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Suburban Gentrification: Understanding the Determinants of Single-family Residential Redevelopment, A Case Study of the Inner-Ring Suburbs of Chicago, IL, 2000-2010

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Abstract

Suburban gentrification is most visible through capital reinvestment in the built environment. In this paper, I examine one type of reinvestment—the incremental, residential redevelopment process in which older single-family housing is demolished and replaced with larger single-family housing. The paper addresses the question: why is redevelopment more likely to occur in some neighborhoods than in others. I perform a nonnested multilevel logistic regression analysis of parcel-level data for all single-family parcels in 128 suburbs and unincorporated areas of Chicago between 2000 and 2010 to examine the property and neighborhood characteristics associated with single-family residential redevelopment in inner-ring suburban neighborhoods. Findings indicate that properties with smaller houses, lower floor area-to-lot size ratios (FAR), and lower ratios of their value to that of their neighborhood are more likely to be redeveloped. The median property value of a neighborhood does not have a large effect on whether a property is redeveloped, but neighborhoods with higher proportions of Black and Hispanic residents were significantly less likely to experience redevelopment. School district quality was very highly associated with redevelopment; the odds of redevelopment for properties located in the highest-ranked school districts are 2.5 times that of those that are not.

Introduction

"Suburban gentrification" of older, inner-ring suburbs is an emerging phenomenon that has the potential to transform the spatial structure of American metropolitan regions. It may foreshadow shifts in household location patterns and changes in the socio-economic composition of neighborhoods similar to examples of classical gentrification observed in central cities. Yet, few empirical studies address the transformation of inner-ring suburbs. Gentrification includes physical, social, and economic changes in neighborhoods, but it is arguably most visible through physical reinvestment in the built environment. This paper examines one particular type of reinvestment—the incremental, private sector, residential redevelopment process, in which older single-family housing is demolished and replaced with larger single-family housing. Preliminary evidence indicates that single-family residential redevelopment is widespread; however, it is not ubiquitous. This paper addresses the question: why is this type of redevelopment more likely to occur in some suburban neighborhoods than others? I perform a nonnested multilevel logistic regression analysis of parcel-level data for all single-family residential parcels in 128 suburbs and unincorporated areas of Chicago between 2000 and 2010 to examine the property and neighborhood characteristics associated with single-family residential redevelopment in inner-ring suburban neighborhoods.

This paper specifically focuses on single-family housing in older, inner-ring suburbs, much of which was built during the postwar era. The period following World War II was one of prolific residential construction in the suburbs surrounding American cities. A postwar housing supply shortage, and federal policies that promoted homeownership and supported decentralized growth, led to a substantial increase in suburban development (Nicolaides & Wiese, 2006). In the first twenty years following the end of World War II, over 26 million single-family homes were constructed (Nicolaides & Wiese, 2006). Although metropolitan regions have continued to grow in a decentralized pattern and at a rapid pace since then, single-family housing in inner-ring suburbs remains a significant part of the metropolitan landscape. Today, inner-ring suburbs contain approximately 20% of the housing stock in the United States (Puentes & Warren, 2006).

As inner-ring suburbs have aged, some have begun to experience population and income decline, crime increase, and reduction in their tax base (Hanlon, 2010; Hanlon, Short, & Vicino, 2010; Hudnut, 2003; Jargowsky, 2005; Lucy & Phillips, 2000; Orfield, 2002; Vicino, 2008). In *Crabgrass Frontier*, Jackson (1987, p. 301) writes, "The cycle of decline has recently caught up

with the inner suburbs." He adds that although some are prospering, others "are already encountering fiscal, educational, racial, and housing crises as severe as those which troubled major cities in the 1960s and 1970s" (Jackson, 1987, p. 301). Davis (1997) foretells a second urban crisis looming in the inner-ring suburbs of American cities, resulting from the competition between inner-ring suburbs and newer outer-ring suburbs, as well as with the central cities. But, while some older suburban neighborhoods are experiencing continued disinvestment, others are receiving a significant amount of reinvestment; their housing stock is being dramatically transformed through incremental, private-sector redevelopment.

This paper examines a conspicuous form of capital reinvestment in inner-ring suburban neighborhoods—the private-sector demolition and replacement of single-family housing—referred to colloquially as "teardowns," "scrape-offs," or "dozers." In this process, older single-family housing is demolished and larger single-family housing is built in its place. A property owner may decide to demolish a single-family house and rebuild another house on the property for his/her own use; or a real estate developer may purchase a property with the intention of demolishing the existing house, rebuilding a larger one, then selling the property for a profit.

Suburban residential redevelopment may raise neighboring property values and create additional municipal revenue through increased property tax assessments, which is often welcomed by local municipalities heavily reliant on residential property taxes to fund public services. Moreover, many smart growth proponents support inner-ring suburban residential redevelopment, considering it an anti-sprawl tactic. Although it does not increase the density of land use on a unit-per-acre basis, they view this type of redevelopment as an attempt to recycle older, well-located neighborhoods by attracting households that might otherwise have chosen new, larger housing on the urban fringe (Bromley, Tallon, & Thomas, 2005; Danielsen, Lang, & Fulton, 1999).

But like examples of central city gentrification, inner-ring suburban residential redevelopment may result in the displacement of existing residents, limit housing choice by reducing the stock of smaller, affordable (or mid-priced) housing, and alter the physical and socio-economic characteristics of neighborhoods. Some suburban municipalities encourage this type of private-sector redevelopment, while others have enacted policies to discourage it. A nuanced understanding of the determinants of residential redevelopment is needed in order for

policy makers to craft more equitable, more accurately targeted, and more effective housing and urban development strategies.

Theoretical Foundations

Many residential properties in inner-ring suburbs were fixed into their present use when they were originally developed. Initially, the properties were developed to their highest and best, most profitable use as single-family housing—this includes the particular characteristics of the house (i.e., floor area, features, style, etc.). Over time, as the housing ages and depreciates, it may no longer represent the highest and best use for that particular property. However, since it is long-lasting and fixed in space, it prevents redevelopment from occurring at that location until it has outlived its economic life. Yet separately, the value of the land upon which it is built may have increased in value, based on demand for its location. Redevelopment of the property may return it to its most profitable use once again. This disparity between the economic return from a property's original development and that of its most profitable use is the basis of the "rent gap" (Smith, 1979).

The rent gap is the difference between the actual economic return from a property given its present land use and the potential return if it were developed to its highest and best use (Smith, 1979). This concept is widely attributed to Smith's (1979) influential paper; however, economists have used similar concepts (e.g., the value differential) to explain redevelopment.[1] When the rent gap grows large enough for a developer to purchase the property, pay for redevelopment and carrying costs, and then sell it for a satisfactory profit, redevelopment will occur (Smith, 1979).

Several empirical studies substantiate the validity of the rent gap as an explanation for redevelopment activity. Rosenthal and Helsley (1993) explore the redevelopment of single-family, detached housing in Vancouver, British Columbia. They find that property is redeveloped when the existing building is economically obsolete—redevelopment occurs when the price of a property in its current state is less than the price of vacant land (Rosenthal & Helsley, 1993). Moreover, in his study of commercial and industrial property in the city of

[1] There are significant differences between the rent gap and the value differential relating to the underlying concepts of ground rent and land value. However, both theories are similar in that they address the difference between the financial return from a property under its original land use to that of its most profitable use in the decision to redevelop a property.

Chicago, Munneke (1996) finds that redevelopment occurs when the value of a property, plus demolition costs, is less than or equal to that of vacant land. Additionally, Dye and McMillen (2007) study single-family residential redevelopment in six suburbs of Chicago and also present additional evidence to support the theory that the price of property purchased for redevelopment reflects the value of vacant land, controlling for sample selection bias. Hufbauer and Severn (1974) find that in order for a single-family dwelling to be redeveloped, the anticipated value of the redeveloped structure must at least triple. They find that as a city's population grows, ground rents increase and older depreciated buildings are demolished and replaced with higher density buildings (Hufbauer & Severn, 1974).

Rosenthal and Helsley (1993), Helms (2003), Weber et al. (2006), Dye and McMillen (2007), and McMillen (2009) find that older, wood-frame structures with lower FARs are more likely to be redeveloped. In the study that most closely resembles this one in terms of its specific focus on suburban, single-family residential redevelopment at the parcel-level, Dye and McMillen (2007) find that properties located closer to commuter rail stations and Lake Michigan and those with lower floor area to lot size ratios were more likely to be redeveloped. They also find that several structural characteristics of houses are significantly associated with redevelopment. However, their sample only included six wealthy suburbs with high rates of redevelopment, and they did not consider neighborhood-level socio-economic and demographic characteristic or school district quality in their analysis.

Data

This study focuses on the older, inner-ring suburbs of Chicago, Illinois. The Chicago metropolitan area was chosen for this case study because it is an area where anecdotal evidence indicates that residential redevelopment is particularly widespread (Dye & McMillen, 2005, 2007; Fine & Lindberg, 2002). The National Trust for Historic Preservation has described the residential redevelopment phenomenon in Chicago as an epidemic, and, in 2002, they labeled the Chicago metropolitan area the epicenter of teardowns, specifically identifying over 50 suburbs in the Chicago area that are experiencing high rates of residential redevelopment activity (Fine & Lindberg, 2002).

Previous studies use the issuance of a demolition permit as a proxy for redevelopment activity. This study begins by using the issuance of a demolition permit to identify single-family

residential parcels upon which a house was demolished. It combines the demolition permit data with parcel data from the Cook County Assessor's Office (CCAO) to identify parcels upon which a structure was both demolished and subsequently rebuilt. The dataset used in this study includes all single-family residential parcels in the 128 older, inner-ring suburbs of Chicago and adjacent unincorporated areas located in Cook County, Illinois.

Property owners in suburban Cook County are required to obtain a demolition permit prior to the demolition of a structure on their property. Information regarding all single-family residential demolition permits in all Cook County suburban municipalities and unincorporated areas issued between January 1, 2000 and December 31, 2009 was collected and digitized. These data include property address, structure type, and the permit issue date. Permits that were issued for partial house demolitions, detached garage demolitions, or land-uses other than single-family residential were discarded. The demolition permit data were then matched by street address to the CCAO database of all single-family residential parcels in suburban Cook County.

The issuance of demolition permits may be an imprecise indicator of redevelopment activity; a demolition permit may be issued, but the house is not demolished; or house may be demolished, but it is not replaced with new construction. In order to capture only properties upon which a house was demolished and a new house was built, the square footage of each house in 1997 for which a demolition permit was issued was compared with the house square footage on record with the CCAO in August 2010.[2] Only parcels for which a demolition permit was issued and that experienced an increase in square footage between 1997 and 2010 were classified in the dataset as having been redeveloped.

The 1997 CCAO database of all properties in Cook County includes each parcel's street address, latitude and longitude coordinates, land use, lot size, house floor area, house age, tax assessed value, and house attributes such as the type of construction, basement type, garage type, and central air conditioning.[3] Nonresidential parcels, multi-family residential properties, vacant properties, and properties with incomplete data were removed from the database. These data were matched by PIN with the demolition permit data.

In addition to a parcel's redevelopment status and characteristic included in the 1997 CCAO database, several other variables were generated for each parcel and added to the dataset.

[2] CCAO data for 2000 was not available. CCAO data from 1997 was used to measure the building square footage prior to any redevelopment that occurred during the time period of the study, 2000-2010.
[3] The latitude and longitude coordinates for each parcel were calculated by Professor Daniel McMillen.

Using Geographic Information Systems (GIS) software, I geographically located each parcel on a map of Cook County, and calculated several variables based upon its spatial location. I also obtained census tract-level data from the Geolytics Neighborhood Change Database (NCDB) for 1990 and 2000. These data define additional variables that characterize socio-economic and demographic attributes of the census tract in which each parcel is located, as well as changes in those characteristics from 1990 to 2000. The geographic coordinates were used to associate each parcel with its public elementary and high school districts. Additionally, I obtained the property tax rate for each property tax district code from the Cook County Tax Extension Office, and matched it to the property tax district code indicated for each parcel. Several properties were removed from the dataset because they lacked data for one or more variables. The resultant dataset used includes 560,310 single-family residential parcels, of which 3,924 were redeveloped between 2000 and 2010.

Figure 1 presents a map that indicates the location of each of the redeveloped parcels in the 128 suburban municipalities and unincorporated areas studied between 2000 and 2010. Figure 2 illustrates the percentage of housing demolished per ¼ x ¼ mile area. The percentage of redeveloped parcels per quarter mile grid ranges from zero to 33.3%. Exploratory analysis of the spatial pattern of redevelopment indicates that residential redevelopment occurred in many different types of suburbs—across a differentiated landscape in terms of property value, household incomes, occupation, and racial and ethnic composition. The maps reveal that a significant amount of redevelopment occurred on the northern suburbs of Cook County; several neighborhoods with high median household incomes and property values as well as high percentages of residents employed in managerial and professional occupations had high levels of redevelopment. But, the maps also indicate that equally high rates of redevelopment occurred in neighborhoods with moderate household incomes and property values. Several neighborhoods with socio-economic and housing characteristics equal or slightly lower than the median for suburban Cook County were identified as having among the highest rates of redevelopment.

Regression Analysis

The dependent variable used in the regression models (*REDEV*) is defined as a discrete variable that equals one if a parcel was redeveloped between January 1, 2000 and December 31, 2009, and zero otherwise. Consistent with the theory of the rent gap as a key explanation for residential redevelopment activity, characteristics of a parcel that either decreases its actual economic return compared to its potential economic return or increases its potential economic return relative to its actual economic return, will increase the rent gap and therefore its chances of being redeveloped. Table 1 presents the mean and standard deviation of the independent variables for all parcels, nonredeveloped parcels, and redeveloped parcels.

Previous studies find a statistically significant association between a house's age and its likelihood of redevelopment. As a house ages and depreciates, its value may decline at the same time as the value of the land continues to appreciate. Older housing may have depreciated and the land upon which it is located—land fixed into its original land use at the time of the construction of the original house—may be located in relatively desirable locations. Thus, I hypothesize that older housing is more likely to be redeveloped. This hypothesis is supported by the summary statistics. The average age of single-family housing in suburban Cook County is 42 years; on average, redeveloped houses are 14 years older. Although I expect that older houses are more likely to be redeveloped, I do not anticipated that a one year increase in house age will have a consistent effect on the likelihood of redevelopment across the entire range of house age. Thus, the continuous age variable was transformed into three dummy variables to indicate whether a house was built before 1945 (*PREWAR*), between 1945 and 1970 (*POSTWAR*), or after 1970 (*NEW*). The latter two categories are included in the regressions models. The category denoting whether a house was built before 1945 is the reference category.

It is expected that houses built after 1970 are significantly less likely to be redeveloped than housing built before 1945. Whether housing built during the postwar era would be more or less likely to be redeveloped than older housing is more ambiguous. Postwar housing may be less desirable in its design and amenities than older housing; prewar housing may be viewed as having attractive historic qualities. Therefore, postwar housing would be more likely than prewar housing to be redeveloped. However, the neighborhoods in which postwar housing is located may have less desirable aesthetic qualities, and the suburbs in which they are located may also be

viewed as less desirable. Thus, an argument can also be made that postwar housing is less likely to be redeveloped than prewar housing. Thus, the expected result is unknown.

Americans have demonstrated a preference for increasingly larger homes, causing the average floor area of newly constructed houses to increase substantially over time. The average floor area of newly-built single-family houses peaked in 2007 at 2,521 square feet, which is over 1,100 square feet larger then the average single-family home in suburban Cook County (National Association of Homebuilders, 2010).[4] Thus, smaller houses are expected to be relatively less desirable and more likely to be redeveloped. On average, redeveloped parcels are only slightly smaller than parcels that were not redeveloped, (1,342 and 1,395 square feet, respectively). As an independent variable in regression analysis, house floor area does not meet the assumptions of parametric statistical tests. Using regression techniques on these data may give unreliable results; therefore, I transformed the data by taking the natural logarithm of house age. The natural logarithm of the house floor area (*LOGSF*) is expected to be negatively associated with redevelopment, with smaller houses more likely to be redeveloped, controlling for all other variables.

Small houses located on relatively large lots may signify a large rent gap. Weber et al. (2006) found the house floor area to lot size ratio (FAR) to be the most important determinant of demolition. A low FAR may indicate that there is more land area upon which to build a larger new house than a parcel with a higher FAR. The average FAR in 2000 for a redeveloped parcel is 0.137, and the average FAR of a non-redeveloped parcel in is 0.196. Like the house floor area variable discussed above, exploratory data analysis indicates that the FAR variable is not normally distributed. Consequently, the natural logarithm of the FAR (*LOGFAR*) is included in the regression models. A parcel's FAR is expected to be negatively and highly significantly associated with redevelopment. Stated another way, parcels with a low FARs—houses located on relatively larger lots—are expected to be more likely to be redeveloped, holding constant the other explanatory variables.

Parcels with lower property values than their neighbors may signify a rent gap and also a greater potential to realize economic gains through redevelopment in that surrounding parcels are

[4] The National Association of Home Builders (NAHB) reports that since the peak in the average new house size in 2007, the average new house size was flat in 2008 and dropped to 2,438 square feet in 2009. However, the average house size in 2009, albeit smaller than in previous years, is still significantly higher than the average for suburban Cook County.

developed to a greater highest and best use. This rent gap is notable in neighborhoods where previous redevelopment activity has taken place—an area within which property values are somewhat diverse. It could also occur if some parcels are, for some reason, not maintained to the same level of highest and best use as their neighbors. This variable would not be significantly associated with the early stages of suburban gentrification in a neighborhood. However, it would be a characteristic of redevelopment in historically wealthy neighborhoods, such as in a property inhabited by a long-term residents that later is offered for sale upon their move or death. A variable indicating the ratio of a parcel's value to the average value of its neighbors (*VALRATIO*) was calculated by dividing each parcel's individual CCAO assessed value to the average CCAO assessed value in its census tract. The value ratio should be negatively associated with the likelihood of demolition, controlling for the other independent variables.

Parcel characteristics that result in relatively less functional utility than others are expected to be positively associated with redevelopment activity. Several explanatory variables reflect the physical characteristics of the houses built upon the parcels prior to the study period, including whether it is built of masonry (*MASON*), has a finished basement (*BASEFIN*), has central air conditioning (*CENTAIR*), or has a one-car garage (*ONEGAR*). I anticipate that houses built of masonry construction are be less likely to be demolished due to the greater demand and value placed upon masonry construction and their tendency to require less maintenance than houses built of wood-frame construction and their tendency to depreciate slower. Houses with finished basements are likewise more desirable and have higher demolition costs. A house with a finished basement has already undergone renovation, so the rent gap may be reduced, and owners/developers may be less inclined to redevelop it. Houses without finished basements are consequently expected to be more likely to be redeveloped, controlling for other variables. The same holds true for houses without central air-conditioning. Houses with one-car garages—a common parcel configuration in which a detached, one-car garage is located at the back of a residential lot—are expected to be relatively less desirable than those with two-car garages or attached garages, and therefore more likely to be redeveloped than other houses, holding constant the other explanatory variables.

Since models of urban spatial structure indicate a strong relationship between land values and access to a CBD, I added a variable measuring the distance of each parcel to the intersection of State and Madison Streets (*DISTCBD*) to the dataset. The descriptive statistics indicate that

the average nonredeveloped parcel is located 18.2 miles from the CBD, while the average redeveloped parcel is located only 15.7 miles from the CBD. Land values are posited to decline with distance from the CBD. Therefore, I expect to find that parcels located closer to the CBD are be more likely to be redeveloped, all other factors being equal.

Given the important suburban employment and commercial subcenters in the Chicago metropolitan region, the distance to the CBD may not entirely capture the location-specific demand for housing in the region (McMillen, 2003). Several variables are included in the models to capture additional locational attributes of each parcel. Its distance to the nearest commuter rail station (*DISTMETRA*) and distance to the nearest expressway access point (*DISTHWY*) are included to measure the accessibility of each parcel. Both of these factors are expected to be negatively associated with redevelopment activity, with parcels located closer to commuter rail stations and expressway access points expected to be more likely to be redeveloped, holding all other variables constant.

Redevelopment is most likely to occur in neighborhoods with rising property values (Weber et al., 2006). However, it is unclear whether a neighborhood with already high property values in 2000—where presumably the majority of the parcels are already at their highest and best use—would increase or decrease the likelihood of redevelopment. A measure of the median value of housing in each parcel's census tract in 2000 (*MEDVAL*) is included in the dataset. The summary statistics indicate that the median value of properties in the census tracts of redeveloped parcels is, on average, over $142,000 higher (75% higher) than the census tracts of non-redeveloped parcels. However, preliminary evidence indicates that redevelopment is also occurring in high numbers in less wealthy neighborhoods; therefore, it is unclear whether the median housing value of a parcel's census tract will be positively or negatively associated with redevelopment, once all other independent variables are held constant.

The redevelopment of sub-optimal housing in neighborhoods with already high median house values is a well-publicized scenario of single-family residential redevelopment, as discussed with respect to the value ratio variable above. But neighborhoods with initially lower median house values (in 2000) may also experience redevelopment activity if developers act upon the perceived potential for neighborhood-wide increases in property values. Redevelopment activity in neighborhoods with relatively lower property values could be due to a rent gap formed by sustained disinvestment—a decrease in the actual economic return compared

to the potential economic return from redevelopment. This type of rent gap is described by Smith in examples of classic urban gentrification (Smith, 1979). As he notes, increased construction loan and mortgage lending in certain areas or by public policies that target specific areas for redevelopment may incite this type of redevelopment activity. I suspect that these are two different typologies of residential redevelopment within Cook County, which vary spatially and temporally.

Census tracts that experienced a decadal increase in house values from 1990 to 2000 may have already captured a rent gap through redevelopment that occurred prior to 2000, or the increase could be a precursor to suburban gentrification. A variable measuring the percent change in each parcel's census tract's median property value in the decade prior to 2000 (*PCMEDVAL*) was added to the dataset. It is expected that the percent change in median property value will be positively associated with redevelopment activity; parcels located in census tracts that experienced greater increases in median property values are more likely to be redeveloped. A variable that measures the percent change in the median household income of each parcel's census tract from 1989 to 1999 (*PCMEDINC*) is also included in the dataset. It appears that parcels located in census tracts that experienced greater increases in median household income from 1989 to 1999 may be areas where gentrification is underway—with wealthier households replacing relatively lower income households. Consequently, parcels in census tracts that sustained greater increases in median incomes will be more likely to be redeveloped.

Weber et al. (2006) hypothesize that race and ethnicity may play an important role in developers'/home owners' decisions to demolish properties in urban neighborhoods. Yet, they found that after controlling for political jurisdiction, Hispanic heritage was not significantly associated with demolition activity. However, in a suburban context, the racial and ethnic composition of a neighborhood may indeed play a significant role in redevelopment. A variable indicating the proportion of Black residents living in each parcel's census tract in 2000 (*BLACK*) was added to the dataset. Additionally, a variable reflecting the change in the proportion of Black residents in each parcel's census tract between 1990 and 2000 (*PCBLACK*) was also included. A variable indicating the proportion of Hispanic residents living in each parcel's census tract in

2000 (*HISP*) was also added to the dataset.[5] I suspect that even after controlling for such factors as median income, median property value, public school quality, parcel location characteristics, and property tax rate, a racial and ethnic bias of suburban developers and in-movers may be revealed. Thus, I anticipate that parcels located in neighborhoods with lower proportions of Black and Hispanic residents, and lower percent change in the proportion of Black residents in each census tract in the decade preceding the study, will be more likely to be redeveloped.

This study includes a potentially important additional variable omitted from previous studies of redevelopment in urban neighborhoods, one that is particularly relevant to redevelopment within a suburban context: the quality of the public school district. Prior research indicates that public school quality is an important determinant of residential property values, and consequently plays an important role in overall neighborhood desirability.[6] Many factors, such as student-teacher ratio, expenditure per pupil, and student test scores have been used to measure public school quality (Brasington, 1999; Crone, 1998; Downes & Zabel, 2002). Although arguably an imperfect measure of school quality, standardized test scores are widely available and accessible to the public. In Illinois, the State Board of Education and Northern Illinois University maintain the Interactive Illinois Report Card, a searchable, online database of all public elementary and high school district test scores.[7]

One of the scores reported by the Interactive Illinois Report Card is the Illinois Standards Achievement Test (ISAT), which is administered to elementary school students. The examination measures achievement relative to the statewide standards set by the Illinois Board of Education and are widely used as an indicator of school district quality.[8] Each parcel's geographic location and its associated elementary school district were determined using ArcGIS, and the average ISAT score from 2002 through 2008 for each parcel's elementary school district were added to the dataset. The incremental change in the likelihood of redevelopment associated with a one-unit increase in average test score is not expected to be uniform across the entire range of test scores. Home buyers or developers may place a premium on the highest ranked school districts—one that makes a particular residential neighborhood more desirable, and

[5] A variable reflecting the change in the proportion of Hispanic residents in each parcel's census tract between 1990 and 2000 (*PCHISP*) was not included due to its high correlation with the variable *HISP*.
[6] This is particularly true in areas where students' assignments to particular schools are dependent upon the location of the students' homes, as it is in suburban Chicago.
[7] The Interactive Illinois Report Card is available online at http://iirc.niu.edu/
[8] The ISAT covers reading and mathematics in grades 3 through 8, science in grades 4 and 7, and writing in grades 5, 6, and 8.

consequently, a place where redevelopment is more likely to occur. Dummy variables indicating whether each parcel is located in an elementary school district with an average ISAT score above 90 (i.e., the 87th percentile) were generated and added to the dataset. This variable is expected to be positively associated with redevelopment and highly significant.

A large body of literature addresses the capitalization of property taxes into property values. Property values, including the potential value of a property when redeveloped, should be negatively impacted by higher property tax rates. Parcels subject to higher property tax rates may be seen as less desirable candidates for redevelopment.[9] This study uses the specific nominal property tax rate applied to each parcel. Annual property tax rates were obtained from the Cook County Clerk's Tax Extension Office. The property tax rate for each tax code for each year from 2000 through 2008 was averaged, and the average property tax rate (*TAX*) was joined by tax code to the parcel data in ArcGIS.[10,11] Holding all other independent variables constant, parcels subject to lower property tax rates are expected to be more likely to be redeveloped.

Estimation Results

This paper uses regression modeling to examine the determinants of redevelopment activity for all single-family residential parcels within the 128 suburban Chicago municipalities in Cook County, Illinois. A standard statistical approach used to fit regression models for binary dependent variables is a generalized linear model (GLM), of which logistic regression (or logit) is one type. Generalized estimating equations (GEE) are an extension of GLMs to adjust for correlated observations when the interest is in marginal (population-averaged) effects (Liang & Zeger, 1986; Miglioretti & Heagerty, 2007; Zeger, Liang, & Albert, 1988). Correlation can arise in longitudinal studies, in which repeated measurements are taken on one subject at different points in time; or, as is the case in this study, measurements are taken on parcels that share a common characteristic, e.g. census tract and/or school district (Liang & Zeger, 1986). In this study, the data is not only correlated by census tract and school district, but the groups are not

[9] This variable should be interpreted with caution. Several other variables, not included in the regression analysis, may be associated with areas with higher property tax rates, such as higher crime rates, etc.
[10] Parcels with property tax district codes that did not exist through all eight years of data were deleted from the dataset.
[11] The nominal property tax rate is multiplied by the tax-assessed value determined by the CCAO to calculate the annual amount of property tax due. In Cook County, the tax-assessed value of a residential property is 10% of the market value of the property (Cook County Board of Commissioners, 2008). The average property tax rate ranges from 4.9% to 18.8%.

nested within one another. Two parcels located in the same school district may be in different census tracts, and two parcels in the same census tract may be in different school districts. This poses problems for standard hierarchical modeling using GEEs. This study uses a process developed in the field of epidemiology by Miglioretti and Heagerty to model GEEs for nonnested clusters (Miglioretti & Heagerty, 2004, 2007).

Table 2 presents the results of the five nested logistic regression models, including the estimated coefficients, the standard errors, and the odds ratios for the full model (model 5). Starting with the logistic regression in Model 1, each of the subsequent four models includes additional explanatory variables. Model 2 includes parcel location variables. Model 3 includes neighborhood socio-economic and demographic variables. Model 4 includes the neighborhood socio-economic and demographic decadal change variables, and Model 5 adds measures of the public school quality and the property tax rate. The McFadden psuedo-R^2 values range from 10.2% to 22.3%, for Model 1 through Model 5, respectively. Although pseudo-R^2 values are most appropriately compared among cumulative models, it should be noted that the psuedo-R^2 values are consistent with those in similar studies of redevelopment by Weber et al. (2006) and considerably higher than that of Helms (2003; Hosmer & Lemeshow, 2000).

The results indicate that, in all but the first model, postwar housing is not significantly more or less likely to be redeveloped than older housing. In the first model, which only includes parcel characteristics, postwar era houses (*POSTWAR*) were significantly less likely to be redeveloped. However, in the models that control for location characteristics, socio-economic characteristics, school district and tax rate, postwar era houses are no longer significantly more or less likely to be redeveloped than older houses. As expected, houses constructed after 1970 (*NEW*) were significantly less likely to be redeveloped than prewar housing; the odds of a house built after 1970 being redeveloped are 12% of that for a house built prior to 1945. This finding is significant at the 1% significance level.

Contrary to expectations, in the first two models the log of a house's floor-area (*LOGSF*) is positive and significantly associated with redevelopment activity at the 1% significance level. But, in Models 3, 4, and 5, which hold constant socio-economic and demographic variables as well as school district and property tax rate, smaller buildings are more likely to be redeveloped. This result is significant at the 5% significance level and consistent with my hypothesis. More

specifically, the odds of redevelopment decrease 14% when the square footage increases from the mean, 1,395 square feet, to 1,895 square feet.

The regression results also demonstrate that the log of the FAR (*LOGFAR*) is significantly associated with redevelopment activity; in fact, FAR is significant at the 1% significance level and negatively associated with redevelopment in all five models. For example, if the FAR increases from the mean of 0.196 to 0.266—which is equivalent to the difference in the FAR of an average sized, 1,395 square foot house on a 7,120 square foot lot to a 1,895 square foot house on the same 7,120 square foot lot—the odds of redevelopment decreases 27%, holding all other explanatory variables constant. Thus, previously developed parcels with relatively small houses upon them—with ample room to rebuild a larger house—are more likely to be redeveloped. This finding is revealing, but it is does not indicate whether there is a certain range of FAR or a certain ratio of FAR to the maximum allowed FAR in a particular jurisdiction that is more likely to be redeveloped. For example, a parcel with a very low FAR (reflecting an average size house on a very large lot) may not be more likely to be redeveloped than one with a moderately higher FAR.

Dye and McMillen (2007) found relative measures of house floor area and age not to be significantly associated with redevelopment. In this study, I test the association of another relative measure—the ratio of the value of a parcel relative to its neighbors (*VALRATIO*). I found this variable to be statistically significant and negative in all five models, albeit significant at only the 5% significance level, in the full model. Parcels that have lower tax-assessed values relative to the average in their neighborhood (census tract) are more likely to be redeveloped, holding constant all other explanatory variables. Note that Models 3, 4, and 5 control for the median house value in the parcel's census tract, so this result tells us that properties with lower ratios of their value to that of their neighborhood are more likely to be redeveloped, regardless of the overall property values in their neighborhood.

The regression results support the theory that characteristics that make a house more desirable and/or more expensive to demolish are significantly associated with a decreased likelihood of redevelopment. Holding all other variables equal, houses constructed of masonry (*MASON*) and houses with finished basements (*BASEFIN*) are less likely to be redeveloped than houses with frame construction and without finished basements, respectively. The odds of a house constructed of masonry being redeveloped are 27% of that of a house that is not built of

masonry, and the odds of a house with a finished basement being redeveloped are 39% of that of one without a finished basement, controlling for all other explanatory variables. Houses with central air conditioning (*CENTAIR*) were expected to be less likely to be redeveloped, but after controlling for socio-economic and demographic characteristics, school district quality, and property tax rate, a parcel with central air conditioning is not significantly more or less likely to be redeveloped. Also as expected, parcels with a one-car garage (*ONEGAR*) are more likely to be redeveloped than parcels with two-car or attached garages; more specifically, the odds of a parcel with a one-car garage being redeveloped are 26% of a house with a two-car or attached garage.

A parcel's distance to the Chicago CBD, the nearest commuter rail station, and the nearest expressway access point are each significant determinants of redevelopment activity in all four models, albeit at varying levels of significance. Each variable is significant at the 1% significance level in the full model. The distance of a parcel to the Chicago CBD (*DISTCBD*) is significant at the 1% significance level in all four models, controlling for all other explanatory variables. A one-mile increase in a parcel's distance from the Chicago CBD is associated with a 10% decrease in the odds of redevelopment. The distance of a parcel to the nearest highway access point (*DISTHWY*) is significant at the 1% significance level in all four models. A one-mile increase in distance of a parcel to the nearest highway access point is associated with an 18% decrease in the odds of redevelopment. Of all three distance variables, a parcel's distance to the nearest Metra commuter rail station (*DISTMETRA*) has the greatest effect on the odds of its redevelopment: each one-mile increase in the distance of a parcel from the nearest Metra station is associated with a 26% decrease in the odds of redevelopment.

Although the median house value of a parcel's census tract (*MEDVAL*) is significant and positively associated with the probability of redevelopment in Models 3 and 4, once all independent variables (school quality, and property tax rate, the median value of housing per census tract) are controlled, it is only significant at the 10% significance level. Moreover, the odds ratio is very close to one (i.e., 1.001)—this indicates that the increase in the odds of redevelopment associated with each $1,000 increase in the overall median property value is very small. Recall that this variable does not refer to the specific value of individual parcels but to the overall median house value in the neighborhood. Thus, these results indicate that differences in overall median house value do not have a large effect on the likelihood of a parcel's

redevelopment, controlling for all other variables, including the ratio of an individual parcel to that of its neighbors. Moreover, the change in median parcel value in the decade preceding the study (*PCMEDVAL*) is not significantly associated with redevelopment activity.

The change in the median income per census tract between 1990 and 2000 (*PCMEDINC*) is significant only at the 10% level of significance, and the odds ratio is very close to one (i.e., 0.993), indicating that there is very little change in the odds of redevelopment associated with a 1% increase in the change in median income in the census tract between 1990 and 2000. Thus, these findings suggest that the independent variables reflecting property values and household incomes (in 2000 and the preceding decadal change) do not have large impacts on the odds of redevelopment. This may indicate that the redevelopment process is occurring in both wealthy and moderate neighborhoods, or the location of redevelopment may shift between 2000 and 2010.

The proportion of Black residents in each census tract (*BLACK*) is negatively associated with redevelopment, and is significant at the 1% significance level in all three models, even after controlling for other socio-economic characteristics, parcel characteristics, parcel location characteristics, school district quality, and property tax rate. Thus, holding constant the aforementioned explanatory variables, parcels located in census tracts with greater proportions of Black residents are less likely to be redeveloped. For each 10% increase in the percentage of Black residents in a census tract, the odds of redevelopment decrease by 20%.

The change in the proportion of Black residents living in a census tract between 1990 and 2000 (*PCBLACK*) is negatively associated with redevelopment activity, at the 5% level of significance. For each 10% increase in Black residents in a census tract between 1990 and 2000, the odds of redevelopment decrease 30%, accounting for all other explanatory variables in the model. Thus, these regression results indicate that a racial bias may be at play affecting the choice of where real estate developers and in-movers choose to undertake residential redevelopment.

The proportion of Hispanic residents per census tract (*HISP*) is also negatively associated with redevelopment activity. Parcels located in areas with a greater proportion of Hispanic residents in 2000 were less likely to be redeveloped. For each 10% increase in the percentage of Hispanic residents in a census tract the odds of redevelopment decrease 52%. Note that the change in the proportion of Hispanic residents in the decade preceding this study was not

included in the regression models because the variable was very highly correlated with the proportion of Hispanic residents per census tract in 2000.

As expected, elementary public school district quality was highly significant and positively associated with redevelopment activity. The variable that reflects whether a parcel is located in an elementary school district with average ISAT scores over 90 (*SCHOOL90*) is positive and significant at the 1% significance level. The odds of a parcel located in an elementary school district with ISAT scores higher than 90 (above the 87th percentile) being redeveloped are 2.5 times that of a parcel not located in such a district, holding constant parcel characteristics, parcel location characteristics, socio-economic and demographic characteristics, and property tax rate.

The predicted probability of redevelopment for each parcel is computed (using Model 5), and the average predicted probability of redevelopment is calculated for each ¼ x ¼ mile area. The regression residuals were also calculated for each parcel and aggregated to the ¼ x ¼ mile grid, then they were divided into quintiles. Negative values indicate that redevelopment activity is under-predicted by the model; positive values indicate that redevelopment activity is over-predicted by the model. A Local Indicator of Spatial Association (LISA) was calculated using GeoDa software and mapped to identify the location of statistically significant clusters of under-predicted areas. The map in Figure 3 presents local clusters of under-predicted redevelopment activity, significant at the 95% level, shaded in red. For the most part, the neighborhoods in which redevelopment is under-predicted do not represent the most publicized and most contested examples of redevelopment activity. These findings are particularly interesting in that, with a few exceptions, the areas of clustered under-predicted redevelopment activity include areas with moderate median household incomes and housing values.

There are several explanations for why the models under-predict demolition activity in some neighborhoods. The explanatory variables were chosen to account for important characteristics of parcels and neighborhoods that lead to redevelopment, but the models do not account for unknown or immeasurable variables that make redevelopment more likely. Attributes such as the aesthetic character of the housing stock or of particular neighborhoods and streets, as well as specific public policies designed to encourage or discourage single-family residential demolitions, are not included in the regression models. However, these certainly have an effect on the overall desirability of a parcel and whether it is redeveloped. Also, the models don't

include a measure of the availability of other municipal amenities, such as police and fire protection, as well as recreational/community centers and public parks.

Another explanation, posited by Helms (2003), is that residential redevelopment activity is spatio-temporally dependent—that endogenous neighborhood feedback effects affect the pattern of redevelopment activity. These feedback effects cause the redevelopment of a house to increase the likelihood that other houses nearby will also be redeveloped. This may occur because residential developers prefer to redevelop parcels in close proximity to each other for convenience, scheduling efficiency, and to exploit their local knowledge of regulations and the entitlement process. A developer may begin two or more redevelopments in one neighborhood at the same time, or redevelop one property successfully and then apply that local knowledge to subsequent projects in the same area. Developers may also observe other successful early-acting colleagues and decide to undertake redevelopment in the same neighborhood.

Conclusions

This study identifies several factors that are significantly associated with the rent-gap in suburban settings. I confirm many of the findings of previous studies that explore factors associated with redevelopment activity in an urban context; however, this study makes several unique contributions to the literature. Findings indicate that properties with smaller houses, lower floor area-to-lot size ratios (FAR), and lower ratios of their value to that of their neighborhood are more likely to be redeveloped. Increased distance of a property from the Chicago CBD, the nearest commuter rail station, and the nearest highway access point are each associated with a decrease in the odds of redevelopment. The median property value of a neighborhood does not have a large effect on whether a property is redeveloped, but neighborhoods with higher proportions of Black and Hispanic residents were significantly less likely to experience redevelopment. School district quality was very highly associated with redevelopment; the odds of redevelopment for properties located in the highest-ranked school districts are 2.5 times that of those that are not.

This paper explores one aspect of the gentrification process—the physical change in inner-ring suburbs. However, the physical change in the housing stock may result in social changes through the market-driven, exclusionary displacement of original residents. When properties are redeveloped, the sale prices are typically at least three times that of the original

property (Fine & Lindberg, 2002). Households with incomes similar to that of the residents of the original, pre-redevelopment house are often unable to afford to buy or rent the new, redeveloped house (Marcuse, 1985). Continued redevelopment of single-family housing may limit housing options for low- and moderate-income households and result in commensurate changes in the socio-economic characteristics of neighborhoods. These changes in household location patterns may result in more divided metropolitan areas. As Fishman (2000) predicts, wealthy residents will locate in portions of central cities and inner-ring suburbs, and the most vulnerable residents will be pushed to less-expensive inner-ring and exurban areas—areas are less desirable due to their less highly ranked school districts, their distance from employment centers and services, as well as their reliance on automobile transportation. The paper helps to better understand why redevelopment occurs in some areas and not in others, information that can be used to craft more equitable, more accurately targeted, and more effective housing and urban development policies.

Table 1: Descriptive statistics

Name	Description	Units	Measurement Level	All Parcels Mean	All Parcels Std. Dev.	Nonredeveloped Parcels Mean	Nonredeveloped Parcels Std. Dev.	Redeveloped Parcels Mean	Redeveloped Parcels Std. Dev.
Parcel Characteristic Variables									
POSTWAR	House constructed between 1945 and 1970	0, 1	*i*	0.539	0.498	0.538	0.499	0.640	0.480
NEW	House constructed after 1970	0, 1	*i*	0.276	0.447	0.278	0.448	0.013	0.114
LOGSF	Log of house size	sq. ft.	*i*	7.241	0.372	7.241	0.372	7.202	0.402
LOGFAR	Log of floor area ratio	%	*i*	-1.630	0.581	-1.628	0.580	-1.987	0.563
VALRATIO	Ratio of parcel value to the U.S. Census tract average	%	*i*	1.018	0.324	1.019	0.324	0.894	0.298
MASON	Masonry construction	0, 1	*i*	0.319	0.466	0.319	0.466	0.285	0.452
BASEFIN	Finished basement	0, 1	*i*	0.322	0.467	0.323	0.468	0.210	0.407
CENTAIR	Central air conditioning	0, 1	*i*	0.458	0.498	0.459	0.498	0.330	0.470
ONEGAR	One-car garage	0, 1	*i*	0.244	0.429	0.243	0.429	0.371	0.483
Parcel Location Variables									
DISTMETRA	Distance to the nearest commuter rail station	mi.	*i*	1.547	1.083	1.551	1.084	1.093	0.694
DISTHWY	Distance to the nearest expressway access point	mi.	*i*	1.922	1.204	1.924	1.205	1.609	0.922
DISTCBD	Distance to State/Madison streets (CBD)	mi.	*i*	18.235	6.227	18.253	6.235	15.724	4.165
Neighborhood Socio-economic Variables									
MEDVAL	Median parcel value (2000)	$1,000	*j*	190.522	110.460	189.525	108.890	331.915	202.249
BLACK	Percent Black residents (2000)	%	*j*	14.666	25.737	14.755	25.798	2.038	7.261
HISP	Percent Hispanic residents (2000)	%	*j*	9.921	13.179	9.960	13.210	4.396	5.412
Neighborhood Socio-economic Change Variables									
PCMEDVAL	Percent change in the median parcel value (1990-2000)	%	*j*	48.404	18.531	48.358	18.546	54.899	14.908
PCMEDINC	Percent change in the median family income (1989-1999)	%	*j*	38.565	17.229	38.540	17.251	42.094	13.283
PCBLACK	Change in the percentage of Black residents (1990-2000)	%	*j*	5.268	10.682	5.300	10.710	0.703	2.573
School District and Property Tax									
SCHOOL90	Average ISAT test score above 90	0, 1	*k*	0.084	0.277	0.082	0.274	0.416	0.493
TAX	Average nominal property tax rate	%	*k*	9.238	2.257	9.250	2.259	7.580	1.047
Total Observations				560,310		556,386		3,924	

Table 2: Results of the regression models

Variable		Model 1	Model 2	Model 3	Model 4	Model 5 (full model)	Odds Ratio Model 5 (full model)
House constructed between 1945 and 1970	*POSTWAR*	-0.5417 ***	-0.0472	-0.0495	-0.065	-0.123	0.884
		(0.147)	(0.121)	(0.081)	(0.083)	(0.099)	
House constructed after 1970	*NEW*	-3.6938 ***	-2.3228 ***	-2.174 ***	-2.1978 ***	-2.1438 ***	0.117
		(0.200)	(0.240)	(0.264)	(0.269)	(0.260)	
Log of house size	*LOGSF*	1.3137 ***	1.8548 ***	-0.4804 **	-0.5036 **	-0.4841 **	0.616
		(0.330)	(0.298)	(0.207)	(0.204)	(0.219)	
Log of floor area ratio	*LOGFAR*	-0.9129 ***	-1.5326 ***	-1.0563 ***	-1.0426 ***	-1.0251 ***	0.359
		(0.112)	(0.129)	(0.118)	(0.116)	(0.121)	
Ratio of parcel value to the U.S. Census tract average	*VALRATIO*	-2.061 ***	-2.5808 ***	-0.5822 ***	-0.5663 ***	-0.5641 **	0.569
		(0.260)	(0.254)	(0.213)	(0.211)	(0.228)	
Masonry construction	*MASON*	-0.0598	-0.2901 ***	-0.326 ***	-0.3149 ***	-0.3184 ***	0.727
		(0.108)	(0.097)	(0.083)	(0.082)	(0.087)	
Finished basement	*BASEFIN*	-0.3073 **	-0.2606 **	-0.4896 ***	-0.4917 ***	-0.4905 ***	0.612
		(0.121)	(0.118)	(0.113)	(0.114)	(0.111)	
Central air conditioning	*CENTAIR*	0.1261 **	0.139 **	-0.0617	-0.0661	-0.0732	0.929
		(0.059)	(0.060)	(0.048)	(0.047)	(0.047)	
One-car garage	*ONEGAR*	0.3718 ***	0.4029 ***	0.2428 ***	0.239 ***	0.2314 ***	1.26
		(0.054)	(0.049)	(0.049)	(0.048)	(0.050)	
Distance to the nearest commuter rail station	*DISTMETRA*		-0.5217 ***	-0.2434 **	-0.2424 *	-0.2983 ***	0.742
			(0.165)	(0.123)	(0.124)	(0.111)	
Distance to the nearest expressway access point	*DISTHWY*		-0.2899 ***	-0.3447 ***	-0.3412 ***	-0.2003 ***	0.818
			(0.093)	(0.079)	(0.079)	(0.061)	
Distance to State/Madison streets (CBD)	*DISTCBD*		-0.1107 ***	-0.0972 ***	-0.0979 ***	-0.1024 ***	0.903
			(0.037)	(0.037)	(0.037)	(0.027)	
Median parcel value (2000)	*MEDVAL*			0.0031 ***	0.00303 ***	0.00106 *	1.001
				(0.000)	(0.000)	(0.001)	
Percent Black residents	*BLACK*			-0.0591 ***	-0.0413 ***	-0.022 ***	0.978
				(0.012)	(0.008)	(0.006)	
Percent Hispanic residents (2000)	*HISP*			-0.0907 ***	-0.0919 ***	-0.0739 ***	0.929
				(0.015)	(0.015)	(0.011)	
Percent change in the median parcel value (1990-2000)	*PCMEDVAL*				-0.0013	0.00319	1.003
					(0.005)	(0.004)	
Percent change in the median family income (1989-1999)	*PCMEDINC*				-0.0015	-0.0066 *	0.993
					(0.005)	(0.004)	
Change in the percentage of Black residents (1990-2000)	*PCBLACK*				-0.0578 ***	-0.0359 **	0.965
					(0.021)	(0.018)	
Average ISAT test score above 90	*SCHOOL90*					0.9212 ***	2.512
						(0.287)	
Average nominal property tax rate	*TAX*					-0.3252 ***	0.722
						(0.074)	
Constant	Constant	-13.471 ***	-15.418 ***	0.2323	0.5903	3.082 **	0.884
		(2.245)	(1.901)	(1.311)	(1.327)	(1.488)	
Observations		560,310	560,310	560,310	560,310	560,310	
Psuedo R2 (naïve model)		0.1019	0.1402	0.2084	0.2099	0.223	

* denotes significance at 10%, ** denotes significance at 5%, *** denotes significance at 1%

Stand errors and in parenthesis

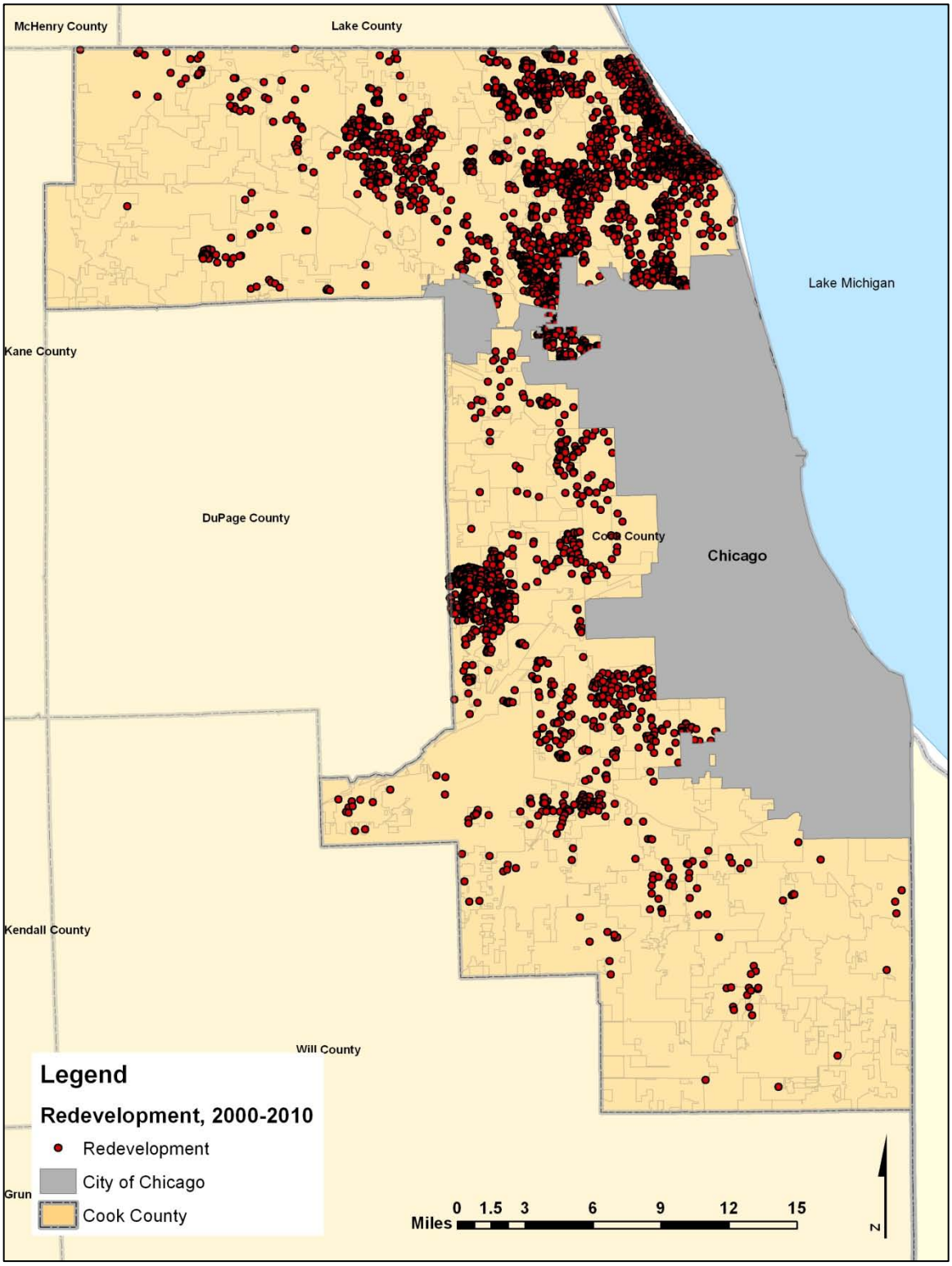

Figure 1: Redeveloped single-family parcels, 2000-2010

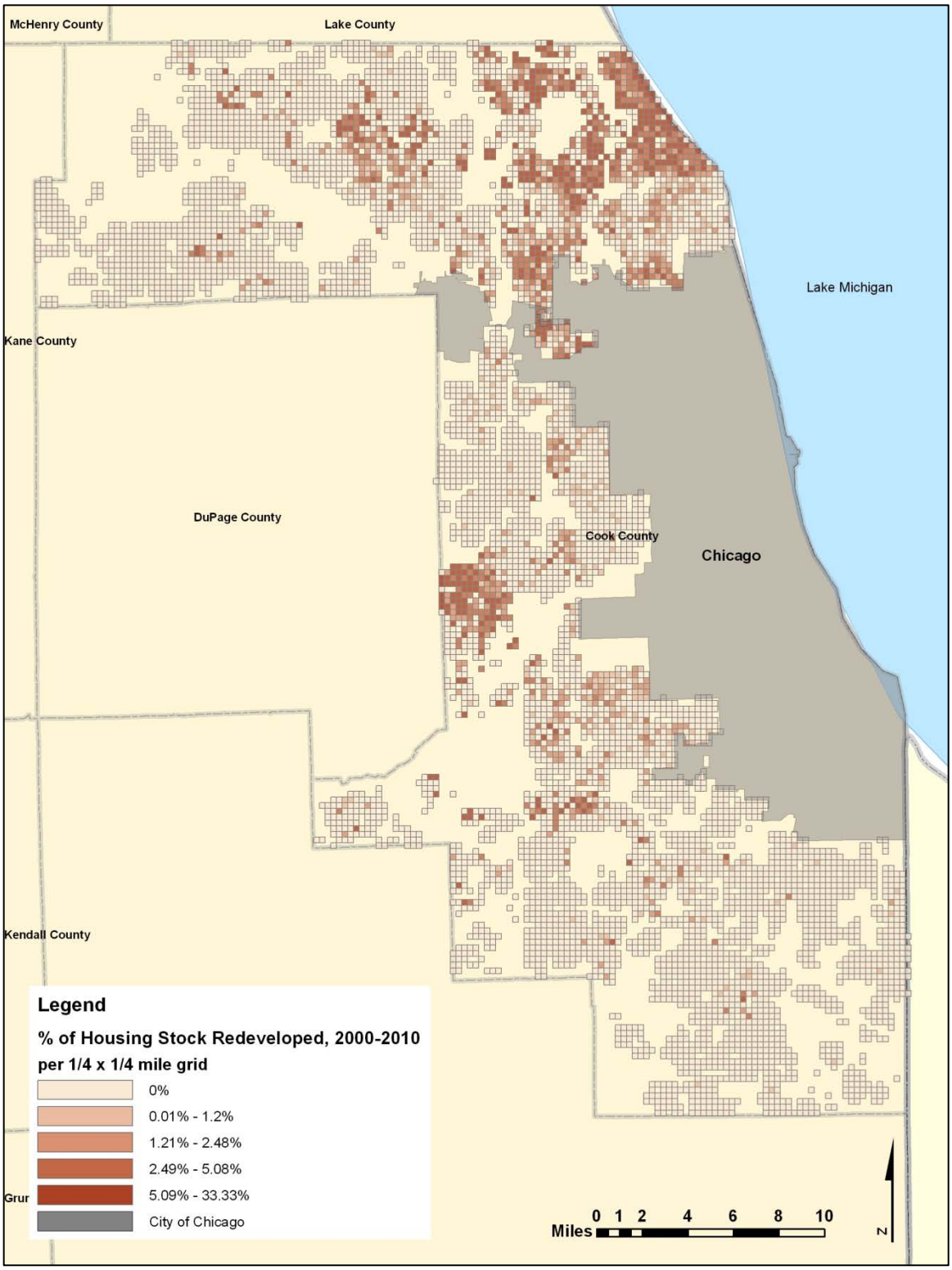

Figure 2: Percentage of redeveloped parcels per ¼ x ¼ mile grid, 2000-2010

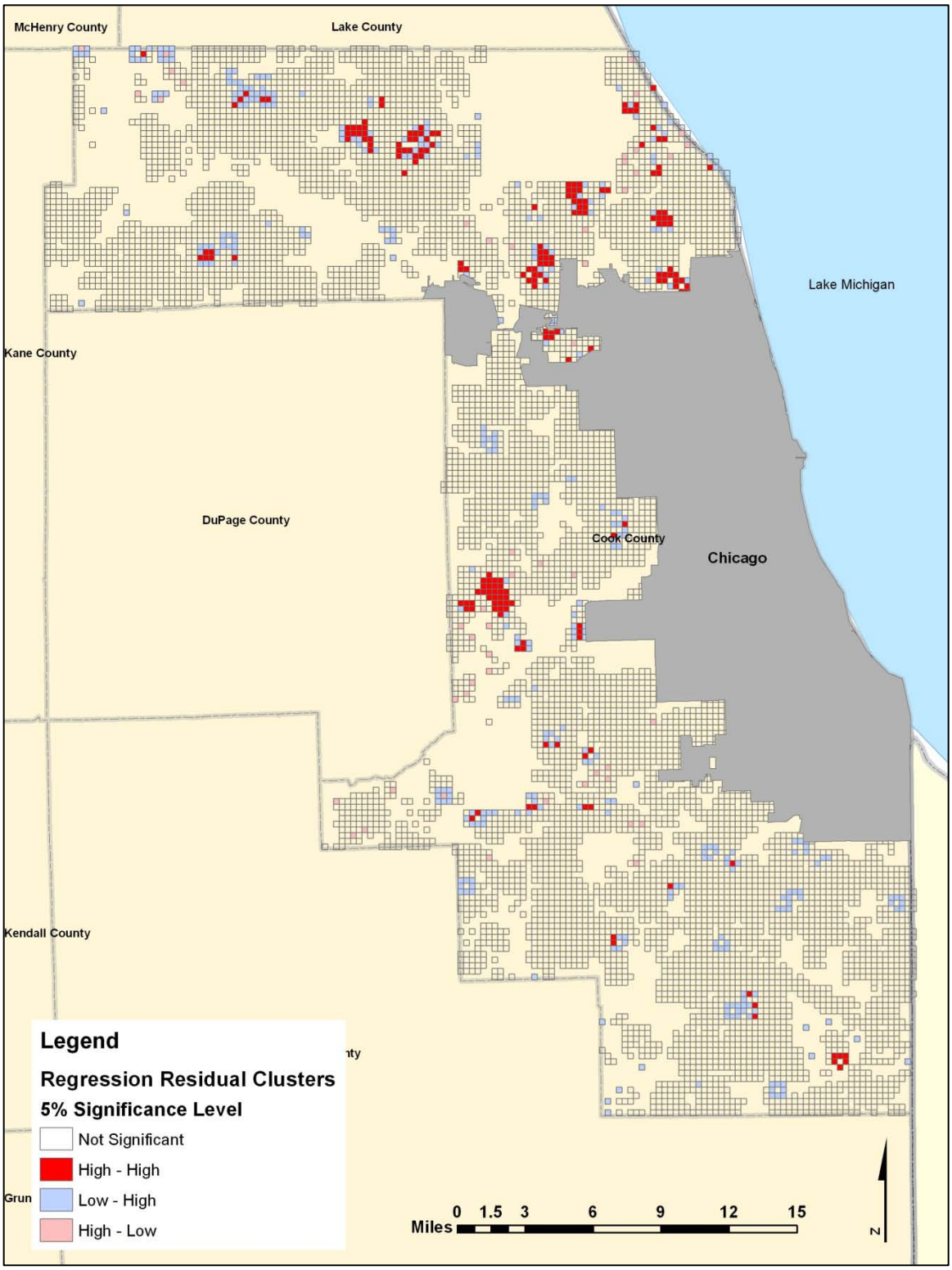

Figure 3: Regression residuals clusters, per ¼ x ¼ mile grid, statistically significant at the 5% level.

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