Investigating the Association of Historical Preservation and Neighborhood Status in Detroit, 1970-2015

by

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To my mother

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List of Abbreviations

ACS	American Community Survey
DiD	Difference-in-differences Analysis
GIS	Geographic Information System
MAUP	Modifiable Areal Unit Problem
NHGIS	National Historical Geographic Information System
OLS	Ordinary Least Squares
SEMCOG	Southeast Michigan Council of Governments
SHPO	Michigan State Historic Preservation Office
UAW	United Automobile Workers

Abstract

Cities throughout the United States have adopted historical designations in order to protect the historic architectural resources and promote economic development of areas that carry a cultural significance to their communities. Detroit, a city in steep economic decline from 1970 until 2015, has also attempted to use historical preservation to promote economic development in particular neighborhoods. The role of historic preservation has rarely been considered in a city in steep, ongoing economic decline. The study presents spatial analysis techniques that can help determine the association, if any, of historical district designations with neighborhood rise or fall. By using various approaches to count structures and measure preserved space within census tracts, a difference-in-differences (DiD) analysis and an ordinary least squares regression model was developed to test the association of preservation and neighborhood status change from 1970 to 2015.

The results indicate that census tracts with a historic designation showed less decline and quicker improvement in neighborhood status when compared to census tracts with no protections. To further corroborate DiD results, ordinary least squares analysis indicated statistically-significant relationships between the percentage of historical district coverage and historically protected building counts and changes in all but two indicator values, but these results should not be accepted as evidence of causality because there is significant spatial autocorrelation. Also, Detroit's socio-economic conditions differ from other metropolitan statistical areas in the U.S. Further research is needed in other cities during periods of economic decline and with additional control variables.

Chapter 1 Introduction

The adoption of Detroit's historical district ordinance 161-H in 1976, allowed the City of Detroit to protect historical resources from a variety of perspectives. In the words of the statute, the law preserves areas of the city with historical resources of the following types: "cultural, social, spiritual, economic, political, engineering, or architectural history or its archeology" (City of Detroit 1976, Sec. 25-2-1). This study focuses on the ways in which the law preserves the built environment, particularly historically significant buildings, and the affect this may have on economic and social status of neighborhoods over time.

This study presents spatial analysis techniques that can help determine the effects, if any, of historical district designations on neighborhood rise or fall. By using difference-in-differences analysis and an ordinary least squares (OLS) regression model, the research investigates the relationship between census tracts that contain some type and degree of historical protections as a treatment group, pairing them against census tracts that contain little or no historical protections as a control group. Analyzing decennial census and American Community Survey (ACS) data, the research utilizes four indicators of neighborhood status: median household income, vacancy percentage, owner occupancy percentage, and percentage of white population. If census tracts experiencing various forms of historical protections rise in status or decline in status less than census tracts that did not have protections, this provides evidence of the impact of the historical designations in the law.

1.1 Detroit Historical Districts

Throughout cities in the United States, a historical district designation is generally assigned to a particular area as a subset of land use regulation in order to preserve a unique

identity to the area (Costonis 1989). In most cases, it is guided by historic preservation of landmarked buildings. In New York City, for example, a commission is in place to review the appropriateness of any work performed on the exterior of buildings within a historic district (Allison 2005). This maintains the historic character of the neighborhood in the physical sense.

Detroit's historical districts originate from the outcome of a failed appeal to the zoning board, in order to avoid the demolition of two houses across the street from the house of Beulah Groehn Croxford in 1965. Her activism, and that of a few neighbors, initiated the process of exploring what it would take to obtain historical protections for their own neighborhood of West Canfield, Detroit. To many, she deserves to be named the mother of historic preservation in Detroit (Bragg 2015).

As this was something that had never been done before in Detroit, with no legal precedents at the local or state level, it was necessary to validate such designation by creating a city ordinance. Detroit adopted historic district ordinance 161-H in 1976, allowing the city to regulate the construction, reconstruction, addition, alteration, repair, moving, excavation, and demolition of resources in historic districts within city limits. The ordinance allows for historic preservation to be declared a public purpose, protecting buildings of significant value to a community and safeguarding the cultural heritage of the city (City of Detroit, ordinance 161-H).

1.1.1. Implementation

A panel of seven residents of local historic districts appointed by the mayor are given the task to implement the purpose of ordinance 161-H. The Historic District Commission's purpose (HDC) is to ensure the preservation of historically and culturally significant areas in the city (Planning and Development Department 2016). Upon receiving the request by a person or

business of a local area, the city council may adopt a resolution directing the advisory board to perform a study to determine whether that area meets the criteria to become a historic district. Upon receipt of substantial evidence demonstrating definite significance for designation under the provisions described in ordinance 161-H, the city council, at its discretion, may first adopt a resolution for interim historic designation, and later on upon the recommendation of the advisory board assign permanent historical district status (Detroit Section 25-2-4)

Furthermore, the commission promotes the use of historic districts for the education, pleasure, and welfare of city residents and aims for the stabilization and improvement of property values in historic districts and its surrounding neighbors. The commission attempts to foment community pride and strengthen the local economy.

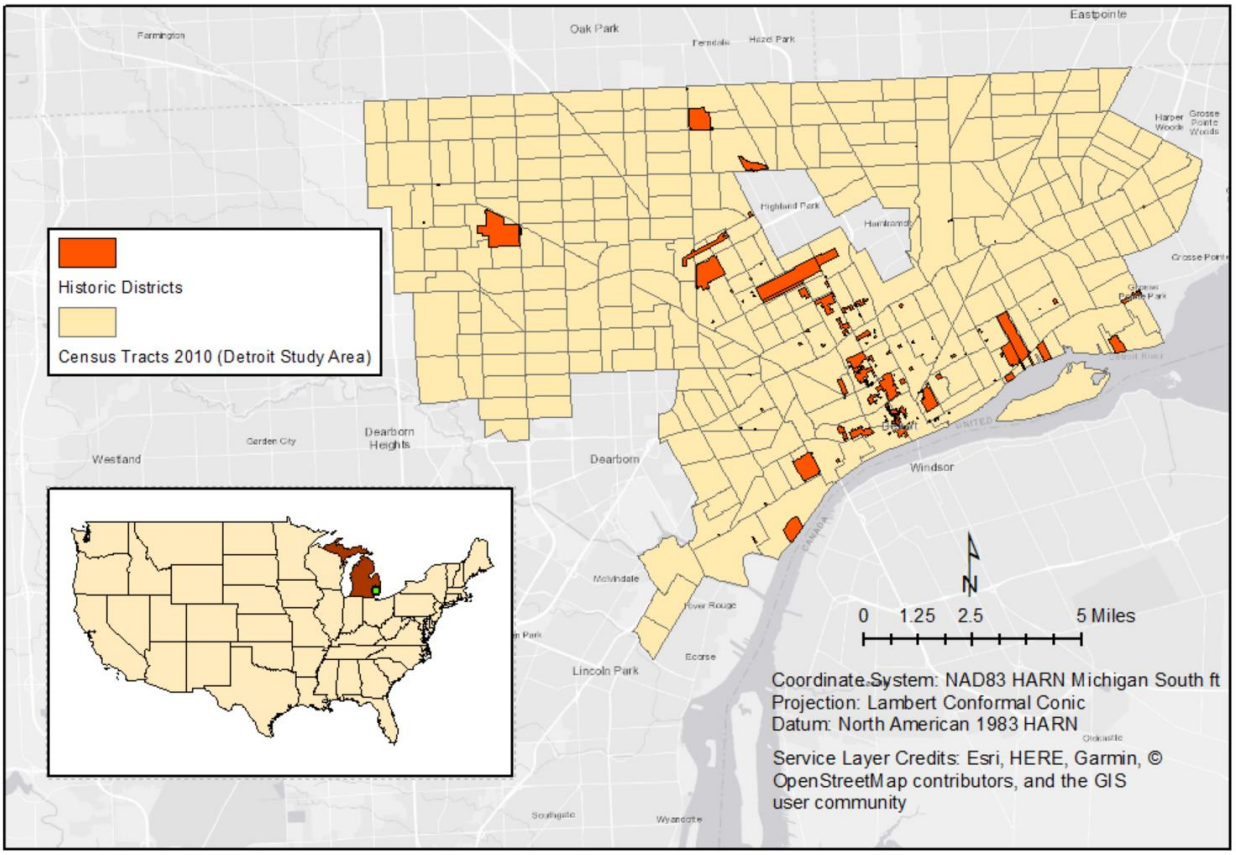

Figure 1 City of Detroit, Michigan

While the historic district advisory board surveys and researches the proposed areas, the city council by ordinance may establish additional designations, reject proposed areas, eliminate historic designation area, and modify boundaries of existing historic districts. As of 2015, based on data provided by the Planning and Development Department, Detroit has 140 historic district designations. As seen in Figure 1 above, historic districts are conglomerated primarily around downtown Detroit, and each historic district has unique spatial characteristics, varying in the area covered from several city blocks to as small as one building. This study in Chapter 3 explores different measures for establishing the extent of historic protections to define experimental versus control neighborhoods. The measures were created by assigning historic designations based on spatial conditions instead of being based solely on the provided boundary delimitations.

1.2 Motivation

Over the past 60 years, hundreds of communities across the Rust Belt have lost population (Bertron 2013). Left in a state of peril, as problems compounded upon each other, Detroit went from a booming city to a city in obvious decline. In 1955, at the height of its success, almost two million people lived and worked in Detroit, yet by 2015 the population had shrunk to approximately 675,000 (Farr 2011).

Detroit, like many other cities in the region, is searching for strategies to manage vacant land and abandoned properties. Historic preservation is touted as a way of revitalizing neighborhoods that are deemed eligible due to the location of historically significant building structures within its boundaries (Bertron 2013). Designation and preservation of historic districts is believed to be an important tool in efforts to promote economic development in blighted urban areas (Coulson et al. 2003).

Detroit's deep economic and social divide makes the study area a unique case study in that many indicators are so low that a minimal rise or slowed decline related to historical protections would be considered a positive outcome towards recovery. Coulson et al. (2003) utilize Fort Worth, Texas as a study area due to the extent to which historical designations had been implemented. The study area closely resembled the demographical statistics of other metropolitan areas in the U.S., so it can be argued that the results can be used as an indicator of effects of historical protections. The Metro Detroit statistical area in contrast is so far skewed negatively when compared to the U.S. average that results have to be analyzed only for that region.

Previous studies have compiled a strong theoretical articulation utilizing census indicators as means of measuring neighborhood quality, nonetheless existing literature makes relatively limited use of GIS technologies. To contribute to existing literature on the topic of historic district designations and the effects on neighborhood rise, fall or stasis, this study will explore various spatial analysis techniques to uncover, significant relationships, if any, between neighborhood quality and preservation of the built environment.

1.3 Research Goals

The research aims to investigate viable methods to spatially associate preservation of historical structures with neighborhood rise, fall, or stasis in the city of Detroit. The study tests the hypothesis that census tracts that contain within their boundaries some degree or type of historical protection experienced greater improvement, remained unaltered, or declined less in the face of broad declines in neighborhood status throughout Detroit. The hypothesis is tested using a variety of spatial methods for gauging the impact of the historical designation within

each census tract. The spatial analysis is used to explore different ways of defining the extent to which neighborhoods are associated with preservation of historical structures.

1.4 Study Organization

This study contains four additional chapters. Chapter 2 begins with a brief overview of the history of the City of Detroit. In order to clearly comprehend the study area, it is important to understand what events occurred that set current living conditions. Also, it explores related literature to identify methods and neighborhood quality indicators from similar or comparable studies. Chapter 2 sets the foundation for the methodology that will be presented in Chapter 3, a difference-in-differences analysis (DiD) and ordinary least squares (OLS) regression to investigate the historical association between the concentration of historical structure preservation in certain census tracts and neighborhood trajectories over a period from 1970 to 2015. Chapter 4 presents results obtained from the DiD analysis, as well as explores for statistically-significant associations between historic preservation and neighborhood status. Chapter 5 discusses data limitations, as well as drawing conclusions about the results, understanding that such results should be interpreted as a case study of effects of historic preservation. It also provides suggestions for future research.

Chapter 2 Background

In order to understand the circumstances and conditions that surround our study area, this chapter undertakes a brief look at the history of Detroit and summarizes existing literature related to historical preservation as it relates to neighborhood economic and social status.

The historical background section explores important events in the history of Detroit that have influenced and shaped the study area. Ultimately presenting how historical events relate to each of the chosen neighborhood status indicators.

The literature review exhibits previous works that have undertaken to study how historic preservation relates to the condition of neighborhood status. It also discusses existing studies that utilize rigorous data analysis methods to explore historic preservation and suggests how such research might be expanded by incorporating the use of GIS technologies.

2.1 History

Detroit took the nickname “Motor City” due to its thriving automobile industry. At its height around the 1950’s, the city boasted some of the highest wages in the U.S., highest single-family home ownership percentage, and a population of over 1,800,000. As of 2015, its population had plunged 63% since 1950, thousands of structures and lots had been abandoned, and it had become the most racially segregated city in the U.S. (Boyle 2001). What caused such a pronounced and rapid decline?

2.1.1. Historical Background

On July 24, 1701, an expedition of over 100 men at the command of Antoine Loumet de Lamothe Cadillac, upon surveying the terrain on a narrow point of the Detroit River, set to

constructing a small fort: “Fort Pontchartrain du Detroit,” and thus the city of Detroit was born (Woodford 2001).

Cadillac’s original commission was to build an outpost that would prevent British encroachment on the region and allow the French to gain control of the rich fur trade in what is now Michigan and then was part of the Northwest territory. Situated in the heart of the Great Lakes region, near the eastern edge of the Great Central Plain of North America, over the years the region prospered due to trading between French, British, and American Indian merchants (Parkins 1918). While the population in the area grew slowly, it was not until 1805 upon the establishment of the Territory of Michigan with Detroit as its capital by President Thomas Jefferson, that the population began to flourish. The creation of a city plan and ordinances defined the layout of how the city was to grow and gave the traditional spatial characteristics of Detroit: spacious, large lots, with single-family homes. It helped Detroit to lead the nation among major cities in the number of homes occupied by single owners. Ultimately this characteristic also produced problems from which Detroit still suffers to this day, such as the lack of effective transportation (Woodford 2001).

In 1835, white settlers in Michigan adopted a constitution, and declared themselves a state. However, it was not until 1837 that Michigan having settled a territorial dispute with Ohio, was finally admitted into the Union (Woodford and Woodford 1969). The two decades following statehood were a time of continued growth. The population in Detroit reached 6,927 in 1836, by 1840 it hit 9,124, and by 1850 it had doubled. (Woodford 2001). There also was the beginning of Detroit’s first real heavy industry, the manufacture of railroad cars. The industry employed a number of skilled workmen and established the foundation of manufacturing plants from which inventions and improvements of mechanical nature came out (Woodford and Woodford 1969).

Offering an abundance of machine-shop facilities and skilled labor, the thesis that Detroit was well-equipped to offer the automobile industry a home is widely supported (Lewis and Goldstein 1983). Nonetheless, other contributing factors such as the availability of raw materials, access to transportation routes (land or water), development of new technology, and a large stock of immigrant labor played an important role. This was particularly important during the U.S. efforts in the two World Wars, as Detroit's industry was called upon to supply armaments, tanks, boats, and chemicals (Booza and Metzer 2004).

2.1.2. Black Migration

A haven from slavery and Negrophobia that existed in other parts of the country, an increase on black population began around 1840. From 193 Black residents in Detroit, the number grew to 587, and the city provided a public sphere where Black communities and families could thrive and prosper. The first permanent Black institutions in Detroit, were the churches, and by 1846 the small community had three. The basements were used as colored public schools, and their chapels as political halls. It is important to mention that the contiguous geographical area in which the small Black population lived in 1860 permitted some differentiation in residential patterns. In all wards, wealthy Black owners of real estate clustered together, apart from the renters. Housing units for the rest of the Black population were in poor condition, and many of them lived in old dwellings, and reflecting the working-class level of many workers (Katzman 1973).

The "Great Migration" in the two decades between 1910 and 1930 brought a large number of black southerners into Northern cities. One of the most significant demographic events to occur in the U.S. during the twentieth century, it produced a dramatic redistribution of the black population (Tolnay 2003). In 1910 the black population in Detroit stood at 1.2% of the

total population, by 1930 that number had increased to 9.1% (Gavrilovich and McGraw 2000). Migration from southern states allowed workers steady work, but also favorable worker laws (Farr 2011). With the adoption of more restrictive immigration policies by the U.S. during World War I, northern employers in order to fulfill the shortage in the labor force had to consider southern blacks as a source of inexpensive labor (Tolnay 2003). The "Great Migration" contributed in large part to the increase of Detroit's black population during the first part of the 20th century, while the total numbers and percentages continued to increase at a steady pace in later decades, another contributing factor for the increase was the exodus of white population starting in the 1950's. By 1970, the percentage of black population had increased to 44.5% of the total population (Gavrilovich and McGraw 2000).

2.1.3. Rise of the Industrial City

The shift in population from the core of the city to the outer rings occurred at the time of Detroit's greatest population expansion in the 1890's. A conglomeration of ethnic and racial neighborhoods, with common community names, arise, such as: Dutchtown, Polacktown, and Corktown (Irish immigrants from County Cork). The ties to birth, culture, and language bound together ethnic colonies within a common geographical area, developing in most cases an autonomous social system (Katzman 1973). Immigrants from all over the world began descending upon the city, clustering around their own ethnic groups. Census records from 1880 show a breakdown of twenty-six different nationalities. Industrial development required a substantial labor force, and while most factory jobs were taken by native-born Americans, as demand grew so did the need for additional labor. The first automobile appeared on the streets of Detroit in 1896, small mechanic shops throughout the city gave birth to an industry that would later be revolutionized by Ford's Model-T mass production on an assembly line. The automobile

industry would transform the city into the sixth largest city in the United States with a bustling population and a skilled labor force with a steady income stream that in turn translated into rising social status of Detroit's neighborhoods (Woodford 2001).

The car industry led to quick urban growth as workers moved to the city. An example of this took place in the neighborhood of Highland Park, which was later designated a historic district, the neighborhood grew from 400 to 40,000 residents between 1900-1920. With 139 square miles, Detroit by the 1920's had grown to the size (i.e., physical extent) it remains today (Farr 2011).

A significant factor that takes place with all migration is the introduction of new cultural elements that are assimilated by the population that currently reside in the area. While interaction between new immigrants and local Detroiters took place in the workplace, for the most part the city remained highly segregated. Originally at the end of the 1800's, lines divided distinct ethnic populations and there was little consensus understanding of race. As an example, by the 1920's, the U.S. census counted foreign-born of European descent and their U.S.-born children as white, but in separate categories from those whose parents were U.S.-born. Third-generation immigrants gained full membership to the white American race after the 1924 immigration restrictions which ensured no interaction between them and new generation immigrants (Roediger 2005).

2.1.4. Decline

At the height of Detroit's economic golden age in the 1940's and 1950's, the automobile industry boomed. The United Automobile Workers (UAW) union, at the height of its powers, assured that all of its members, overwhelmingly white males, shared the prosperity. This made its members amongst the highest paid industrial workers in the nation. To a lesser degree,

working class black Detroiters enjoyed the benefits of steady employment and higher wages when compared to black workers in other parts of the country. Some among these black workers had the opportunity to boosted into a prodigious middle-class.

In its pursuit of higher wages and benefits for its majority white members, in the 1940's the UAW abandoned the progressive agenda that once challenged corporate power in the 1930's. Dubbed the "Treaty of Detroit," the UAW and the auto companies reached an accord that ruled labor relations for the following three decades, giving control of investment decisions and plant conditions to the automakers. Effectively splitting the working class in two, by the 1960's, union members in its majority white males enjoyed more security, while non-members, in its majority blacks or females, received low wages and few benefits (Boyle 2001).

As homeownership increased after World War II throughout major metropolitan areas in the US, local variations in the housing situation of blue-collar workers depended in part upon the local industrial and wage structure. In comparison to other metropolitan areas, wages were considerably higher in Detroit during the 1940's as the steel and automobile industry provided many secured and well-paid jobs (Harris 1990). The city flourished with new buildings in downtown, and new housing tracts that allowed more families access to homeownership. Detroit was the flagship of American industrialization (Boyle 2001).

Although incomes were roughly comparable between white and black auto workers, the standard of living diverged the most at housing. There was simply insufficient decent housing for black workers at any price. White workers had more control over housing patterns than they did over employment practices. The single most important measure of success in America is homeownership. By the 1940's, first-and-second generation immigrants, who by then had

already assimilated as white, were more often homeowners than native Detroiters (Petterson 1979).

Median household income in Wayne County, where Detroit is located was 13% higher in 1950 when compared to the national median income (Social Explorer 2013). A strong middle class, in its majority white, once made Detroit America's capitalist dream town. Having fallen the longest and the furthest, Detroit is often considered to be the greatest urban failure in the U.S. (Binelli 2013).

Once the symbol of modernity's great tool room in the first half of the twentieth century, since the 1960's Detroit has become the symbol of urban decay. Many historians and scholars have struggled with the question of how its decline from prominence occurred so quickly. A series of events drove to its boisterous decline, including a riot in 1967 that exacerbated the existing racial divide, the subsequent collapse of the domestic automobile industry that destroyed the city's economic base, and the exodus of one third of its population (Boyle 2001).

While fear for crime and violence following the riots of 1967 contributed to the exodus to the suburbs by Detroit's white residents, the migration had actually started as early as the 1950's. However, the pace of the migration sped up later, so that between 1970 and 1980, more than 310,000 white residents moved to the suburbs, taking with them a significant portion of the city's economic base and also depriving the city of important professional service and leadership (Woodford, 2001). It is important to emphasize that white flight alone was not the only cause for the devastation of inner-city Detroit. However, it is important to note its significance since this study uses the percentage of white population as an indicator of neighborhood rise, fall or stasis within the city of Detroit.

Across the Rust Belt region, places that used to pride themselves on the affordability of single-family houses now have thousands of empty buildings and vacant lots (Bertron 2013). The value of property fell sharply, which fueled the exodus, and a population loss of about a million people from 1950 to 1980. People left so quickly that many buildings were left abandoned (Farr 2011). A direct consequence of this phenomenon was the steady rise of the vacancy percentage in our study area which reached slightly over 30% in 2015, in comparison to the 13% U.S. vacancy rate for the first quarter of 2015 (Census Bureau 2015). The vacancy rate of particular neighborhoods is another measure used in this study.

2.2 Historic Preservation Research

Preserving the built environment through the enforcement of local ordinances or historic landmark designations has often been viewed to be in direct opposition to economic development. Debunking this idea is a primary focus of existing historic sites preservation literature which focuses on preserving existing building structures through reuse or reclassification. Smaller-scale level grassroots efforts such as historical neighborhoods or districts present a noticeable impact on the community that can later translate to improvements at a city level (Farr 2011).

Historic Preservation can contribute an essential perspective to reshaping cities by helping articulate their unique identity (Bertron 2011). According to the Michigan State Historic Preservation Office (SHPO), historic preservation as a planning and economic development tool enables communities to manage how they will grow and change.

An idea not to the liking of many communities presents the displacement of poor and ethnic minorities as something necessary and worth undertaking. The increase in the number of affluent and well-educated residents to historic district or protected areas enhances city revenue

by means of higher property taxes. Instead of placing the blame on government failure to produce affordable housing, this argument presents the scenario that a city that attracts more affluent residents can aggressively finance affordable housing (Byrne 2002).

In many instances historical sites preservation is believed to be directly linked to changes to neighborhood's economic and social status. However, through analysis of demographic and economic data in a study that examined nine historic districts in New York City, Allison (2005) showed that there is no indication of a direct relationship between neighborhood rise and either historic district designation or the drive to create one. The research is composed of nine case studies, each comparing two census tracts that encompass a historic district (treatment group) with two neighboring census tracts (control group). While comparing census data indicators changes over a period from 1950 to 2000, the study draws conclusions based on a small percentage of historic districts. New York City has over 80 historic designations. It also only utilizes a simple on or off measure for whether a census tract has a historic designation that does not involve the use of GIS.

2.2.1. Research about neighborhood quality

The complexities involved in obtaining and geocoding historical addresses and measuring the impact of preservation on the neighborhood social environment have rarely been undertaken (Rose et al. 2004). Determining the effects of revitalization efforts through historical districts over a period of time requires a comparison analysis of indicators to determine how each one has affected neighborhood status. In a study that took place in Salt Lake City, Utah from 1992 to 2000, a natural experiment stemming from a neighborhood revitalization project allowed researchers to produce neighborhood maps with a gradation scale for each neighborhood status variable at the property level and aggregate block level. The intervention focused on an area that

was declining, and its new direction to alleviate further deterioration of urban fabric (Perkins et al. 2009). The study compared 60 blocks from two adjacent and similar neighborhoods with propensity score matching and utilized three sources of data: a resident survey, an environmental assessment, and archived issued building permits. A strength of this study was the use of GIS to analyze large cluster samples and geocoding of all data sources to select through spatial analysis neighborhoods with similar spatial characteristics.

Urban expansion is driven by demographic and economic factors (Liu et al 2005) and is a traditionally a transformation process from a predominantly agricultural society to a modern metropolitan society. Studies on urban sprawl have primarily focused on the use of Landsat data comparing satellite imagery between different periods of time. While studying spatio-temporal patterns in China, Liu et al., identified through visual interpretation of Landsat data, modes of urban land expansion. During the period between 1990-1995, most of the urban expansion came from cultivated land. This particular phenomenon is inverted from the process that is currently taking place in Detroit. As the metropolitan area experienced a rapid decline in quality of life due to loss of jobs, and population migration to other more prosperous or solvent cities, many areas in the city became abandoned. Long-term population loss is recognized as a major challenge in older industrial cities throughout the rust belt (Bertron 2011). Attempting to bring a higher quality of life in the face of sustained loss of population, some cities have policies and programs to ease restrictions and speed up building permits processes. While the attempt is to rapidly transform the affected areas, the policies only take into consideration an economic stand point, neglecting historic preservation elements that are important for the current local population (Bertron 2011).

Researchers often use income and housing value taken from census data as an indicator for neighborhood quality. Unfortunately, it is also limited because it only offers nationwide and metropolitan level summaries not providing more granular geographic data (Holzer 2017). Using census tracts as the unit of observation, five demographic and housing indicators were examined in order to measure historic preservation and neighborhood change in Fort Worth, TX between 1990 and 2000 (Coulson et al. 2004).

Another study by Leichenko et al. (1999), in which Coulson is involved, expands on the idea that historic designations have a positive impact on property values and analyzes the effect across several cities in the state of Texas. Using multivariate regression models to assess the impact of historic designations on residential property values, the authors are able to establish basic explanatory variables and create a matrix that assigns a value to additional variables that compensate for any differences in square footage and room composition.

There is a limited number of studies that explore effects of historic designations utilizing GIS. Research for the most part focuses on statistical computations that do not take into consideration spatial characteristic other than the designated boundaries. The study reported below in contrast explores different spatial analysis techniques that will consider additional variables, such as the areal extent of coverage of historically-designated space within census tracts and the counts of historical building structures to which historical protection applies to differentiate treatment and control groups.

Chapter 3 Methodology

One purpose of this study is to present various spatial analysis techniques that can help determine the effects, if any, of historical district designations on neighborhood rise or fall. The following sections offer an overview of the research design and particular spatial analysis methods employed, as well as present potential issues that may arise when comparing spatial data over a period of time.

3.1 Data Sources

The study analyzes four census indicators as measures of neighborhood status over time: median household income, owner occupied percentage, vacancy percentage, and percentage of white population. A common phenomenon that occurs in comparing census tracts from one historical period with another is that they can be split or consolidated, and their boundaries altered in complex ways based on population totals (Logan et al. 2014). To overcome the obstacle of presenting historical data rendered on different spatial boundaries, interpolation by area weights method was utilized to overlay and match to 2010 census tracts. Further details are given below.

Overall, the study first employs a difference-in-differences analysis to compare census tracts that contain historical protections and aims to examine the impact on neighborhood rise or fall against census tracts that do not have such protections. Second, the study uses regression analysis to determine whether any associations that are observed result from spatial autocorrelation.

The National Historical Geographical Information System (NHGIS) provided the main source of data for this study for the four variables that represent neighborhood status. The

NHGIS draws from the decennial census data for the years 1970, 1980, 1990, and 2000. The study also uses American Community Survey (ACS) data for the years 2010 and 2015. The NHGIS was selected as a source due to its vast historical archive of decennial data, and the interpolation methods used to extract historical census data.

Decennial data provided by the NHGIS does not offer data summarized at a smaller scale than census tracts for years prior to 1980. While it was explored if data summarized at the census block group level better aligned with the boundaries of local historic districts, due to the unavailability of data at that scale, it was necessary for this study to utilize census tracts as a study unit. As local historic district designations in the city of Detroit first started with the approval of ordinance 161-H in 1976, the study explores the period from 1970-2015. The time frame provides a solid base that takes place prior to the origination of historic district designations, providing a starting point as well as a long interval of time that historically covers the city's decline.

Table 1 Historic districts and protected census tracts over the study period

Year	Historic Districts	Census Tracts
1980	22	19
1985	44	27
1990	54	32
1995	62	40
2000	74	50
2005	101	56
2010	123	64
2015	139	73

The number of historic districts periodically increased as new designations were approved by the City council. Table 1 presents the cumulative total number of historic districts established and the total number of associated census tracts with 2010 boundaries every five

years from 1980 to 2015. As new areas continued to gain protections throughout the study period, it was necessary to establish a threshold year for the DiD analysis that would allow sufficient time had passed in order to evaluate any effects of historic designations. The historical protections included in the DiD analysis for this study came into place by the end of the year 1995. For the purposes of the DiD analysis, this means that census tracts have a minimum 20 years to perceive whether historical protections influence changes in neighborhood status. They represent 44% of the current historic districts in the City of Detroit. Note below that for the OLS analysis, the entire set of historical protection districts was used.

NHGIS also provided geometry files for GIS as shapefiles that can be rendered utilizing GIS software. During this study, ArcMap 10.5 was the software of choice. All boundary files are derived primarily from U.S. Census Bureau's TIGER/Line files with numerous additions to represent historical boundaries that do not appear in TIGER/Line files. NHGIS also erases coastal water areas in all years to produce polygons that terminate at the coasts and Great Lakes shores (NHGIS 2018).

The extent of historical protections in each census tract were derived from a GIS analysis of Detroit's historic districts. Further details on this data source and how it was analyzed to measure the extent of historical protections are given below.

3.1.1. Indicators of Neighborhood Status

Previous literature has used a variety of indicators to determine neighborhood status. In each case, the researcher, based on the study question, chose the variables best fit to explain effects over a period of time. While Ceballo et al. (2005) chose median household income as the only census indicator to determine neighborhood status, Coulson et al. (2004) used a combination of five different indicators, among them vacancy percentage and the Simpson

diversity index. For this study the following indicators are used: median household income, owner occupied percentage, vacancy percentage, and percentage of White population.

Median household income, is the most common census indicator used to measure an area's actual economic status. A higher median household income is associated with wealth and purchasing power. Households with a higher than average median household income are able to select the most attractive neighborhoods, as they have more mobility (Holzer 2017). Sometimes they are able to revert and transform neighborhoods from lower to higher status. An increase of income on local historic districts in Detroit would indicate an increase in neighborhood status.

All monetary values displayed in this study are in 2015 dollars and were adjusted for inflation using the Consumer Price Index (CPI). The CPI is a statistical estimate constructed from the average change over time in the prices paid by urban consumers for a market basket of consumer goods and services (Bureau of Labor Statistics 2018).

At the height of Detroit's opulence in the 1950's, the city was at the forefront of owner-occupied, single-family residences in the U.S. Owner occupancy in the U.S. is an indicator that is associated with stability and wealth. Owning a home is a path to wealth, and neighborhoods with a high percentage of owner-occupied dwellings are generally viewed as higher status neighborhoods than those with mostly renters. The owner-occupied percentage was calculated by diving the number of owner-occupied housing units by the total number of housing units. An increase on the percentage of owner occupancy represents stability, and a rise in neighborhood status.

Losing a third of its population left the city of Detroit with numerous abandoned building structures. During Detroit's decline, many areas suffered from abandoned dwellings and lots, which caused a decline in property tax revenue and led to bankruptcy proceedings in 2013.

Vacancy percentages increased as the demand for housing decreased due to the loss of population throughout the city. A constant flow of tax revenue is an important issue for any municipality in order to be able to provide public services. Neighborhood status has been in nearly constant decline across the city when compared to the study benchmark of 1970, and a rise of vacancies and abandoned properties with no owners has been a determining factor on the shortage of property-tax revenue. The vacancy-percentage rate is calculated by dividing the number of vacant dwellings by the total number of housing units. A low vacancy suggests a neighborhood is popular and in demand (Holzer 2017). A vacancy percentage decrease of census tracts containing local historic district designation would indicate a rise in neighborhood status.

Detroit has become the most segregated city in the U.S., as higher income households (predominately white) migrated to the suburbs, they left economically disadvantaged households (mostly blacks) to live in the urban core (Freeman and Braconi 2007). The phenomenon of white population flight from the city of Detroit started to occur around the 1960's. Several historians argue that the riots of 1967 were the catalyst to the phenomenon, but evidence points towards the exodus already taking place as early as the 1950's. It is important to mention that there were many other contributing factors aside from the 1967 riots, such as whites gaining higher incomes than other races that increased their mobility and access to newly constructed housing tracts that led them to relocate to suburbs outside the city.

Nonetheless, the exodus deprived the city of Detroit of a significant portion of its economic base. An increasing middle-class in central-city neighborhoods that includes white households, could help desegregate the metropolitan region (Lee et al. 1985). Therefore, for our study purposes, a return of white population to live in or around local historic districts would indicate a rise in neighborhood status. Contributing factors such as higher incomes and

educational attainment would benefit the neighborhoods so long as the existing residents were not displaced.

3.1.2. Interpolation

A common situation faced by researchers using areal data is discrepancies in the boundaries of reporting units (Logan et al. 2014). Census tract boundaries change over time due to increase or decrease of population. The city of Detroit, like many other cities in the Midwest region of the US, has experienced a large decrease in population, similarly Detroit's census tracts boundaries over time have changed. During the study period research, Detroit in 1970 had 420 census tracts, by 1990 the number had decreased to 321, and during the last reporting boundaries of 2010 (which still conforms to 2015 reporting data), the number decreased yet further to a total of 297 census tracts.

Table 2 Census tracts from 1970-2015

Year	**Census Tracts**
1970	420
1980	344
1990	321
2000	314
2010 (2015)	297

Prior to every U.S. census, for redistricting purposes and other planning and policy functions, state and local officials identify small areas for which they wish to receive population totals. As a result, units that were defined on previous census could be split or consolidated, and their boundaries altered in complex ways (Logan et al. 2014). In order for this study to research

changes in units over time, the interpolation with area weights method is necessary to create a bridge between years.

The first step is to establish a benchmark boundary layer to which all other boundary layers will be overlaid. For our study, estimates for 1970-2015 are based on tract boundaries provided by the NHGIS, and the most recent gathered decennial data, 2010, was used as the benchmark census tract layer. All census tract boundary layers from the years 1970, 1980, and 1990 were overlaid and merged to a 2000 Census tract polygon layer. The results provided a new single layer for each of the paired years which included both records that experienced change, which were displayed with multiple records, and the records that remained the same, displayed with a single polygon and data record. All newly created layers were matched and overlaid to a 2010 census tract polygon layer.

In 2010, the census bureau created a more detailed census tract polygon layer for the U.S. The NHGIS modified the provided layer by removing coastal lines and projecting land-based areas. They also created a 2000 census tracts layer that aligns to the 2010 census tracts layer but creates discrepancies with previous census tracts years of 1970-1990. To better analyze changes over the study period, both 2000 census tracts were used during the interpolation with area weights method.

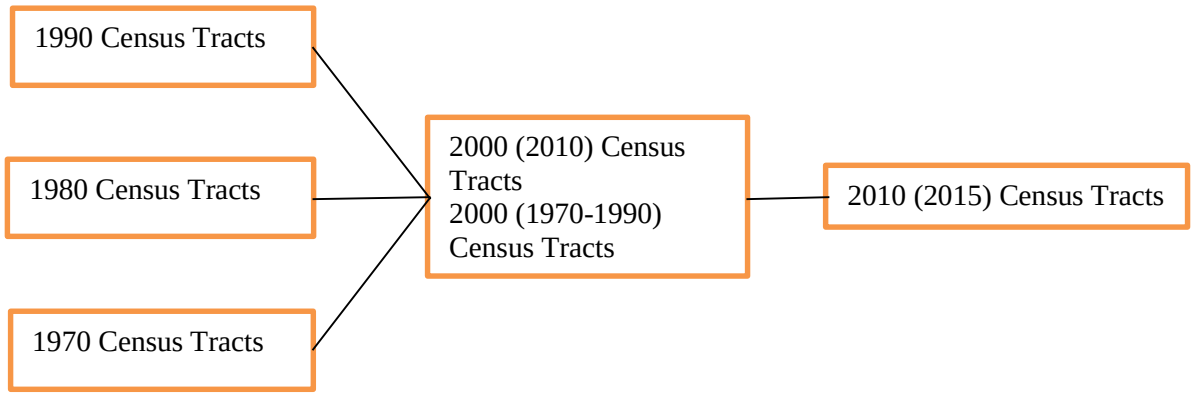

Figure 2 Interpolation diagram (NHGIS datasets)

Once the 2000 census tracts polygon layer was selected as the base layer, the interpolation by area weights process was initiated. The next step overlaid the 1970 tracts boundary file on to the 2000 tracts boundary file utilizing the union tool on ArcMap. The resulting polygon layer included shape length (perimeter) and area in square feet. Once the shape area was obtained, it was transformed to obtain the percentage of overlay area that changed over time. The field calculator tool supplied each census tract with a percentage overlay number by dividing the overlay area by the original area then multiplying the result by one hundred.

At this point the file layer was ready for census indicators data to be attached, a table containing all indicators for each individual year was joined to the newly created census tract layer which contained the percentage overlay utilizing the join tool in ArcGIS. The join made it possible to obtain only the percentage of each indicator that was contained within the overlay boundaries of the newly created polygon layer. As an example, the median household income for 1970 pertaining to each area in the overlay layer was obtained by multiplying the original number by the overlay percentage divided by 100, the result represents the interpolated amount utilizing the area weights method.

It should also be noted that there are potential errors from an interpolation that is based only on area weights. As an example, areas within a census tract may be uninhabitable or unpopulated, creating the results to be skewed to one portion of the tract (Logan et al. 2014). While the city of Detroit experienced population loss, many census tracts were consolidated. The exodus created a large inventory of abandoned dwellings, and many became focal points of criminal activity. In order to bring a solution, the city demolished over 13,000 building structures from January 2014 to May 2018. As a consequence, large areas of vacant land are now prevalent in Detroit. It is important to note that in some cases the existence of large amounts of vacant land on a census tract may have skewed interpolation results. Nonetheless, as better options would require extensive heads-up digitizing to create new datasets, the study uses the aereal weights method that is standard in the literature. It is suggested for future studies to use interpolations methods that would take into consideration the balance between habitable and vacant land.

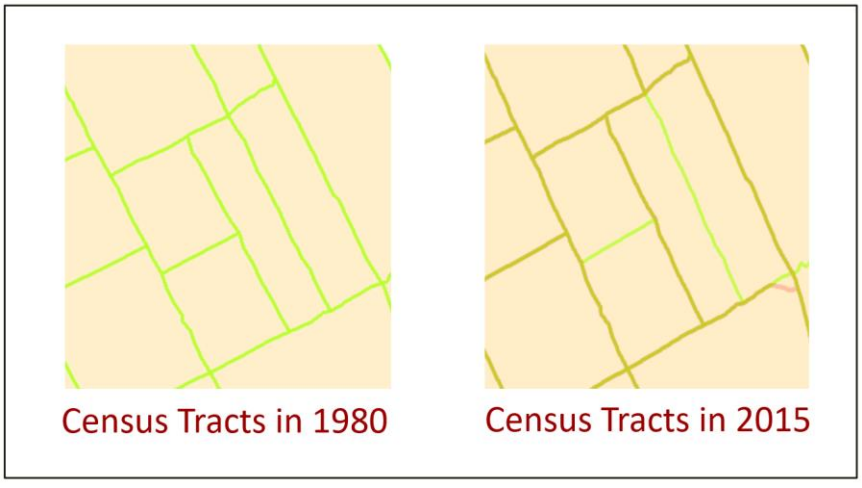

Figure 3 Example of census tracts that experienced change between 1980 and 2015

As Detroit experienced an extreme loss in population, census tracts boundaries changed accordingly. Over the study period it was common for two census tracts to become one. As

shown above on figure 3, the example presents how the boundary of four census tracts from 1980 changed over time to become two census tracts in 2015.

The distribution of tract changes is reviewed in detail for 1970-2015 in Table 3, which shows the number of tracts that did not change, two to one, three to one, and complex types of changes that involved multiple tracts.

Table 3 Number of census tracts that experienced change

Type of Change	From 1970-2000	From 1980-2000	From 1990-2000	From 2000-2010
No change	249	275	303	214
Two to one	125	56	15	70
Three to one	37	12	3	24
Many to many	9	1	0	6

The final step on the interpolation by area weights process was to summarize the overlay percentage results. Utilizing the dissolve tool on ArcMap, each indicator statistical field was summarized utilizing the census tract number or identification code. The NHGIS utilizes the code GISJOIN to identify each individual census tract number. The dissolve process allows for all four indicator statistical fields to be processed simultaneously.

3.1.3. Extent of Historical Protections

The city of Detroit hosts an online database called the Detroit Open Data Portal. It is a platform that allows the general public to download datasets which are provided by various city departments. For this study, the Detroit Planning and Development Department provided the local historic districts polygon shapefile which contained the official boundaries of Detroit's 140 historic districts. The provided dataset was joined to a 2010 census tract dataset already containing the interpolated data from 1970 to 2015 to enable further analysis. The resulting layering was used to establish treatment groups (tracts with historic protections) and control

(tracts without historic protections) groups. When overlaid, those 2010 census tracts that coincided with the boundaries of local historic districts were giving the value of 1, and those that did not, were giving the value of 0.

Upon an initial visual inspection of the local historic districts, it was determined that most of the districts converged around Detroit's downtown section, and each individual district varied in area and shape. Once, overlaid with the 2010 census tract layer, it was also evident that many historic districts extend over multiple census tracts.

Upon approval by the city council, historic designations are assigned. The city council is the only entity that can revoke or modified district boundaries. The intent of safeguarding and preserving historic building structures and/or sites through historic designations is first supported by local residents of the area. They then bring to the attention of the city council the areas and structures that would benefit from the designation, whether it is a collection of buildings or a single building structure. Once approved, each district has a unique boundary, and depending on the structures inside the boundary contains a specific amount of building footprint. Thus, it is important to note that in this study the treatment group is not selected at random, but rather is provided through a process involving community activists and City of Detroit, which likely takes into account historical values in existing building as well as other factors.

In addition to creating a unified census geography with which to analyze the effects of historical preservation over a long time period, this study also explored different spatial thresholds to evaluate which census tracts would be considered as part of the treatment group, and which would be part of the control group. The measures used relied on current historic designation polygons, but went beyond these to measure the effect of these designations given the size and number of buildings in each census tract.

The first measurement of historic preservation is simply whether or not there is any existing designation (any polygon or part of polygon) that intersects with a given census tract. A second measure indicates the intensity of historic preservation by measuring the area percentage of a census tract covered by polygons with historic designations. To obtain the overlay percentage of each census tract, it was necessary to utilize the *union tool* from the overlay toolset (Spatial Analysis) on ArcMap 10.5, with both 2010 census tracts and local historic districts shapefiles as input datasets. The output layer included all data from both datasets and provided the overlay area. The overlay area percentage was obtained by diving the overlay area by the census tract area multiplied by 100. Upon *selecting by attributes* only the areas with a historic designation, it was then possible to summarize the overlay percentage within each census tract by utilizing the dissolve tool in the generalization toolset (Data Management toolbox) in ArcMap 10.5. The overlay percentage was summarized using the provided NHGIS census tract number or GISJOIN identification code.

The next step was to explore changing the threshold of the area percentage covered by a historic designation that would consider a census tract as being part of the treatment or control groups. Although, historical district boundaries closely match those at the census block group, the unavailability of census indicator data at the census block group level prior to 1980, made it necessary for this study to utilize census tracts as the study unit. Census tracts are much larger in area compared to historic districts or census block groups. That difference in size means that the overlay percentage of most historic districts is quite small. Taking this into consideration, the two threshold values were established when determining control groups for two different DiD analyses: any census tract with an overlay percentage of 1% or below would be considered as

part of the control group and on a different DiD analysis, any census tract with an overlay percentage of 10% or below would become part of the control group.

A third way of measuring the intensity of historical preservation in each census tract is to count the number of protected structures. Therefore, additional exploration was performed utilizing building structure footprint in the city of Detroit. The Southeast Michigan Council of Governments (SEMCOG) data portal provides the digital footprint of each building in Southeast Michigan (http://semcog.org). The dataset named building Detroit, contained building type, building ID, city ID, year built, median height, parcel ID, residential square feet, and non-residential square feet. While this study only focused on the building structure count contained within each census tract as part of the local historic districts, further studies can explore additional spatial parameters utilizing building structure footprint such as square feet and building type.

Using the select by location tool for building structures contained within a local historic district, it was then possible to create a new layer named historic building structures. The newly created layer was then joined utilizing the spatial join tool, to the 2010 census tract layer. The resulting output layer provided the building count for each census tract. As the 2010 census tract had previously determined which census tracts contained historic designations, it was then possible to explore changing the parameters on the treatment group. By manipulating the building count threshold, the study explored if DiD results would change when census tracts part of the original treatment group would become part of the control group.

The following threshold counts were used to determine control groups on two additional DiD analysis reports. Any census tract with a building structure count of 1 to 10 became part of

the control group for one report, and similarly on a second report, any census tract with a building structure count 1 to 100 was considered as part of the control group.

Table 4 Census tracts totals

	Control Group	Treatment Group
Existing Historic Designation	221	76
Existing Historic Designation by 1995	257	40
Area 1% or below by 1995	280	17
Area 10% or below by 1995	285	12
Count 1 to 10 by 1995	281	16
Count 1-100 by 1995	286	11

3.1.4. Difference-in-Differences Analysis

Difference-in-differences (DiD) is a popular technique used to assess the effect of treatment over time in comparison to the control group (Holzer 2017). A DiD analysis uses longitudinal data from treatment and control groups to obtain an appropriate counterfactual to estimate a causal effect (Columbia 2016).

When studying the effects of home prices before and after the creation of historic districts in the Boston-Cambridge-Quincy MSA between 2000-2007, Heintzelmand & Altieri (2011) used DiD to control for higher starting value homes in historic districts by carefully selecting control and treatment groups with matched starting home values. By using a DiD analysis, this study was able to isolate the effects of historic district designations on each of the selected census indicator between 1970-2015. Assuming that in the absence of intervention both matched treatment and control neighborhoods would have similar outcomes, it is then possible to measure any effects that historic districts designations would have on census tracts that enclose one within its boundaries.

A positive DiD value when using the indicators of median household income, owner occupied percentage, and percentage of white population, and a negative value for vacancy percentage imply that neighborhood quality in census tracts that contain a local historic district increased when compared to non-local historic district designation census tracts.

For the study, the DiD required data that measures historical protections to be cumulative up to a cut-off year. As noted above, protections established in 1995 or earlier were included. Therefore, as we examine changes in decennial census data, the baseline for the study was established utilizing reported data from 1970, 1980, and 1990. Additional comparable measuring points in the years 2000, and 2010 provided assessment references, and the final reported data used for the DiD analysis was ACS data for 2015. A total of 62 historic districts and 40 census tracts associated with them were formed by 1995 are part of the treatment group for this study. Combined they represent 44% of the current historic districts in the City of Detroit.

DiD requires a parallel trend assumption, although both our treatment and control groups do not start at the same neighborhood status at the time of first measurement, it is assumed that the treatment group if not treated would follow a parallel movement similar to that of the control group. The DiD provides a visual form of analysis that allows for rapid comparison of trend lines that may show linear or non-linear changes in either improving or declining neighborhood status for each variable explored in this study. This is quite useful in this study where Detroit over the study period may show results below the original measuring point in the opening decades with possible upward trends at the end of the study period. The DiD allows for visualization of whether declines in neighborhood status are more or less pronounced and recoveries more or less steep in treatment versus control groups. The DiD analysis for this study served as an exploratory analysis technique, and further exploration is possible through the use of a regression analysis

model, which allows for continuous rather than only discrete measurement of the intensity of historic preservation.

3.1.5. Regression Analysis (Temporal Progression)

A series of ordinary least squares (OLS) analyses tested whether the change was related to local historic district designations based on two different continuous independent variables. For the OLS analysis, there is no need to use a cut-off year. Instead, the spatial extent of the historical protections is multiplied by the number of years' protections have been in place in a given census tract. The two independent variables for the OLS were the census tract percentage covered by a local historic district and historical building structure count multiplied by the number of years each historic designation had been in effect.

The OLS regressions examined the association between the independent variables listed above and the change in neighborhood status indicator values from 1970 to 2015. If the coefficient had a statistically significant p-value <0.05, then it indicates there was a relationship between the test variable and the change in the indicator value. When the dependent variable represented the change from 1970 to 2015 for median household income, owner occupancy percentage and percentage of white population, a positive coefficient indicates an association of historical preservation with a rise in neighborhood status, and when the dependent variable represented a change in vacancy percentage, a negative coefficient indicates an association of historical preservation rise in neighborhood status.

As an example, the first test evaluated the relationship between the census tract percentage of area covered by a historic district designation times the amount of years each designation had been in effect and the percentage change of each indicator over the period of time from 1970 to 2015. This design evaluated the relationship of each census indicator

individually, so four different OLS models were used in order to isolate test results. The residuals of tests that presented statistically significant p-values were further analyzed utilizing spatial autocorrelation.

The next series of tests evaluated the relationship between the count of historical building structures within each census tract times the amount of years each designation had been in effect and the percentage change of each of the four indicators over the period of time from 1970 to 2015. In all tests, OLS models that showed statistically significant coefficients, and their residuals were further analyzed utilizing spatial autocorrelation testing.

Chapter 4 Results

This chapter presents the results of the various spatial analysis techniques presented in chapter 3. DiD results over the study period from 1970 to 2015 indicate that census tracts that contained a local historic district designation experienced a slight increase in neighborhood quality in comparison to census tracts that did not contain one within its boundaries. Due to the drastic socioeconomic changes that took place in the city of Detroit during that period, it is important to note that each census indicator shows an upward trend in 2015, yet most all census tracts values are still below the original starting point in 1970. OLS Regression results found a positive relationship of local historic district area percentage in a census tract and the indicators of median household income and owner-occupied percentage, but the OLS results all show significant spatial autocorrelation. In order to understand the clustering that results in this finding, this chapter starts with a brief report on a hot spots analysis of the count of building structures and then details the DiD and the OLS regression results.

4.1 Hot Spot Analysis

To identify statistically significant spatial clusters, a Getis-Ord hot spot analysis was used to provide visual identification of statistically significant hot spots in the downtown Detroit area. With a Gi_Bin 95% confidence level or higher, Detroit's historic designation areas cluster around each other near the downtown district (see Figure 4 below). This is an important context to note before reviewing the results of the DiD and OLS models. The areas with historic protections generally share a locational characteristic and given their common location also may share other characteristics that influence their neighborhood status over time.

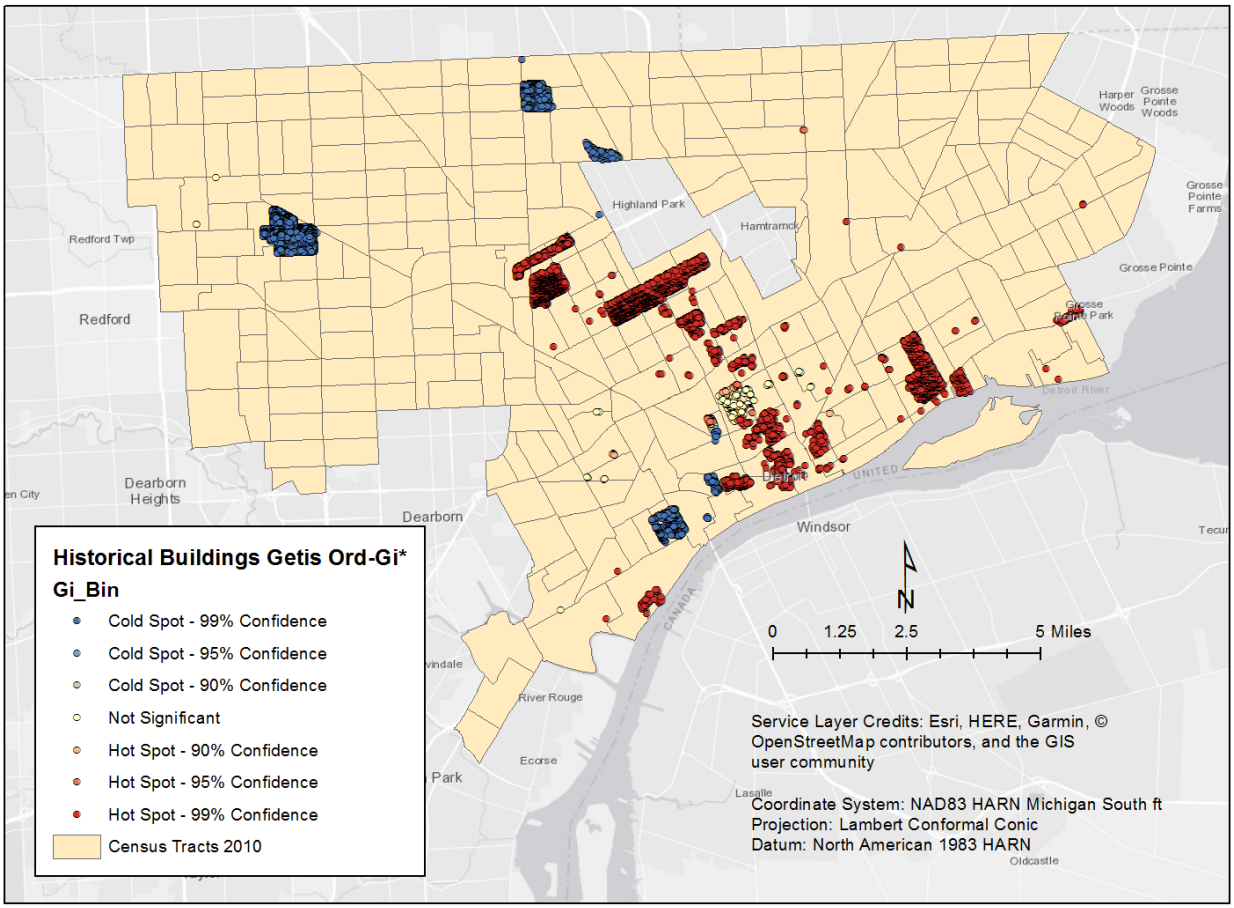

Figure 4 Building structures hot spot analysis

4.2 Difference-in-differences

The local historic district designations were approved and assigned by the Detroit city council upon review of an extensive report provided by the Historic District Commission. As of 2015, 138 historic districts are designated protected areas in the City of Detroit. The results presented on this section evaluate the treatment group that encompasses census tracts that were covered under the designation prior to the end of 1995. The results calculate the average totals of each census indicators across all the tracts starting in 1970 and ending in 2015. Throughout the

study, the experimental group was assigned the value=1 and the control group was assigned the value=0. In the following section, DiD results are detailed below if there is difference apparent in the trajectory of the treatment group compared with the control group in the years 2000, 2010, and 2015 (i.e., when the result is not "null").

Table 5 Summary of difference-in-differences trends by varying spatial thresholds

	Median Household Income	Owner Occupied Percentage	Vacancy Percentage	Percentage of white population
Existing Designation	null	stable	stable	recover
>1% of area	null	recover	null	recover
>10% of area	null	recover	null	recover
>10 buildings	null	recover	null	recover
>100 buildings	null	recover	null	recover

Table 5 summarizes the results of the multiple difference-in-differences analyses that show current existing designations as well as trends that occur when various spatial thresholds are given. When both experimental and control groups are virtually the same, a "null" value is given, if the status holds up in census tracts with historical protections even as it declines in tracts without historical protections, a "stable" value is assigned; a "recover" value is given when both control and experimental tracts decline at the outset of the study but protected tracts recover faster and/or finish on a better trend.

4.2.1. Existing Designations

When exploring DiD results for existing designations for owner-occupied percentage change, census tracts with historical protections started with a lower percentage of owner-occupied housing than census tracts in the control group but managed to hold steady their share

of owner-occupied housing while non-protected census tracts on average dropped from around 68% to about 50% owner-occupied housing.

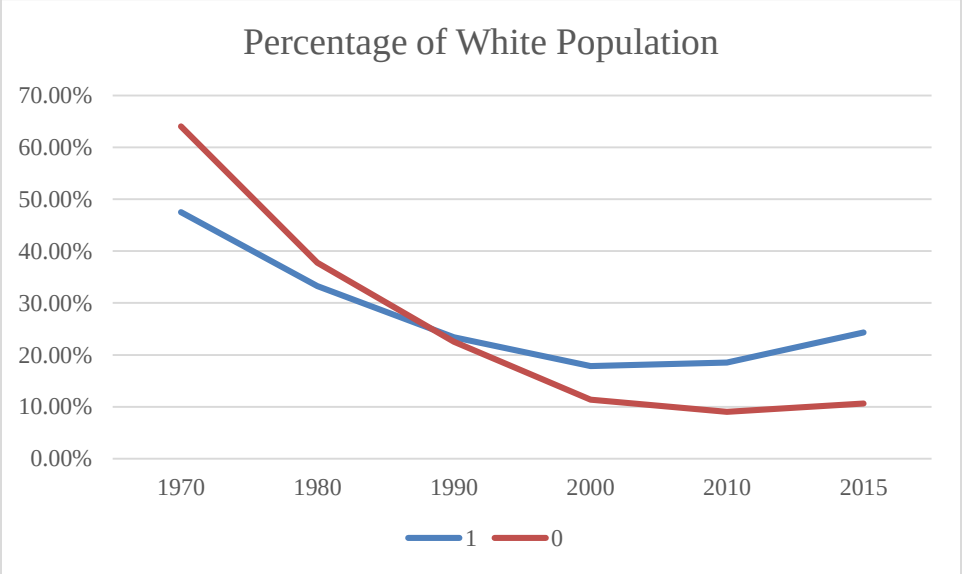

Figure 5 DiD results: experimental group recovery trend for existing designations

By contrast, when exploring percentage of white population change (Figure 5 above), DiD results indicate that while census tracts with historical protections started with a lower percentage of white population in comparison to census tracts in the control group they managed to end with a higher percentage. Both groups experienced a decline at the outset, and non-protected census tracts on average dropped from around 65% to 10% while census tracts with historic designation protections presented a recovery from that pattern ending approximately 14% higher than the control group.

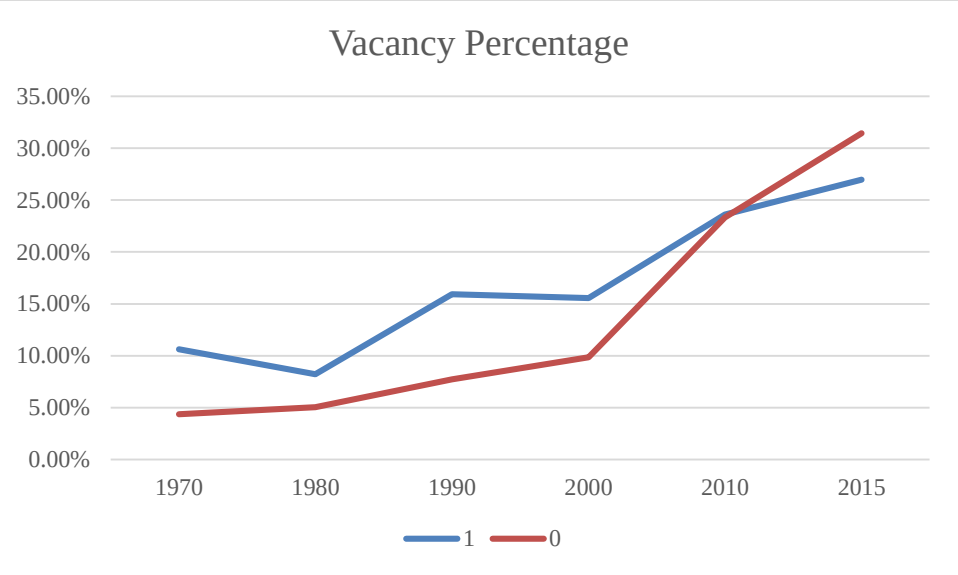

Figure 6 DiD results: experimental group stabilizing tend for existing designations

Census tracts that were acquiring any level of historical protections from 1970-1995 initially experienced a decline in vacancy percentage from 1970 to 1980 (Figure 6), after which a sharp increase occurred as historical protections were coming into place. This followed more or less a parallel pattern to census tracts without historical protections. It is important to note that while non-protected census tracts experienced a steady increase from 2000 onwards, protected census tracts ended the study period with a lower vacancy-percentage in a sort of stabilizing trend, which creates an approximately 5% difference in vacancy rates at the end of the study period.

4.2.2. Area Percentage in a Census Tract

Further analysis compared results derived from utilizing the area percentage of a census tract covered by a historical district designation. The results display changes by calculating the difference of the average totals of each census indicator when assigning the value=1 to census tracts with historic designation coverage of <1% and assigning the value of 0 to census tracts

with > 1% of historic district coverage. Additional exploration was performed utilizing a more stringent threshold. Census tracts assigned the value of 1 with a historic district area coverage ranging from 10% to 100%, and census tracts assigned the value of 0 with historic district area coverage under 10%.

For the owner-occupied percentage census indicator for both <1% and <10%, the treatment group goes up steadily from 30% owner-occupied in 1970 to 40% owner-occupied in 2015. During this same period of time, the control group steadily declines from 65% to 48%. The treatment census tracts achieved higher levels of homeownership in spite of declines across the city (i.e., a recovery trend).

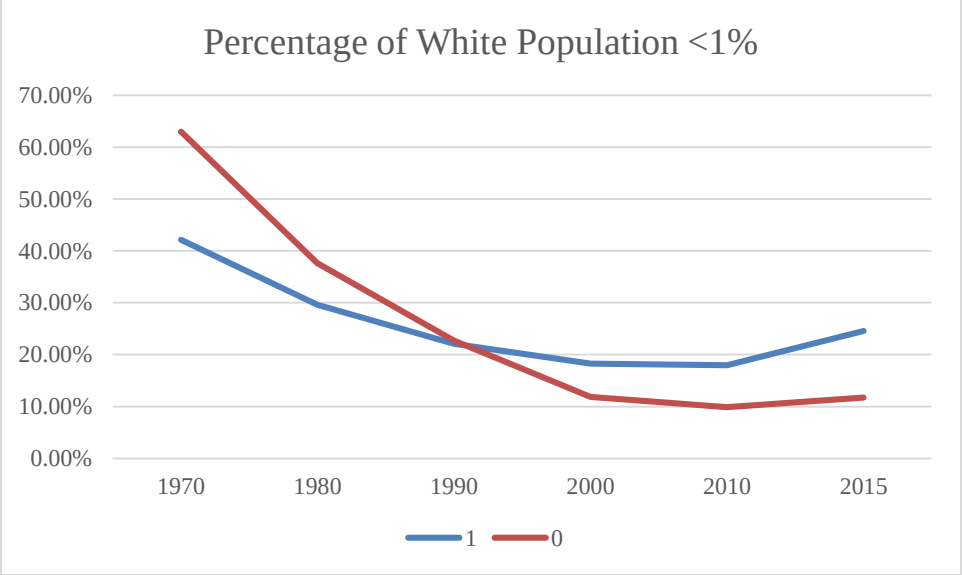

Figure 7 DiD results: experimental group recovery trend for historic designation coverage of <1%

At the onset of the study period in 1970, Figure 7 shows that there was a 20% lower white population for the census tracts that acquired historic designations from 1970-1995. Although initially both groups present a parallel downward trend, towards the 2000's tracts with

at least 1% protected area initiate a recovery period. When the control group threshold is set at <1%, by 2015 the treatment group outperforms the control group by 12.78%. Tracts with 10% or greater areal coverage of historical protections show almost an identical trend for percentage white population to those with only 1%.

4.2.3. Building Structure Count

This study also explored the effects of the total building structure count as a parameter to determine control and treatment groups. By making changes to the threshold count of building structures, this study explored the effects of the built environment as it relates to the selection of historic designations. When selecting census tracts that would become part of the treatment groups the parameters used were: >10 buildings and >100 buildings.

Results presented indicate that census tracts with protected building structures prior to the end of 1995 increased in status while those without protected structures declined in status on owner-occupation and percentage white population indicators. The result is almost identical for both parameters.

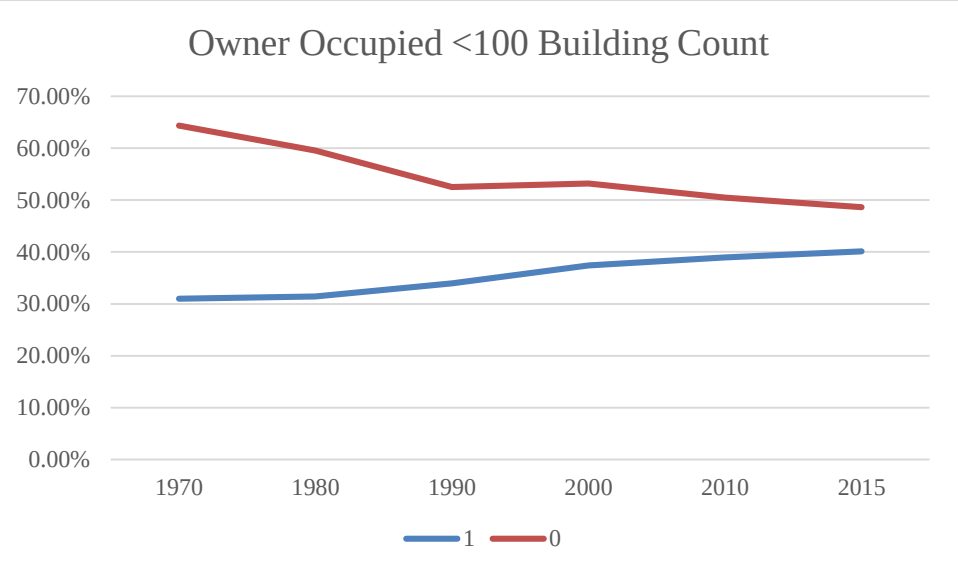

Figure 8 DiD results: experimental group recovery trend for historic designation building count of <100

Figure 8 shows the DiD analysis results for owner-occupied percentage for historic designation building structure count >100. It shows a pronounced recovery for the census tracts with 100 or more protected structures in spite of declines in the rest of the city. As shown on Figure 8 above, control and treatment groups at the onset of the study period in 1970 start with an approximately 30% difference margin between them. By 2015 that difference is reduced to under 10%.

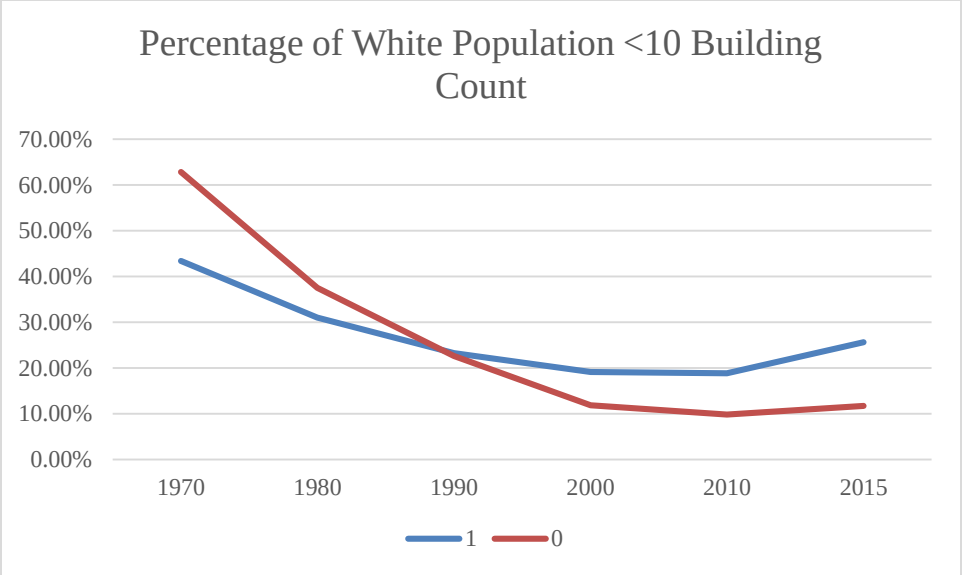

Figure 9 DiD results: experimental group recovery trend for historic designation building count <10.

When establishing the threshold building count at <10 as seen on Figure 9 above, census tracts with historical protections recovered from a steep decline of the 1970's and present a greater increase in percentage of white population. It is important to note that census tracts part of the treatment group initiated almost 20% below the control group and as the study period progressed both groups directly invert positions with census tracts part of the treatment group outperforming the control group by 13.92%.

A similar result with smaller margins at the end of the study period is seen when the threshold is set to <100 building structure count to percentage of white population change. Census tracts with historical protections started with a lower percentage of white population than census tracts with no protections but managed to increase their share of percentage of white population by the end of the study period. Census tracts part of the control group presented a steep decline of 50% finishing 10% below the treatment group. It is important to note that

although census tracts part of the treatment group performed better, at the end of the study period finish 30% lower than the original baseline. In general, the results for building structure counts and area percentage measures parallel one another for owner-occupied and percent white population.

4.3 OLS Regression Results

A series of ordinary least squares models individually tested the significance of two independent variables and four dependent variables. Each independent variable was multiplied by the amount of years each historic designation was in place. Each dependent variable obtained represents the amount of change (median household income) and the percentage change (owner-occupied, vacancy percentage change and percentage of white population change) that has taken place on census tracts with historic designations from 1970 to 2015.

Table 6 OLS regression output

Indicator (Dependent Variable)	Coefficient	p-value	Adjusted R-squared	Probability	Robust Probability
Independent Variable: Coverage Perecentage					
Median Household Income	1324.6524	p<0.01	0.001349	0.001361*	0.001151*
Owner-occupied	0.013690	p< 0.01	0.098626	0.000000*	0.000000*
Vacancy-percentage	-0.003478	p< 0.01	0.004833	0.119557	0.049580*
Percentage of white population	0.017323	p< 0.01	0.030018	.001601*	0.000000*
Independent Variable: Building Count					
Median Household Income	0.572594	p< 0.01	0.005641	0.102739	0.218171
Owner-occupied	0.000010	p< 0.01	0.073304	0.000002*	0.000000*
Vacancy-percentage	-0.000002	p< 0.01	0.001445	0.233019	0.183071
Percentage of white population	0.000011	p< 0.01	0.014858	0.020064*	0.000962*

The results of the 297 census tracts, when exploring median household income change as a dependent variable, indicate statistical significance when the independent variable was percentage coverage of a census tract by a historic designation and historically protected building count. Both are significant at p< 0.01 level with the expected positive slope. The Adjusted R-Square value for median household income is below 1%, indicating that very little of variability across the decades is explained by the degree of historical protection.

With only two exceptions, as noted below, the OLS results for all the other independent variable and dependent variable pairs are similar to median household income. In the case of owner-occupied housing and to a lesser degree percentage white population, the Adjusted R-Square values are somewhat higher. This is consistent with the strong findings on these two census indicators in the DiD analysis.

Two exceptions where the relationships are not significant should be noted. One exception is when the independent variable is building count, in which case there is no association with vacancy percentage. Here it is interesting to note that when measuring by coverage percentage, there is a statistically significant association. The second exception is when the independent variable is building count and the dependent variable is for median household income. Here again, while the relationship is in the expected direction, the association is not statistically significant. The different OLS results for percent coverage and protected building counts highlight the importance of how the spatial measure of historical protection is constructed.

It is important to note that only building structures that are part of a historic designation were taken as part of the study. To corroborate that the model was not biased, a preliminary histogram was visually inspected, and a natural log was created (Figure 10, below). The distribution is somewhat skewed, but mostly because of the large number of zero values in the data. As many tracts in the data contain a 0, the natural log would alter the data, and therefore it was not used. Nonetheless, the results show that the way this variable lays out in the real-world, it will tend to suppress findings of an OLS analysis. Highlighting the need for this study to explore different spatial parameters to define control and experimental groups.

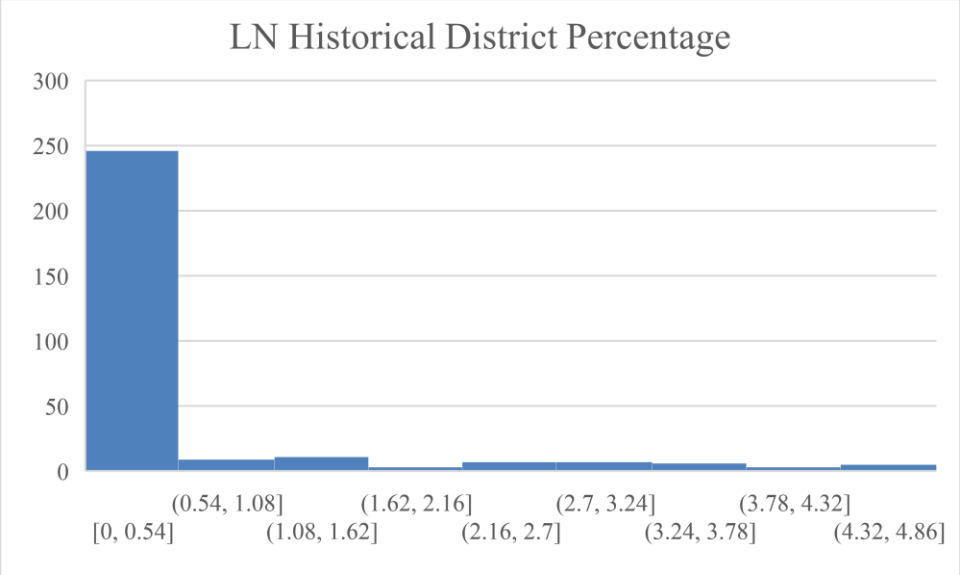

Figure 10 Natural logarithm (LN) Historic District area coverage percentage results

It is also important to note that a negative coefficient for vacancy percentage change is the expected direction, as it indicates that a census tract is experiencing neighborhood status rise. During the OLS, results for vacancy percentage a robust probability of 0.049580 indicated statistical significance with a negative coefficient of -0.003478.

Following each individual OLS analysis, to corroborate the results and to remove the possibility of other external factors from contributing to the results, a spatial autocorrelation analysis was performed on the remaining coefficient residuals.

4.4 Spatial Autocorrelation

A spatial autocorrelation check was performed in order to verify if the residuals were independently distributed with respect to the location of the census tract. The results indicate that in all cases, based on positive z-score values, there is likely an underlying spatial process of clustering in residuals in the data. This is not surprising; given that we know from the hot spots analysis, which shows that the historically-protected structures cluster near downtown Detroit.

Nonetheless, it raises the possibility that some additional factor or factors related to downtown location explains the associations seen here for median household income, owner occupied percentage, and vacancy percentage, perhaps over and above the historical protections. This finding means that it is not possible to infer causality in the associations found between historical protections and neighborhood status.

Table 7 Spatial autocorrelation results

Indicator (Dependent Variable)	Moran's Index	Expected Index	Variance	z-score	p-value
Independent Variable: Census Tract Percentage					
Median Household Income	0.141928	-0.003378	0.001268	4.1	0.000045
Owner-occupied	0.434961	-0.003378	0.001286	12.2	0.000000
Vacancy	0.535444	-0.003378	0.001266	15.1	0.000000
Percentage of white population	0.859574	-0.003378	0.001293	24.0	0.000000
Independent Variable: Building Count					
Median Household Income	0.150446	-0.003378	0.001269	4.3	0.000016
Owner Occupied	0.463269	-0.003378	0.001286	13.0	0.000000
Vacancy	0.546422	-0.003378	0.001266	15.5	0.000000
Percentage of white population	0.877820	-0.003378	0.001293	24.5	0.000000

Chapter 5 Conclusion

This study investigated spatial analysis techniques that would help determine the effects of historical district designations and examined its impact on neighborhood rise or fall. This section will discuss results, make conclusions, discuss study limitations, and provide suggestions for future research.

Given the historical background of the city of Detroit, it is important to notice the events that lead to the socioeconomic conditions of our study period. Based on the DiD and OLS results in the previous chapter, it is apparent that in general census tracts that have historical protections are experiencing a stabilization of decline or rise in neighborhood status as of 2015. Nonetheless, while the upward trend is evident, in most cases, neighborhood status does not yet meet the original 1970's baseline conditions established for this study. Future studies should allow sufficient time to pass to investigate if the results that are present in 2015 are consistent and strong enough for upward changes to be considered robust reflections of any of associations explored here.

While there are many similarities in the DiD and OLS results, there are also a few differences several of which were noted in Chapter 4. It is important to note that in general, a conservative approach was taken in identifying stabilizing and recovery trends in the DiD analysis. Because the OLS is based on continuous variables and includes all data on historical designations up to 2015, including measurement of the length of time of the designation, it is a more sensitive measure of potential associations.

Owner-occupied percentage on census tracts that contain historical protections has increased at a steady pace and is the only census indicator that regardless of changes made to spatial thresholds finished the study period above the initial values. On the other hand, owner-

occupied percentage on census tracts with no historical protections remain on a constant downward trend. A steep decline is present on both control and experimental groups at the outset of the study period when observing percentage of white population. The percentage of white population on census tracts with historical protections have recovered quicker than those without any designations experiencing an increase starting in the 2000's.

A negative change in vacancy percentage is an indicator of a positive change in neighborhood status, but DiD results show that from 1970 to 2015 vacancies in the city of Detroit have increased across the city. This was an expected phenomenon due to the massive exodus of population that has occurred since the 1950's. The original assumption that historic district designations would contribute to lower vacancy percentages than non-historic district areas in Detroit is inconclusive as DiD results indicate a parallel rise in vacancy percentages from 1970 to 2010, and a redirection in its initial stages in 2015. Further studies can investigate the change utilizing future decennial data, or ACS estimates, or by concentrating on areas where the redirection is clearly evident, as in downtown Detroit.

The use of areal interpolation to determine census indicator values for census tracts in Detroit introduces uncertainty. During Holzer's neighborhood comparison study of Minneapolis and St. Paul (2017), which explores the impact of economic development programs, uncertainty arises as different neighborhoods belong to different census block group and selecting census block groups as a geographic unit makes it impossible to determine the impacts of economic development funding. As census tract boundaries shifted from 1970 to 2015, areal interpolation is necessary in order to define and create a consistent study unit. Standardizing census tract boundaries from 1970-2000 to census tract boundaries from 2010 by areal interpolation determines consistent indicator values for all census tracts in the city of Detroit throughout the

study period from 1970 to 2015. While there is still some degree of error in the data, the compromise is necessary to obtain consistency when comparing census tracts that have shifted boundaries multiple times over the study period.

As data availability in the city of Detroit increases, future studies could compare results with a different study unit, exploring perhaps census block group data that better aligns with local historic district boundaries and evaluating the degree of uncertainty in this test. The NHGIS portal is only able to provide median household income prior to 1980 at the census tract level. Through areal interpolation, exploration of decennial data from 1950 and 1960 may expand on this study's assessment of Detroit's socioeconomic conditions that led to its decline.

The lack of a precision match between the historic district polygons and census tracts means that in the vast majority of cases the historic designation area coverage percentage coverage is well below 50 percent of a census tract. The large area of a census tract that is not covered by a historic designation protection may skew results. This is the modifiable areal unit problem (MAUP), which may be solved in the future by obtaining census indicator data at the block level or even smaller spatial units. A smaller study unit may be able to better isolate results and compare them to the overall Detroit metropolitan region.

To overcome the MAUP, new data is needed. Future work could explore non-census data to build measures of neighborhood status. For example, the use of tax assessor data could depict property values at the parcel level. The total census population flows over time at the block level could indicate neighborhoods with sharply diminishing or growing populations. Such measures might well produce different results than the ones obtained at the census tract level. Increases in property values and population growth at the census block level may be a more sensitive measure of potential associations between historic preservation and neighborhood status.

It is important to mention the unique socioeconomic conditions that are prevalent in the city of Detroit. While historic preservation efforts in other cities in the U.S. may show an association with an increase in neighborhood status, Detroit's extreme decline has created a different environment with conditions well below the original starting point of 1970. For that reason, when analyzing results, it is important to acknowledge that while findings in the treatment groups present an upward rise towards the end of our study period, when the results are compared to the initial baseline, those conditions are merely starting to move towards the original starting point. Historic districts in Detroit have performed better in preserving or increasing neighborhood status when compared to other neighborhoods without the designation.

Efforts by other cities in the U.S. may perform at a higher rate in part because the initial conditions did not deteriorate to the extent to which the city of Detroit was exposed. In Detroit, many census tracts with historical protections at the onset of the study period start at greater disadvantage far behind the control groups, an indication that perhaps major deteriorations to theses tracts had already started prior to 1970. These reasons may explain the major disparity in results between major metropolitan areas in the Midwest region and other areas in the U.S.

The use of decennial and ACS census data to determine the value of each census indicator also creates data uncertainty. As decennial data provided actual values from 1970 to 2000, ACS data provided estimates for 2010 and 2015. Using the most recent and available data allowed this study to assess change over a long period of time by setting up a starting point prior to the assignment of local historic district designations in Detroit in 1978, and ACS data for 2015. It was essential to study such a wide period of time in order to assess the impact of historic district designations in the city of Detroit since its original inception. Future studies should analyze other census indicators to determine neighborhood status, as well as specific regional

economic data that can help describe smaller spatial units that better align with historical districts.

While it is difficult to isolate the effects of historical district designations, this study suggests that over time historical designations are perhaps one of the contributing factors for median household income, owner-occupied percentage and percentage of white population to increase, and vacancy percentage to decrease, therefore becoming a factor of neighborhood status to rise. However, there are likely other factors related to the location of the census tracts not yet uncovered.

Temporal regression results validate that a positive relationship is present between historic designated census tracts and the selected census indicators. Nonetheless, based on the spatial autocorrelation results that were obtained from the OLS residuals, other factors may have contributed to the increase in neighborhood status seen in Detroit census tracts that host a historical district designation. What other factors may have contributed? A strong investment on Detroit's downtown and financial neighborhoods, which happen to be historical protected areas, has been spearheaded by the conversion of commercial structures into residential dwellings as well as the creation of the most compact sports district in the U.S. which has led to more affluent population to relocate and live in the area.

Although historic districts have been in effect since the 1970's, new areas are added to existing conditions as residents petition to the City council for an area to be considered for the designation. Spatial conditions will change in the future as new areas become part of Detroit's historic district designations. Therefore, this study can serve as a starting point on how these new parameters can be later analyzed.

Corroborated by hot spot analysis results, most historical protected building structures are located in the downtown area. Further studies can explore whether redevelopment efforts in downtown Detroit will have any spillover effects to surrounding neighborhoods.

Understanding that historical protections may contribute to neighborhood status rise by attracting more affluent residents, potential displacement due to neighborhood improvements should be researched in future studies. A major criticism of historical preservation efforts is that it leads to the displacement of disadvantaged population that can no longer afford to live in their communities. It will be important to research whether neighborhood status rise benefit the existing residents or if the increase is the result of more affluent people moving in (Holzer 2017).

There is a limited amount of historical preservation literature that utilizes GIS. To offset that void, related literature on the fields of historical preservation, sociology, history, and GIS analysis was necessary to establish a foundation to build upon a methodology. In order to understand the extent of historical protections and obtain stronger results no single analysis method with simple measures will give good results. Instead this study has shown the importance of using multiple spatial analysis methods. Using OLS analysis as an exploratory method, the research shows the importance of tracking spatial autocorrelation which has not been done in previous studies.

A surge of revitalization efforts on the urban core of metropolitan areas throughout the U.S. has sparked the debate whether historic preservation designations are good or bad for economic development. One purpose of this study was to present various spatial analysis techniques that can help determine the effects, if any, of historical district designations on neighborhood status rise or fall. Furthermore, it exhibits the limitations that were encountered

and suggests that similar studies expand on the topic to measure the effects of historic preservation.

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