurement model will be applied. Average linkage, the centroid method, density linkage, and the minimum variance method are the representative methods of similarity measurement. And then, a clustering algorithm will be applied as follows; hierarchical clustering, k-means algorithm, and self-organizing maps (SOM). For validation, we can apply several measurement models and clustering algorithms, and compare each result.

Data for cluster analysis

Neighborhoods, designated as census tracts, will be specified according to the following neighborhood characteristics.[14]

Neighborhood Income. The 2000 Census "Income and Earnings" provides data about the income of the householder and all other individuals 15 years old and over in the household, whether they are related to the householder or not. Median household income in the census tract, which is computed based on the distribution of the total number of households, will be used for the neighborhood income variable.

Employment. The 2000 Census "Employment (Labor Force) Status" provides data about households with earnings, households with social security income, households with supplemental security income, households with public assistance

[13] Census tracts were designed to be relatively homogeneous with respect to population characteristics, economic status, and living conditions. And they do closely approximate neighborhoods for many areas (U.S. Census Bureau, 2000).

[14] Census tracts are defined by the Census Bureau and organized as sub-county areas. Over time, with demographic shifts, census tracts may be split due to population growth or combined as a result of substantial population decline (U. S. Census Bureau, 2000). This study is based on the boundaries of census tracts from the 2000 census, which are consistent with the 2011 census to allow for comparison.

income, and households with retirement income in 1999. To reflect employment status in the case study neighborhoods, the number of households identified in the 2000 report as having earnings in the past 12 months will be used.

Table 3-9. Data for cluster analysis.

Data	Measurement	Source	Based on:
Neighborhood Income	Median household income	U.S. Census (2000)	Anacker, Carr & Pradhan (2013) Baxter & Lauria (1999, 2000) Calem et al. (2004) Li & Morrow-Jones (2010) Reardon & Bischoff (2011) Schuetz, Been & Ellen (2008)
Employment	Households with earnings in the past 12 months	U.S. Census (2000)	Baxter & Lauria (1999, 2000) Li & Morrow-Jones (2010)
Tenure	Percentage of owner-occupied homes	U.S. Census (2000)	Baxter & Lauria (1999, 2000)
Home Value	Median value of owner-occupied housing units	U.S. Census (2000)	Baxter & Lauria (1999, 2000) Been (2008), Carroll et al. (1997) Forgey et al.(1994), Harding et al.(2009) Immergluck & Smith (2006a) Leonard & Murdoch (2009) Lin et al.(2009) Schuetz, Been & Ellen (2008)
	Median contract rent (renter-occupied)	U.S. Census (2000)	
Occupancy Status	Vacancy rate by census tract	U.S. Census (2000)	Anacker, Carr & Pradhan (2013) Schuetz, Been & Ellen (2008)
Age of Houses	Median year housing units built	U.S. Census (2000)	Anacker, Carr & Pradhan (2013)

Tenure and Occupancy Status. The 2000 Census "Housing Occupancy Status" offers material about household type, occupancy and vacancy status, tenure in occupied units, and demographic characteristics of householders. To understand housing tenure and occupancy status of communities in the Miami Metropolitan Area, the percentage of owner-occupied homes and vacancy rate by census tract is used.

Home Value. The 2000 Census "Housing Financial Characteristics" provides data related to the value of homes, rent, housing costs, and mortgage status. The home value data will be applied to owner-occupied and renter-occupied homes respectively. For the value of owner-occupied homes, median value of owner-occupied housing units in neighborhoods is selected, and for renter-occupied home value, median contract rent of neighborhoods is chosen.

Age of Houses. The 2000 Census 'Housing Physical Characteristics' data consists of the number of bedrooms, building materials, heating and air conditioning, kitchen facilities, and year structure built. The housing units' median year built data provides the approximate age of the housing units in a neighborhood; for example, if the housing units' median year built is 1990, the median age of housing units in the neighborhood is 10 years in 2000. This data was obtained from a national household survey of both occupied and vacant housing units, indicating when the building was first constructed, not remodeled, added to, or converted.

In this chapter, the methodology for analysis is discussed. For determining appropriate methods, first of all, the basic hypothesis is set; 1) the foreclosure effect on income segregation occurs differently in different neighborhoods, 2) neighborhoods tend to change based on the "Threshold Effect Theory", considering that the foreclosure

effect is highly related to the size (number and rate) of foreclosures. To test the first hypothesis in an empirical way, cluster analysis is applied to neighborhoods in the Miami Metropolitan Area on the basis of the demographic and economic characteristics. And the second hypothesis is proved through spline regression analysis, which can express the non-linearity of variables by joining regression lines; the dependent variable, income segregation is measured by the segregation index as outlined by Massey et al. (1996)—the dissimilarity index and the isolation index. The results of the analysis, neighborhood classification and threshold effect of foreclosures, will be discussed in the next chapter.

CHAPTER 4
FINDINGS

This chapter examines the results of applying the methodology. In the first section, Foreclosure Effect I, we assess whether the foreclosures, indeed, cause more segregated communities by income, and whether the threshold effect theory can effectively explain the foreclosure effect in the Miami Metropolitan Area. The findings from the Foreclosure Effect I analysis can provide empirical evidence to link the overall economic status in the study areas, such as decreased median household income since 2008, intensified poverty rate, and/or the decreased homeownership rate between 2000 and 2010 understood, to the recent foreclosure crisis. And then, to investigate how the foreclosure effect varies by neighborhoods with different economic characteristics, neighborhoods in the analysis areas are classified according to neighborhood type based on their overall economic characteristics. Based on these neighborhood types, the threshold effect of foreclosures is empirically tested (Foreclosure Effect II).

Foreclosure Effect I

Relationship between Foreclosures and Income Segregation

The SAS program provides a non-parametric regression technique, the ADAPTIVREG procedure, combining regression splines and methods of model selection. It builds spline function “by automatically selecting appropriate knot values for different variables” and gets reduced models “by applying model selection techniques” as the multivariate adaptive regression spline methods (SAS Institute Inc., 2012, p.844). The ADAPTIVEREG generates an over-fitted model having overly selected spline knots, then discards less significant knot points based on the

multivariate adaptive regression spline (MARS)[1] function as suggested by Friedman (1991) (SAS Institute Inc., 2012). In the Foreclosure Effect Model I, the response variable is the income segregation index, dissimilarity index and isolation index, and the predictor variable is the size (number and rate) of foreclosures. According to the hypothesis, the dependency of the foreclosure effect might be nonlinear. The nonlinear dependency structure is explored through the ADAPTIVEREG procedure, and a predictive model is produced. The model will be selected as a form of piecewise-linear splines, and it helps to interpret the nonlinearity of the variable.

Foreclosure Effect in terms of the Number of Foreclosures

The distribution of segregation indices triggered by concentrated foreclosures in neighborhoods is as follows. Figure 4-1 and Table 4-1 display the effect of the number of foreclosures on the dissimilarity index, and Figure 4-2 and Table 4-2 show the foreclosure effect in terms of the number of foreclosures on the isolation index. Although the total explanatory power is not very high (the Adjusted R-square of the dissimilarity index and the isolation index are 0.174 and 0.306 respectively), it can be interpreted that the number of foreclosures influences income segregation of neighborhoods, and the isolation index is more closely related than the dissimilarity index. Also, the dissimilarity index has two tipping points and the slopes of the regression lines become steeper as the number of foreclosures increases. In the case of the isolation index, which can better explain the foreclosure effect, the index value increases at a rapid pace until the number of foreclosures reaches the tipping point that

[1] It is a non-parametric regression statistical method and can automatically produce knot points from data based on hinge functions, partitioning the independent variables into their own regression lines (Friedman, 1991). The detailed mathematical formula is explained in the Methodology chapter.

is located at the early stage of the foreclosure concentration, and then the slope becomes flattened slightly.

Dissimilarity index

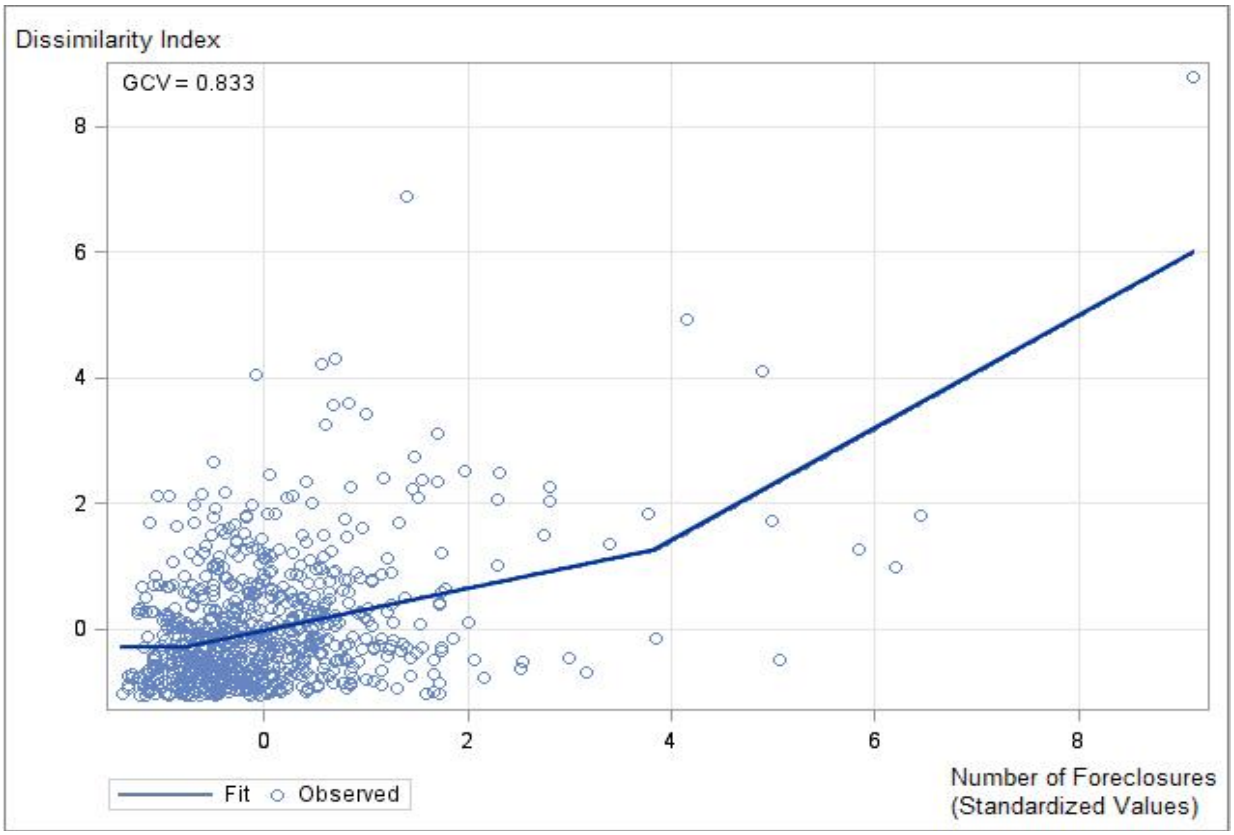


Figure 4-1. Spline regression fit for dissimilarity index.

Table 4-1. Fit statistics for the dissimilarity index.

Fit Controls		Fit Statistics	
Maximum Number of Bases	21	GCV	0.83330
Maximum Order of Interaction	1	GCV R-Square	0.16776
Degrees of Freedom per Knot	2	Effective Degrees of Freedom	5
Knot Separation Parameter	0.05	R-Square	0.17628
Penalty for Variable Reentry	0	Adjusted R-Square	0.17416
Missing Value Handling	Include	Mean Square Error	0.82584
Number of Observations Read	782	Average Square Error	0.82267
Number of Observations Used	781		

Isolation index

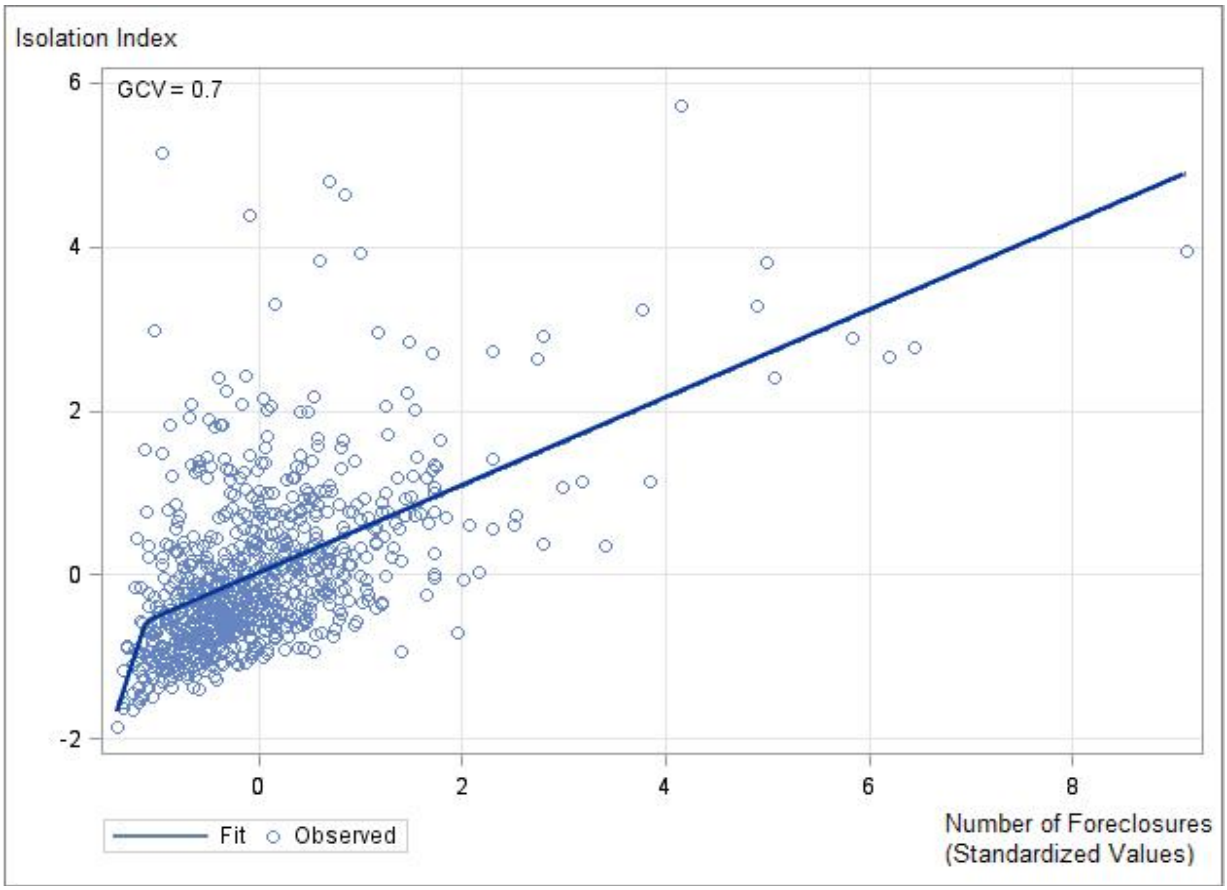


Figure 4-2. Spline regression fit for isolation index.

Table 4-2. Fit statistics for the isolation index.

Fit Controls		Fit Statistics	
Maximum Number of Bases	21	GCV	0.69999
Maximum Order of Interaction	1	GCV R-Square	0.30091
Degrees of Freedom per Knot	2	Effective Degrees of Freedom	5
Knot Separation Parameter	0.05	R-Square	0.30807
Penalty for Variable Reentry	0	Adjusted R-Square	0.30629
Missing Value Handling	Include	Mean Square Error	0.69371
Number of Observations Read	782	Average Square Error	0.69105
Number of Observations Used	780		

Foreclosure Effect in terms of the Rate of Foreclosures

The result of spline regression, which analyzes the relationship between the foreclosure rate and income segregation, is displayed in Figure 4-3 and 4-4, in Table 4-3 and 4-4. Figure 4-3 and Table 4-3 represent the foreclosure effect in terms of the rate of foreclosures on the dissimilarity index, and Figure 4-4 and Table 4-4 show the relationship between the foreclosure rate and the isolation index.

Dissimilarity index

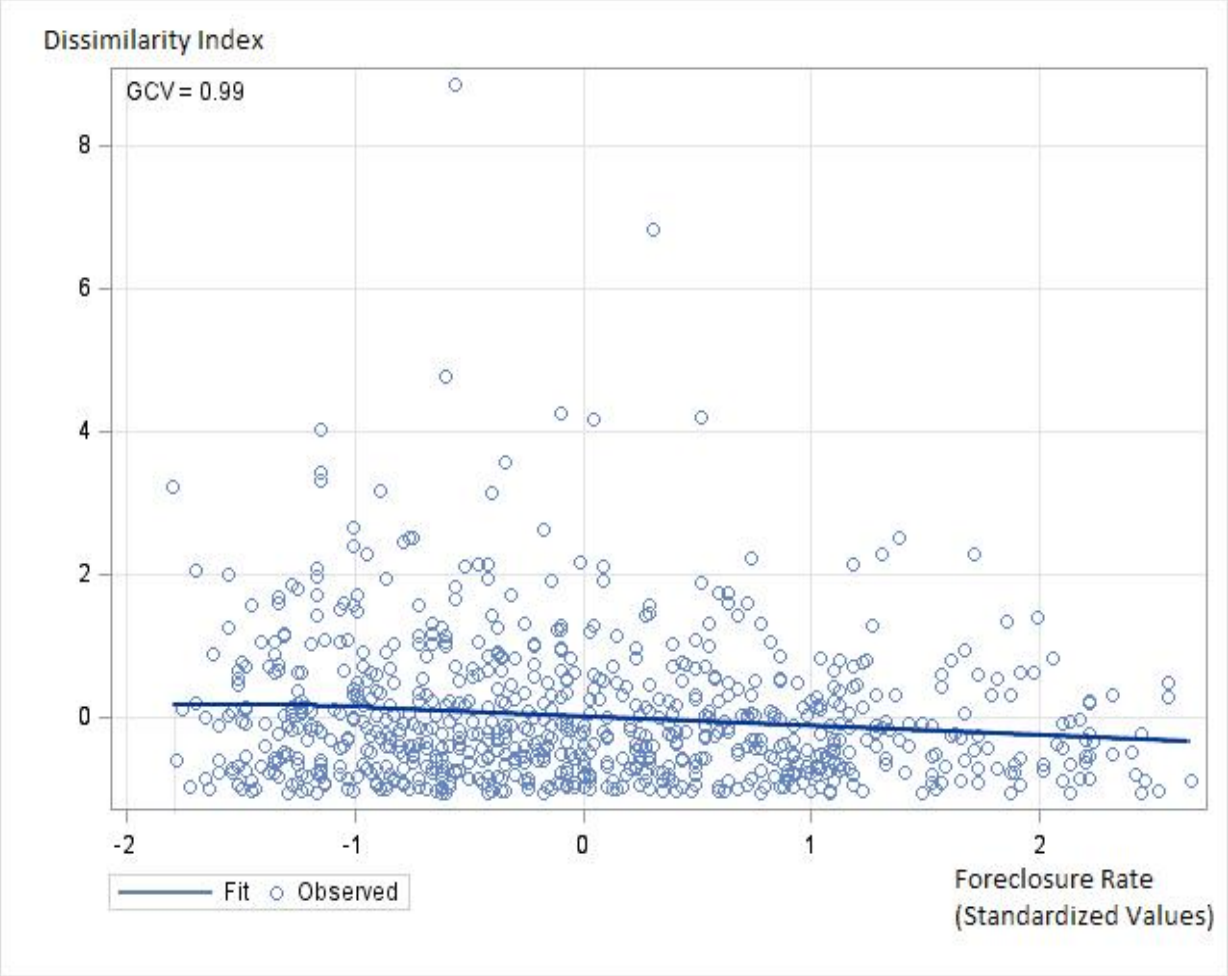


Figure 4-3. Spline regression fit for dissimilarity index.

Table 4-3. Fit statistics for the dissimilarity index.

Fit Controls		Fit Statistics	
Maximum Number of Bases	21	GCV	0.99247
Maximum Order of Interaction	1	GCV R-Square	0.00880
Degrees of Freedom per Knot	2	Effective Degrees of Freedom	3
Knot Separation Parameter	0.05	R-Square	0.01388
Penalty for Variable Reentry	0	Adjusted R-Square	0.01261
Missing Value Handling	Include	Mean Square Error	0.98739
Number of Observations Read	782	Average Square Error	0.98486
Number of Observations Used	781		

Isolation index

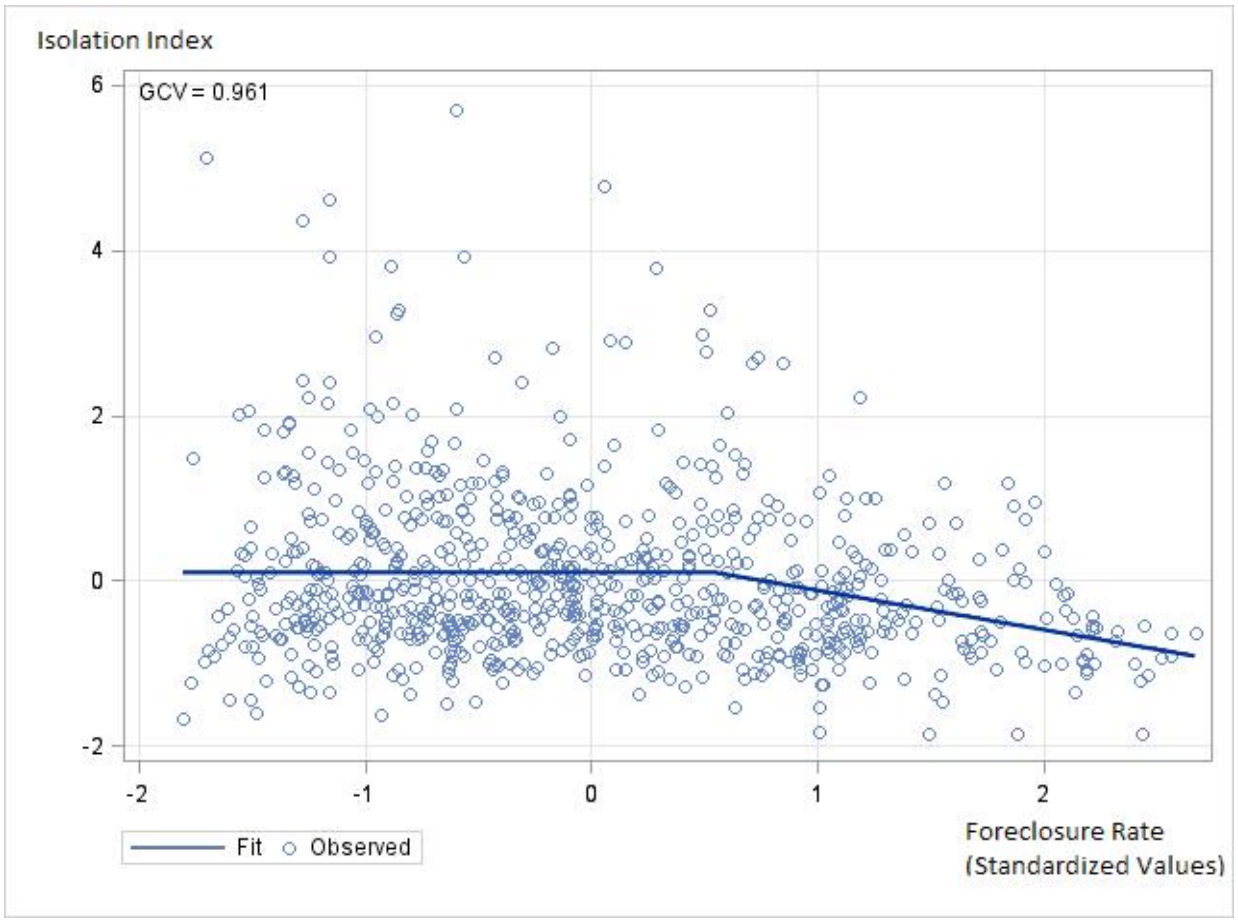


Figure 4-4. Spline regression fit for isolation index.

Table 4-4. Fit statistics for the isolation index.

Fit Controls		Fit Statistics	
Maximum Number of Bases	21	GCV	0.96694
Maximum Order of Interaction	1	GCV R-Square	0.03430
Degrees of Freedom per Knot	2	Effective Degrees of Freedom	3
Knot Separation Parameter	0.05	R-Square	0.03925
Penalty for Variable Reentry	0	Adjusted R-Square	0.03801
Missing Value Handling	Include	Mean Square Error	0.96199
Number of Observations Read	782	Average Square Error	0.95952
Number of Observations Used	780		

As seen in Table 4-3 and 4-4, the effect of the foreclosure rate on income segregation does not have statistical significance. The Adjusted R-Square is less than 0.05; the Adjusted R-Square of the dissimilarity index and the isolation index are 0.016 and 0.038 respectively. Thus there is insufficient evidence that the rate of foreclosures influences income segregation, whereas the number of foreclosures has some statistical significance to income segregation of neighborhoods.[2] Namely, from the perspective of the foreclosure effect on income segregation, the quantity of foreclosures is more significant than the rate of foreclosure occurrence.

Index Selection and Outliers Detection

Given the analysis results that the statistical significance of the foreclosure effect is more effectively explained by the isolation index than the dissimilarity index and the quantity of foreclosures has more statistically significant explanatory power than the rate of foreclosures, this study investigates the foreclosure effect on income segregation

[2] The Adjusted R-Square of the dissimilarity index and the isolation index are 0.174 and 0.306 respectively (seen in Table 4-1 and 4-2).

based on the number of foreclosures and measures income segregation by using the isolation index. However, based on the graph showing the number of foreclosures and the isolation index (Figure 4-2), these regression models may have outlier problems. In statistics, an outlier refers to an observation that is distant from the rest of the data, thus it generates large residuals that can degrade the quality of model fit (Grubbs, 1969). Because the outlier indicates that the data has an unusual value, entry error, or other problem, this issue needs to be addressed.

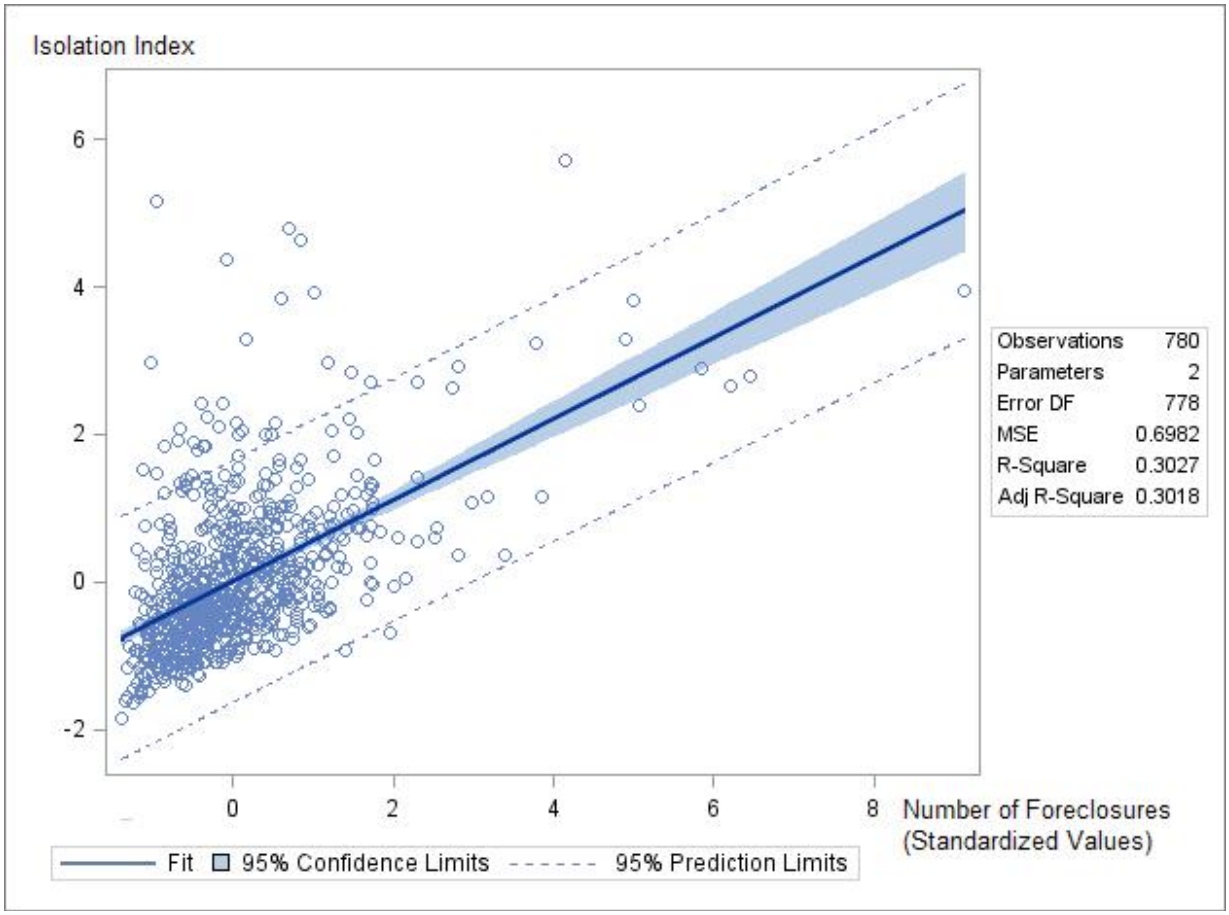


Figure 4-5. Linear regression for detecting outliers.

In this study, Cook's distance diagnostics is used to determine observation points worth checking for validity.[3] It is calculated by using the number of regression coefficients estimated and standardized residuals for the observation. Observation points having large Cook's distance values need detailed examination in the analysis. Generally, the influence or leverage of an outlier is high when the Cook's distance is larger than 4/n where n is the number of sample observations. The observations which have large Cook's distance values are shown in Figures 4-5 and 4-6.

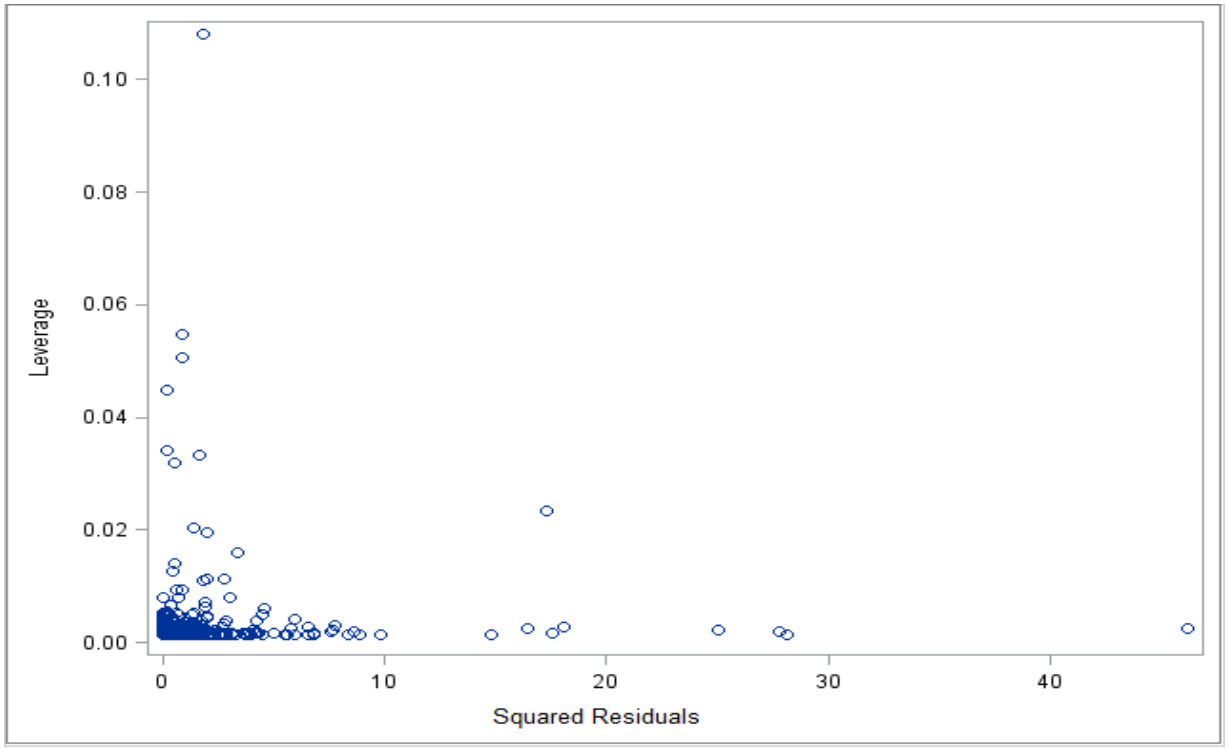


Figure 4-6. Leverage and squared residuals of regression model.

[3] Cook's distance is one of the commonly used diagnostic measures to estimate the influence of a observation point by combining the information of leverage and residual values of the observation by conducting least squares regression analysis (Mendenhall and Sincich, 1996). Cook's distance for an observation is defined as:

$$C_i = (1/k^*) \cdot \left[h_{i,i}/\left(1 - h_{i,i}\right)\right] \cdot \varepsilon_i^2$$

k^*: the number of fitted parameters in the model
$h_{i,i}$: the i^{th} diagonal element of the hat matrix $(X(X^TX)^{-1}X^T)$
X: the $n \times k^*$ matrix of regressors
ε_i: the standardized residual for the i^{th} observation in the model

Table 4-5. Detected outliers.

STFID	Iso	Nfore	cookd	STFID	Iso	Nfore	cookd
12086005202	0.00715	61	0.00951	12086010138	0.00861	536	0.00578
12086002702	0.01021	77	0.02404	12086000113	0.00991	539	0.01205
12086004602	0.00706	91	0.00709	12086010607	0.00964	583	0.01137
12099000301	0.01478	94	0.05606	12086003908	0.00250	629	0.01422
12011092000	0.00780	108	0.00859	12011110500	0.00384	637	0.0063
12011040201	0.00798	140	0.00718	12086009801	0.00404	665	0.00694
12099001902	0.00833	146	0.0079	12086004300	0.00966	691	0.01236
12099000700	0.00796	177	0.00541	12086009802	0.00950	774	0.01025
12011031100	0.00901	196	0.00728	12086010153	0.01008	783	0.01569
12099000901	0.00865	208	0.00592	12086010703	0.00473	784	0.01148
12011040600	0.00905	245	0.00581	12086009902	0.00471	894	0.02724
12011010601	0.01315	251	0.01821	12099007906	0.01077	962	0.01989
12011110314	0.01087	296	0.00971	12086009008	0.00637	978	0.01433
12086003802	0.01200	379	0.0154	12086000115	0.01595	1032	0.20684
12086006702	0.01401	397	0.02671	12086010144	0.01086	1170	0.00866
12099005919	0.0137	422	0.02744	12086009009	0.01194	1188	0.0285
12011070308	0.01221	452	0.02111	12086010173	0.00952	1410	0.02335
12099007727	0.01018	484	0.01183	12086011004	0.00979	1457	0.02607
12086010157	0.00200	527	0.00804	12011110317	0.01225	1949	0.11126

When these detected outliers are dropped, the result of spline regression is as shown in Figure 4-7 and Table 4-6. As we can see when comparing Table 4-2 and 4-6, the result changes slightly; the Adjusted R-square of the isolation index changes from 0.306 to 0.311 after removing the outliers. More significant change is that the spline regression fit does not show distinct tipping points, while the spline regression fit before removing the outliers (seen in Figure 4-2) displays an obvious threshold point during the early stage of the foreclosure concentration[4].

[4] The standardized number of foreclosures is -1.133 (68 foreclosed homes).

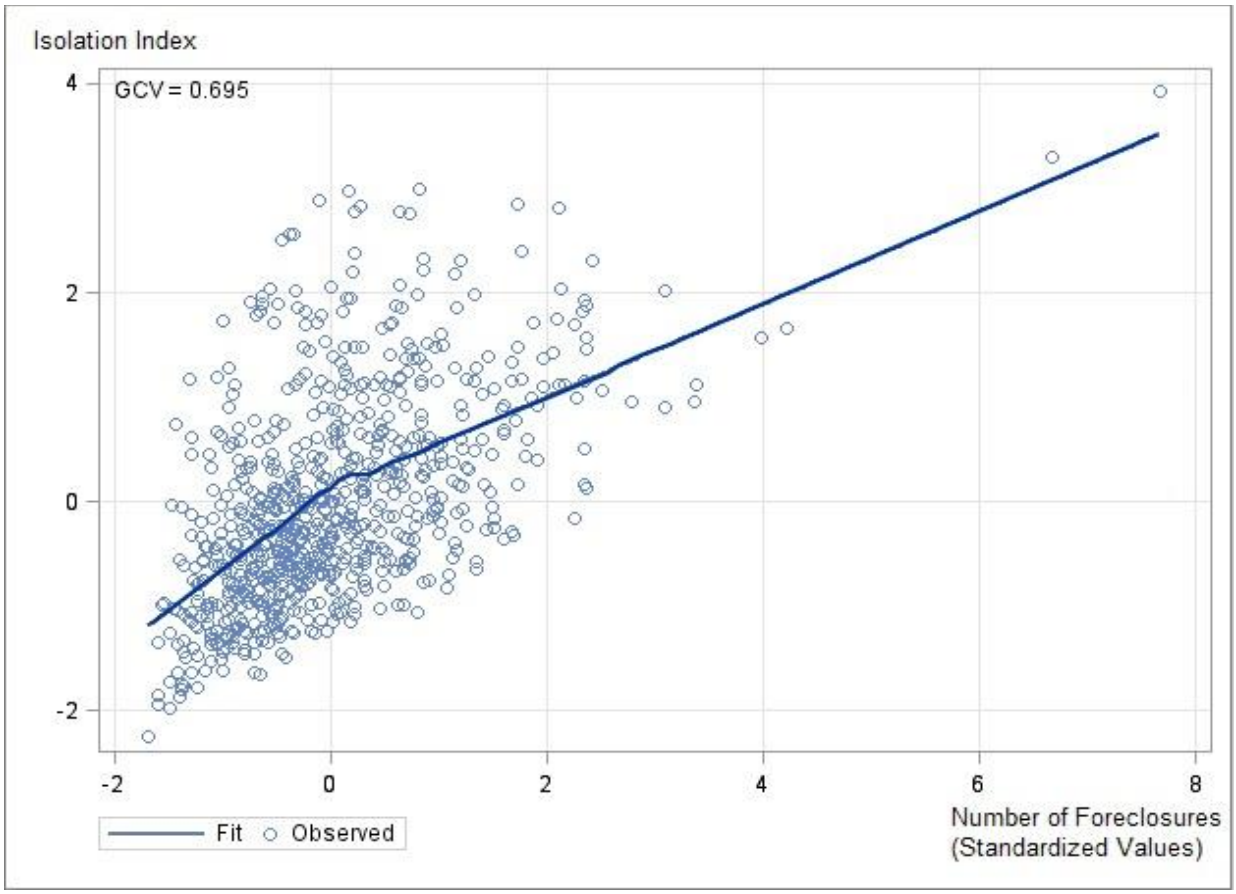


Figure 4-7. Spline regression fit for isolation index without outliers.

Table 4-6. Fit statistics for the isolation index.

Fit Controls		**Fit Statistics**	
Maximum Number of Bases	21	GCV	0.69509
Maximum Order of Interaction	2	GCV R-Square	0.30584
Degrees of Freedom per Knot	2	Effective Degrees of Freedom	5
Knot Separation Parameter	0.05	R-Square	0.31332
Penalty for Variable Reentry	0	Adjusted R-Square	0.31146
Missing Value Handling	Include	Mean Square Error	0.68854
Number of Observations Read	744	Average Square Error	0.68576
Number of Observations Used	742		

Consequently, the foreclosure effect on income segregation can be explained by the relationship between the number of foreclosures and the Isolation index as shown in Figure 4-8 and Table 4-7. The result shows that the more foreclosure activities generated, the deeper the income segregation is. Also, a neighborhood goes through more rapid income segregation until the number of foreclosures reaches the tipping point (number of foreclosures = 274), after that, the slope of the isolation index becomes slightly flatter than before the tipping point although the difference is not great.

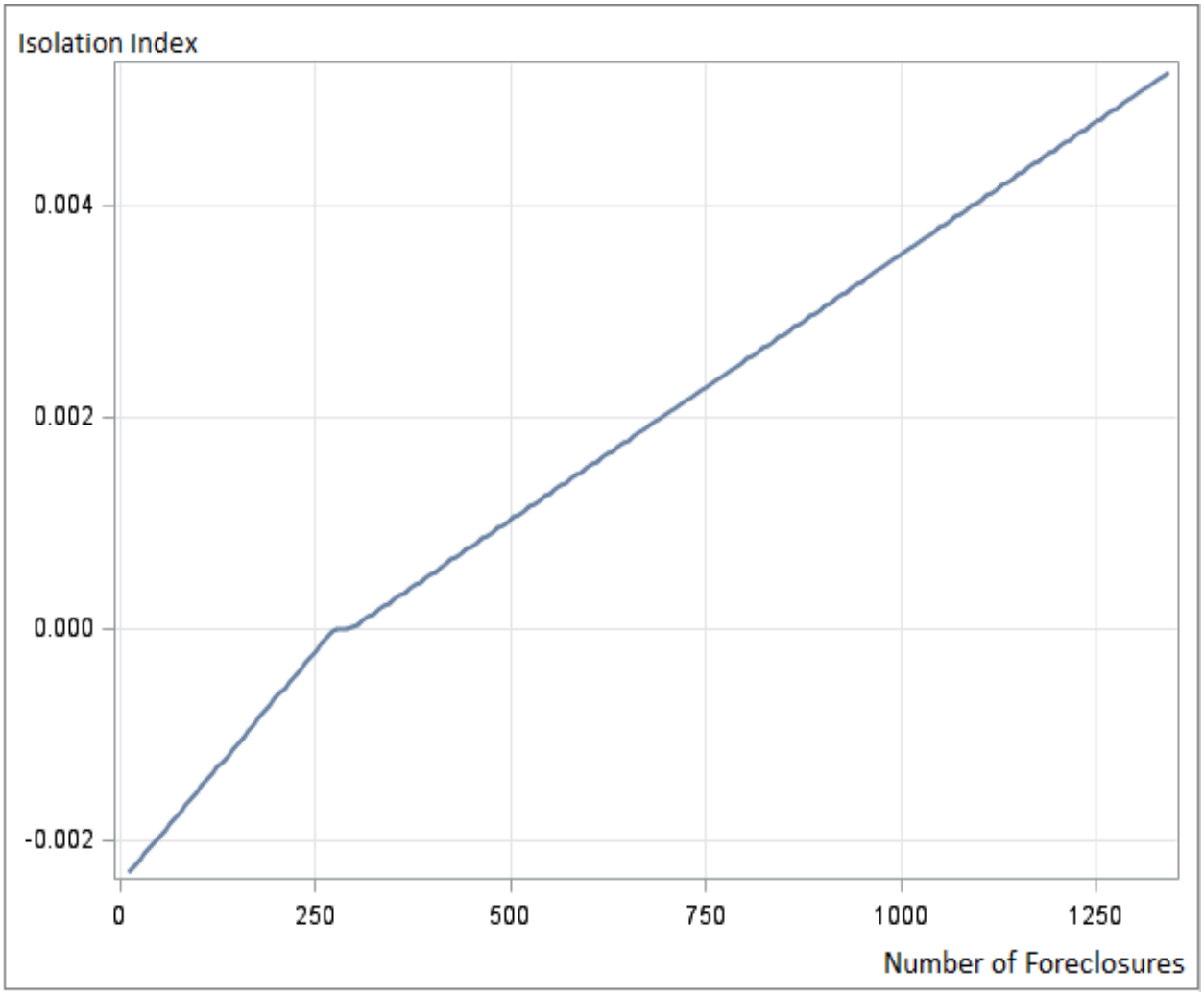


Figure 4-8. Spline regression model.

Table 4-7. Estimated coefficient and knot points.

Variable	Coefficient	Parent	Standardized Knot	Knot
Intercept	0.2496			
No. of Foreclosures	-0.7758	Basis0	0.1619	274
No. of Foreclosures	0.4440	Basis0	0.3093	295

For a more detailed examination of this segregation trend—whether the spline regression fit displays different trends according to neighborhood characteristics—this study will classify neighborhoods and will conduct spline regression by the classified neighborhood types. The neighborhood characteristics will function as control variables. Neighborhood classification based on the neighborhood characteristics will be explained in the next section.

Neighborhood Classification

Cluster Analysis

In order to classify neighborhoods, this study applies cluster analysis by using the SAS program Proc FASTCLUS. The FASTCLUS procedure is a SAS command for disjointed clustering of data set on the basis of distances computed from one or more quantitative variables; the variables are partitioned into clusters such that every variable belongs to one and only one cluster (SAS Institute Inc., 2012). This procedure is designed to find clusters with good fits by applying only two or three iterations through the data set. By default, the FASTCLUS procedure finds initial clusters with an iterative algorithm for minimizing the sum of squared distances from cluster means; thus this kind of procedure is called the k-means model (Hartigan, 1975; MacQueen, 1967). As seen in the result tables in Figure 4-9, the census tracts in the Miami MSA study areas are clustered into three groups, and this result has statistical significance.

The FASTCLUS Procedure

Cluster Summary

Cluster	Frequency	RMS Std Deviation	Maximum Distance from Seed	Nearest Cluster	Distance Between Cluster Centroids
1	122	1.1447	11.8406	1	2.8953
2	399	0.7006	4.8545	3	2.0417
3	273	0.7759	9.0914	1	2.0417

(Maximum Number of Clusters=3 Maximum Number of Iteration =50)

Statistics for Variables

Variable	Total STD	Within STD	R-Square	RSQ/(1-RSQ)
Neighborhood Income (Median Household Income)	1.00000	0.56389	0.682832	**2.152907**
Tenure (Home-ownership Rate)	1.00000	0.73326	0.463688	**0.864587**
Occupancy Status (Vacancy Rate)	1.00000	0.95426	0.091694	**0.100950**
Employment (Households with Earnings)	1.00000	0.95929	0.082090	**0.089432**
Home Value (Owner-occupied) (Median Value of Housing Units)	1.00000	0.79446	0.370423	**0.588368**
Home Value (Renter-occupied) (Median Contract Rent)	1.00000	0.72649	0.473545	**0.899497**
Age of Houses (Median Year Housing Units Built)	1.00000	0.85766	0.266275	**0.362908**

Pseudo F Statistic = 210.37

Approximate Expected Over-All R-Squared = 0.19429

Cubic Clustering Criterion = 42.102

Figure 4-9. Result of cluster analysis.

Cluster Means (Standardized Value)							
Cluster	**Neighborhood Income**	**Tenure**	**Occupancy Status**	**Employment**	**Home Value (owner)**	**Home Value (Renter)**	**Age of Houses**
1	1.749808	0.956211	-0.173608	-0.143943	1.401465	1.427124	-0.809829
2	0.001617	0.316494	-0.232320	0.277607	-0.150436	0.029742	-0.197563
3	-0.784329	-0.889886	0.417128	-0.341407	-0.406427	-0.681232	0.650647

Cluster Standard Deviations							
Cluster	**Neighborhood Income**	**Tenure**	**Occupancy Status**	**Employment**	**Home Value (owner)**	**Home Value (Renter)**	**Age of Houses**
1	1.050610	0.457147	1.057333	1.006931	1.616035	1.398996	1.076290
2	0.448391	0.691574	0.686836	0.999237	0.467756	0.542407	0.879641
3	0.373461	0.877946	1.208519	0.874110	0.594626	0.483421	0.701149

Figure 4-9. Continued.

Neighborhood Characteristics by Neighborhood Types

Based on the cluster analysis and its data set, the three groups in the Miami MSA study areas are named as follows: Economically Strong, Moderate, and Economically Distressed neighborhoods as shown in Tables 4-8 and 4-9, and Figures 4-10, 4-11, and 4-12. The Economically Strong neighborhoods include 122 census tracts of study areas in the Miami MSA, and the Moderate neighborhoods and the Economically Distressed neighborhoods have 399 census tracts and 273 census tracts respectively.

Table 4-8. Economic characteristics by neighborhood types.

Neighborhood Type	Economically Strong (122 tracts)	Moderate (399 tracts)	Economically Distressed (273 tracts)
Average Foreclosure No.(Rate)	258 (16.9%)	315 (21.7%)	195 (24.4%)
Average Total Mortgage No.	1,463	1,431	829
Average Median Household Income ($)	80,267	43,373	26,786
Average Below Poverty	78 (4.2%)	247 (10.1%)	470 (25.4%)
Average Employment Rate	85.0%	79.6%	73.4%
Average Home-ownership Rate	87.6%	72.8%	44.8%
Average Home Value ($)	231,534	107,464	86,998
Average Median Building Age	16.9	23.9	33.7

Overall, the classified neighborhood types are contiguous with each other as shown in Figure 4-10. The Economically Distressed neighborhoods correspond closely with brownfield areas.[5] Also, neighborhood income and the number of foreclosed homes show segregated patterns by categories. In the case of foreclosure distribution, the foreclosed homes are mostly concentrated in Moderate and Economically Strong neighborhoods rather than in Economically Distressed neighborhoods.

[5] Brownfields are defined by the Florida Department of Environmental Protection (FDEP) as abandoned or underused land that was previously used for industrial purposes or commercial uses, thus they are generally located in a city's industrial section with abandoned facilities. Such areas may include all or portions of community redevelopment areas, enterprise zones, empowerment zones, other such designated economically deprived communities and areas, and Environmental Protection Agency (EPA) designated brownfield pilot projects (Florida Geographic Data Library (FGDL)).

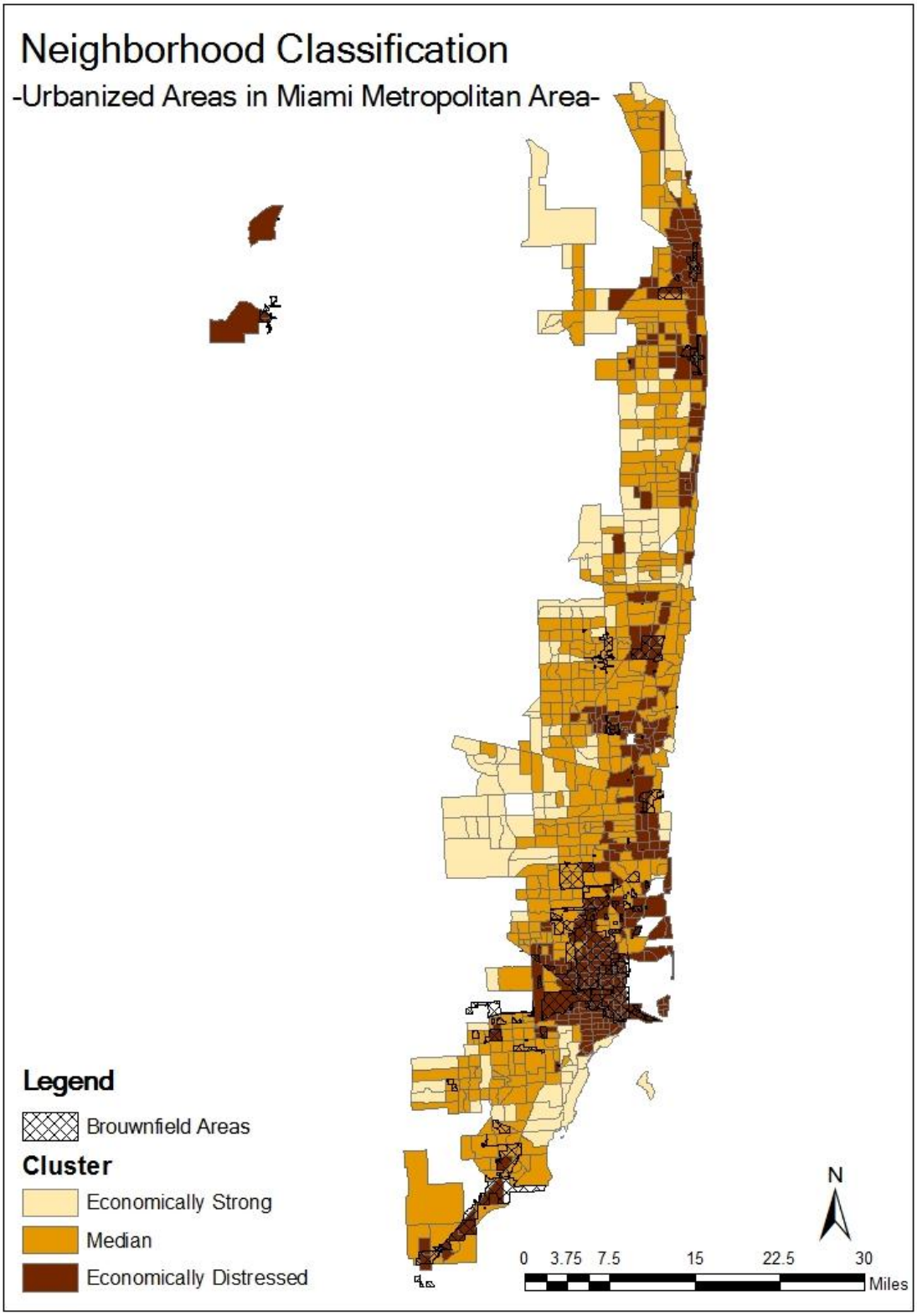


Figure 4-10. Neighborhood classification.

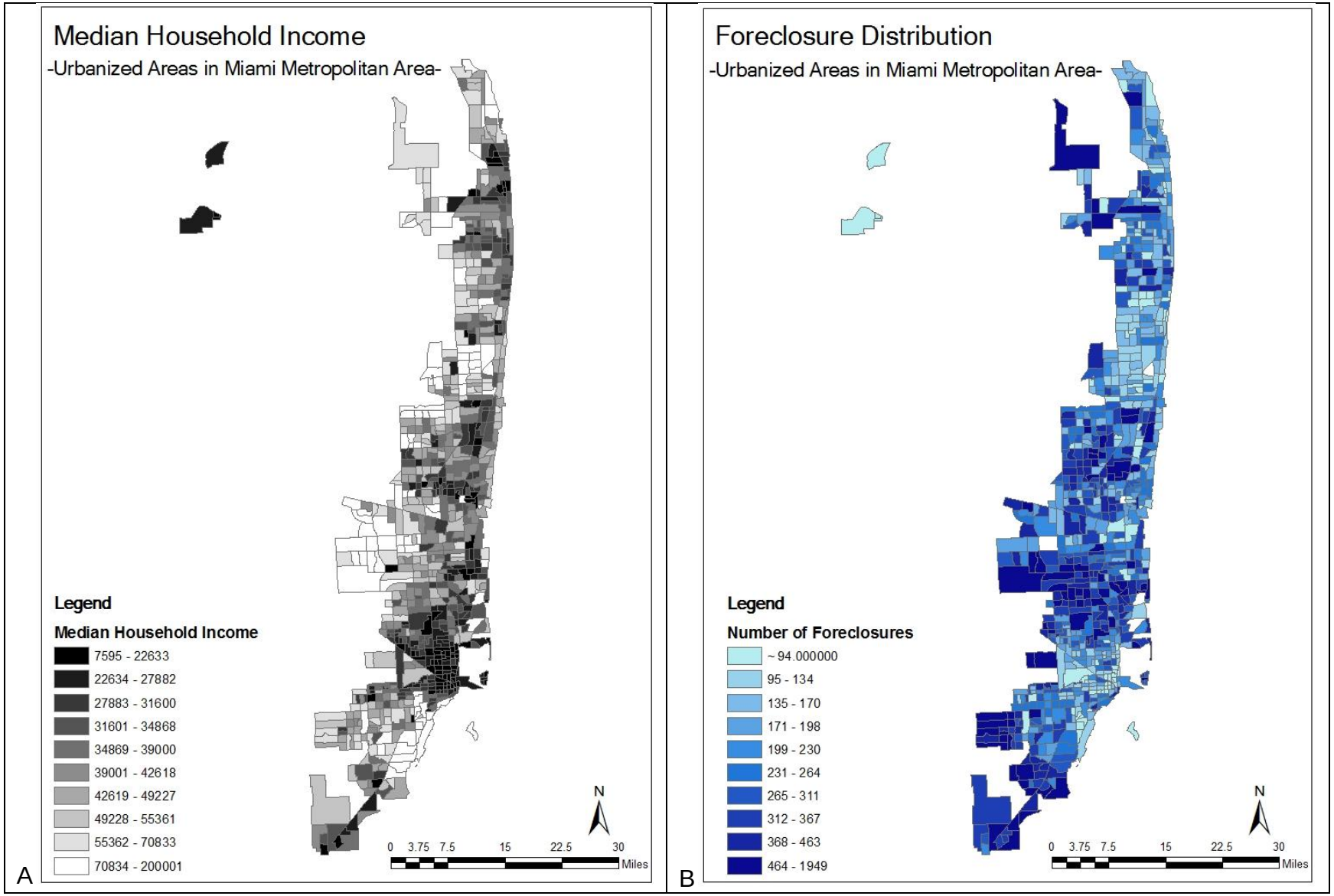


Figure 4-11. Income and foreclosure distribution A) Neighborhood income distribution, B) Foreclosure distribution.

The finding is contrary to the assumption that foreclosed homes are likely to be concentrated in Economically Distressed neighborhoods because low-and median-income borrowers are primary targets of subprime lending, and thus low-income neighborhoods are the most vulnerable for these foreclosures. This apparent contradiction might come from low demand for housing in Economically Distressed neighborhoods. The income of households in Economically Distressed neighborhoods is generally too low to purchase homes. Also the areas that include most of the brownfields in the Miami Metropolitan Area as shown in Figure 4-10 are not likely to be attractive to homebuyers because brownfields are perceived as having a high incidence of crime, concentrated hazardous waste or pollution, and outdated infrastructure. The low housing demand is due to the low demand for mortgage loans, thus households in the Economically Distressed neighborhoods have been less vulnerable to the subprime mortgage and foreclosure crisis. Another possibility of the reason why the finding is different from the hypothesis—mostly concentrated foreclosures in Economically Strong and Moderate neighborhoods—is that these foreclosures might not simply come from subprime mortgage defaults,[1] but from multiple mortgage defaults or economic recession resulting in unemployment, household income decrease, and home value depreciation. In fact, the recent economic recession is not limited to Economically Distressed neighborhoods, rather its effect may be more dramatic in the Economically Strong neighborhoods. The detailed characteristics of each neighborhood type are as shown in Table 4-9.

[1] This study has limits in informing whether the foreclosures are the result of subprime mortgages or not, because the foreclosure data used in this study does not provide information about mortgage loan type, classified into prime, Alt-A, and subprime mortgages.

Table 4-9. Summary of neighborhood characteristics.

Neighborhood Type	Characteristics
Economically Strong	▪ Second level in the number of foreclosures ▪ Highest number of mortgage loans (Demand for homeownership is high.) ▪ Lowest level in the foreclosure rate ▪ Highest median household income ▪ Lowest poverty level ▪ Highest employment rate ▪ Highest homeownership rate ▪ Highest home value ▪ Lowest median building age
Moderate	▪ Highest level in the number of foreclosures ▪ High level in the number of mortgage loans, meaning demand for homeownership is high.
Economically Distressed	▪ Lowest level in the number of foreclosures ▪ Lowest number of mortgage loans, meaning demand for homeownership is low. ▪ Highest foreclosure rate ▪ Lowest median household income ▪ Highest poverty level ▪ Lowest employment rate ▪ Lowest home value ▪ Highest median building age

In Economically Strong neighborhoods, the average number of foreclosures (258 homes) is at the second level, and the average foreclosure rate (16.9%) is at the lowest level.[2] In these neighborhoods, the median household income is the highest ($80,267), and the poverty level is the lowest (the average number of below poverty households is 78 households). Further, the employment rate (the rate of households with earnings in the past 12 months is 85.0%) and homeownership rate (87.6%) are both at the highest

[2] The foreclosure rate is calculated by dividing the number of foreclosures in census tracts by the total number of mortgage loans in the census tracts.

level. Further, the average home value of owner-occupied homes is the highest at $234,534, and the average building age is the lowest (16.9 years).

The Moderate type has the highest number of foreclosed homes (315 homes or 21.7%). Given that its employment rate is quite high (79.6%), and the average number of mortgage loans is at the second highest level (1,431 homes), demand for homeownership is high in Moderate type neighborhoods. These neighborhoods have the highest number of mortgage loans for all of 2007 and the first six months of 2008. The foreclosure status and economic condition of the Moderate neighborhoods show that households in the Moderate neighborhoods have been most affected by subprime mortgages, thus policies to respond to the foreclosure crisis need to pay more attention to this neighborhood type, the Moderate neighborhoods.

Finally, the Economically Distressed neighborhoods are in an economically vulnerable situation. Specifically, their median household income ($26,786), and employment rate (73.4%) are lowest. Also the average number of households below the poverty level is the highest (470 households). What is unique about these neighborhoods is that the number of foreclosures is not very high (195 homes, lowest), while the foreclosure rate is the highest (24.4%). This status does not follow the basic premise of other studies.[3] This finding might be because home ownership is low in the Economically Distressed neighborhoods, and households are likely to take fewer mortgage loans (the average number of mortgage loans is 829) in comparison to the Economically Strong and Moderate neighborhood areas (1,463 and 1,431 loans

[3] Given the strong relationship between the recent foreclosure crisis and subprime lending—designed for those with low-income and few- or no-assets, with troubled credit histories, and with little or no down-payment (Engel & McCoy, 2011)—most studies find that foreclosed homes tend to be concentrated in lower income and minority communities (Immergluck and Smith, 2006a, 2006b; Simkovic, 2011).

respectively). The relatively high foreclosure rate among home owners in these neighborhoods demonstrates that mortgage loans made in Economically Distressed neighborhoods are riskiest. In the next section, we are going to look at how the foreclosure effect varies by neighborhood type.

Foreclosure Effect II

Foreclosure Effect by Neighborhood Type

Based on these neighborhood types, the foreclosure effect is estimated by conducting spline regression analysis. The spline regression results—the degree of foreclosures' influence on income segregation and its tipping points—show distinct differences among neighborhood types. The results of the Foreclosure Effect II analysis provide empirical evidence for the hypothesis that the threshold effect of foreclosures on income segregation varies depending on neighborhood characteristics such as median household income, employment status, poverty rate, homeownership rate, building age as well as the extent of foreclosure concentration in a neighborhood. To be specific, first, in the Economically Strong neighborhoods, the explanatory power of the regression model shows a significant improvement from 0.306 of Adjusted R-square value in the Foreclosure Effect 1 model to 0.502 in the Economically Strong neighborhood model (as shown in the Tables 4-2 and 4-10). In the Median neighborhoods, the Adjusted R-square value also increases to 0.350 (as shown in the Tables 4-2 and 4-11). The results displaying improved model significance can be understood as the concentrated foreclosures in Economically Distressed neighborhoods are the most effective in aggravating income segregation. However, in the Economically Distressed neighborhoods, the statistical significance is weaker than found in the Foreclosure Effect 1 model; the Adjusted R-square decreases to 0.271 (as

shown in Tables 4-2 and 4-12). As discussed in the neighborhood classification section, the problems triggered by mortgage foreclosures are less serious than in other neighborhood types. Because the home ownership rate is much lower, the number of foreclosures is lower.[4]

Also, in the Economically Strong neighborhoods, the isolation index changes most rapidly during the early stages of foreclosure concentration in these communities, as we can see in Figure 4-12. The value of the isolation index (standardized value) rises steeply until the number of foreclosures reaches thirty homes. Furthermore, provided the same number of homes is entering foreclosure in each type of neighborhood, the isolation index in Economically Strong neighborhoods has the largest value response to the foreclosures. For example, when the number of foreclosures (standardized value) reaches two, the standardized value of the isolation index is about two in the Economically Strong neighborhoods, whereas the standardized isolation index is about one in the Moderate neighborhoods for the same number of foreclosures (see Figure 4-15). Based on this finding, it appears that the segregated pattern of low-income households triggered by foreclosures is more rapid and distinct in the Economically Strong neighborhoods than other neighborhood types. This result contrasts with the hypothesis that when the foreclosed homes are in middle- or upper-income neighborhoods, the foreclosure effect may not be deleterious because this condition has the potential to produce opportunities for homebuyers to purchase at lower prices (Li & Morrow-Jones, 2010; Schuetz, Been & Ellen, 2008; Simkovic, 2013).

[4] Considering the improved statistical significance of spline regression analysis in Economically Strong and Moderate neighborhoods, this study conducts spline regression combining these two neighborhood types. The Adjusted R-square value (0.324) is lower than when analyzed separately, and the shape of graph is more similar with Moderate neighborhood types than Economically Strong neighborhood types. The detailed results are displayed in the Appendix.

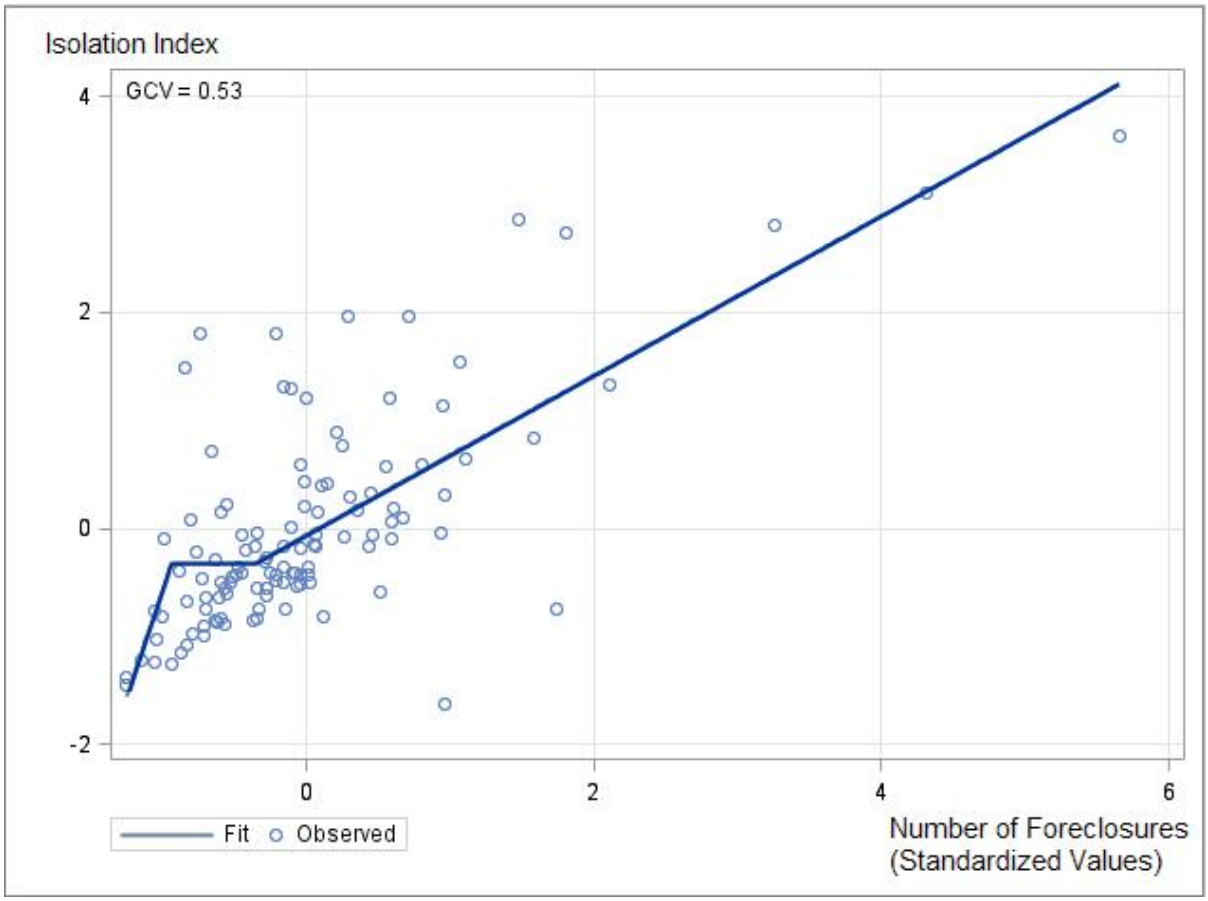


Figure 4-12. Spline regression fit in Economically Strong neighborhoods.

Table 4-10. Spline regression fit in Economically Strong neighborhoods.

Fit Controls		**Fit Statistics**	
Maximum Number of Bases	21	GCV	0.52993
Maximum Order of Interaction	1	GCV R-Square	0.47468
Degrees of Freedom per Knot	2	Effective Degrees of Freedom	5
Knot Separation Parameter	0.05	R-Square	0.51090
Penalty for Variable Reentry	0	Adjusted R-Square	0.50217
Missing Value Handling	Include	Mean Square Error	0.49783
Number of Observations Read	116	Average Square Error	0.48485
Number of Observations Used	115		

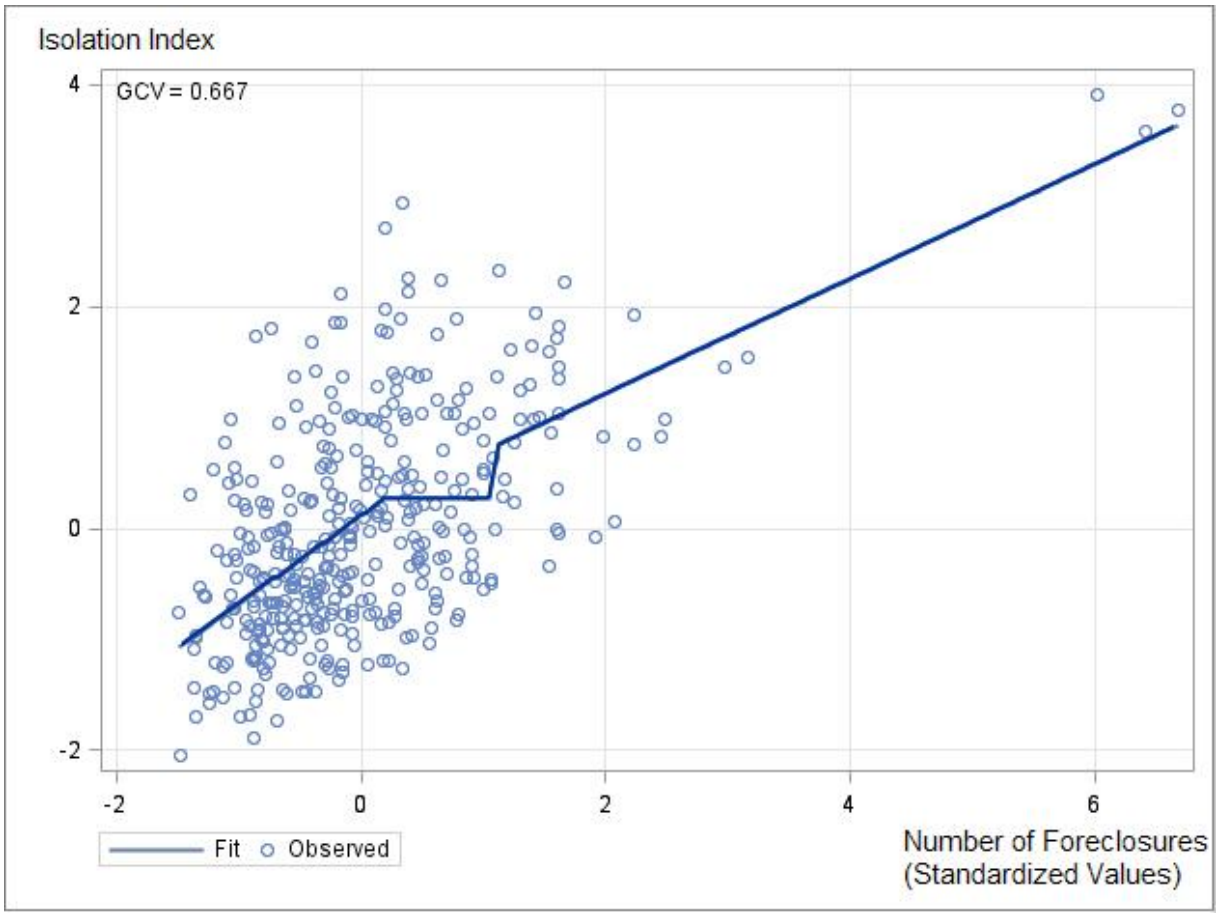


Figure 4-13. Spline regression fit in Moderate neighborhoods.

Table 4-11. Spline regression fit in Moderate neighborhoods.

Fit Controls		**Fit Statistics**	
Maximum Number of Bases	21	GCV	0.66730
Maximum Order of Interaction	1	GCV R-Square	0.33447
Degrees of Freedom per Knot	2	Effective Degrees of Freedom	7
Knot Separation Parameter	0.05	R-Square	0.35560
Penalty for Variable Reentry	0	Adjusted R-Square	0.35040
Missing Value Handling	Include	Mean Square Error	0.64960
Number of Observations Read	379	Average Square Error	0.64269
Number of Observations Used	376		

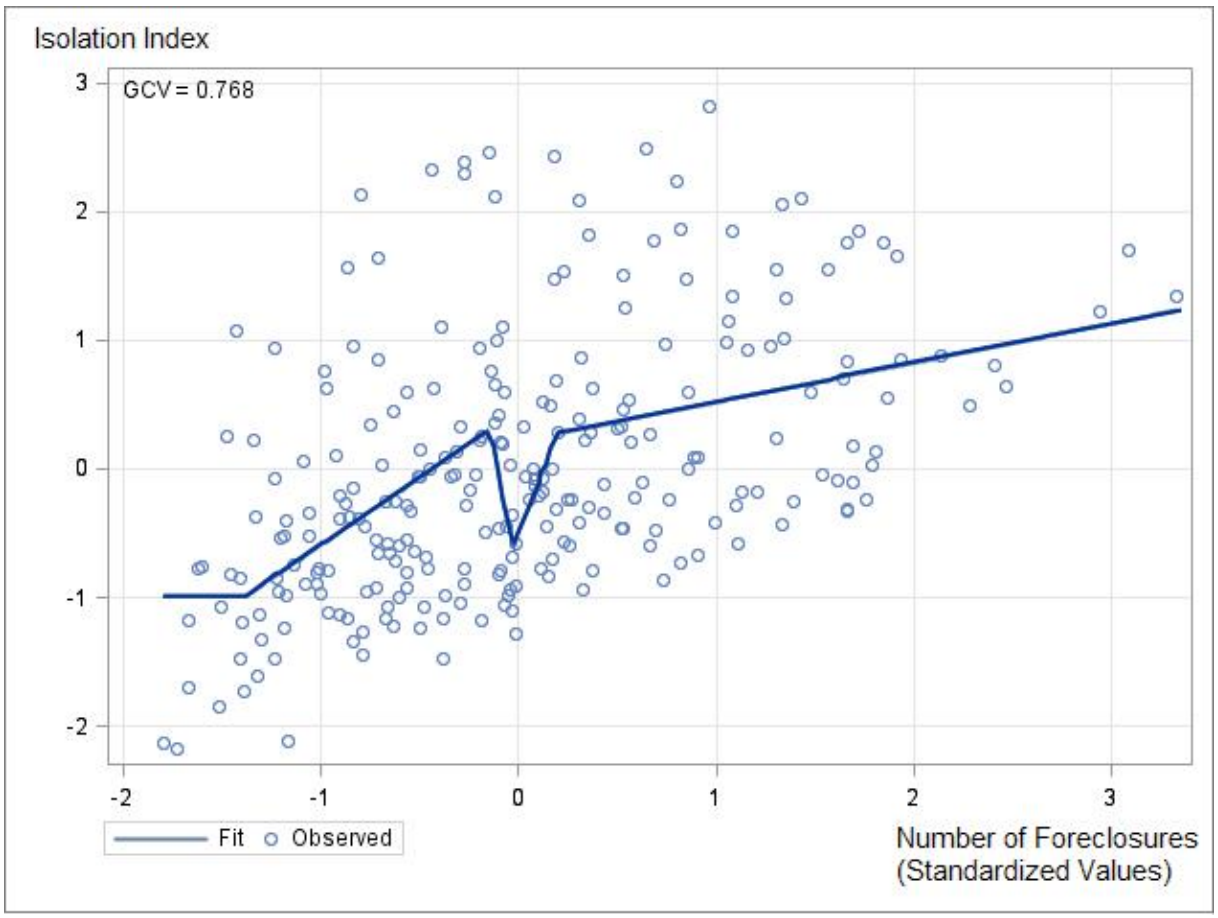


Figure 4-14. Spline regression fit in Economically Distressed neighborhoods.

Table 4-12. Spline regression fit in Economically Distressed neighborhoods.

Fit Controls		**Fit Statistics**	
Maximum Number of Bases	21	GCV	0.76768
Maximum Order of Interaction	1	GCV R-Square	0.23532
Degrees of Freedom per Knot	2	Effective Degrees of Freedom	9
Knot Separation Parameter	0.05	R-Square	0.28255
Penalty for Variable Reentry	0	Adjusted R-Square	0.27112
Missing Value Handling	Include	Mean Square Error	0.72888
Number of Observations Read	260	Average Square Error	0.71465
Number of Observations Used	256		

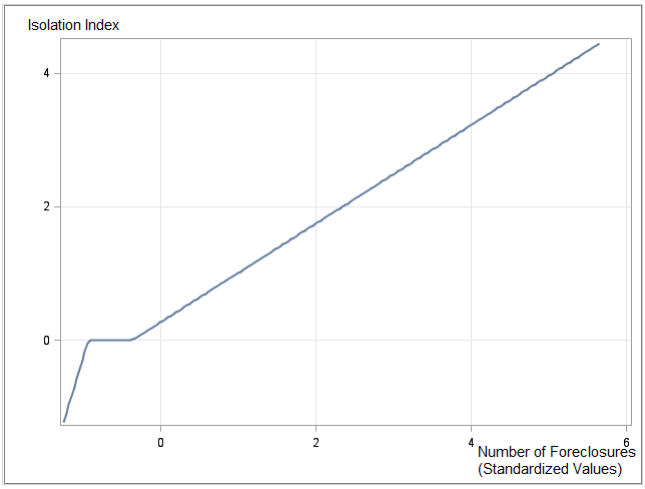
For explaining the rapid and distinct income segregation in the Economically Strong neighborhoods, some possibilities can be suggested. Residents in Economically Strong neighborhoods may be most intolerant of concentrated foreclosures and depreciated nearby properties, thus they tend to easily move out of the existing community, consequently, the Economically Strong neighborhoods are more rapidly segregated by income. Or, the foreclosed homes of higher income residents who are forced to move out of the area—considering the higher home-ownership rate (87.6% in 2000) with little rental housing available in the same communities—are likely to be replaced by lower income households, and thus more segregated. Additionally, the recent economic recession may affect the rapid low-income segregation; the residents, who had high income in 2000 at the time when the neighborhoods are classified as "Economically Strong", may not be able to earn a high income because of losing their jobs after the financial crisis, resulting in the neighborhoods becoming more segregated.[5]

Although the initial pace of segregation in the Moderate and Economically Distressed neighborhoods—the foreclosure effect on income segregation when the number of foreclosures in the neighborhood is low—is slower than in Economically Strong neighborhoods, the foreclosure effect on income segregation is also significant in the Moderate and Economically Distressed neighborhoods. Namely, the isolation index has increasing trends in all these neighborhood types, and the value of the index—the magnitude of the foreclosure effect—during the early stages of foreclosure

[5] Based on the result that the neighborhoods classified as "Economically Strong" in 2000 become highly segregated by income during 2007-2011, we can expect that there might have been changes in economic characteristics of these neighborhoods from that point of neighborhood classification.

concentration in these communities is the largest in the Economically Strong neighborhoods, and the smallest in the Economically Distressed neighborhoods.

Finally, all three neighborhood types show short stationary-phases or even an inverse-trend during overall increasing trends. This finding might mean that some programs for reducing the foreclosure effect are implemented when the neighborhoods reach a certain number of foreclosures and may retard the segregation trends to some extent. Indeed, the U.S. Department of Housing and Urban Development has funded state and local governments to alleviate the negative effect of foreclosures through the Neighborhood Stabilization Program (NSP) based on the extent of the concentration of foreclosed properties in communities; the funds have been used for purchasing and rehabilitating foreclosed and abandoned homes and residential properties. However, at present the amount and spatial distribution of the NSP funds are not available at a census tract level, the empirical evidence is insufficient to tell if the stationary- or inverse-trend comes from the implementation of the policy. Thus, more detailed analysis about these trends in all three neighborhood types is needed in the future.

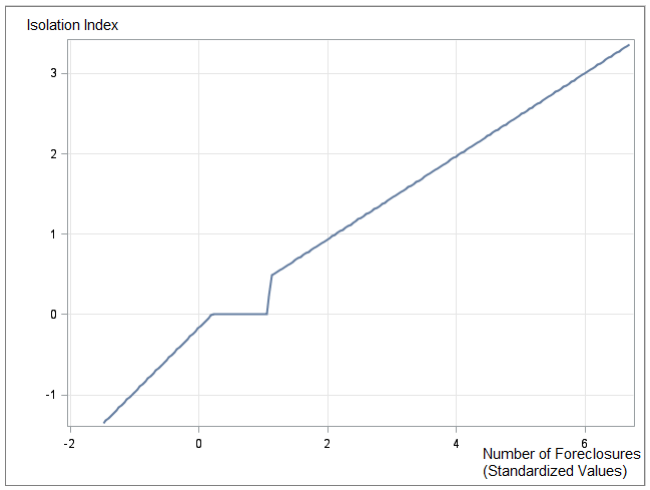


Regression Spline Model after Backward Selection

Variable	Coefficient	Parent	Standardized Knot	Knot
Intercept	-0.3335			
Nfore	-3.8408	Basis0	-0.9399	30
Nfore	0.7375	Basis0	-0.3768	170

Spline model and tipping points in Economically Strong neighborhoods

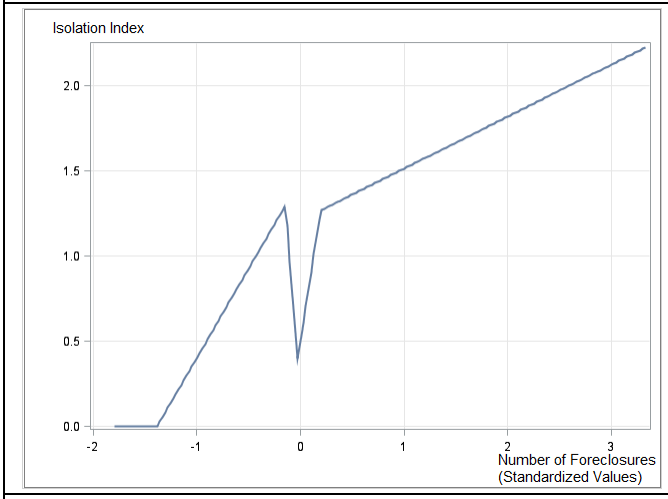
Figure 4-15. Spline model and tipping points by neighborhood types.



Regression Spline Model after Backward Selection

Variable	Coefficient	Parent	Standardized Knot	Knot
Intercept	0.2795			
Nfore	-0.8026	Basis0	0.1981	350
Nfore	6.9534	Basis0	1.0534	510
Nfore	-6.4364	Basis0	1.1232	520

Spline model and tipping points in Moderate neighborhoods



Regression Spline Model after Backward Selection

Variable	Coefficient	Parent	Standardized Knot	Knot
Intercept	-0.9920			
Nfore	1.0476	Basis0	-1.3854	30
Nfore	12.1876	Basis0	-0.0308	193
Nfore	-9.2739	Basis0	-0.1428	180
Nfore	-3.6564	Basis0	0.1933	221

Spline model and tipping points in Economically Distressed neighborhoods

Figure 4-15. Continued.

In sum, this study looks at the foreclosure effect on income segregation by using spline regression analysis through the two-step process: the Foreclosure Effect I (for all study areas) and II (by neighborhood type). And to analyze the Foreclosure Effect II in the Miami Metropolitan Area, the neighborhood study areas are classified based on their characteristics by using cluster analysis. For cluster analysis, the neighborhood characteristics variables are selected informed by their relationship to foreclosures as outlined in the literature. First, the results of the spline regression analysis show that

the foreclosures concentrated in residential neighborhoods have an effect on income segregation—the more foreclosure activity, the greater the income segregation is. Second, through cluster analysis, the study areas' neighborhoods are grouped into three types: Economically Strong, Moderate, or Economically Distressed neighborhoods. Each neighborhood type tends to be contiguous with similar neighborhoods, and neighborhood income and the number of foreclosed homes show segregated patterns. Foreclosed homes are mostly concentrated in Moderate and Economically Strong neighborhoods rather than Economically Distressed neighborhoods.

This finding might imply that the areas of economically distressed households have low demand for owner-occupied housing, which will result in lower demand for mortgage loans. In the Foreclosure Effect II analysis, there are distinct differences in the degree of foreclosures' influence on income segregation by neighborhood types. The statistical significance of the spline model is improved in Economically Strong and Moderate neighborhoods, whereas it becomes weaker in the Economically Distressed neighborhoods. Also, the segregated pattern of low-income households triggered by foreclosures is more rapid and distinct in the Economically Strong neighborhoods than other neighborhood types. This finding might mean that the households in the Economically Strong neighborhoods move out of their existing community more rapidly as foreclosures escalate, because higher income residents in the Economically Strong neighborhoods may be intolerant of concentrated foreclosures and depreciated nearby properties or because households who lose their home by foreclosures are forced into other neighborhoods where they can find the house to rent. Or the recent financial crisis might make the Economically Strong neighborhoods segregated by damaging

their economic status such as income, employment, or home values. Finally, the estimated isolation indices indicate brief stationary- or inverse-trends in the middle of increasing trends. Although this finding may result from the implementation of programs that alleviate foreclosure impacts in communities with increasing foreclosure problems and the possible program, NSP program, is currently operating in reality, more detailed data is needed to identify the relationship between the funds allocation and income segregation at a neighborhood level. If the reason why the segregation trends have an unusual shape in all three type of neighborhoods can be empirically proven, it can suggest important planning implications.

CHAPTER 5
IMPLICATIONS AND FUTURE STUDY

Summary and Implications

This study attempts to understand whether a causal relationship exists between residential mortgage foreclosures and income segregation in neighborhoods. Because the foreclosure crisis is strongly related to subprime lending, which represents high-risk loans (Engel & McCoy, 2011), it can be assumed that foreclosed homes are likely to be concentrated in lower income communities (Immergluck & Smith, 2006a, 2006b; Simkovic, 2013). Further, the concentrated foreclosures have direct negative consequences for those who lose their homes but also negative impacts on nearby households who see their property depreciate as a result (Schuetz, Been & Ellen, 2008).

Based on the premise that foreclosed homes tend to be spatially concentrated in economically distressed neighborhoods, this study empirically tests the foreclosure effect on income segregation through classifying neighborhoods according to their characteristics such as median-household income, home value, employment rate, and the number of owner-occupied homes.[41] Applying neighborhood classification introduces a geographical feature of foreclosures at the neighborhood level and provides information about economic characteristics in neighborhoods with high frequencies of foreclosures. Despite the premise based on the strong relationship between the foreclosure crisis and subprime lending, found in the literature (Immergluck

[41] In this study, the foreclosure effect is examined based on the number of foreclosures according to the statistical explanatory power of the spline regression analysis. However, there is still a possibility of significant relationship between the rate or percentage of foreclosures and income segregation if the analysis is conducted with more updated data, because neighborhood characteristics are constantly changing as time goes on. Thus, the foreclosure effect in terms of the foreclosure rate or percentage is needed to be examined as a future study.

& Smith, 2006; Simkovic, 2011), surprisingly, in the Economically Distressed neighborhoods, the number of foreclosed homes is at the lowest level. Rather, the average number of foreclosures is higher in the Moderate and the Economically Strong neighborhoods, showing the premise is incorrect in the case of the Miami Metropolitan Area. This result is consistent with the finding that the foreclosure effect model for Economically Distressed neighborhoods has a lower statistical significance, and the magnitude of the foreclosure effect is the smallest in the Economically Distressed neighborhoods.

The results of neighborhood classification here suggest that policies addressing foreclosure problems need to consider home ownership demand. For example, in the Economically Distressed neighborhoods, fewer households secure mortgage loans in comparison to the Moderate and Economically Strong neighborhood types. The demand for home ownership is relatively low, thus residents overall are less vulnerable to the subprime mortgage and foreclosure crisis, though clearly individuals can be quite vulnerable. On the other hand, the Moderate and the Economically Strong neighborhoods represent the large percentage of mortgage loans in all of 2007 and the first six months of 2008. To be more specific, the average number of mortgage loans made in 2007 and the first six months of 2008 were 1,463 homes in the Economically Strong neighborhoods, 1,431 homes in the Moderate neighborhoods, and 829 homes in the Economically Distressed neighborhoods. Further the demand for mortgage loans reflects the demand for home-ownership.[42] Namely, some aspects of the recent

[42] As of 2000, average home-ownership rate is 87.6% in the Economically Strong neighborhoods, 72.8% in the Moderate neighborhoods, and 44.8% in the Economically Distressed neighborhoods (seen in Table 4-8).

foreclosure crisis have come from those who do not have enough money to purchase homes outright, but have a desire to own their homes. From the potential relationship between foreclosure activities and demand for mortgage loans, we can re-examine the mortgage lending system, including the lending decision process, lending standards, and/or supervision of lenders, and can devise protections for borrowers that reduce the probability of foreclosures such as the Hope Now Alliance, the federal Home Affordable Modification Program, and/or the Home Affordable Refinance Program.

Also, the result of spline regression, threshold-theory-based analysis, suggests implications regarding the foreclosure effect by neighborhood types. The Economically Strong neighborhoods in the Miami MSA show the most rapid segregation during the early stages of foreclosure, when the number of foreclosures in a neighborhood is relatively low. This study began with the assumption that higher-income neighborhoods might be able to manage the foreclosure problem without significant changes in spatial income composition during the early stages, however, the results demonstrate that the Economically Strong neighborhoods are most vulnerable to the foreclosure problem; the segregated pattern of low-income households triggered by foreclosures is more distinct in the Economically Strong neighborhoods than other neighborhood types. Also, although the initial pace of segregation in the Moderate and Economically Distressed neighborhoods is slower than in Economically Strong neighborhoods, the foreclosure effect on income segregation is also significant in the Moderate and Economically Distressed neighborhoods.

The results show that implementation of programs for mitigating the foreclosure effects are needed as soon as possible in all three types of neighborhoods, though the

Economically Strong neighborhoods have more urgency. Indeed, the U.S. Department of Housing and Urban Development (HUD) operates the Neighborhood Stabilization Program, which offers funding to states and local governments to rehabilitate foreclosed and abandoned homes (Government Accountability Office, 2010). The spline regression model by neighborhood type (Foreclosure Effect II) having short stationary-phases or inverse trends in the middle of increasing trends of segregation might imply the impact of the NSP program. However, at present the amount and spatial distribution of the NSP funds are not available at a census tract level, the empirical evidence is insufficient to tell whether the stationary- or inverse-trend can be explained as the effect of the program. Thus, more detailed analysis about these trends in all three neighborhood types is needed in the future.

Future Study

Data Availability

This study used 2007-2011 American Community Survey (ACS) samples to measure income segregation after the foreclosure crisis; it contains five-year data for housing units and the population from households and the group quarters (GQ) population based on the American Community Survey (ACS) for 2007, 2008, 2009, 2010 and 2011. However, using data which includes information for 2007, 2008, 2009 might produce unclear results, because the crisis began in 2007; it takes time to produce an effect on income segregation. Moreover, the dramatic increase in foreclosures, especially strong during the early stage of the crisis, makes housing markets unstable, and this status could distort the results concerning the role of foreclosures in structuring geographical distribution of households, specifically by income. Thus, it is meaningful to analyze the foreclosure effect after housing markets

stabilize when the data are available and to compare these findings with the results of this study.

In this study, neighborhoods are designated as census tracts and the foreclosure effect analysis is conducted at the census tract level based on the literature and data availability; the foreclosure data—independent variables for spline regression analysis—from the U.S. Department of Housing and Urban Development's (HUD) Neighborhood Stabilization Program (NSP) is provided at the census tract level. However, if the foreclosure data are available at a more subdivided geographical unit level, such as census block groups, we can analyze the foreclosure effect at the block group level, compare it with the results of this study, and suggest more appropriate geographical units for investigating the effect of foreclosures on neighborhood units.

Also, foreclosure data used in this study does not provide detailed information such as tenure type of the foreclosed home and the number of renters, or mortgage loan classified into prime, Alt-A, and subprime mortgage. The data about borrowers and mortgage loan type can help to assess why the houses were foreclosed and what happened to the houses, households and renters after foreclosures started, which will be grounds for more appropriate understanding of the analysis results. For example, if we can see whether a foreclosed home is multi-family housing or single-family housing, it is possible to figure out how many renters are affected by the recent foreclosure crisis and how the renters contribute to structuring geographical distribution of residents by income. Moreover, if mortgage loan type information is accessible at a census tract level, foreclosure rate and frequency by loan type and/or by neighborhood type can be comprehended. Although it is not easy to get these detailed data at the census tract

level, we can estimate characteristics of foreclosed homes through property tax data by sampling some areas—at a parcel level—which are hit hard by foreclosures; the just value (market value) of the property tax data from the Florida Department of Revenue has a specific figure for properties that sales are “disqualified as a result of examination of the deed to or from financial institutions, or deed stating ‘In Lieu of Foreclosure’ (including private lenders)” (Florida Department of Revenue, 2013, p.24). Looking at the properties having identical values may help to understand the characteristics of foreclosed homes because the property tax data contains information including site address, owner mailing address, most recent sales information, valuation, building details, and legal description (Florida Department of Revenue, 2013).

Place-based Consideration

This study cannot fully consider spatial factors of foreclosures by neighborhood types. Future studies that spatially analyze the foreclosure distribution and the foreclosure effect in certain areas can offer more practical implications. Especially, hot spot analysis (spatial autocorrelation statistics) such as Moran’s *I,* Geary’s *C*, or Getis’s *G* informs us about “hot spot foreclosure sites”, which means the neighborhoods having heavily clustered foreclosed homes. Also, with the hot-spot neighborhoods, spillover effects—clustered foreclosures in neighborhoods creating a spillover effect in bordering areas of hot-spot neighborhoods—can be analyzed (Pacheco & Tyrrell, 2002). This study needs to further investigate income segregation of hot-spot neighborhoods and the spillover effect in order to examine more place-based planning implications.

With the hot-spot neighborhoods of foreclosures, we can also examine the temporal changes in neighborhood characteristics by neighborhood types. As explained in the Methodology Chapter, the neighborhoods in the Miami Metropolitan

area are classified using 2000 census data to control the initial neighborhood characteristics before the recent foreclosure crisis that started in 2007, and the foreclosure effect on income segregation, measured with 2007-2011 American Community Survey data (after the foreclosure crisis), are compared to the initial neighborhood characteristics (by neighborhood types). If the most recent neighborhood characteristics (2010 census data) are overlapped with the result showing the foreclosure effect on income segregation by neighborhood types and hot-spot neighborhoods, it is easier to assess the analysis results. For example, suppose some Economically Strong neighborhoods show rapid income segregation and fall into hot-spot areas, we can find reasons for this change by comparing the characteristics in 2000 with the recent economic status of these neighborhoods such as home value depreciation, decrease in household income, and/or increase in unemployment after the recent recession.

In addition, given that the Neighborhood Stabilization Program is a leading governmental response to mitigating the foreclosure effect, and the local governments in the Miami Metropolitan Area do not have their own strategies to address foreclosures except applying for federal programs, understanding how the funds of the NSP program are distributed in the Miami Metropolitan Area is essential. What differences exist in the implementation of the NSP programs between neighborhood types, and whether relationships exist between the results of foreclosure effect analysis and the NSP program implementation. According to the result of the Foreclosure Effect II analysis, all three neighborhood types show short stationary-phases or even an inverse-trend during overall increasing trends as shown in Figure 4-15. One possible interpretation of

the retarded increasing trends of income segregation is the implementation of the NSP program. If the possibility can be empirically tested or be supported by data at a neighborhood unit level, through spatially overlapping data of the NSP funds distribution with the neighborhoods showing retarded income segregation, it will provide important planning implications that the NSP programs may contribute to slowing down the segregation trends to some extent. Also, because the increasing trends recur as the number of foreclosures continue to increase, it can be understood as the funds cannot handle the large-scale foreclosures in neighborhoods; this might be empirical evidence for the argument that the NSP funds, by themselves, are too small to make a substantial contribution toward mitigating the negative effect of foreclosures, considering the number of foreclosed properties and the scale of the problem (Immergluck, 2013).

Indicators of Neighborhood Change

The literature associated with foreclosures and their effect on households and their communities has suggested that the subprime mortgage loans, which have a higher risk of default than a prime loan, produced a large part of the payment delinquencies or foreclosures, and they are directly related to the recent foreclosure crisis. Also, because low- and median-income borrowers are primary targets of subprime lending, they are the most vulnerable groups for these foreclosures, and consequently, the foreclosed homes tend to be concentrated in lower income communities (Immergluck & Smith, 2006a, 2006b; Simkovic, 2013; U.S. Department of Housing and Urban Development). Thus, this study was conducted based on the theoretical framework that foreclosures of mortgage lending might cause a certain extent of income segregation, which is described by spatially concentrated poverty and/or affluence (Reardon & Bischoff, 2011); the empirical analysis in this study focuses

on income segregation. However, foreclosures can cause residential segregation in additional ways. For instance, the African American population and the foreclosure rate in the Miami Metropolitan Area have a strong positive relationship; the correlation analysis between the proportion of the African American population and the rate of foreclosed homes in the study area census tracts shows a 65.78% correlation coefficient.[43]

Several studies regarding residential segregation found that individual-level and geographic redlining discrimination occurred in the recent mortgage lending process, and suggest that this discrimination triggered the rise in subprime mortgage lending since higher standards of creditworthiness were applied to minority applicants in the prime mortgage market. They prove that a higher likelihood of default exists on the part of black households compared to whites, which can be interpreted as more black households get higher-risk subprime loans than whites (Berkovec, Canner, Gabriel, & Hannan, 1994; Dymski, 2005). Also, according to the Department of Housing and Urban Development (2000), subprime lending shows continuous growth at a rapid pace during the 1990s with disproportionate concentration in low-income minority communities. The study draws four significant conclusions based on analysis of data from approximately one million mortgages in 1998 taken from Home Mortgage Disclosure Act (HMDA) as follows;

- From 1993 to 1998, the number of subprime refinance loans increased ten-fold.
- Subprime loans are three times more likely in low-income neighborhoods than in high-income neighborhoods.

[43] In the correlation analysis, 2000 Census "Race/Ethnicity" data and HUD Neighborhood Stabilization Program's (2009) "Foreclosure Starts over 18 month (2007 and the first six month of 2008)" data are used.

- Subprime loans are five times more likely in black neighborhoods than in white neighborhoods: In predominantly black neighborhoods, the high-cost subprime lending accounted for 51 percent of home loans in 1998, compared with only 9 percent in predominately white areas.
- Homeowners in high-income black neighborhoods are twice as likely as homeowners in low-income white neighborhoods to have subprime loans: Only 6 percent of homeowners in upper-income white neighborhoods have subprime loans while 39 percent of homeowners in upper-income black neighborhoods have subprime loans, more than twice the rate for home owners in low-income white neighborhoods, 18 percent (Department of Housing and Urban Development, 2000, p.2).

In reality, in the case of New Orleans in 1990, “the higher the percentage of units foreclosed in a block group, the larger the percentage of the black population” (Baxter & Lauria, 1999, p.772). These findings show definitely that residential segregation triggered by the recent foreclosure crisis can be explained in terms of racial segregation as well as income. Moreover, the disproportionate concentration of subprime loans in high-income black neighborhoods may reflect more detailed accounts of concentrated foreclosures and the rapid and distinct low-income segregation in Economically Strong neighborhoods in the Foreclosure Effect II analysis.

In addition, it is usually thought that victims of foreclosures are homeowners who purchased their homes though mortgage loans, and most government programs addressing the foreclosure crisis have focused on the home owners. However, renters and tenants have also been affected considerably by the recent foreclosure crisis because a home can be occupied by both the owner and renters (Allen, 2010; Wardrip & Pelletiere, 2008). The National Low Income Housing Coalition found evidence that the foreclosure crisis is affecting renters based on surveys of 21 national or regional housing counseling intermediaries, 37 state housing finance agencies, 10 local housing counseling agencies, and 1,484 HUD-approved housing counseling agencies, with

questions related to the income and tenure of households who had been threatened by foreclosures; “approximately 17% of those responding indicated that “quite a few” or “nearly all” of their foreclosure and delinquency cases include renters in one of the following living situations: a home occupied by both the owner and renter(s); a single-family home occupied by a renter; or a home occupied by 2+ households, all renting” (Wardrip & Pelletiere, 2008, p.4). Also, according to the Furman Center for Real Estate & Urban Policy of New York University (2008), nearly 60% of the 15,000 mortgage foreclosures, filed in 2007 in New York City, were on two to four family or multi-family buildings—about 40% were on condominiums or single-family homes, implying substantial numbers of renters hit by foreclosures. The Joint Center for Housing Studies of Harvard University (2008) shows that “one out of every five new foreclosure actions nationwide involved absentee owners”, based on the data from the Mortgage Bankers Association Report in 2007 (Joint Center for Housing Studies, 2008, p.2). Further, the renters typically get informed of the foreclosure late in the process without warning; in many cases, they not only are evicted from their rented houses but also lose their security deposits, and only a small number of states “already protect tenants from foreclosure-related evictions by requiring a “just cause” for eviction, such as non-payment of rent” (Wardrip & Pelletiere, 2008; Been & Glashausser, 2009, p.4). Even when they are legally protected from eviction, the renters still stand a risk of losing homes; in turn, this situation may threaten the affordability of the rental market, because both former owners of foreclosed homes and displaced renters are entering and competing simultaneously in the rental market (Joint Center for Housing Studies, 2008; Wardrip & Pelletiere, 2008). In this regards, more research is needed to grasp how the

foreclosed homes impact spatial distribution of residences with various characteristics such as racial composition of the community, home-ownership status as well as household income.

APPENDIX
SPLINE REGRESSION ANALYSIS

Economically Strong Neighborhoods

The ADAPTIVEREG Procedure

Model Information	
Data Set	WORK.O2STD
Response Variable	Iso
Distribution	Normal
Link Function	Identity

Fit Controls	
Maximum Number of Bases	21
Maximum Order of Interaction	1
Degrees of Freedom per Knot	2
Knot Separation Parameter	0.05
Penalty for Variable Reentry	0
Missing Value Handling	Include

Number of Observations Read	116
Number of Observations Used	115

Fit Statistics	
GCV	0.52993
GCV R-Square	0.47468
Effective Degrees of Freedom	5
R-Square	0.51090
Adjusted R-Square	0.50217
Mean Square Error	0.49783
Average Square Error	0.48485

Regression Spline Model after Backward Selection				
Name	**Coefficient**	**Parent**	**Variable**	**Knot**
Basis0	-0.3335		Intercept	
Basis2	-3.8408	Basis0	Nfore	-0.9399
Basis17	0.7375	Basis0	Nfore	-0.3768

ANOVA Decomposition				
Functional Component	Number of Bases	DF	Change If Omitted	
			Lack of Fit	GCV
Nfore	2	4	58.2426	0.4788

Variable Importance		
Variable	Number of Bases	Importance
Nfore	2	100.00

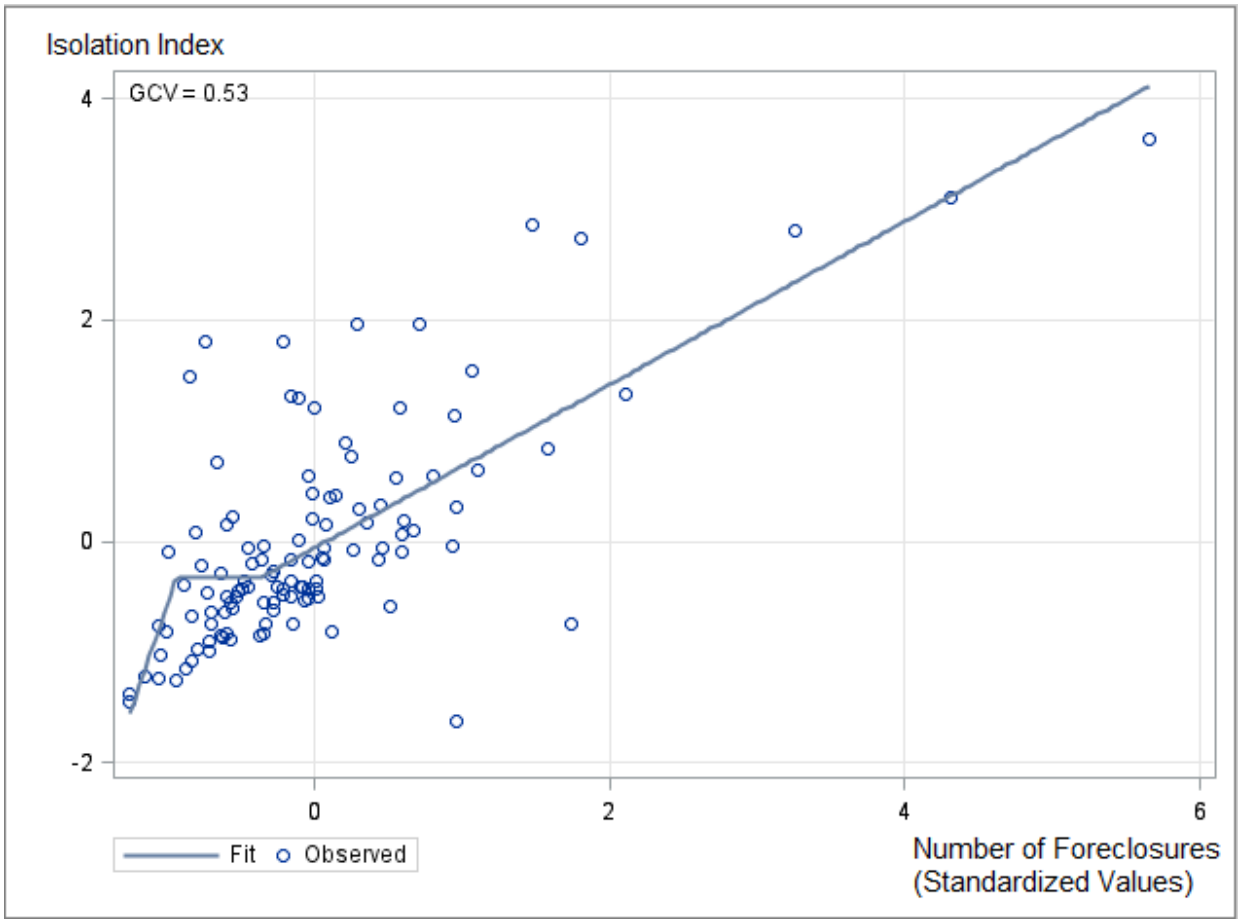
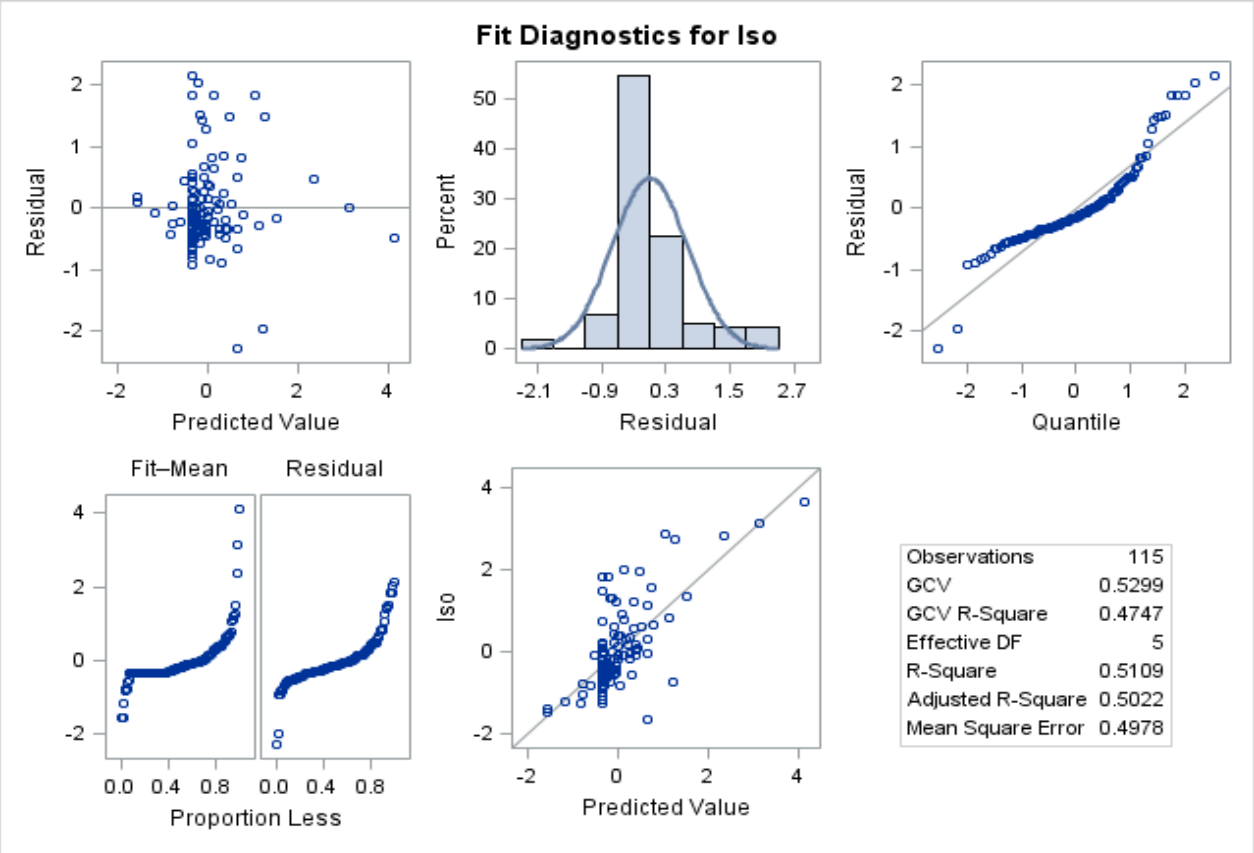
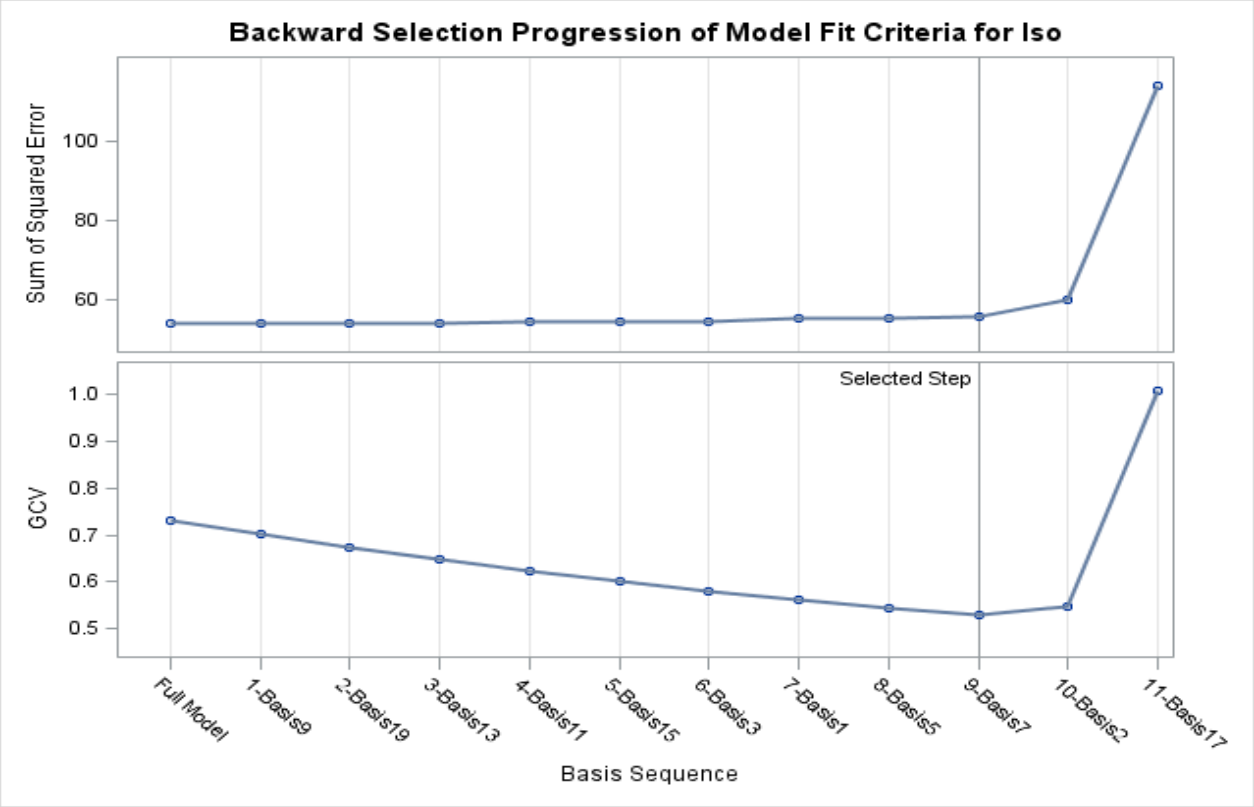


Figure A-1. Spline regression fit in Economically Strong neighborhoods.


Fit Diagnostics for Iso
Residual
Predicted Value
Percent
Residual
Residual
Quantile
Fit–Mean
Residual
Proportion Less
Iso
Predicted Value
Observations 115
GCV 0.5299
GCV R-Square 0.4747
Effective DF 5
R-Square 0.5109
Adjusted R-Square 0.5022
Mean Square Error 0.4978


Backward Selection Progression of Model Fit Criteria for Iso
Sum of Squared Error
GCV
Selected Step
Full Model
1-Basis9
2-Basis19
3-Basis13
4-Basis11
5-Basis15
6-Basis3
7-Basis1
8-Basis5
9-Basis7
10-Basis2
11-Basis17
Basis Sequence

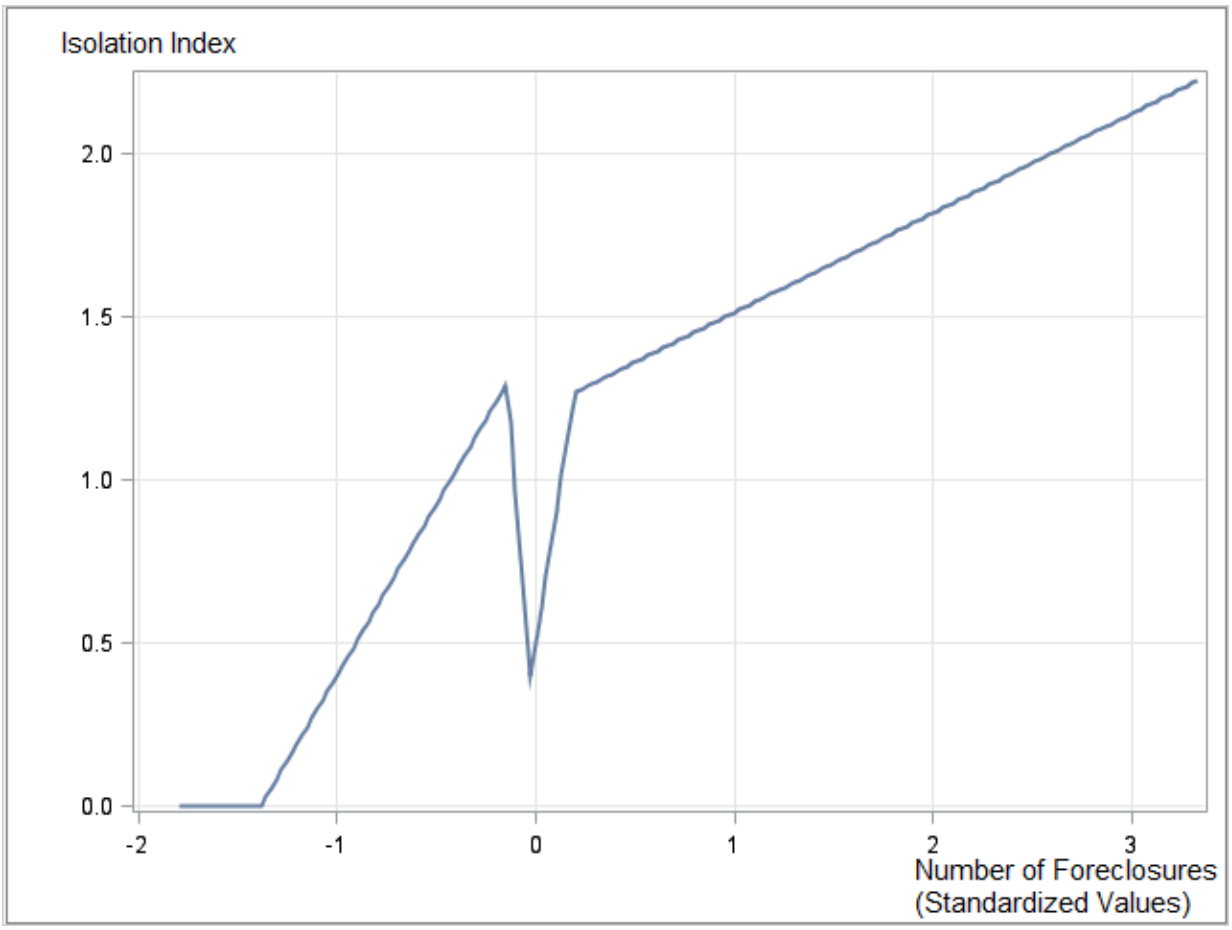


Figure A-2. Spline regression model in Economically Distressed neighborhoods.

Moderate Neighborhoods

The ADAPTIVEREG Procedure

Model Information	
Data Set	WORK.O1STD
Response Variable	Iso
Distribution	Normal
Link Function	Identity

Fit Controls	
Maximum Number of Bases	21
Maximum Order of Interaction	1
Degrees of Freedom per Knot	2
Knot Separation Parameter	0.05
Penalty for Variable Reentry	0
Missing Value Handling	Include

Number of Observations Read	379
Number of Observations Used	376

Fit Statistics	
GCV	0.66730
GCV R-Square	0.33447
Effective Degrees of Freedom	7
R-Square	0.35560
Adjusted R-Square	0.35040
Mean Square Error	0.64960
Average Square Error	0.64269

Regression Spline Model after Backward Selection

Name	Coefficient	Parent	Variable	Knot
Basis0	0.2795		Intercept	
Basis2	-0.8026	Basis0	Nfore	0.1981
Basis11	6.9534	Basis0	Nfore	1.0534
Basis15	-6.4364	Basis0	Nfore	1.1232

ANOVA Decomposition				
Functional Component	**Number of Bases**	**DF**	**Change If Omitted**	
			Lack of Fit	**GCV**
Nfore	3	6	133.35	0.3354

Variable Importance		
Variable	**Number of Bases**	**Importance**
Nfore	3	100.00

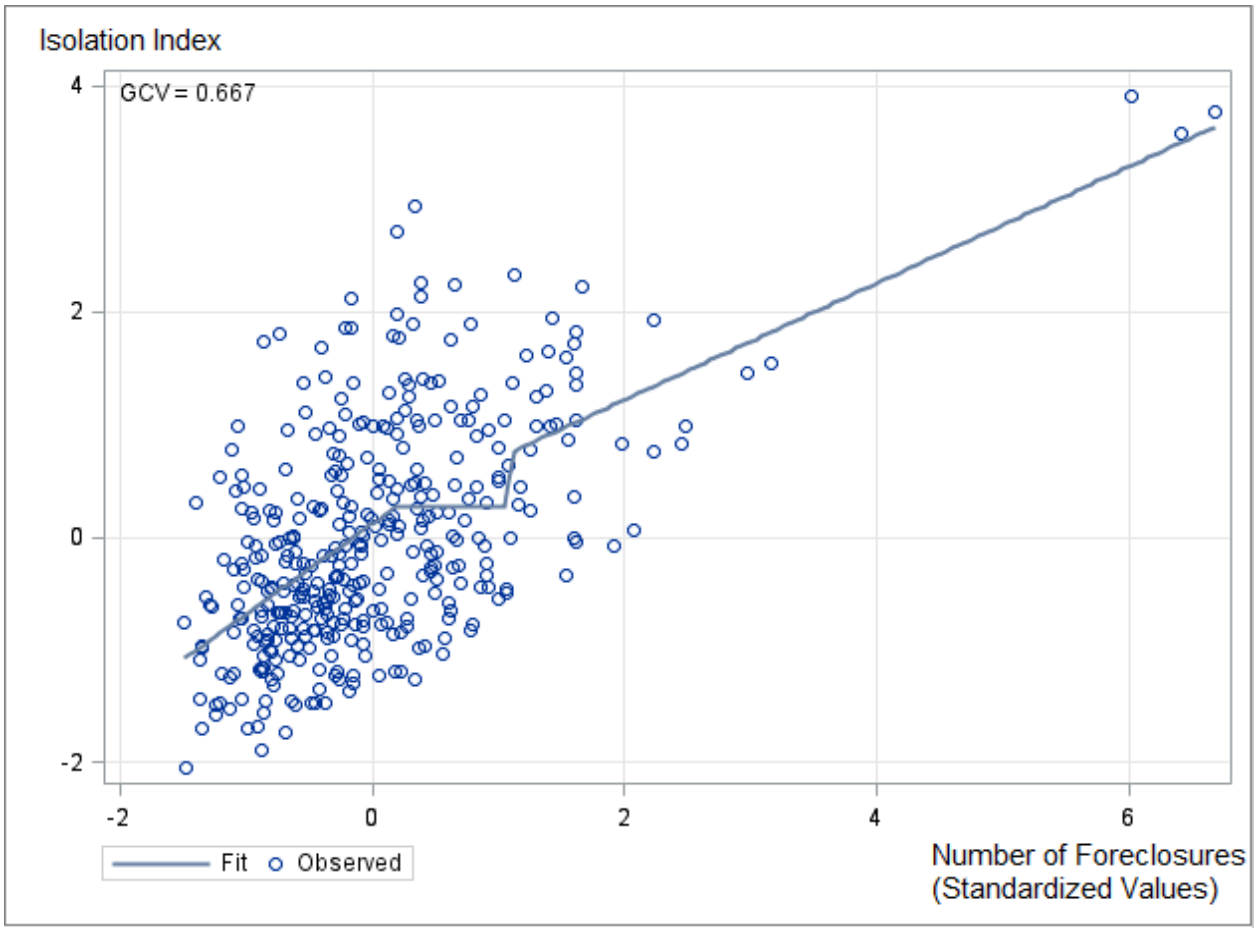
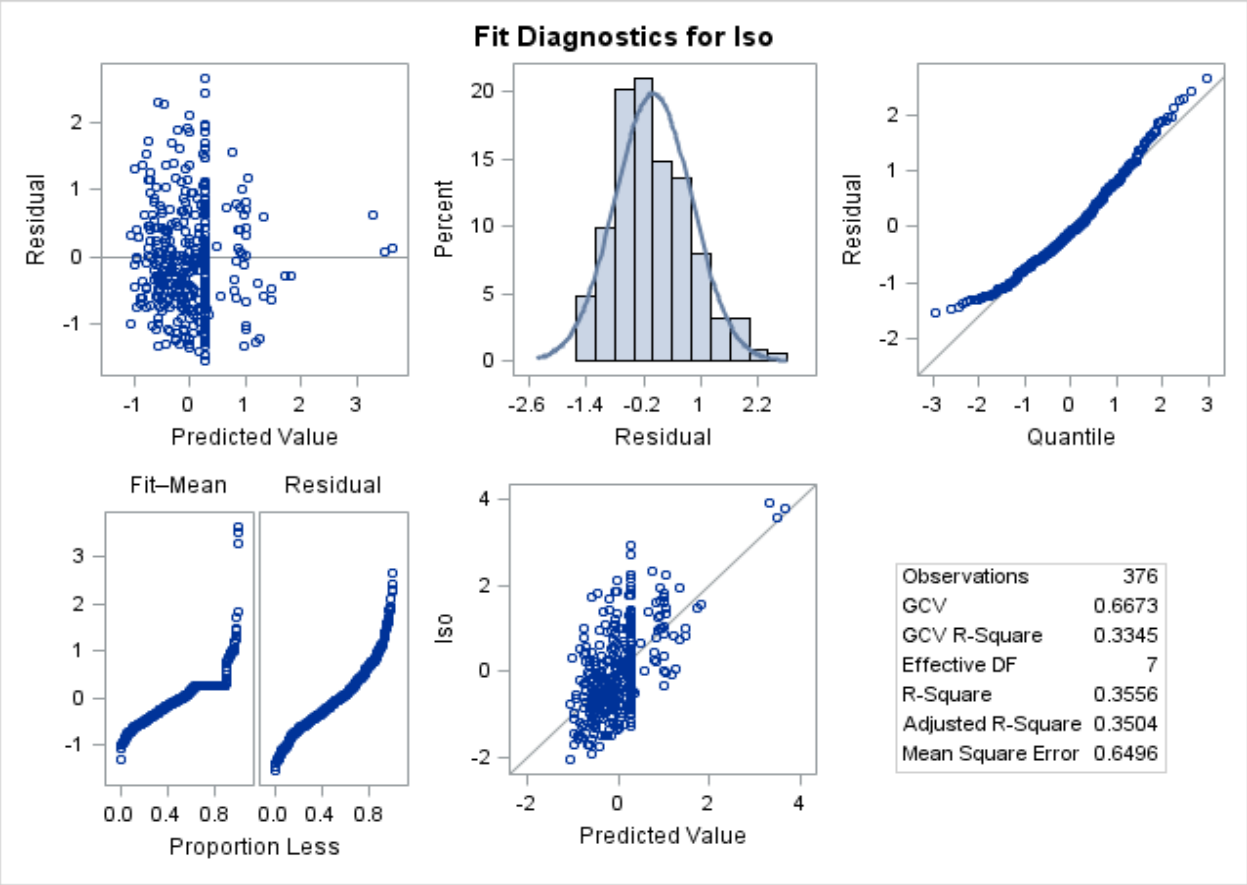
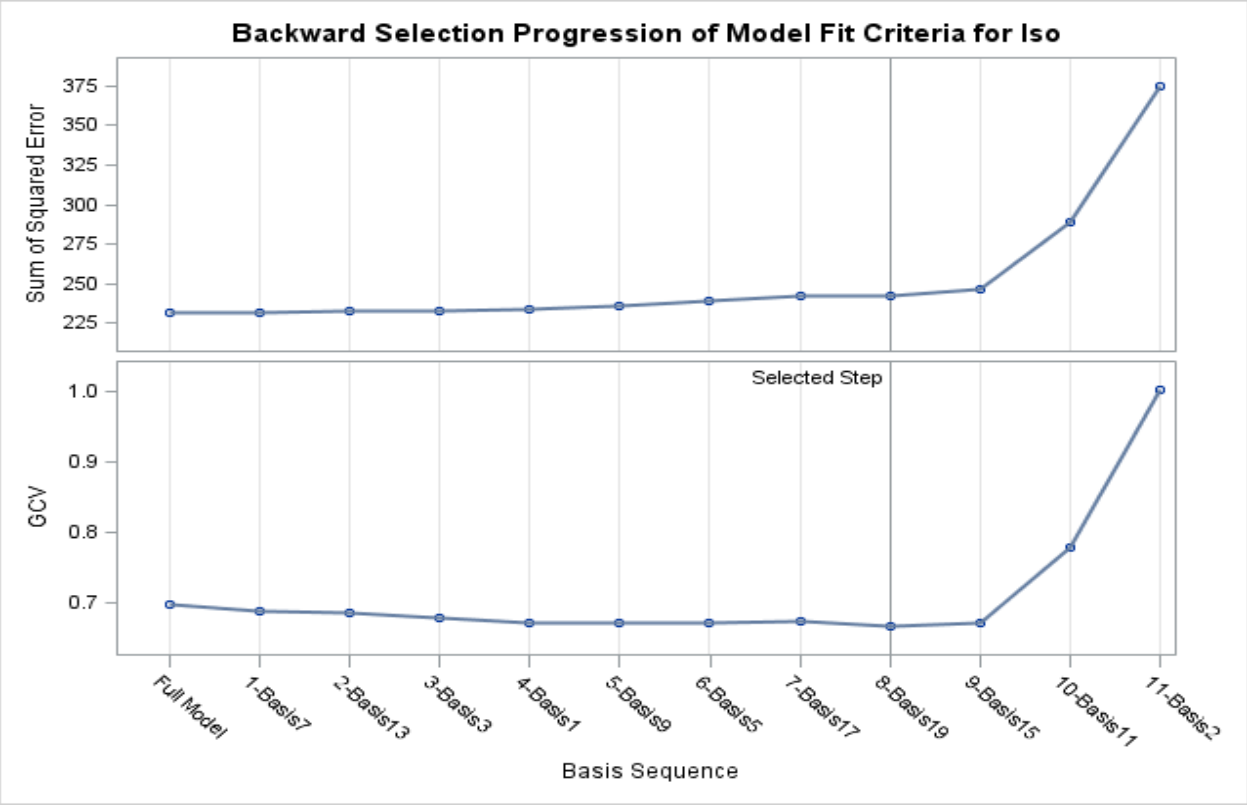


Figure A-3. Spline regression fit in Moderate neighborhoods.


Fit Diagnostics for Iso
Residual
Predicted Value
Percent
Residual
Residual
Quantile
Fit–Mean
Residual
Proportion Less
Iso
Predicted Value
Observations 376
GCV 0.6673
GCV R-Square 0.3345
Effective DF 7
R-Square 0.3556
Adjusted R-Square 0.3504
Mean Square Error 0.6496


Backward Selection Progression of Model Fit Criteria for Iso
Sum of Squared Error
Selected Step
GCV
Full Model
1-Basis7
2-Basis13
3-Basis3
4-Basis1
5-Basis9
6-Basis5
7-Basis17
8-Basis19
9-Basis15
10-Basis11
11-Basis2
Basis Sequence

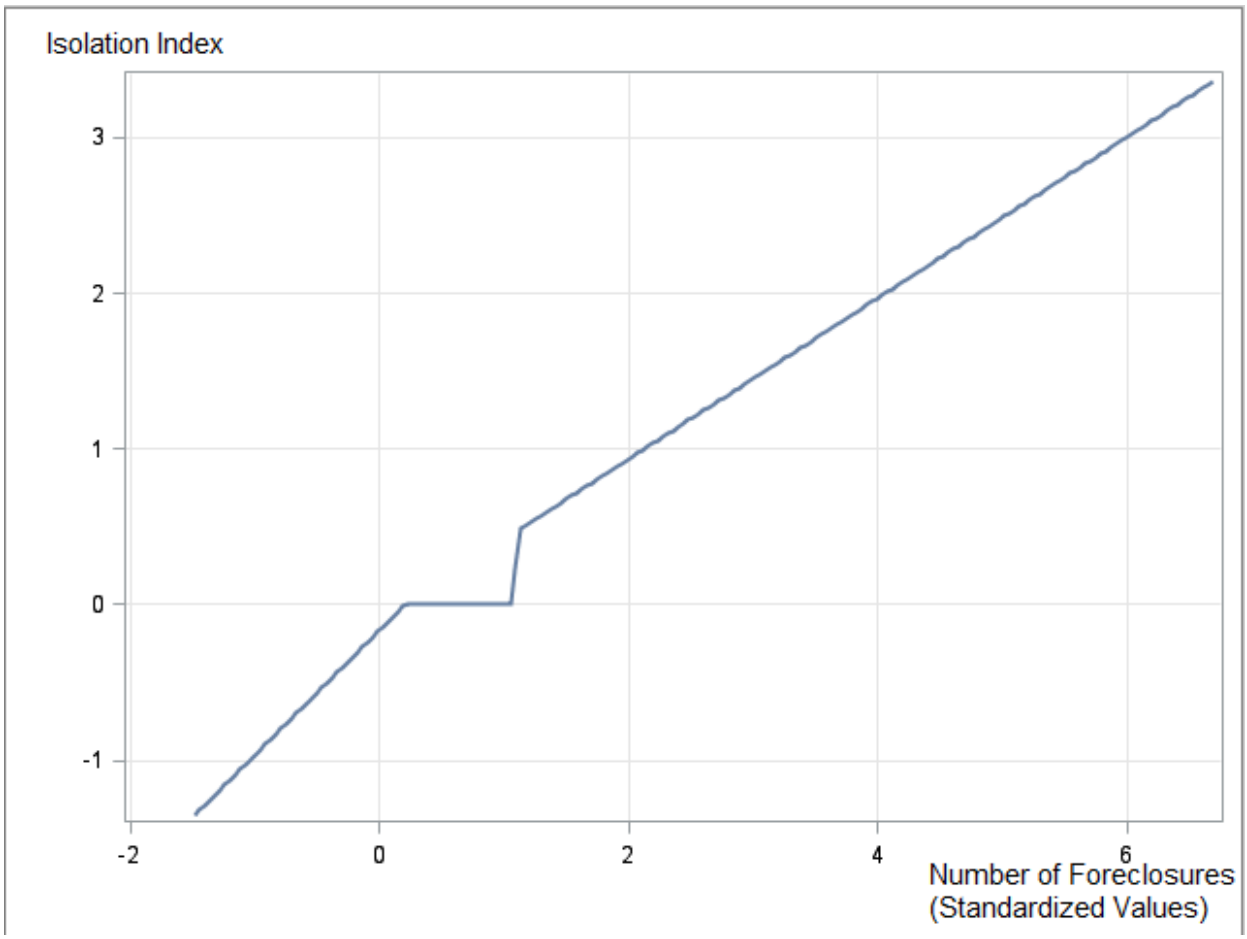


Figure A-4. Spline regression model in Moderate neighborhoods.

Economically Distressed Neighborhoods

The ADAPTIVEREG Procedure

Model Information	
Data Set	WORK.O3STD
Response Variable	Iso
Distribution	Normal
Link Function	Identity

Fit Controls	
Maximum Number of Bases	21
Maximum Order of Interaction	1
Degrees of Freedom per Knot	2
Knot Separation Parameter	0.05
Penalty for Variable Reentry	0
Missing Value Handling	Include

Number of Observations Read	260
Number of Observations Used	256

Fit Statistics	
GCV	0.76768
GCV R-Square	0.23532
Effective Degrees of Freedom	9
R-Square	0.28255
Adjusted R-Square	0.27112
Mean Square Error	0.72888
Average Square Error	0.71465

Regression Spline Model after Backward Selection

Name	Coefficient	Parent	Variable	Knot
Basis0	-0.9920		Intercept	
Basis5	1.0476	Basis0	Nfore	-1.3854
Basis15	12.1876	Basis0	Nfore	-0.03079
Basis17	-9.2739	Basis0	Nfore	-0.1428
Basis19	-3.6564	Basis0	Nfore	0.1933

ANOVA Decomposition				
Functional Component	Number of Bases	DF	Change If Omitted	
			Lack of Fit	GCV
Nfore	4	8	72.0500	0.2362

Variable Importance		
Variable	Number of Bases	Importance
Nfore	4	100.00

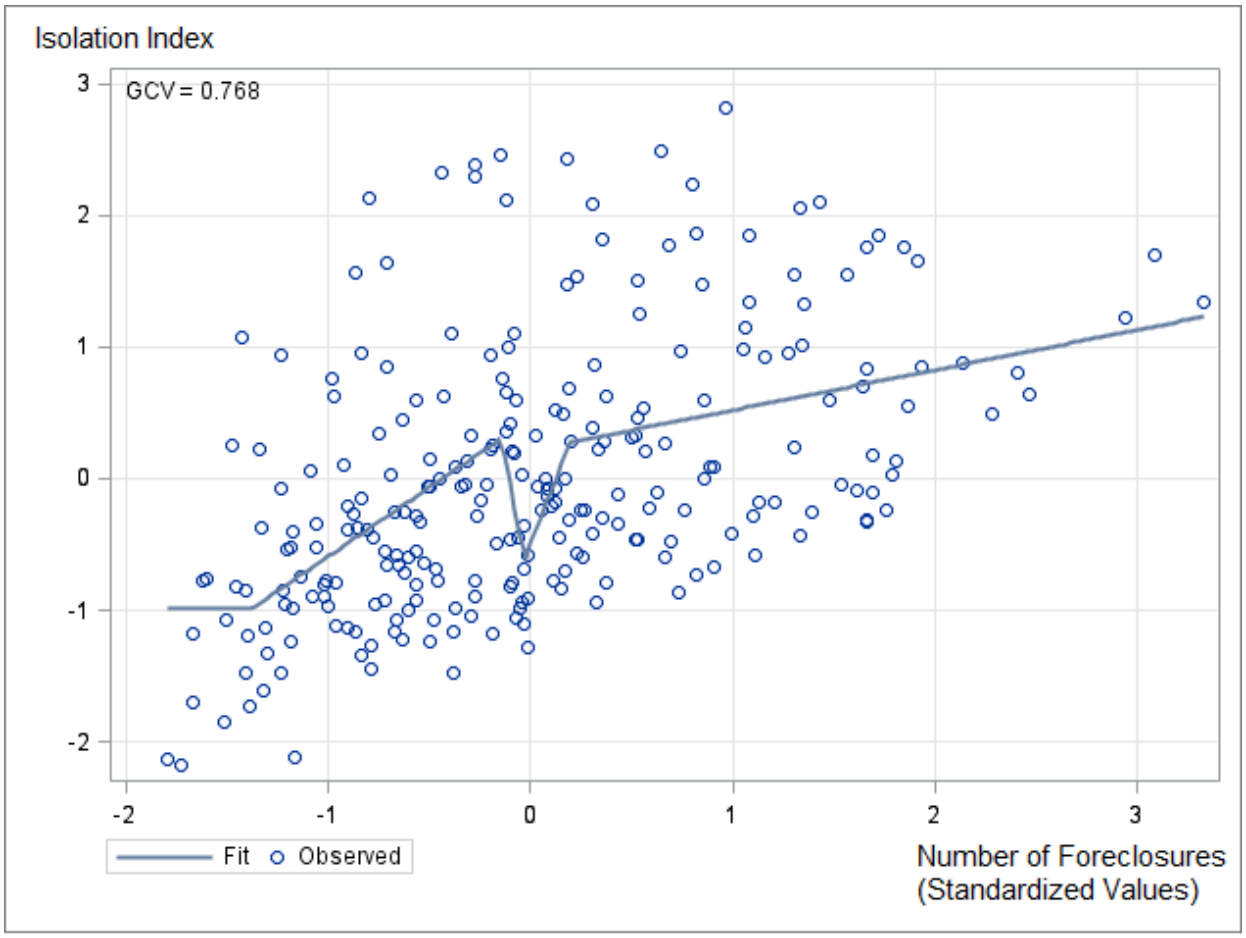
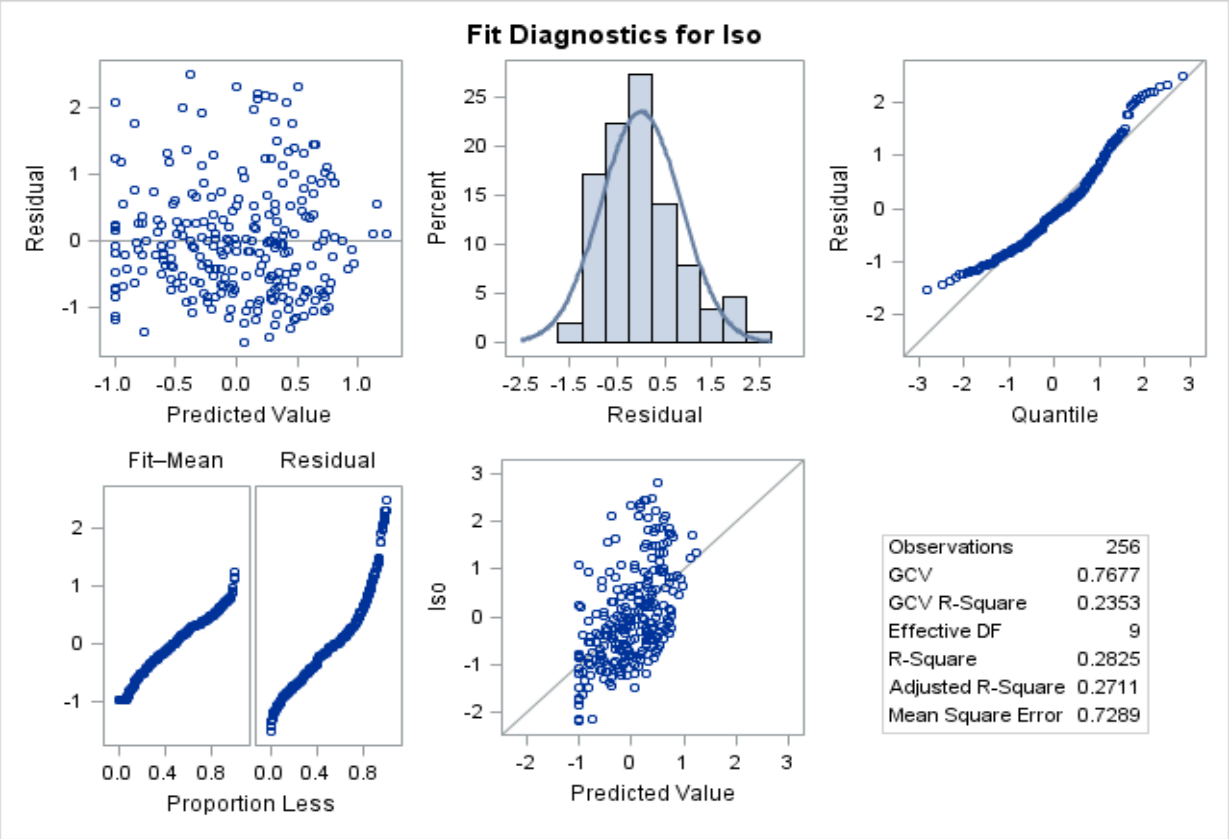
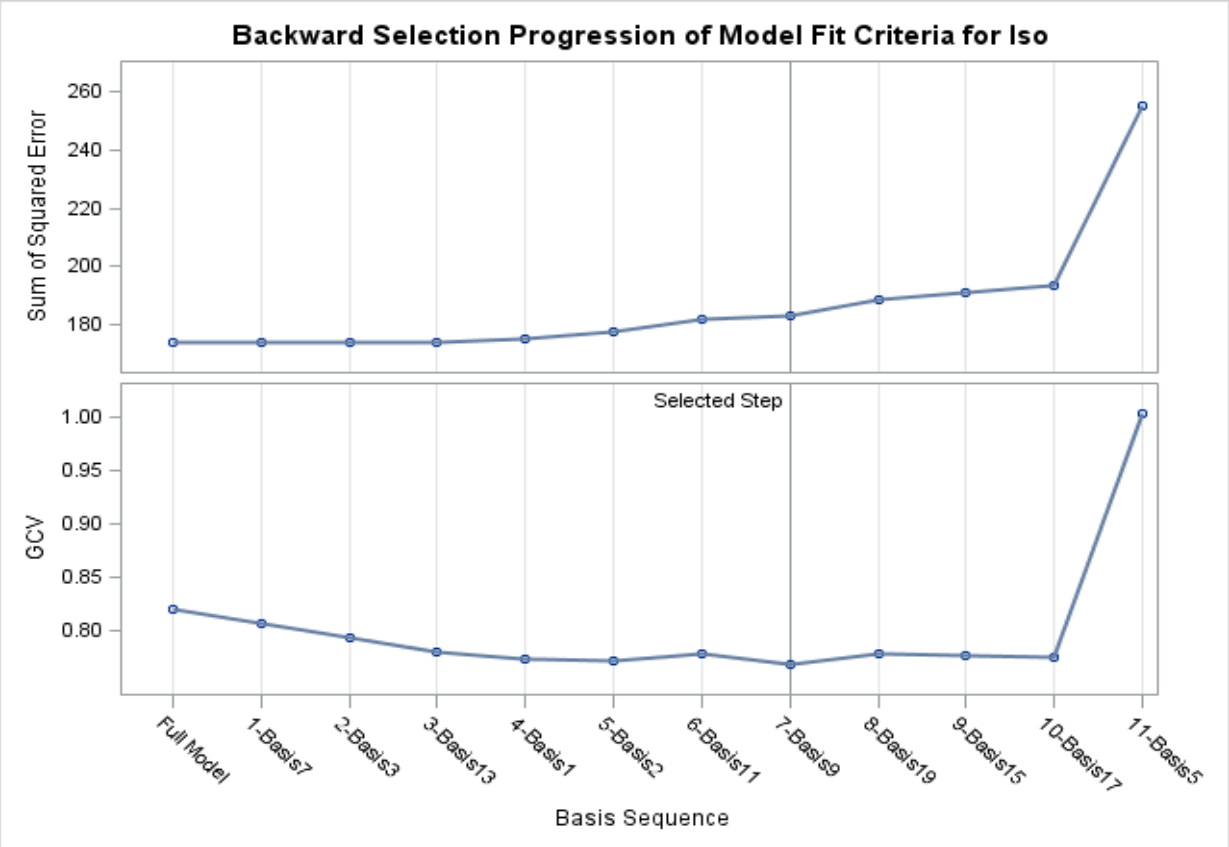


Figure A-5. Spline regression fit in Economically Distressed neighborhoods.


Fit Diagnostics for Iso
Residual
Predicted Value
Percent
Residual
Residual
Quantile
Fit–Mean
Residual
Proportion Less
Iso
Predicted Value
Observations 256
GCV 0.7677
GCV R-Square 0.2353
Effective DF 9
R-Square 0.2825
Adjusted R-Square 0.2711
Mean Square Error 0.7289


Backward Selection Progression of Model Fit Criteria for Iso
Sum of Squared Error
GCV
Selected Step
Full Model
1-Basis7
2-Basis3
3-Basis13
4-Basis1
5-Basis2
6-Basis11
7-Basis9
8-Basis19
9-Basis15
10-Basis17
11-Basis5
Basis Sequence

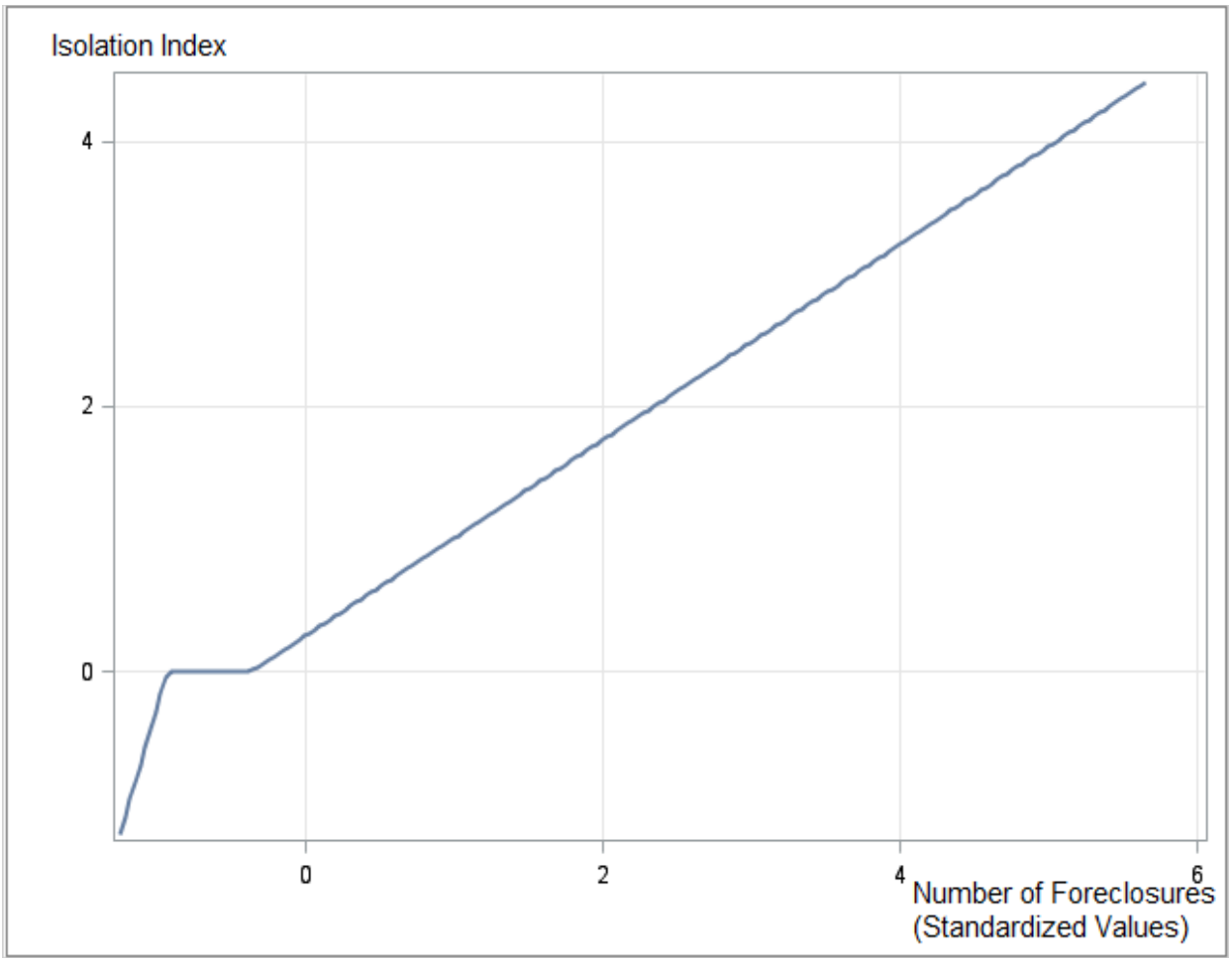


Figure A-6. Spline regression model in Economically Distressed neighborhoods.

Combining Economically Strong and Moderate Neighborhoods

The ADAPTIVEREG Procedure

Model Information	
Data Set	WORK.SC1STD
Response Variable	Iso
Distribution	Normal
Link Function	Identity

Fit Controls	
Maximum Number of Bases	21
Maximum Order of Interaction	1
Degrees of Freedom per Knot	2
Knot Separation Parameter	0.05
Penalty for Variable Reentry	0
Missing Value Handling	Include

Number of Observations Read	490
Number of Observations Used	488

Fit Statistics	
GCV	0.69415
GCV R-Square	0.30727
Effective Degrees of Freedom	9
R-Square	0.32984
Adjusted R-Square	0.32429
Mean Square Error	0.67571
Average Square Error	0.66878

Regression Spline Model after Backward Selection				
Name	**Coefficient**	**Parent**	**Variable**	**Knot**
Basis0	0.07869		Intercept	
Basis2	-0.7946	Basis0	Nfore	-0.06940
Basis11	-6.6026	Basis0	Nfore	0.3692
Basis13	1.6030	Basis0	Nfore	0.7162
Basis15	5.5202	Basis0	Nfore	0.2579

ANOVA Decomposition				
Functional Component	Number of Bases	DF	Change If Omitted	
			Lack of Fit	GCV
Nfore	4	8	160.63	0.3079

Variable Importance		
Variable	Number of Bases	Importance
Nfore	4	100.00

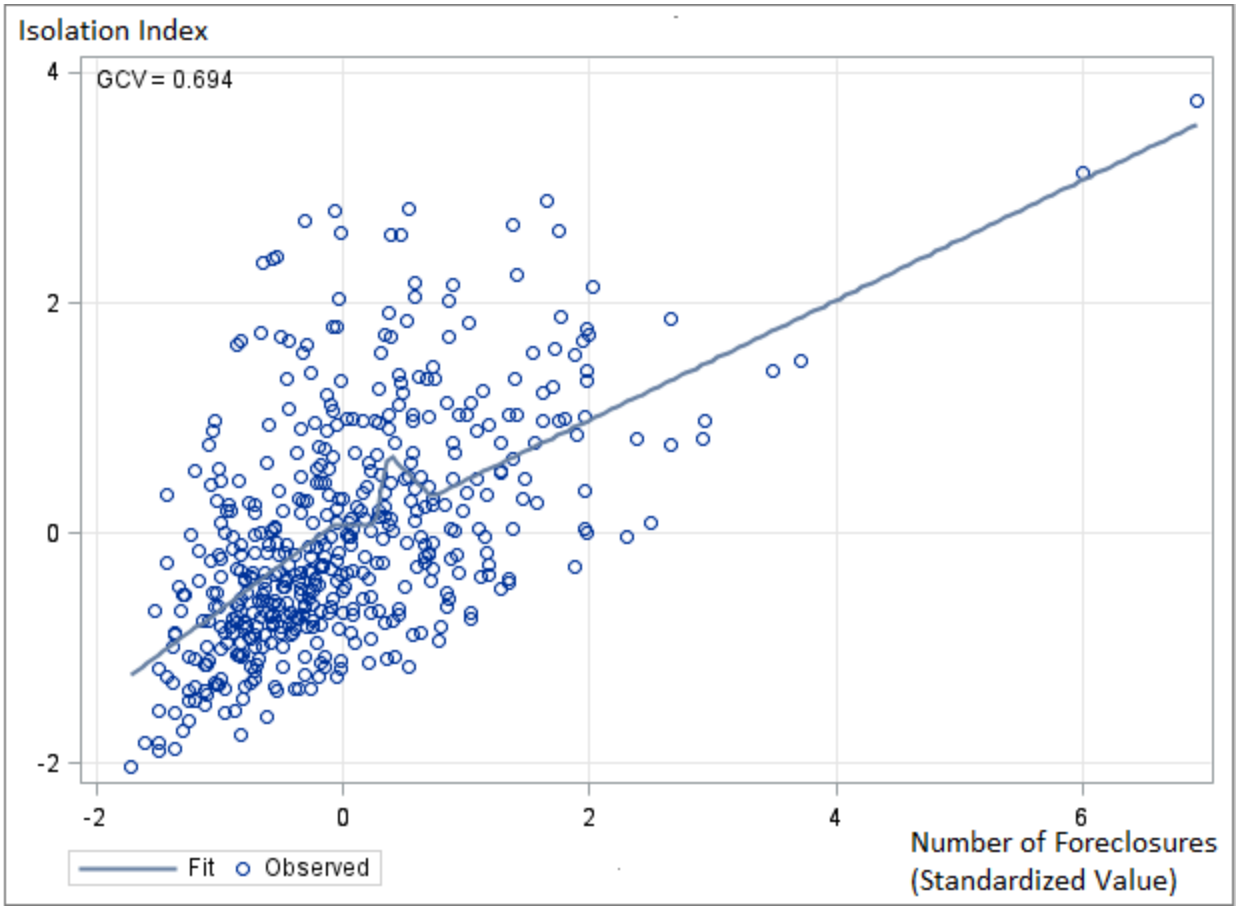
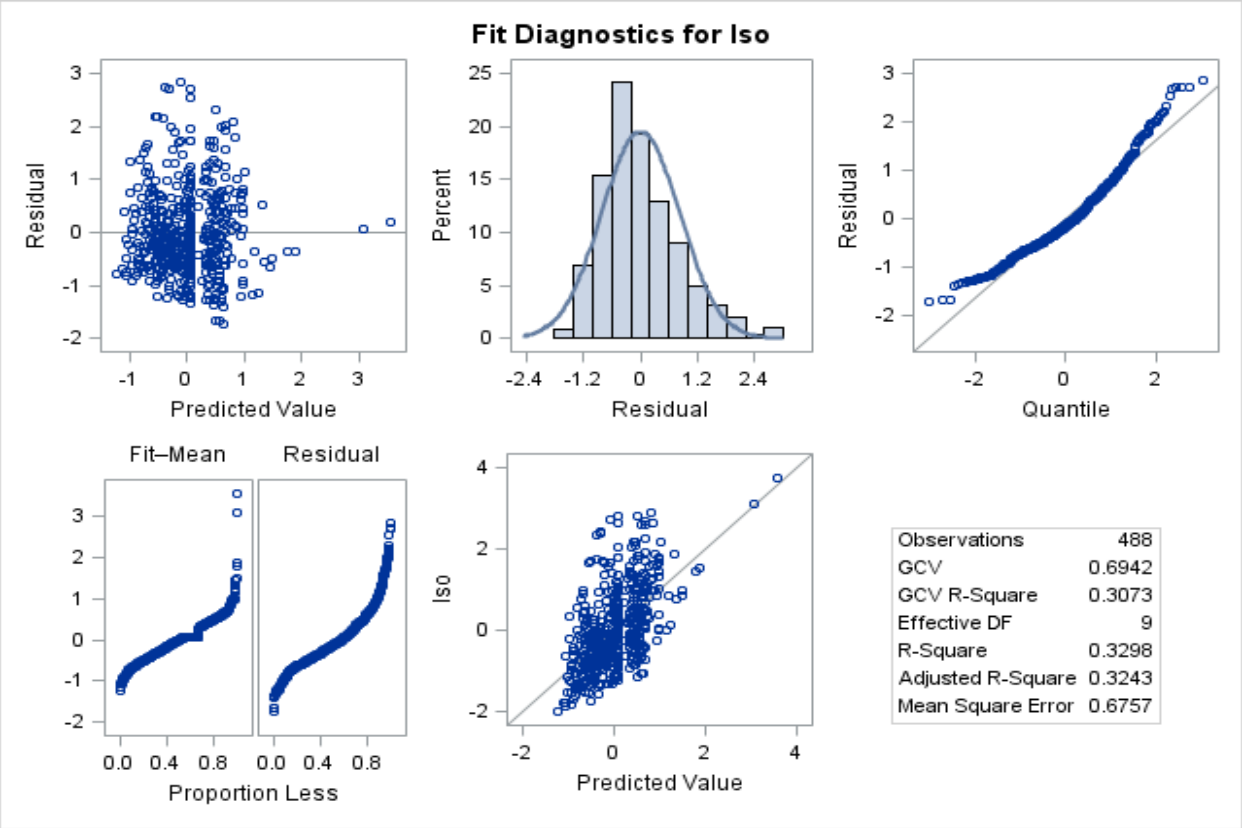
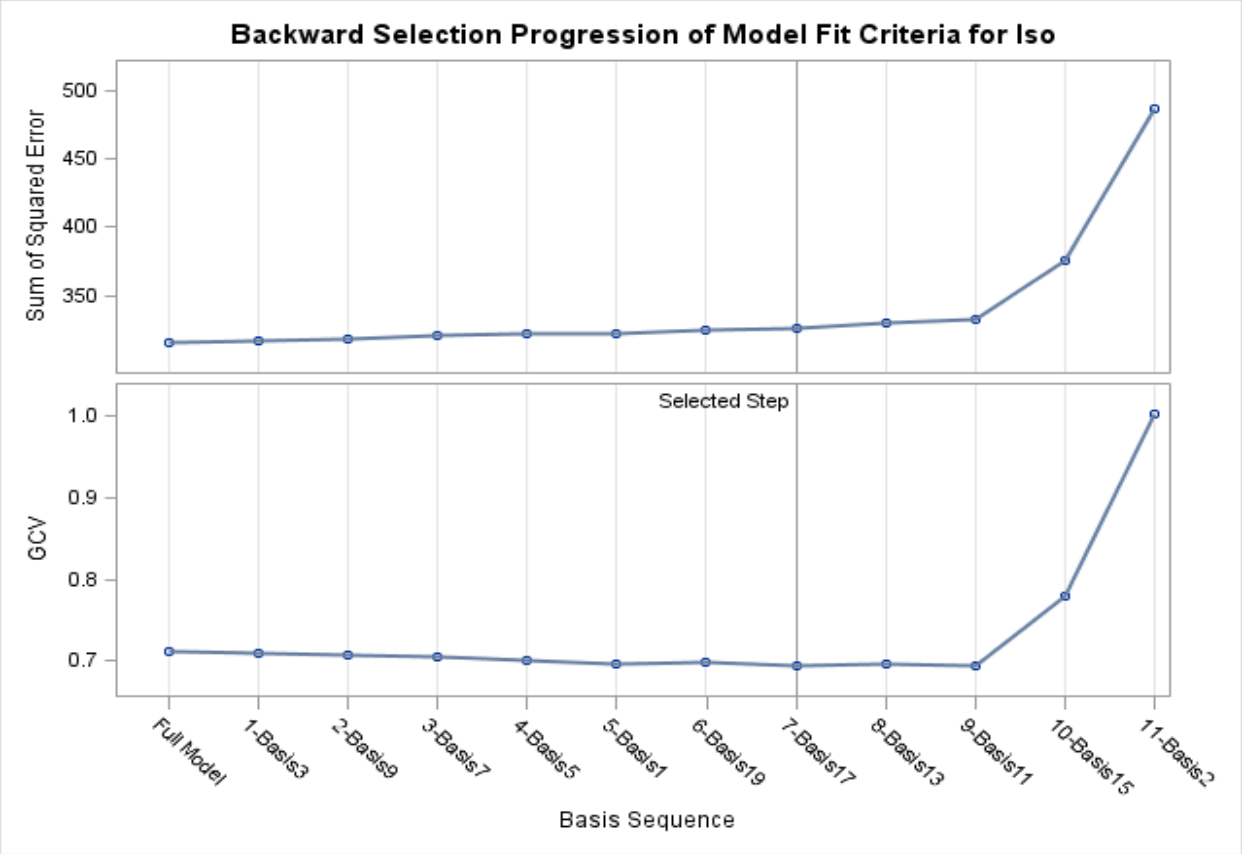


Figure A-7. Spline fit for isolation index.


Fit Diagnostics for Iso
Residual
Predicted Value
Percent
Residual
Residual
Quantile
Fit–Mean
Residual
Proportion Less
Iso
Predicted Value
Observations 488
GCV 0.6942
GCV R-Square 0.3073
Effective DF 9
R-Square 0.3298
Adjusted R-Square 0.3243
Mean Square Error 0.6757


Backward Selection Progression of Model Fit Criteria for Iso
Sum of Squared Error
Selected Step
GCV
Full Model
1-Basis3
2-Basis9
3-Basis7
4-Basis5
5-Basis1
6-Basis19
7-Basis17
8-Basis13
9-Basis11
10-Basis15
11-Basis2
Basis Sequence

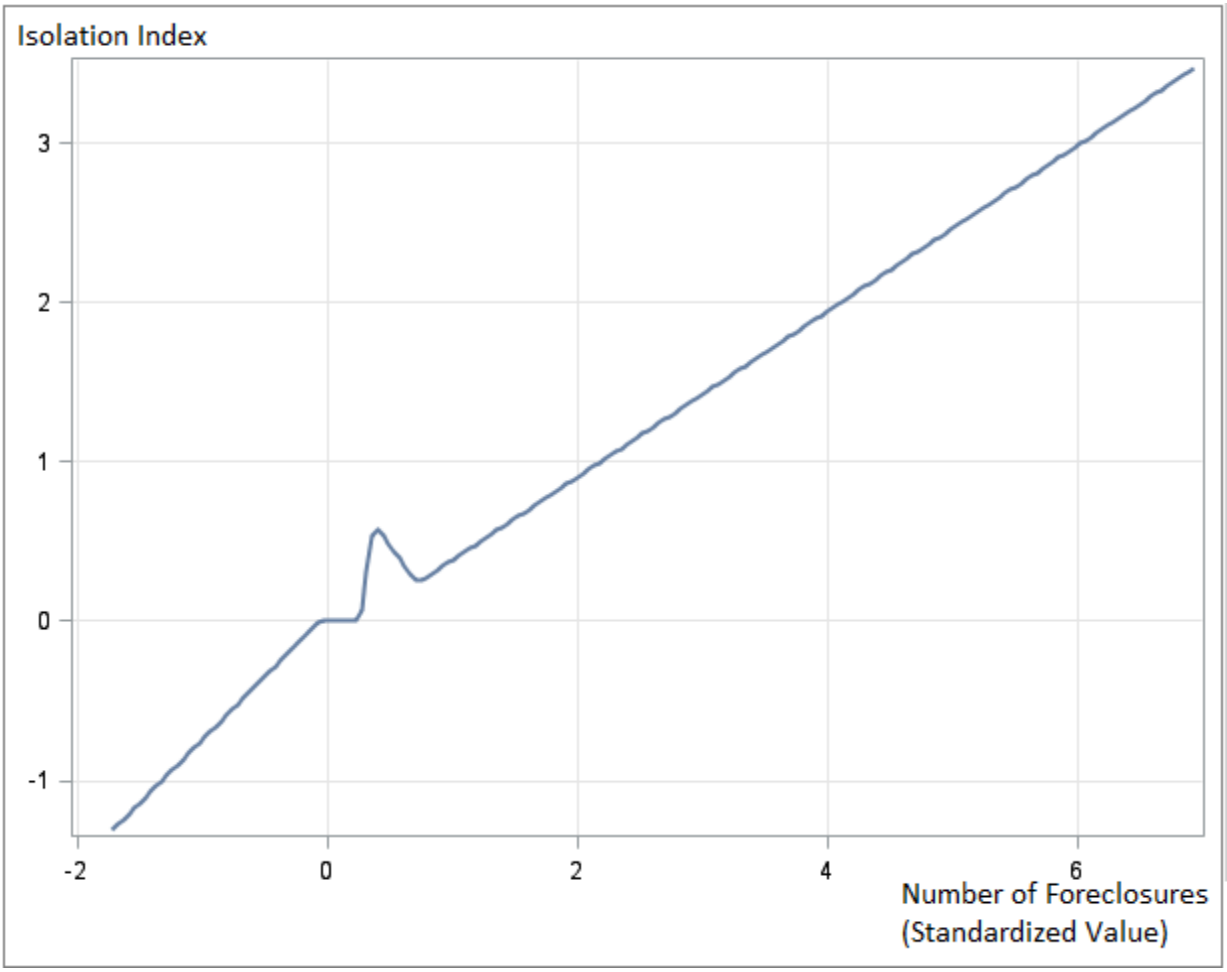


Figure A-8. Spline regression model.

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BIOGRAPHICAL SKETCH

Young Sun Kwon majored in Urban and Regional Planning at University of Florida. Her research focuses on planning implications of community development—particularly the relationship between housing crises, industrial location, and other investment policies, and economic development at the neighborhood level. Such approaches can be a basis of the public decision-making process that targets resources such as housing programs, revitalization efforts, etc. Young Sun received the degrees of Bachelor of Science and Master of Science in urban planning in Korea, and after graduation, worked as an assistant research fellow in Korea's government-run research institutes in the field of urban planning and land management. During this roughly 4 year period, she mainly conducted research focused on the impact analysis of urban development projects and plans for industrial revitalization.