A LONGITUDINAL ANALYSIS OF THE LINEAR AND NONLINEAR IMPACTS OF HOUSING ABANDONMENT ON NEIGHBORHOOD PROPERTY VALUES

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ABSTRACT

Hye-Sung Han: A longitudinal Analysis of the Linear and Nonlinear Impacts of Housing Abandonment on Neighborhood Property Values
(Under the direction of William M. Rohe)

This dissertation examines the linear and nonlinear impacts of housing abandonment on neighborhood property values in three separate but related papers.

Paper 1: The Impact of Abandoned Properties on Nearby Property Values

Previous research has shown that housing abandonment contributes to neighborhood decline by depressing nearby property values. However, most past research estimated the impact of abandonment through cross-sectional analysis without controlling for nearby foreclosures or local housing market trends. Therefore, it remains unclear whether abandoned properties reduce nearby property values or whether abandonment is more common in areas with already lower-valued properties. Prior research also has not explored how the duration of abandonment influences nearby property values. Therefore, to extend the current level of understanding of the impact of abandonment, this research examines the impact of abandoned properties on nearby property values in Baltimore, Maryland, from 1991 to 2010 using longitudinal data sets while simultaneously controlling for both nearby foreclosures and local housing market trends. This research finds that as properties are abandoned for longer periods of time, the impact on nearby property values not only increases in magnitude but also is seen increasingly farther away.

Paper 2: Exploring Threshold Effects in the Impact of Housing Abandonment on Nearby Property Values

Most prior research examining the impact of distressed (foreclosed, vacant, abandoned) properties on nearby property values has assumed that each additional distressed property has the same marginal effect on nearby property values as the prior distressed property had. In other words, these studies assumed that the impact of distressed properties on nearby property values is linear. Scholars have suggested that there could be threshold effects in the impact of distressed properties, yet no prior research explored this issue. Therefore, this research explores the presence of threshold effects in the impact of housing abandonment on nearby property values in Baltimore, Maryland, from 1991 to 2010. This research finds that the magnitude of the impact of housing abandonment does not increase proportionally to the number of nearby abandoned properties; rather that there is a threshold effect. Specifically, this research finds that the marginal impact on nearby property values increases significantly in magnitude when the number of abandoned properties within 250 ft. increases by more than 2. It also finds that the marginal impact drops significantly when the number of abandoned properties within 250 ft. increases by more than 14.

Paper 3: Neighborhood Characteristics and Resiliency to the Impacts of Housing Abandonment

Housing abandonment is often disproportionally distributed across a city. Previous research has determined that a number of neighborhood socio-economic and spatial characteristics were associated with housing abandonment. However, past research has not examined the degree to which the impact of housing abandonment varies with specific neighborhood characteristics. Therefore, this research examines whether the impact of housing abandonment on nearby property values varies among different neighborhoods, whether the impact changes at unequal rates over time, and, if so, what accounts for such variability. Focusing on Baltimore neighborhoods between 2001 and 2010, this research found considerable variability in the magnitude of impact of housing

abandonment among neighborhoods and that the magnitude of impact changed at unequal rates among neighborhoods over time. Neighborhood crime rate was the strongest predictor of the change in the magnitude of impact of housing abandonment among neighborhoods. Neighborhood unemployment rate, housing unaffordability, proportion of properties with housing violations, and foreclosure rate were also influenced the impact of housing abandonment.

To my family, thank you.

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INTRODUCTION TO THE RESEARCH

In 2006, the United States began to experience a dramatic increase residential mortgage foreclosures. According to the Mortgage Bankers Association of America, 1.2% of all loans were in the foreclosure process and 4.6% of all loans were delinquent at the end of 2006[1]. Both delinquency and foreclosure rates have continued to increase since then. The foreclosure rate increased to 4.6% and the delinquency rate increased to 9.3% as of end of 2010[2]. As foreclosures continue to spread across the country, many of the foreclosed properties end up abandoned contributing to a total of more than 4.8 million vacant residential properties in the U.S. by the end of 2012[3]. This problem is particularly acute in new suburban developments that have excess housing supply and weak housing markets (Kingsley, Smith, & Price, 2009). Scholars argue that lengthy and complex foreclosure processes lead to prolonged periods of vacancy, which allow for greater chances of vandalism and of the property falling into disrepair (Immergluck, 2006). In addition, very high foreclosure costs increase the instances in which lenders *walk away* from properties that are of marginal value, which in turn leads to vacancy and abandonment (Apgar, Duda, & Gorey, 2005; Immergluck, 2006).

[1] Source: Mortgage Bankers Association of America, Washington, DC, "MBA Mortgage Originations Estimates," National Delinquency Survey, quarterly, <http://www.mortgagebankers.org/>

[2] Same as note 1.

[3] Source: HUD Aggregated USPS Administrative Data on Address Vacancies, Quarter 4 ending December 31, 2012, <http://www.huduser.org/portal/usps/home.html>

The foreclosure crisis has brought heightened awareness to vacant and abandoned residential properties nationwide. But the problem of housing abandonment is not new. Long before the current mortgage crisis, many large metropolitan areas were grappling with housing abandonment (Sternlieb & Indik, 1969; U.S. General Accounting Office, 1979). Despite the extent and the problems of the housing abandonment, research on housing abandonment and the development of effective policies to address abandonment has been, however, very limited. Therefore, this dissertation attempts to examine the impact of housing abandonment to extend the current level of understanding of the relationship between housing abandonment and neighborhood decline. Without a concrete understanding of this relationship, policymakers lack the information necessary to develop effective policy strategies to address the housing abandonment problems.

The purpose of this introduction section is to explain why further research on the impact of housing abandonment is needed. This section begins by defining housing abandonment and examining the extent of housing abandonment in U.S cities. After presenting what past research has found regarding the impact of housing abandonment, I discuss the shortcomings of past research. Next, I present the overview of my three research papers: research questions, data, and analytical methods. This section concludes with a discussion of the scholarly significance and policy implications of this dissertation.

1. How Has Housing Abandonment Been Defined?

What defines a property as abandoned is not consistent (Cohen, 2001; Sternlieb, Burchel, & Paulus, 1972) and the terms *abandoned* and *vacant* are often used interchangeably. The 1979

Comptroller General's Report to the Congress that examined the housing abandonment in U.S. cities stated that no single definition of the term *housing abandonment* existed among cities (U.S. General Accounting Office, 1979). This report stated that although cities defined abandoned housing in various ways, some of the more frequently used definitions described abandoned housing as those which were tax delinquent, vacant on a year-round basis, not receiving utilities, not being maintained, boarded up and/or open to causal entry (U.S. General Accounting Office, 1979).

Cities often identify an abandoned property depending on its structural condition and the length of vacancy (Cohen, 2001). For instance, Pagano and Bowman, in their 1998 survey estimating abandoned structures in 60 U.S. cities, found that some cities consider a structure abandoned, and therefore an immediate danger to the public safety or health, if it has been unoccupied for 60 days (Cohen, 2001; Pagano & Bowman, 2000). Others use 120 or more days as a threshold (Cohen, 2001; Pagano & Bowman, 2000).

Many scholars consider neglected property ownership duties (e.g., delinquent property taxes or noncompliance with relevant codes) as an indicator of abandonment. Sternlieb, Burchell, Hughes, and James (1974) defined an abandoned building as a residential structure that the owner has removed from the housing stock by neglecting property ownership duties regarding functional, financial, and physical maintenance. Hillier, Culhane, Smith, and Tomlin (2003) stated there are three distinct aspects of abandonment: functional, financial, and physical. Functional abandonment concerns a vacant property that is not suitable for residency, such as one that lacks sealed doors and windows. Financial abandonment happens when an owner stops meeting his financial responsibilities such as making property tax or mortgage payments. Physical abandonment happens when a property is unfit for occupation because the owner neglected to maintain the inside or outside of the residence. Mallach (2006) considers a property abandoned if the owner has stopped

carrying out at least one of the significant responsibilities of property ownership, causing a property to be vacant or likely to become vacant.

In this dissertation research, a property is considered *abandoned* based on its functional (i.e., inhabitable with boarded up windows and doors) and physical aspects (i.e., showing the signs of neglect). Harding, Rosenblatt, and Yao (2009) stated that the mechanism by which a distressed property influences the value of neighboring properties is largely visual, based on evidence in their empirical study measuring the contagion effect of foreclosed homes on nearby property values. Therefore, the sign of neglect is a major indicator of abandonment. Thus, the residential property is considered *abandoned* if either (a) it is boarded up or (b) it is unboarded but the conditions are unlivable, severely dilapidated, or inadequately secured with missing doors and windows. The research does not consider the following properties as *abandoned*: (a) mortgage or tax delinquencies and (b) unoccupied properties but if they are still livable.

2. What Is the Extent of Housing Abandonment in U.S. Cities?

To date there have been few attempts to count the number of abandoned properties in U.S. cities. Some federal agencies, such as the U.S. Bureau of the Census and the United States Postal Service (USPS), compile data on the number of vacant properties in the United States. Decennial census data identify a unit as vacant if no one is living in it at the time of the survey (U.S. Government Accoutability Office, 2011). The USPS defines a vacant address if mail has not been deliverable for 90 days or longer (U.S. Government Accoutability Office, 2011). However, it is difficult to use these data to identify unoccupied property that is unsafe or unfit for human habitation or other authorized uses (U.S. Government Accoutability Office, 2011). The primary

difficulty stems from the lack of accurate methods to identify abandonment. For example, simple exterior inspection methods may not be sufficient to identify actual vacant or abandoned properties (U.S. Government Accoutability Office, 2011).

Furthermore, estimates of abandoned properties in U.S. cities vary among studies or across jurisdictions. This is mainly because there is no standardized definition of property abandonment. For instance, James Cohen reported that the number of abandoned housing units in Baltimore is between 12,700 and 42,481; the low number is the city's recent count of vacant units unfit for habitation, whereas the high number is the number of vacant units from Census 2000 (Cohen, 2001). The lack of a shared definition of property abandonment often complicates efforts for researchers or government officials trying to accurately measure the extent of abandoned housing (Pagano & Bowman, 2000). Furthermore, maintaining a count of abandoned properties is not an easy task. Properties often turn over rapidly and tracking abandoned properties requires a substantial amount of resources and efforts (Pagano & Bowman, 2000).

Although there has not yet been a nationwide attempt to systematically count and track the number of abandoned properties, a number of studies illustrate the extent of the housing abandonment problem. As early as in 1967, Sternlieb and Indik surveyed Newark, New Jersey, and found that 6.74% of the housing units were vacant (Sternlieb & Indik, 1969). The 1979 Comptroller General's Report to the Congress reported that 113 large U.S. cities had housing abandonment problems to some degree; 55 of these cities acknowledged substantial to moderate housing abandonment problems (U.S. General Accounting Office, 1979). This report examined three cities – Philadelphia, Pennsylvania; St. Louis, Missouri; and Detroit, Michigan – in more detail and reported that as of 1977, Philadelphia had 21,214 abandoned residential structures and St. Louis had 2,738 and as of 1976, Detroit had 11,684 (U.S. General Accounting Office, 1979).

More recently, Allan Mallach (2006), using 2000 U.S. Census Bureau data, estimated an average of about 10,000 abandoned residential properties per city in 19 cities with populations over 100,000. Another survey by Pagano and Bowman (2000) at the Brookings Institution in 2000 found an average of 2.63 abandoned structures for every 1,000 residents in 60 U.S. cities with populations over 100,000. The cities in the Northeast region reported the highest average number of abandoned structures per 1,000 residents: 7.47 (Pagano & Bowman, 2000). The high average for the Northeast is caused by a few cities with exceptional statistics: Philadelphia with 36.5 abandoned structures per 1,000 residents, and Baltimore with 22.2 abandoned structures per 1,000 residents, for example (Pagano & Bowman, 2000).

3. Why Should We Be Concerned About Housing Abandonment? Findings of Past Research

Weakening Local Housing Market

One of the major problems of housing abandonment is its spillover effect on neighborhood housing market. Studies found that property abandonment affects other properties within the area by lowering property values (Griswold & Norris, 2007; Mikelbank, 2008; Shlay & Whitman, 2006). Shlay and Whitman, for example, examined the impact of vacant housing units on nearby property values in Philadelphia and found that the presence of a vacant property on a block reduces the value of all the other property by an average of $6,720. This study also estimated the net impact of distance from an abandoned house on nearby properties' sales prices and found that housing closer to abandoned properties had lower prices than property located farther away. For instance, at less than 150 ft. from an abandoned property, houses experienced a loss of value of $7,627 whereas the

properties located between 300 and 449 ft. from an abandoned house experienced a loss of value of $3,542.

In another study, Mikelbank (2008) examined the impact of both foreclosures and vacant/abandoned properties in Columbus, Ohio, in 2006, and concluded that for a property located near foreclosed and vacant/abandoned properties, the property value is reduced by an average of $8,600 – $4,256 by foreclosed properties and $4,411 by vacant/abandoned properties. Furthermore, this study found that the effects of vacant/abandoned properties were more concentrated than the effects of foreclosed properties; the impact of vacant/abandoned properties on a nearby property was more severe within 500 ft. but was insignificant beyond 500 ft. whereas the impact of foreclosed properties was less severe overall but still significant out to 1,000 ft. (Mikelbank, 2008).

Griswold and Norris (2007), in their study of Flint, Michigan, also found that an additional abandoned structure within 500 ft. would reduce the sale price of a property by 2.27%. This study also found that the farther the abandoned property was located, the lower the impact of an additional abandoned structure on nearby property value. Thus, the previous research findings are consistent: housing abandonment weakens local housing market by lowering nearby property values.

Impact on Neighborhood Crime through Weakened Social Fabric of Communities

A number of past researches examined the association between housing abandonment and neighborhood crime. Scholars have long agreed that disorder – either physical or social – undermines neighborhood stability and plays a significant role in neighborhood decline (Sampson & Raudenbush, 1999; Skogan, 1990). Social disorganization theory focuses on the relationship

between neighborhood social structure, social control, and crime. Scholars of this theory have found a consistent relationship between urban crime and social disorder as measured by the presence of public intoxication, loitering, or drug dealing (Sampson & Raudenbush, 1999). They also have found a consistent relationship between urban crime and physical disorder as measured by the presence of abandoned cars, graffiti, or litter (Sampson & Raudenbush, 1999). Skogan also argues that physical disorder, such as abandoned properties, not only raises fear of crime among neighborhood residents but also may cause an actual increase in serious crime (Skogan, 1990).

Some scholars argue that weakened social fabric of communities by abandoned properties explains the association between abandoned properties and neighborhood crime. Skogan (1990), for instance, argues that physical disorder including abandoned properties increases the fear of crime and this fear isolates the individual within a community, weakening social ties to others and ultimately the sense of collectivity. Kelling and Coles (2006), for instance, also argue that disorder encourages people to withdraw physically, and as they withdraw, they also withdraw from roles of mutual support with fellow residents on the streets, therefore relinquishing the community social controls.

Much of the interest in disorder has stemmed from Wilson and Kelling's "broken windows" theory. Increased physical incivilities and lack of social control attract more potential offenders to the neighborhood (Wilson & Kelling, 1982). However, general studies show that the direct link between disorder and crime may not be as strong as the broken window theory would suggest, and that disorder may be predicted by the same characteristics as crime itself (Sampson, Morenoff, & Gannon-Rowley, 2002). For example, a number of studies recently challenged Wilson and Kelling's broken windows theory, arguing that their research found no significant evidence to support their theory (Harcourt & Ludwig, 2006). Ralph Taylor (2001) in his longitudinal study on the relationship

between disorder and crime or fear of crime in Baltimore neighborhoods found that although observed disorder generally predicts several violent crimes, there are other stronger predictors for change in crime such as neighborhood exchange value, home ownership, and racial composition.

A few studies explored the impact of abandoned properties on crime. Spelman examined 59 abandoned residential properties in a low-income neighborhood in Austin, Texas. Of these buildings, he found that 34% were being used for illegal activities, and of the 41% of abandoned buildings that were unsecured, some 83% were being used for illegal activities (Spelman, 1993). This study also found that the crime rates on blocks with unsecured abandoned buildings were twice as high as the rates on matched blocks with secured abandoned buildings (Spelman, 1993). Another study on the relationship between foreclosure, vacancy, and crime in Pittsburgh, Pennsylvania, by Cui (2010) also found that violent crime increases by more than 15% when foreclosed homes become vacant. Immergluck and Smith (2006b), who examined the relationship between neighborhood foreclosures and crime, found that higher foreclosure levels do contribute to higher levels of violent crime; approximately 2.8 foreclosures per 100 owner-occupied properties in one year leads to an approximately 6.7% increase in neighborhood crime. Thus, there is evidence that housing abandonment increases neighborhood crime.

Threatening Neighborhood Stability

A neighborhood is stable when its key characteristics remain stable, balancing inflows with outflows, such as when the population is replaced by a similar population and when physical decline is replaced by repairs, maintenance, and renovations (Downs, 1981). Therefore, neighborhood stability requires the constant inflows of similar population and of investment. Housing

abandonment can threaten neighborhood stability. For instance, Sternlieb et al. (1974) explained that when landlords invest less on their aging properties because of increased maintenance costs and lowered rents or housing prices as a result of increased housing supply in suburbs, then their aging properties deteriorate further and can no longer attract similar households. As properties continue to decay, neighborhoods decline, and some of worst structures end up abandoned. At this stage, relatively more affluent residents move out, threatening neighborhood stability and leading to further disinvestment in residential properties (Sternlieb et al., 1974).

In addition, abandoned properties lower residential satisfaction with the neighborhood, thereby triggering residents' decisions to move out, and eventually threatening neighborhood stability. The residential mobility theory argues that when a household is not satisfied with the characteristics of the house or neighborhood, the household undergoes stress (Quercia & Rohe, 1993). When the stress level becomes too strong, the household chooses to move to another unit or neighborhood. If a household finds the neighborhood condition satisfactory but not the house itself, then the household is likely to remain and improve their housing condition. However, if the household is not satisfied with the neighborhood condition, they are more likely to move out of the neighborhood (Quercia & Rohe, 1993). As for empirical evidence, Ahlbrandt and Cunningham (1979) in their study provided evidence that low satisfaction with neighborhood condition threatens the stability of neighborhood population. Their study found that factors affecting a household's decision to move include neighborhood physical condition and satisfaction with the dwelling unit.

Financial Burden on Local Governments

Abandoned properties impose financial burden on local governments. An abandoned house is a waste of a housing resource. But the problem is not confined to the property alone; abandonment harms local governments and neighborhoods. Housing abandonment means lost tax revenue for local governments, and lost revenue for the local economy as a whole. Furthermore, abandoned properties increase costs for local governments that must expend resources to inspect, secure (locks, boarding up doors and windows), and even demolish abandoned properties that pose health or safety hazards (U.S. Government Accoutability Office, 2011). The United States Government Accounting Office's November 2011 report on vacant properties stated that Chicago City spent about $875,000 to board up 627 properties in 2010 whereas Detroit City spent $1.4 million to board up about 6,000 properties in the same year (U.S. Government Accoutability Office, 2011). Baltimore City spends $2 million per year on boarding up and cleaning (U.S. Government Accoutability Office, 2011). Abandoned properties require additional police and fire services. In 2008, Baltimore City undertook a detailed study on the cost of police and fire services associated with vacant properties. The study found that the cost of police and fire services per block showed an annual increase of $1,472 for each vacant property (U.S. Government Accoutability Office, 2011; Winthrop & Herr, 2009).

4. Questions Still Remain: Limitations of Prior Research

Despite the extent and the impacts of the housing abandonment problem, research on housing abandonment and the development of effective policies to address abandonment has been limited. Traditionally, abandonment has been viewed as an indicator of market failure, a symptom

of urban disinvestment, or the result of a neighborhood's life cycle, instead of being viewed as a problem itself (Accordino & Johnson, 2000). This view led to a lack of interest among urban researchers and policymakers whereas it provided justification for them to focus on policies to stimulate market demand and urban investment rather than directly address the abandoned property problem (Accordino & Johnson, 2000). Although the recent foreclosure crisis led to increased interest in research on housing abandonment, there is still very limited research and empirical evidence on the relationship between housing abandonment and neighborhood decline.

Shortcomings of Prior Research

Past researches that estimated the impact of abandoned properties on nearby property values did not isolate the impact of abandoned properties sans foreclosure. Many vacancies are related to mortgage foreclosures, especially in recent years, and numerous studies have shown that foreclosures have substantial impacts on nearby property values (Immergluck & Smith, 2006a; Lin, Rosenblatt, & Yao, 2009; Rogers, 2010; Schuetz, Been, & Ellen, 2008; Simons, Quercia, & Levin, 1998). Therefore, without controlling for foreclosures, it may be difficult to measure the impact of only abandonment on nearby property values.

Most past researchers estimated the impact of abandonment on nearby property values through cross-sectional analysis. These studies assumed that the markets have already fully captured information about nearby abandonment and that the impact of abandonment is fully reflected in nearby property prices. However, studies have shown that it often takes some time for such information and its impact to be fully diffused into a market price (Kilpatrick, 2006; Simons, Estimating Proximate Property Damage from PCB Contamination in a Rural Market: A Market Technique Approach, 2002). Thus, prior studies have not been able to control for preexisting information such as prior abandonment. Without such controls, the estimated impact of

abandonment on nearby property values could simply mean that abandonment occurs in areas with relatively lower-valued properties. And it becomes unclear whether nearby abandoned properties caused a decline in nearby property values, or whether a general decline in property values caused properties to be abandoned in the area.

Past research demonstrated that the impact of abandoned property on nearby property values decreases as the distance between them increases. However, no research has examined how the duration of property abandonment influences nearby property values. Scholars argue that the mechanism by which a distressed property influences nearby property values is largely visual. Then, it is plausible to assume that the impact of recently abandoned properties may not be same as the impact of properties that have been unmaintained for a much longer time.

Most prior research examining the impact of distressed properties – foreclosures or vacant/abandoned properties – on nearby property values assumed that each additional distressed property had the same effect on nearby property value as the prior distressed property. That is, these studies assumed that the impact of distressed properties was linear. These studies used linear least squares to measure the impact of a distressed property on nearby property values. However, some of the studies did find evidence suggesting that the impact of distressed properties on nearby property values is nonlinear. They found that the magnitude of impact of distressed properties on nearby property values did not increase proportionally to the number of distressed properties. Yet, there were very limited attempts to explore the possible nonlinearity of the impact of distressed properties in planning literature.

If the impact of housing abandonment is indeed nonlinear, are there threshold effects in the impact of housing abandonment on nearby property values? In planning literature, there are theories and empirical evidence documenting threshold effects in the dynamics of neighborhood

change. Yet, no studies investigated the existence of threshold effects in the impact of distressed properties including foreclosures and vacant/abandoned properties. If threshold effects exist in the impact of housing abandonment on nearby property values, what would be those threshold values? How would the impact of housing abandonment on nearby property values change when the number of abandoned properties exceeds those threshold values?

Finally, past research has not thoroughly examined whether the impact of foreclosed or vacant or abandoned properties on nearby property values would vary among different neighborhoods. Neighborhoods are not homogenous; each neighborhood has distinct geographic, demographic, and social characteristics. And housing abandonment is often disproportionally distributed, and grows at different rates across the city. There are a number of theories and empirical studies that explain why there is variability in the rate of housing abandonment across neighborhoods. Then, it is plausible that as the rate of housing abandonment differs among neighborhood types, the magnitude of impact of housing abandonment on nearby property values may differ. If so, what accounts for such variability? What neighborhood characteristics mitigate or exacerbate the impact of abandoned properties on nearby property values?

5. Objectives of this Research and Overview of Three Studies

Research Objective and Questions

Despite the prevalence of the housing abandonment problem, there is limited research on the impact of housing abandonment. The previous section on the limitations of past research shows the need for additional research. Therefore, this research attempts to extend the current level of understanding of the impact of housing abandonment on nearby property values in two ways: i)

providing empirical findings on areas that have not been addressed by previous research; and ii) employing analytical models that represent methodological improvements over previous research to yield more accurate measurements of the impact of housing abandonment.

To achieve this objective, this research addresses the following three major research questions:

1. What is the impact of housing abandonment on nearby property values?

    1) Does the impact of abandoned property on nearby property values differ depending on the distance between an abandoned property and nearby property? If so, how?

    2) Does the impact of abandoned property on nearby property values differ depending on how long the property has been abandoned? If so, how?

2. Are there threshold effects in the impact of housing abandonment on nearby property values?

    1) Does the impact of housing abandonment on nearby property values experience an abrupt change in magnitude when the number of nearby abandoned properties reaches some critical point?

    2) Is there a second threshold in the number of abandoned properties beyond which nearby property values do not drop dramatically?

3. Does the impact of housing abandonment on nearby property values vary among different neighborhoods? And if there exists variability in the degree of impact of housing abandonment among different neighborhoods, what neighborhood characteristics explain such variability?

1) Is a neighborhood with a relatively high level of neighborhood-level social organization more resilient than a neighborhood with a relatively low level?

2) Is a neighborhood with a relatively high level of concentrated disadvantage less resilient than a neighborhood with a relatively low level?

Each of the questions is addressed in one of the three papers that constitute the body of this dissertation.

Research Site and Data

To answer the above research questions, I conduct an empirical study of housing abandonment and its impact on nearby property values in Baltimore, Maryland, between 1991 and 2010. Baltimore was selected as a study area because the city has been grappling with property abandonment for decades. Baltimore's abandonment has two major drivers: economic decline and population loss (Cohen, 2001). Historically, Baltimore was a home to a vibrant manufacturing and shipping industry (EIR Economics Staff, 2006). In the late 1950s, Baltimore was the sixth-largest city in the U.S. and supported the region with more than 75% of its jobs, more than 34% of which were in manufacturing (Levine, 2000). However, the deindustrialization that began in the 1960s caused a large decline in the manufacturing industry. Between 1950 and 1995, Baltimore lost more than 100,000 manufacturing jobs, representing 75% of its industrial employment (Levine, 2000). As the manufacturing jobs disappeared, the city's population declined. According to the U.S. Census, after reaching its peak population of 949,708 in 1950, Baltimore continued to lose population at an average rate of 7% per decade, reaching a population of 620,961 in 2010 – a loss of about one-third

since 1950[4]. This loss of population and jobs has resulted in a large amount of vacant, abandoned, and underutilized residential and commercial property in the city.

Although there is no generally agreed upon definition of abandonment, Baltimore City defines a property as *abandoned* if it is boarded up, or if it is unboarded but the conditions are unlivable and severely dilapidated, regardless of the property's status with mortgage or tax delinquencies. Baltimore City considers a property simply *unoccupied* if it is livable and uninhabited (Harding, Rosenblatt, & Yao, The Contagion Effect of Foreclosed Properties, 2009). According to Baltimore City's vacancy data, there were 16,850 abandoned residential properties as of 2010, compared to 5,925 in 1991 – an increase of more than 10,000 in just two decades.[5]

Furthermore, housing abandonment is disproportionally distributed in Baltimore City. Abandoned properties are often concentrated in low-income, minority neighborhoods. Baltimore City has adapted various approaches to address housing abandonment problems. One of the common strategies is to acquire and rehabilitate abandoned properties, often using federal funds (U.S. Government Accoutability Office, 2011). Demolition and infill development and adaptive reuse were other approaches Baltimore City adapted to address severely blighted properties. Most recently, Baltimore City began to focus on abandoned properties in emerging market areas or near large public investments or the city's major amenities in order to generate interest among private developers in rehabilitating nearby abandoned properties (U.S. Government Accoutability Office, 2011).

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[4] Source: 1) U.S. Census Bureau. (2010). 2010 Census Summary File 1, Table DP-1. Retrieved from http://factfinder2.census.gov. 2) U.S. Census Bureau. (2010). Population of the 100 Largest Urban Places:1950. Internet Release Date: June 15, 1998. Retrieved from http://www.census.gov/population/www/documentation/twps0027/tab18.txt.

[5] Source: The Vacant House File 1991 -2010, the Baltimore City Department of Housing and Community Development. This database contains the list of properties with outstanding Vacant House Notice, identified as abandoned by the city's Code Enforcement Office. This database is updated monthly.

However, there have been several factors that have complicated the city's efforts to address its abandoned housing problem including: the need for more comprehensive approach that addresses both causes and impacts of housing abandonment; the financial cost of taking a comprehensive approach; the difficulty of reaching consensus on the optimal strategy in a given area; and limited administrative and the financial resources for acquisition and demolition of abandoned properties (Cohen, 2001). Since the early 1990's, Baltimore City has concentrated on improvements and investments in areas surrounding the downtown, which has helped to attract visitors and generated high-end residential development in those areas. During this time however, conditions of blight and deterioration in many other Baltimore neighborhoods were worsening (Kromer, 2002).

To conduct this research, the following data were obtained for the study period (1991 to 2010). The residential property sales data and abandoned property data were obtained from the Baltimore City Department of Housing and Community Development. To identify the foreclosed residential properties, the foreclosure filing case numbers were first obtained from the Circuit Court of Baltimore City. Using scripting tools, the address of each property and the initial filing dates for each case were scraped from the Maryland Judiciary Case Search web portal. GIS data was downloaded from the Baltimore City website to identify the locations of all abandoned properties, sold residential properties, and foreclosed properties. Finally, a range of Baltimore neighborhood characteristics were obtained from sources including U.S. Census, Baltimore City Department of Planning, Baltimore neighborhood Indicators Alliance – Jacob France Institute, and Baltimore City Police Department.

Research Analytical Methods

Existing research on housing abandonment has employed two major empirical models to estimate the spillover effects of distressed properties on nearby property values: a hedonic price model and a repeat sales approach. Most prior studies estimated the impact of distressed properties on nearby property values using cross-sectional hedonic price models. This dissertation uses a weighted repeat sales approach to construct a model to estimate the impact of housing abandonment on nearby property values. In simple term, the repeat sales method is a means of calculating average price changes in repeat sales on the same properties. Scholars argue that a repeat sales approach substantially reduces the omitted variable bias problem of hedonic price models (Harding, Rosenblatt, & Yao, The Contagion Effect of Foreclosed Properties, 2009). The repeat sales approach is also better suited to estimate the separate effects of the overall market trend and the impact of distressed properties (Harding, Rosenblatt, & Yao, The Contagion Effect of Foreclosed Properties, 2009). This research also uses a longitudinal dataset and estimates the impact of housing abandonment while controlling for nearby foreclosures and local market trend.

The statistical analysis employs a piecewise linear regression model with spline functions to explore threshold effects in the impact of housing abandonment. This statistical technique is effective in modeling thresholds and is commonly used for nonparametric data analysis. I hypothesize that the amount of housing abandonment has a linear effect on nearby property values over a certain range of values, but a different linear effect over a different range. Piecewise linear regression models with spline functions provide a means for conducting this analysis. Since there is no theory to guide the locations of threshold values, a nonlinear estimation method (nonlinear least squares) is used to estimate the location and the regression function (slopes and levels) simultaneously.

To assess how the impact of housing abandonment changes in neighborhoods with different characteristics over time, I use longitudinal data (2001 to 2010) and use latent growth curve modeling which is particularly effective in investigating changes over time. Latent growth curve modeling allows us to examine the process of change, the nature of change over time, and what may explain the change. Specifically, latent growth curve modeling allows us to examine the initial level of the impact of housing abandonment at neighborhood level and the shape and rates of the change in the magnitude of impact of housing abandonment at neighborhood level over time. In addition, time-varying covariates (which may account for variability in the magnitude of impact among neighborhoods) can be incorporated to explain neighborhood-level variability over time.

6. Implications of the Research: Scholarly Contribution and Policy Implications

This research hopes to contribute to current literature on the spillover effects of distressed properties on nearby property values in two ways. First by employing more rigorous analytical methods, it attempts to estimate the impact of housing abandonment on nearby property values more accurately than earlier research. Most previous research used cross-sectional, hedonic price models to estimate the impact of distressed properties on nearby property values. These studies have not been able to control for local market trends or preexisting information (previous housing abandonment or foreclosures, for example). Consequently, it is unclear whether distressed properties caused a decline in nearby property values, or whether a general decline in property value resulted in distressed properties in the area. Studies that estimated the impact of housing abandonment also did not control for nearby foreclosures. Therefore, this research used 20-year longitudinal data sets while simultaneously controlling for both nearby foreclosures and local housing market trends. This research estimates the impact of housing abandonment using a

weighted repeat sales methodology that substantially reduces the major problem of hedonic price models and is better suited to estimate the impact of distressed properties and the effect of the overall market trend separately.

Second, this research hopes to contribute to current literature discussing the impact of distressed properties by providing empirical findings in areas not addressed by previous research. This research examines how the duration of abandonment influences the magnitude of impact on nearby property values. This research explores the nonlinearity of the impact of housing abandonment to look for thresholds in the impact of housing abandonment. Lastly, this research examines whether the magnitude of impact of housing abandonment varies among neighborhoods and, if so, what neighborhood characteristics may explain such variability.

Turning to the policy implications of this research, prior research on foreclosures and vacancies suggested that an increasing number of distressed properties has an adverse effect on neighborhood quality, including weakening the local housing market and increasing neighborhood crime rates, and that the effects are amplified in poor neighborhoods and where distressed properties are densely concentrated (Joice, 2011). These findings provided a justification for policymakers to develop government initiatives in recent years to prevent foreclosures and vacancies and attempt to mitigate the problems of foreclosed and vacant/abandoned properties (Frame, 2010). The U.S. Congress established the Neighborhood Stabilization Program (NSP) in 2008 to assist local governments in addressing the problems of foreclosed and abandoned residential properties. Specifically, NSP helps purchase, rehab, or demolish foreclosed and abandoned properties (Joice, 2011). However, while local governments agree that NSP is very beneficial, the funds are typically insufficient given the rapidly increasing volume of foreclosed and abandoned properties (U.S. Government Accoutability Office, 2011). The methods prescribed by NSP for

acquisition, rehabilitation, and demolition of distressed properties also proved to be very difficult and expensive (U.S. Government Accoutability Office, 2011). For most cities with large-scale housing abandonment and foreclosure crises, government resources are often not enough to adequately address all of their distressed properties.

Therefore, local governments need to be strategic in their decision to target limited resources (Thomson, 2011). Concentrating resources in limited geographic areas to enhance the impact of public intervention, commonly known as strategic geographic targeting, has become an increasingly popular tool for local governments (Thomson, 2011). This research hopes to provide findings that would help governments in their decisions about where and how to allocate their limited resources and to maximize the effectiveness of government interventions and investments.

In particular, an understanding how the duration of abandonment influences the magnitude of the impact of housing abandonment would help governments identify properties to target for immediate intervention. Similarly, an understanding of threshold effects – how the marginal impact of abandoned properties on nearby property values in the neighborhood changes as the number of nearby abandoned properties increases – will serve as guideposts for strategic geographic targeting for governments. If the magnitude of impact of abandoned properties increases dramatically past a certain threshold, then it would be beneficial for local governments to target their resources to areas that are close to reaching that threshold. Finally, understanding what neighborhood characteristics mitigate or exacerbate the negative impact of housing abandonment would guide governments to develop more effective strategies in providing government services in general.

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PAPER 1:

THE IMPACT OF ABANDONED PROPERTIES ON NEARBY PROPERTY VALUES

1. Introduction

Although the ongoing mortgage crisis has brought heightened awareness to foreclosed and abandoned properties nationwide, the problem of housing abandonment is not new. Long before the current mortgage crisis, many large metropolitan areas were grappling with the problems of housing abandonment and neighborhood decline (U.S. General Accounting Office, 1979). This problem, however, is no longer confined to older cities but is spreading to small towns and suburbs across the country, as a result of the recent foreclosure crisis. Many recently abandoned properties are a result of foreclosures, particularly in new suburban developments that have an excess housing supply and in weak housing market areas (Kingsley, Smith, & Price, 2009).

An abandoned property represents a waste of a housing resource. Furthermore, scholars argue that housing abandonment can contribute to neighborhood decline by lowering property values and increasing crime rates (Goetz, Cooper, Thiele, & Lam, 1998; Keenan, Lowe, & Spencer, 1999; Shlay & Whitman, 2006; Skogan, 1990; Spelman, 1993; Sternlieb & Burchell, 1973). Moreover, lowered property values generate lower property taxes. Lost tax revenues means fewer financial resources for local governments to devote to public improvement projects and maintenance in neighborhoods and business districts, which further exacerbates the problems associated with housing abandonment (Accordino & Johnson, 2000).

Despite the extent of the housing abandonment problem, research on the housing abandonment and the development of effective policies to address abandoned properties has not been at the forefront of urban research or policy making in recent years. Traditionally, abandonment has been viewed as an indicator of market failure, a symptom of urban disinvestment, or the result of a neighborhood's life cycle, instead of being viewed as a problem itself (Accordino & Johnson, 2000). This view led to a lack of interest among urban researchers and policymakers whereas it provided justification for them to focus on policies to stimulate market demand and urban investment rather than address the abandoned property problem (Accordino & Johnson, 2000). Consequently, there is a dearth of research on abandonment and very limited empirical evidence regarding the relationship between housing abandonment and neighborhood decline.

This research, therefore, attempts to extend the current level of understanding of the relationship between housing abandonment and neighborhood decline by examining the impact of abandoned residential properties on nearby property values. Specifically, using longitudinal data on housing abandonment and property values in Baltimore, Maryland from 1991 to 2010, this research examines the impact of abandoned residential properties on nearby property values, depending on how far abandoned properties are located and how long they have been abandoned. I used weighted repeat sales methodology and control for nearby foreclosures and local housing market trends.

The rest of this article is divided into five sections. I begin by defining housing abandonment and examining the extent of housing abandonment in U.S. cities. In the following section, the relevant theories and past empirical studies are discussed. After reviewing the limitations of past research, I present the research objective and research questions. The next section of this article describes the research data and methodology used to answer the research questions followed by

research findings. This article concludes with a discussion of the scholarly significance and policy implications of this research.

1.1. How Has Housing Abandonment Been Defined?

One challenge to measuring housing abandonment is the lack of a universal definition. What defines a property as abandoned is not consistent (Sternlieb, Burchel, & Paulus, 1972; Cohen, 2001) and the terms *abandoned* and *vacant* are often used interchangeably. The lack of a shared definition of property abandonment often complicates efforts by researchers or government officials to accurately measure the extent of abandoned housing (Pagano & Bowman, 2000). Cities often identify an abandoned property depending on its structural condition and the length of vacancy (Cohen, 2001). For instance, Pagano and Bowman, in their 1998 survey estimating abandoned structures in 60 U.S. cities, found that some cities consider a structure abandoned, and therefore an immediate danger to the public safety or health, if it has been unoccupied for 60 days (Cohen, 2001; Pagano & Bowman, 2000). Others use 120 or more days as a threshold (Cohen, 2001; Pagano & Bowman, 2000).

Many scholars consider neglected property ownership duties (e.g., delinquent property taxes or noncompliance with relevant codes) as an indicator of abandonment. Sternlieb, Burchell, Hughes, and James (1974) defined an abandoned building as a residential structure that the owner has removed from the housing stock by neglecting property ownership duties regarding functional, financial, and physical maintenance. Hillier, Culhane, Smith, and Tomlin (2003) stated there are three distinct aspects of abandonment: functional, financial, and physical. Functional abandonment concerns a vacant property that is not suitable for residency, such as one that lacks sealed doors and

windows. Financial abandonment happens when an owner stops meeting his or her financial responsibilities, such as making property tax or mortgage payments. Physical abandonment happens when a property is unfit for occupation because the owner neglected to maintain the inside or outside of the residence. Mallach (2006), of the Brookings Institution, considers a property abandoned if the owner has stopped carrying out at least one of the significant responsibilities of property ownership, causing a property to be vacant or likely to become vacant.

In this research, a property is considered abandoned based on its functional (i.e., inhabitable with boarded up windows and doors) and physical aspects (i.e., showing the signs of neglect). Harding, Rosenblatt, and Yao (2009) stated that the mechanism by which a distressed property influences the value of neighboring properties is largely visual, based on evidence in their empirical study measuring the contagion effect of foreclosed homes on nearby property values. Therefore, the sign of neglect is a major indicator of abandonment. Appropriately, the Baltimore City Building Code defines a property *vacant* if either (a) it is boarded up or (b) it is unboarded but the conditions are unlivable, severely dilapidated, or inadequately secured with missing doors and windows (U.S. Government Accoutability Office, 2011). Baltimore City does not consider mortgage or tax delinquencies as *vacant* and further considers a property *unoccupied* but not *vacant* if it is uninhabited but still livable (U.S. Government Accoutability Office, 2011).

1.2. What Is the Extent of Housing Abandonment in U.S. Cities?

To date there have been few attempts to count the number of abandoned properties in U.S. cities. Some federal agencies, such as the U.S. Bureau of the Census and the United States Postal Service (USPS), compile data on the number of vacant properties in the United States. Decennial

census data identify a unit as vacant if no one is living in it at the time of the survey (U.S. Government Accoutability Office, 2011). The USPS defines a vacant address if mail has not been deliverable for 90 days or longer (U.S. Government Accoutability Office, 2011). However, it is difficult to use these data to identify unoccupied property that is unsafe or unfit for human habitation or other authorized uses (U.S. Government Accoutability Office, 2011). The primary difficulty stems from the lack of accurate methods to identify abandonment. For example, simple exterior inspection methods may not be sufficient to identify actual vacant or abandoned properties (U.S. Government Accoutability Office, 2011). However, on the basis of USPS Vacancy data, as of December 31, 2011, 3.25% of the 140 million residential addresses in the United States, totaling 4,556,257 addresses, were identified by the USPS as having been *vacant*.[1] And 73.09% of these 4.56 million vacant residential addresses were identified as having been *vacant* for over 12 months or longer.[2] By contrast, the U.S. Census Bureau reports a higher vacancy rate for the same year; according to the 2011 American Housing Survey, there were 10,339,140 nonseasonal vacant housing units in 2011, accounting for roughly 7.85% of U.S. housing stock.[3]

Furthermore, estimates of abandoned properties in U.S. cities vary among studies or across jurisdictions. This is mainly because there is no standardized definition of property abandonment. For instance, Cohen (2001) reported that the number of abandoned housing units in Baltimore is between 12,700 and 42,481; the low number is the city's recent count of vacant units unfit for habitation, whereas the high number is vacant units from Census 2000. The lack of a shared definition of property abandonment often complicates efforts for researchers or government

[1] Source: HUD Aggregated USPS Administrative Data on Address Vacancies, Quarter 4 ending December 31, 2011, <http://www.huduser.org/portal/usps/home.html>

[2] Same as note 1.

[3] Source: 2011 American Housing Survey, <http://www.census.gov/housing/ahs/data/national.html>

officials trying to accurately measure the extent of abandoned housing (Pagano & Bowman, 2000). Furthermore, counting abandoned properties is not an easy task. Properties often turn over rapidly and tracking abandoned properties requires a substantial amount of resources and efforts (Pagano & Bowman, 2000).

Although there has not yet been a nationwide attempt to systematically count and track the number of abandoned properties, a number of studies illustrate the extent of the housing abandonment problem. As early as in 1967, Sternlieb and Indik surveyed Newark, New Jersey, and found that 6.74% of the housing units were vacant (Sternlieb & Indik, 1969). The 1979 Comptroller General's Report to the Congress reported that 113 large U.S. cities had housing abandonment problems to some degree; 55 of these cities acknowledged substantial to moderate housing abandonment problems (U.S. General Accounting Office, 1979). This report examined three cities – Philadelphia, Pennsylvania; St. Louis, Missouri; and Detroit, Michigan – in more detail and reported that as of 1977, Philadelphia had 21,214 abandoned residential structures and St. Louis had 2,738 and as of 1976, Detroit had 11,684 (U.S. General Accounting Office, 1979).

More recently, Mallach (2006), using 2000 U.S. Census Bureau data, estimated an average of about 10,000 abandoned residential properties per city in 19 cities with populations over 100,000. Another survey by Pagano and Bowman (2000) at the Brookings Institution in 2000 found an average of 2.63 abandoned structures for every 1,000 residents in 60 U.S. cities with populations over 100,000. The cities in the Northeast region reported the highest average number of abandoned structures per 1,000 residents: 7.47 (Pagano & Bowman, 2000). The high average for the Northeast is caused by a few cities with exceptional statistics: Philadelphia with 36.5 abandoned structures per 1,000 residents, and Baltimore with 22.2 abandoned structures per 1,000 residents, for example (Pagano & Bowman, 2000). A newspaper article in 2002 reported more than 15,000 abandoned

properties in Detroit even though the city had already demolished more than 28,000 houses since 1989-1990 (Wilgoren, 2002).

The housing abandonment problem is not limited to large cities; many smaller cities and towns across the United States – such as Dayton Ohio, Durham North Carolina, Cleveland Ohio, and Flint Michigan – are grappling with this problem (Mallach, 2006). The current mortgage foreclosure crisis is exacerbating this problem: housing abandonment is no longer confined to older, low-income neighborhoods, but is spreading to middle-class neighborhoods. The latest Mortgage Bankers Association's delinquency survey data reported that 13.52% of mortgage loans were either delinquent or in the foreclosure process in the third quarter of 2010, which translates to 6.75 million mortgages delinquent or in foreclosure (Mortgage Bankers Association, 2010). Plus, whereas news about the mortgage crisis often focuses on cities and suburbs, research by the Housing Assistance Council found that foreclosures are at least as prevalent in small towns and rural areas as in cities (Housing Assistance Council, 2009). As home foreclosures continue to spread across the country, this would likely increase the number of abandoned properties, because foreclosures can lead to abandoned properties (Immergluck, 2006). Researchers argue that lengthy and complex foreclosure processes lead to prolonged periods of vacancy, which allow for greater chances of vandalism and of the property falling into disrepair (Immergluck, 2006). Plus, very high foreclosure costs increase the instances in which lenders *walk away* from properties that are of marginal value, which in turn leads to vacancy and abandonment (Apgar, Duda, & Gorey, 2005; Immergluck, 2006).

1.3. Why Is Housing Abandonment a Problem?

An abandoned house is a waste of a housing resource. But the problem is not confined to the property alone; abandonment harms local governments and neighborhoods. Abandoned properties can increase costs for local governments that must expend resources to inspect, secure (e.g., install locks and board up doors and windows), and even demolish abandoned properties that pose health or safety hazards (U.S. Government Accoutability Office, 2011). For instance, the U.S. Government Accounting Office's November 2011 report on vacant properties stated that Chicago City spent about $875,000 to board up 627 properties in 2010, whereas Detroit City spent $1.4 million to board up about 6,000 properties in the same year (U.S. Government Accoutability Office, 2011). Baltimore City spends 2 million per year for boarding up and cleaning (U.S. Government Accoutability Office, 2011). In addition, abandoned properties require additional police and fire services. In 2008, Baltimore City undertook a detailed study on the cost of police and fire services associated with vacant properties. The study found that the cost of police and fire services per block showed an annual increase of $1,472 for each vacant property (Winthrop & Herr, 2009; U.S. Government Accoutability Office, 2011). Besides placing an increased financial burden on local governments, scholars argue that abandoned properties contribute to neighborhood decline by lowering property values and increasing crime rates.

Impact on neighborhood crime

Scholars have long agreed that disorder – either physical or social – undermines neighborhood stability and plays a significant role in neighborhood decline (Sampson & Raudenbush, 1999; Skogan, 1990). Social disorganization theory focuses on the relationship between

neighborhood social structure, social control, and crime. Scholars of this theory have found a consistent relationship between urban crime and social disorder as measured by the presence of public intoxication, loitering, or selling drugs (Sampson & Raudenbush, 1999). They also have found a consistent relationship between urban crime and physical disorder as measured by the presence of abandoned cars, graffiti, or litter (Sampson & Raudenbush, 1999). Skogan (1990) also argues that physical disorder, such as abandoned properties, not only raises fear of crime among neighborhood residents but also may cause an actual increase in serious crime.

Much of the interest in disorder has stemmed from Wilson and Kelling's broken windows theory. Increased physical incivilities and lack of social control attract more potential offenders to the neighborhood (Wilson & Kelling, 1982). However, general studies show that the direct link between disorder and crime may not be as strong as the broken window theory would suggest, and that disorder may be predicted by the same characteristics as crime itself (Sampson, Morenoff, & Gannon-Rowley, 2002). For example, more recently a number of studies challenged Wilson and Kelling's broken windows theory, arguing that their research found no significant evidence to support broken windows theory (Harcourt & Ludwig, 2006). Taylor (2001), in his longitudinal study on the relationship between disorder and crime or fear of crime in Baltimore neighborhoods, found that although observed disorder generally predicts several violent crimes, there are other stronger predictors for change in crime (e.g., neighborhood exchange value, home ownership, and racial composition).

A few studies have explored the impact of abandoned properties on crime. Spelman (1993) examined 59 abandoned residential properties in a low-income neighborhood in Austin, Texas. Of these buildings, he found that 34% were being used for illegal activities, and of the 41% of abandoned buildings that were unsecured, some 83% were being used for illegal activities. This

study also found that the crime rates on blocks with unsecured abandoned buildings were twice as high as the rates on matched blocks with secured abandoned buildings. Another study on the relationship among foreclosure, vacancy, and crime in Pittsburgh, Pennsylvania, by Cui (2010) also found that violent crime increases by more than 15% when foreclosed homes become vacant. Immergluck and Smith (2006b), who examined the relationship between neighborhood foreclosures and crime, found that higher foreclosure levels contribute to higher levels of violent crime; approximately 2.8 foreclosures per 100 owner-occupied properties in one year leads to an approximately 6.7% increase in neighborhood crime.

Threatening neighborhood stability

A neighborhood is stable when its key characteristics remain stable, balancing inflows with outflows, such as when the population is replaced by a similar population and when physical decline is replaced by repairs, maintenance, and renovations (Downs, 1981). Therefore, neighborhood stability requires the constant inflows of similar population and of investment. Housing abandonment can threaten neighborhood stability. For instance, Sternlieb et al. (1974) explained that when landlords invest less on their aging properties because of increased maintenance costs and lowered rents or housing prices as a result of increased housing supply on suburb, these aging properties deteriorate further and can no longer attract similar households. As properties decay further, neighborhoods decline, and some of worst structures end up abandoned. At this stage, relatively more affluent residents move out, threatening neighborhood stability and leading to further disinvestment in residential properties (Sternlieb et al., 1974).

In addition, abandoned properties lower residential satisfaction with the neighborhood, thereby triggering residents' decisions to move out, and eventually threatening neighborhood stability. The residential mobility theory argues that when a household is not satisfied with the characteristics of the house or neighborhood, the household undergoes stress (Quercia & Rohe, 1993). When the stress level becomes too strong, the household chooses to move to another unit or neighborhood. If a household finds the neighborhood condition satisfactory but not the house itself, then the household is likely to remain and improve their housing condition. However, if the household is not satisfied with the neighborhood condition, they are more likely to move out of the neighborhood (Quercia & Rohe, 1993). As for empirical evidence, Ahlbrandt and Cunningham (1979) in their study provided evidence that low satisfaction with neighborhood condition threatens the stability of neighborhood population. Their study found that factors affecting a household's decision to move include neighborhood physical condition and satisfaction with the dwelling unit.

Impact on housing market

Skogan (1990) argued that the increased level of crime because of neighborhood physical disorder (e.g., abandoned properties) threatens housing prices and leads to further disinvestment. Skogan stated that increased fear of safety discourages commercial and residential investments, thereby affecting the neighborhood upkeep and property values. All of these undermine residential satisfaction, causing residents to move out, and not only threatening the neighborhood stability but also leading to further disinvestment threatening the housing market (Skogan, 1990).

In fact, studies found that abandonment affects other properties within a neighborhood by lowering property values (Griswold & Norris, 2007; Mikelbank, 2008; Shlay & Whitman, 2006). Shlay

and Whitman, for example, examined the impact of vacant housing units on nearby property values in Philadelphia and found that the presence of a vacant property on a block reduces the value of all the other property by an average of $6,720. This study also estimated the net impact of distance from an abandoned house on nearby properties' sales prices and found that housing closer to abandoned properties had lower prices than property located farther away. For instance, at less than 150 ft. from an abandoned property, houses experienced a net loss of value of $7,627 while the properties located between 300 to 449 ft. from an abandoned house experienced a net loss of value of $3,542.

In another study, Mikelbank (2008) examined the impact of both foreclosures and vacant/abandoned properties in Columbus, Ohio, in 2006, and concluded that for a property located near foreclosed and vacant/abandoned properties, the price value is reduced by an average of $8,600 – $4,256 by foreclosed properties and $4,411 by vacant/abandoned properties. Furthermore, this study found that the effects of vacant/abandoned properties are more concentrated than the effects of foreclosed properties; the impact of vacant/abandoned properties on a nearby property is more severe in magnitude within 500 ft. but is insignificant beyond 500 ft. whereas the impact of foreclosed properties is less severe in magnitude but is significant out to 1,000 ft. (Mikelbank, 2008).

Griswold and Norris (2007), in their study of Flint, Michigan, also found that an additional abandoned structure within 500 ft. would reduce the sale price of a property by 2.27%. This study also found that the farther the abandoned property is located, the lower the impact of an additional abandoned structure on nearby property value.

1.4. Why Does It Need Scholarly Attention?

Policy implications

For decades, housing abandonment has been a chronic problem in many U.S. cities, despite efforts to address it. It is inevitable that the recent foreclosure crisis would not only exacerbate the problem but also spread the housing abandonment to small towns and suburbs. Lack of scholarly interest among researchers on this problem has led to limited understanding of how housing abandonment impacts our neighborhoods. Policymakers have been formulating policies that treat housing abandonment as a symptom rather than a problem itself, leading to massive demolition and revitalization programs (Accordino & Johnson, 2000; Blake & Hersh, 2003; Cohen, 2001).

Massive demolition and revitalization programs were also the major approaches Baltimore adopted to deal with its abandoned properties; the city tried demolishing many of its worst structures, refurbishing abandoned properties, raffling the property for $1, and seizing abandoned properties to sell off city-owned properties. Moreover, demolishing abandoned properties is very expensive in Baltimore City, because most abandoned properties are row houses (U.S. Government Accoutability Office, 2011). Despite these efforts, the number of abandoned houses still continues to rise, and the neighborhoods blighted by abandoned properties continue to experience decline (Blake & Hersh, 2003; Cohen, 2001).

More recently Baltimore City is focusing its limited resources on rehabilitating houses in neighborhoods with stronger housing markets to maximize the investments. For example, Baltimore City's "Vacants to Value" campaign targets the areas near to redevelopment projects in order to generate private developers' interest in rehabilitating some of the blocks (U.S. Government Accoutability Office, 2011). With often-constrained government resources, strategically geographic

targeting is necessary, not just for Baltimore but for other cities with a large stock of abandoned properties. Therefore, in order to increase the potential for maximizing government interventions and investments, this research seeks to provide insights regarding which abandoned properties or areas with specific types of abandoned properties the government should concentrate its limited resources on.

Scholarly Contribution

Though there is limited research on the relationship between housing abandonment and neighborhood decline, past studies have demonstrated that housing abandonment does lower nearby property values (Griswold & Norris, 2007; Mikelbank, 2008; Shlay & Whitman, 2006). However, most past research have some limitations. First, earlier researchers did not isolate the effects of abandoned properties sans foreclosure. Many vacancies are related to mortgage foreclosures, especially in recent years, and numerous studies have shown that foreclosures have substantial impacts on nearby property values (Immergluck & Smith, 2006a; Lin, Rosenblatt, & Yao, 2009; Rogers, 2010; Schuetz, Been, & Ellen, 2008; Simons, Quercia, & Levin, 1998). Therefore, without controlling for foreclosures, it may be difficult to measure the impact of only abandonment on nearby property values. Plus, most past researchers estimated the impact of abandonment on nearby property values through cross-sectional analysis. These studies, therefore, assumed that the markets have already fully captured information about nearby abandonment and that the impact of abandonment is fully reflected in nearby property prices. However, studies have shown that it often takes some time for such information and its impact to be fully diffused into a market price (Kilpatrick, 2006; Simons, Estimating Proximate Property Damage from PCB Contamination in a Rural Market: A Market Technique Approach, 2002). Thus, these studies have not been able to control for

preexisting information. Without such controls, the estimated impact of foreclosures or abandonment on nearby property values would simply mean that foreclosures and abandonment occur in areas with relatively lower-valued properties. It also becomes unclear whether nearby foreclosures caused a decline in nearby property values, or whether a general decline in property values caused foreclosures in the area.

Furthermore, past research demonstrated that the impact of abandoned property on nearby property values decreases as the distance between them increases. However, no research has examined how the duration of property abandonment influences nearby property values. Scholars argue that the mechanism by which a distressed property influences nearby property values is largely visual. Then, it is plausible to assume that the impact of recently abandoned properties may not be same as the impact of properties that have been unmaintained for a much longer time.

1.5. Research Objective and Questions

This research, therefore, has a number of major objectives. First, it attempts to contribute to current literature by providing empirical findings on areas that have not been addressed by previous research in the following ways: First, the impact of housing abandonment is examined while controlling for nearby foreclosures and local market trends; second, this study examines whether the impact of housing abandonment would differ depending not only on how far the abandoned property sits from the subject property but also on how long the property has been abandoned. Second, this research hopes to provide findings that will help policymakers develop more effective policy strategies to address the housing abandonment problem.

To achieve these research objectives, this study estimates the impact of housing abandonment on nearby property values in Baltimore, Maryland from 1991 to 2010 and attempts to answer the following research questions:

1. What is the impact of housing abandonment on nearby property value?

2. Does the impact of abandoned property on nearby property value differ depending on the distance between an abandoned property and nearby property? If so, how?

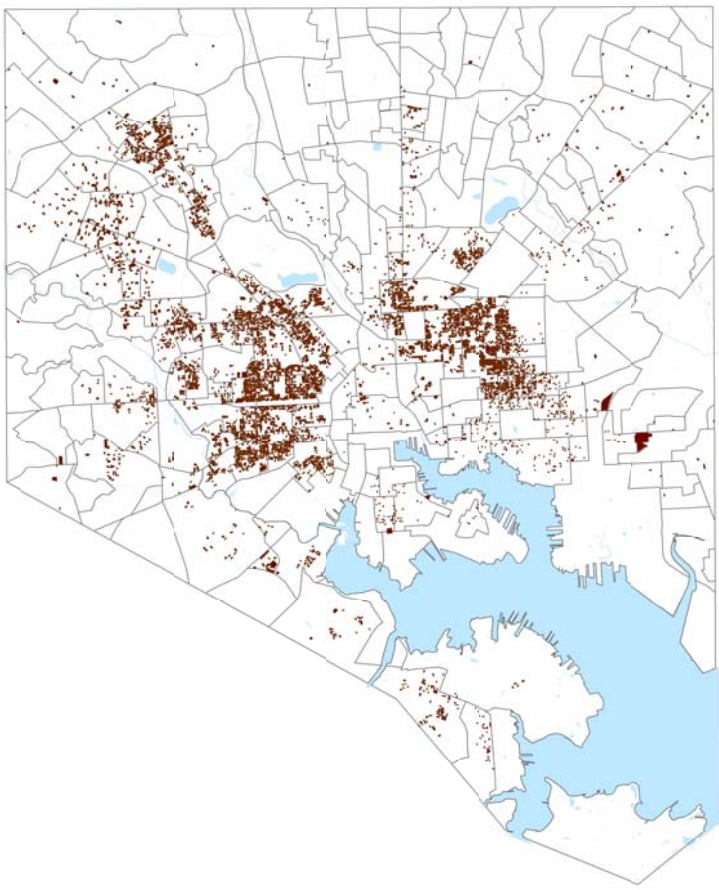
3. Does the impact of abandoned property on nearby property value differ depending on how long the property has been abandoned? If so, how?

2. Data

2.1. Housing Abandonment in Baltimore City, Maryland

To answer the above research questions, I conducted an empirical study of housing abandonment and its impact on nearby property values in Baltimore, Maryland, between 1991 and 2010. Baltimore was selected as a study area because the city has suffered from a substantial amount of housing abandonment over several decades. Since colonial times, Baltimore has been home to a leading manufacturing and shipping industry (EIR Economics Staff, 2006). By the late 1950s, Baltimore was the sixth-largest city in U.S., with a population of 949,708, and provided more than 75% of the jobs in the region, with more than 34% of the city's workforce employed in manufacturing (Levine, 2000). However, the deindustrialization of Baltimore, which began in the 1960s, caused a decline in the manufacturing industry. Between 1950 and 1995, Baltimore lost more than 100,000 manufacturing jobs, representing 75% of its industrial employment (Levine, 2000). As the manufacturing jobs disappeared, the city's population diminished. According to the U.S. Census, after reaching its peak population of 949,708 in 1950, Baltimore continued to lose its population at an average rate of 7% per decade, reaching a population of 620,961 in the year 2010 – a loss of about one-third since 1950 (U.S. Census 2010). This loss of population and jobs contributed to a large amount of vacant, abandoned, and underutilized residential and commercial properties in the city. The distribution of abandoned residential properties in Baltimore in 2010 is shown in Figure 1.

Figure 1. Distribution of abandoned residential properties in Baltimore, Maryland, 2010



Source: Compiled using the Vacant House File (1991-2010) provided by Baltimore City Department of Housing and Community Development, 2011.

Recognizing the extent of the housing abandonment problem in the city, Baltimore has been tracking abandoned properties since the early 1980s. With the recent introduction of the city's Open Notice file and CitiStat, the city compiled the detailed property database to track abandoned properties. Although there is no generally agreed upon definition of abandonment, Baltimore City defines a property as abandoned if it is boarded up, or if it is unboarded but the conditions are unlivable and severely dilapidated, or if it is unboarded or inadequately secured to prevent

unauthorized entry or use of the building by uninvited persons, regardless the property's status on mortgage or tax delinquencies. Baltimore City considers a property simply *unoccupied* if it is livable and uninhabited (U.S. Government Accoutability Office, 2011). Unoccupied properties are not calculated in the City's vacancy data (Baltimore City Department of Housing and Community Development). According to the City's vacancy data, there were 16,850 abandoned residential properties as of 2010, compared to 5,925 in 1991 – an increase of more than 10,000 in just two decades (see Table 1).

Table 1. Number of abandoned residential properties in Baltimore City from 1991 to 2010

Year	Number of Abandoned	Year	Number of Abandoned
1991	5,925	2001	13,227
1992	6,336	2002	13,830
1993	6,871	2003	15,302
1994	7,196	2004	15,807
1995	8,222	2005	16,165
1996	9,269	2006	16,936
1997	10,609	2007	16,084
1998	11,488	2008	15,981
1999	11,844	2009	16,501
2000	12,535	2010	16,850

Source: Compiled using the Vacant House File (1991-2010) provided by Baltimore City Department of Housing and Community Development, 2011.

2.2. Data Source

To estimate the impact of housing abandonment on nearby residential property values in Baltimore from 1991 to 2010, the following data were obtained. The residential property sales data and abandoned property data were obtained from Baltimore City Department of Housing and Community Development. To identify the foreclosed residential properties, the foreclosure filing

case numbers were first obtained from the Circuit Court of Baltimore City. Using scripting tools, the address of the property and the initial filing dates for each case were scraped from the Maryland Judiciary Case Search web portal. Finally, GIS data was downloaded from the Baltimore City website to identify the locations of all of the abandoned properties, sold residential properties, and foreclosed properties.

Table 2. List of data and sources

Data (Period: 1991 – 2010)	Source
Abandoned residential properties	The Vacant House File provided by Baltimore Department of Housing and Community Development
Residential property sales	Property Sales data provided by Baltimore Department of Housing and Community Development
Foreclosed residential properties	Circuit Court of Baltimore City and Maryland Judiciary Case Search website (http://casesearch.courts.state.md.us/inquiry/inquiry-index.jsp)
GIS files (parcel map, zip code map)	http://data.baltimorecity.gov/

Since the 1970s, Baltimore City has been tracking the number and geographic location of abandoned residential properties using the city's "The Vacant House File," a database ancillary to the city's real property database (Baltimore City Department of Housing and Community Development). This database contains the list of every abandoned property identified by the city's Code Enforcement Office and properties that have had an outstanding Vacant House Notice, and it is updated monthly (Baltimore City Department of Housing and Community Development). The provided data contains the parcel identification number (block and lot number), full address, the dates the Vacant House Notice was first issued and reissued, the type of structure, the tax payment status, and the lot size.

Residential property sales data was obtained from Baltimore City Department of Housing and Community Development. This data contains a list of all of the residential properties that were sold from January 1, 1991, to December 31, 2010. Each residential property sale had the following information: parcel identification (block and lot number), date of sale (transaction date), deed date, a type of transaction, full address, sales price, and LUC (land use code). Between January 1, 1991, and December 31, 2010 there were a total of 312,813 residential property transactions in Baltimore.

The Circuit Court of Baltimore City provided the list of foreclosure filing case numbers documented between January 1, 1991, and December 31, 2010. For each case number, the address of the property and the date each filing was initiated were scraped from the Baltimore City Circuit Court website. A foreclosure filing may or may not result in an actual foreclosure; the owner may be able to prevent foreclosure by becoming up-to-date on the delinquent mortgage, selling the property, or modifying the loan. This research considers every filed foreclosure case regardless of outcome. Between January 1, 1991, and December 31, 2010 there were 54,852 foreclosure filings initiated and processed in Baltimore City.

3. Methodology

3.1. Weighted Repeat Sales Methodology

I used the repeat sales methodology to estimate the impact of abandoned residential properties on the sales prices of nearby properties using longitudinal data. Most prior studies (Immergluck & Smith, 2006a; Lin et al., 2009; Rogers, 2010; Schuetz et al., 2008; Shlay & Whitman, 2006) estimated the impact of foreclosures on the sales prices of nearby properties using cross-sectional hedonic price models. However, most recently Harding et al. (2009) used the repeat sales approach using longitudinal data as an alternative estimation procedure because scholars argue that the repeat sales approach substantially reduces the general problem of hedonic price models.

The hedonic price model is based on the premise that the price of a house can be predicted from observable house characteristics. Most prior studies that estimated the impact of foreclosures or abandonment used hedonic price models by regressing house price on a set of house characteristics and measures of nearby foreclosures or abandonment as additional independent variables. However, hedonic price models do pose a challenge: It is impossible to observe and include all of the relevant characteristics in the model (Harding et al., 2009). Controlling for the overall market level is especially critical in estimating the impact of foreclosures because it is unclear whether nearby foreclosures cause a decline in nearby property sales prices or whether foreclosures are caused by a general decline in house prices (Harding et al., 2009). In addition, the coefficient estimates of the included variables in the hedonic price models are subject to omitted variable bias because it is likely that foreclosures are correlated with unobserved property and locational characteristics and especially the local market level (Harding et al., 2009). Consequently, Harding et al. (2009) proposed the repeat sales approach because it significantly reduces the omitted variable

problem of hedonic price models and is better suited to estimate the separate effects of the overall market level and the impact of nearby foreclosures.

The repeat sales model was originally derived by Bailey et al. (1963) and later by Case and Shiller (1989). It assumed that the characteristics (X_t and X_τ) and their implicit prices (β) of a property do not change between the first (τ) and second sale date (t). Additionally, it uses data on properties that have been sold at least twice and estimates price changes rather than prices themselves:

$$\ln(P_{it}) - \ln(P_{i\tau}) = \sum_{t=1}^{T} \alpha_t D_{it} - \sum_{\tau=1}^{T} \alpha_\tau D_{i\tau} + (X_{it} - X_{i\tau})\beta + (\varepsilon_{it} - \varepsilon_{i\tau}) \quad (1)$$

Because it assumes that the characteristics and their implicit prices of a property do not change between the sales, ($X_t = X_\tau$) and their implicit prices ($\beta_t = \beta_\tau$), equation 1 becomes:

$$\ln\left(\frac{P_{it}}{P_{i\tau}}\right) = \sum_{t=1}^{T} \alpha_t G_{it} + (\varepsilon_{it} - \varepsilon_{i\tau}) \quad (2)$$

where G_{it} is a time dummy equal to 1 at the second sale date, -1 at the first sale date, and 0 otherwise, and $\varepsilon_{i\tau}$ and ε_{it} are the error terms at the periods of the first and the second sale, respectively, with zero means, equal variances, and uncorrelated with each other.

Case and Shiller (1989) further expanded the original repeat sales model of Bailey et al. (1963) and proposed the time-based weighted repeat sales method. Case and Shiller argued that the variance in equation 2 might not be constant but related to the holding period between transactions. They argued that the longer the time between sales, the price changes for each house are more likely to be caused by factors other than market forces (Standard & Poor's, 2008): for example, some houses may have been well maintained, whereas others may have deteriorated. Such pricing errors

will accumulate over time. In other words, the repeat sales regression model will have heteroskedastic errors. Therefore, Case and Shiller controlled for heteroskedastic errors by weighting the repeat sales observations by a function that declines with the length of time between the transactions. This method is called three-stage generalized least squares estimation procedure. In the first stage, the repeat sales model of Bailey et al. was estimated using the ordinary least squares method. Next, the squared residuals obtained from the first stage were regressed on a constant term and the time interval between sales. In the final stage, the repeat sales were re-estimated using generalized least squares regression where the weights were inversely proportional to the fitted values of residuals obtained in the second stage (Case & Shiller, 1989). This research used this three-stage generalized least squares estimation procedure to estimate the impact of abandoned properties on nearby property values.

3.2. Repeat Sales Data Construction

Constructing accurate repeat sales data is critical to calculating the impact of abandoned property on nearby property values. Therefore, I applied three stages of filtering to Baltimore City Department of Housing and Community Development's residential property sales data. In the first stage, I extracted a list of transactions of single-family houses that were sold at least twice between January 1, 1991, and December 31, 2010, in Baltimore. After extraction, I created sales pairs while ensuring that two transactions were indeed about the same property by comparing the addresses, block lot number, size of the lot, and land use code. The repeat sales data include only true market transactions. Therefore, in the next stage, I excluded non-representative transactions like non-arm's-length transactions such as lease, gift, auction, foreclosure, straw deed, tax sales, and confirmation deed. In the final stage, I filtered the repeat sales pairs to eliminate any flipped

properties and outliers that violate the repeat sales methodology assumption that property and neighborhood characteristics have not changed between transactions. Clapp and Giacotto (1999) suggested that flipped properties refer to properties that are improved and resold after a short period of time (within one or two years). These flipped properties, therefore, have much higher price appreciation and can cause biased repeat sales index as well as other estimated coefficients. Examining Baltimore residential property sales data, transactions with less than a one-year holding period showed abnormally high price appreciation. Thus, any transactions with a holding period shorter than one year were eliminated from the dataset. Finally, outliers – properties with abnormal price increases – were identified. Abnormal price increases suggest properties that are likely altered or improved, which violates the repeat sales methodology assumption that property characteristics remain the same between transactions. In addition, such abnormal price increases might be indicative of mortgage fraud. In order to identify outliers, quarterly price appreciation was calculated for all the transactions for abnormality and less than 1% of the total remaining transactions that were identified as outliers were eliminated from the data set. After the three stages of filter, the final dataset had a total of 101,497 repeat sales pairs. The average price at the time of the initial purchase in the repeat sales pair was $79,885.14, whereas the average price at the time of the second sale was $116,338.30. The mean holding period between the transactions was 1,761 days (4.83 years).

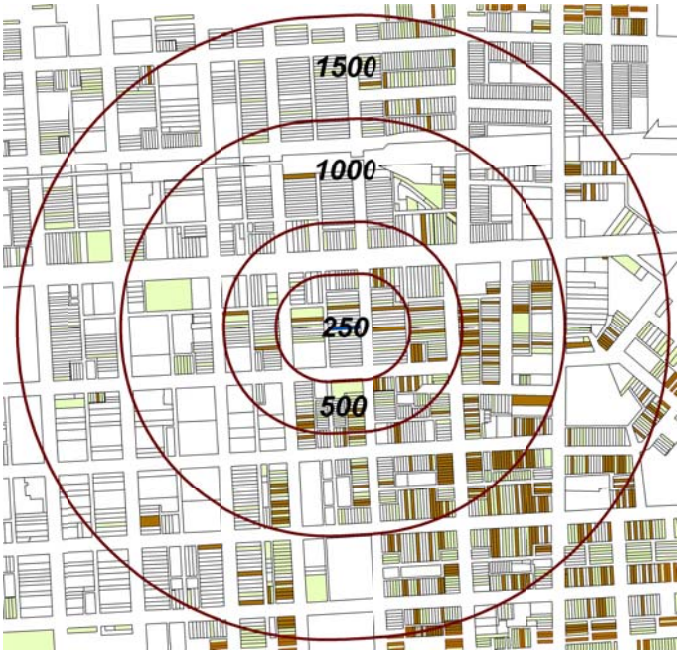
3.3. Abandoned Property Data Set Construction

This research estimates the impact of abandoned properties on nearby property values depending on two factors: (a) how long the property has been abandoned and (b) how far the abandoned property is located from the nearby subject property. Therefore, first I identified all of

the abandoned properties present at each sale date of each repeat sale pair, and then I sorted the identified abandoned properties into 3 groups depending on the duration of abandonment: properties that are abandoned for less than 1 year (P1), properties that are abandoned for longer than 1 year but less than 3 years (P2), and properties that are abandoned for longer than 3 years (P3).

In addition, on the basis of past research findings, I assumed the closer an abandoned property is located, the greater its impact on nearby property values. To confirm this assumption, the area around the subject property was divided into four concentric rings of different radii around each subject property. The radii of the rings were (a) 0-250 ft. (ring R1), (b) 251-500 ft. (ring R2), (c) 501-1,000 ft. (ring R3); (d) 1,001-1,500 ft. (ring R4). As shown in Figure 2, the innermost ring can be thought of as having abandoned properties on the same block as the subject property. The second ring can be thought of as having abandoned properties visible from the subject property. The two outer rings may not be visible from the subject property but could influence the subject price by altering a potential buyer's perception of the neighborhood.

Figure 2. Rings around the subject property (repeat sales pair)



Note: The above image is taken from an actual neighborhood in Baltimore City, Maryland. Rings are drawn around the boundary of the subject property, which is located at the center of the innermost ring. Distances are shown in feet.

The distance between each abandoned property and subject property was calculated using the Generate Near Table tool in ESRI ArcGIS software. Then, depending on the calculated distance, all of the identified abandoned properties were divided into rings R1, R2, R3, and R4

Finally, I combined both the location factor and the duration factor of abandoned properties. I sorted all of the abandoned properties in each ring into 3 different time periods: P1, P2, and P3. Therefore, in the final data set, abandoned properties are divided into 12 different groups depending on the location of the abandoned property and the duration of abandonment as shown in Table 3.

Table 3. Abandoned properties groups

	R1 (0-250 ft)	R2 (251-500ft)	R3 (501-1,000ft)	R4 (1,001-1,500ft)
P1 (≤ 1 year)	R1P1	R2P1	R3P1	R4P1
P2 (1 – 3 years)	R1P2	R2P2	R3P2	R4P2
P3 (> 3 years)	R1P3	R2P3	R3P3	R4P3

Note: For instance, R1P1 is the total number of abandoned properties that are located within 250 ft. of the subject property and have been abandoned for less than 1 year and 1 month before the nearby property sale transaction date. I assume a typical one-month delay in real estate transactions from when a buyer and seller negotiate a sales price to when they actually close the sale. The impact of abandonment happens at the time they negotiate the sales price.

3.4. Model Specification

I started with the standard repeat sales, equation 2, but expanded the equation as shown below to include both the nearby abandoned properties and the foreclosed properties.[4]

$$\ln(P_{it}) - \ln(P_{i\tau}) = \sum_{t=1}^{T} \alpha_t D_{it} - \sum_{\tau=1}^{T} \alpha_\tau D_{i\tau} + a(N_{it} - N_{i\tau}) + b(F_{it} - F_{i\tau}) + (\varepsilon_{it} - \varepsilon_{i\tau}) \qquad (3)$$

$$\ln(\frac{P_{it}}{P_{i\tau}}) = \sum_{t=1}^{T} \alpha_t G_{it} + a(N_{it} - N_{i\tau}) + b(F_{it} - F_{i\tau}) + (\varepsilon_{it} - \varepsilon_{i\tau}) \qquad (4)$$

where $P_{i\tau}$ and P_{it} equals the purchase price of a property at the first and second sale, respectively,

[4] This research paper does not control for nearby vacant lots that have increased or decreased between two sales of a nearby residential property. The repeat sales methodology used in this paper assumes that in most cases, the number of nearby vacant lots remains constant between sales, therefore the implicit prices does not change and eventually are differenced out when the model estimates the rate of price appreciation between two sales. However, it is plausible that there are cases where the number of nearby vacant lots has increased or decreased between sales. The absence of a control variable - change in the number of nearby vacant lots - in the analytical method indicates that the magnitude of the impact of abandoned properties on nearby property value may differ if a change in the number of nearby vacant lots is controlled for. However, this absence would not alter the research findings that (a) the larger the distance from the abandoned properties, the smaller the magnitude of the impact of abandoned properties on nearby property value; and (b) as the properties are abandoned a longer time, the impact on nearby property value would increase.

α_t= the overall market price level,

G_{it}= the standard matrix of indicators that identify sales dates, a time dummy equal to 1 at second sale date, -1 at the first sale date, and 0 otherwise,

N_{it} is the number of nearby abandoned residential properties present at the time of the second sale and $N_{i\tau}$ is the number of nearby abandoned residential properties present at the time of the first sale, and similarly,

F_{it} is the number of nearby foreclosed properties present at the time of the second sale and $F_{i\tau}$ is the number of nearby foreclosed properties present at the time of the first sale, and

ε_{it} and $\varepsilon_{i\tau}$ are the error terms at the periods of the first and the second sale, respectively, with zero means, equal variances, and uncorrelated with each other. The error term is assumed to be independent and identically distributed and captures pure random shocks to the transaction price.

First, I examined whether the distance between the abandoned property and the subject property influences the impact of housing abandonment on nearby property values. I expanded equation 4 to include the abandoned properties in each ring while controlling for the market level and foreclosed properties in each ring. The resulting equation to be estimated is then:

$$\ln(\frac{P_{it}}{P_{i\tau}}) = \sum_{t=1}^{T} \alpha_t \, G_{it} + \sum_{r=1}^{4} a_r \, (N_{tr}^{i} - \, N_{\tau r}^{i}) + \sum_{r=1}^{4} b_r \, (F_{tr}^{i} - \, F_{\tau r}^{i}) + \, (\varepsilon_{it} - \, \varepsilon_{i\tau}) \qquad (5)$$

Second, I examined whether the duration of housing abandonment – how long the properties have been abandoned at the time of the nearby property sale – influences the impact of housing abandonment on nearby property values. To estimate the impact of abandoned properties in each time period (P1, P2, and P3) I slightly modified equation 4 and the resulting equation to be estimated is:

$$\ln(\frac{P_{it}}{P_{i\tau}}) = \sum_{t=1}^{T} \alpha_t \, G_{it} + \sum_{p=1}^{3} a_p \, (N_{tp}^{i} - \, N_{\tau p}^{i}) + b(F_{it} - F_{i\tau}) + \, (\varepsilon_{it} - \, \varepsilon_{i\tau}) \quad (6)$$

Finally, I examined both the location and the duration of housing abandonment on nearby property values at the same time while controlling for foreclosed properties and the market level. I first sorted the total number of abandoned properties located within 1,500 ft. at each sale date of nearby property into 12 groups as shown in Table 3. Then, I estimated the impact of each of 12 groups of abandoned properties on nearby property value while controlling for foreclosed properties in each ring and the market level. The final equation to be estimated is:

$$\ln(\frac{P_{it}}{P_{i\tau}}) = \sum_{t=1}^{T} \alpha_t \, G_{it} + \sum_{p=1}^{3} \sum_{r=1}^{4} a_r \, (N_t^{ipr} - \, N_\tau^{ipr}) + \sum_{r=1}^{4} b_r \, (F_{tr}^{i} - \, F_{\tau r}^{i}) + \, (\varepsilon_{it} - \, \varepsilon_{i\tau}) \quad (7)$$

4. Results

In this section, I present the empirical results of the data analysis of the impact of abandoned properties on nearby property values. First, I present the estimated contagion effect of abandonment depending on how far abandoned properties are located. Next, I demonstrate how the duration of abandonment influences the magnitude of the impact of abandonment on nearby property values. Finally, I show how the magnitude of the impact of abandonment is affected when both the location and the duration of abandonment are taken into account. I present the findings to contend that both the location and the duration of abandonment need to be considered for more accurate assessment of the magnitude of the impact of abandonment.

4.1. Estimation of the Impact of Abandoned Properties Depending on the Location of Abandoned Properties

First, distance decay impact is examined. Table 4 presents the average change in the number of abandoned properties located in each ring between repeat sales pair transactions from 1991 to 2010. As shown in the table, there is a mean increase in the number of abandoned properties as the distance between the abandoned property and the subject property increases. This is largely due to the geometry of the rings; ring 1 covers the smallest area, whereas ring 4 covers the largest area.

Table 4. Change in abandonment between repeat sales pair transactions (1991 – 2010) in each ring (*N*=101,497)

	Mean	Minimum	Maximum
Abandoned in ring 1 (0-250 ft.)	1.72	- 40	88
Abandoned in ring 2 (251-500 ft.)	3.22	- 52	143
Abandoned in ring 3 (501-1,000 ft.)	10.09	- 92	410
Abandoned in ring 4 (1,001-1,500 ft.)	13.83	- 164	499

Now, the impact of an additional abandoned property on nearby property value in each ring is estimated using equation 5 while controlling for nearby foreclosures in each ring and the local market trend. The result is summarized in Table 5.

Table 5. Estimated contagion effect of abandoned properties in each ring (within 1,500 ft; *N*=101,497)

	Contagion effect	*t*-Statistics	*p*>|t|
Abandoned in ring 1: 0-250 ft.	- 0.872***	- 15.88	0.000
Abandoned in ring 2: 251-500 ft.	- 0.139***	- 3.58	0.000
Abandoned in ring 3: 501-1,000 ft.	- 0.047**	- 2.64	0.008
Abandoned in ring 4: 1,001-1,500 ft.	- 0.102***	- 8.75	0.000
Foreclosure in ring 1	- 1.361***	- 9.62	0.000
Foreclosure in ring 2	- 0.196*	- 2.10	0.039
Foreclosure in ring 3	- 0.303***	- 6.57	0.000
Foreclosure in ring 4	- 0.095**	- 2.86	0.004

Note: Coefficients of slopes are scaled by 100: *t*-ratios are based on robust standard errors. Regression output includes the -1, 0, 1 dummy variables from the repeat sales model as additional regressors, but coefficients on those variables are not reported here to save space. *$p < 0.1$. **$p < 0.01$. ***$p < 0.001$.

The result in Table 5 confirms the past research findings; the impact of abandoned properties on nearby property value decreases as the distance between abandoned property and subject property increases. An additional abandoned property within 250 ft. has the greatest impact on nearby property value; it reduces the nearby property value by approximately 0.87% when

nearby foreclosures and market level are held constant.[5] However, it also shows that the magnitude of the impact of abandoned properties declines dramatically when abandoned properties are located beyond 250 ft. An additional abandoned property located between 250 and 500 ft. reduces the nearby property value by 0.14%. Likewise, the property located beyond 1,000 ft. has roughly one eighth of the impact of an abandoned property located within 250 ft. when other factors are held constant.

4.2. Estimation of the Impact of Abandoned Properties Depending on How Long Properties Are Abandoned

Next, I examine whether the duration of the housing abandonment – how long the properties have been abandoned – influences the extent to which abandoned properties impact nearby property values. Table 6 shows the average change in the total number of abandoned properties within 1,500 ft. broken down by three time periods. As shown in the table, many properties in Baltimore were left abandoned for a long time.

Table 6. Change in abandonment between repeat sales pair transactions by the duration of abandonment (1991 – 2010) (within 1,500 ft.; *N*=101,497)

	Mean	Minimum	Maximum
Abandoned ≤ 1 year	2.94	- 147	176
Abandoned 1 – 3 years	5.34	- 184	280
Abandoned > 3 years	20.57	- 197	738

[5] On average, there are 101 housing structures in ring 1 (250 ft. radius ring) in the data sample (*N*=101,497). This means one additional abandoned property in ring 1 can be translated into roughly one percent increase in housing abandonment in ring 1.

The impact of abandoned properties on nearby property values depending on the duration of abandonment is estimated using equation 6. The result is shown in Table 7.

Table 7. Estimated contagion effect of abandoned properties sorted by the duration of abandonment (within 1,500 ft.; *N*=101,497)

	Contagion effect	*t*-Statistics	*p*>|t|
Abandoned ≤ 1 year	- 0.034*	- 2.33	0.020
Abandoned 1 – 3 years	- 0.044***	- 3.98	0.000
Abandoned > 3 years	- 0.173***	- 37.32	0.000
Foreclosure	- 0.258***	- 26.41	0.000

Note: Coefficients of slopes are scaled by 100: *t*-ratios are based on robust standard errors. Regression output includes the -1, 0, 1 dummy variables from the repeat sales model as additional regressors, but coefficients on those variables are not reported here to save space. *$p < 0.1$. ***$p < 0.001$.

Table 7 demonstrates that the longer the abandoned property has been unoccupied and unmaintained, the greater its impact on nearby property values when nearby foreclosures and market level are held constant. With other factors held constant, each additional property that has been abandoned longer than 3 years reduces the nearby property value by 0.17%. However, each additional property that has been abandoned less than 3 years reduces the nearby property value by much less, approximately 0.04%.

4.3. Estimation of the Impact of Abandoned Properties by Location and Duration of Abandonment

Now, I estimate the model that considers both the location and the duration of abandoned properties. First, Table 8 shows the mean increase in the number of abandoned properties in each ring and time period between the repeat sales. Although Baltimore City has demolished many abandoned structures over the years, the number of abandoned properties continued to increase in each ring and time period.

Table 8. Change in the number of abandoned properties in each ring and time period between repeat sales pair transactions (1991 – 2010; *N*=101,497)

Abandonment		Mean	Minimu	Maximu
P1: abandoned ≤ 1 year	R1: located at 0-250 ft.	0.19	- 31	30
	R2: located at 251-500 ft.	0.34	- 37	44
	R3: located at 501-1,000 ft.	1.06	- 74	75
	R4: located at 1,001-1,500 ft.	1.37	- 67	87
P2: abandoned 1-3 years	R1: located at 0-250 ft.	0.33	- 29	34
	R2: located at 251-500 ft.	0.63	- 43	56
	R3: located at 501-1,000 ft.	1.90	- 84	120
	R4: located at 1,001-1,500 ft.	2.49	- 103	156
P3: abandoned > 3 years	R1: located at 0-250 ft.	1.20	- 25	88
	R2: located at 251-500 ft.	2.25	- 51	132
	R3: located at 501-1,000 ft.	7.14	- 106	339
	R4: located at 1,001-1,500 ft.	9.97	- 90	427

I estimate the impact of each of 12 groups of abandoned properties (sorted by the location and the duration of abandonment as shown in Table 8) on nearby property values while controlling for nearby foreclosures in each ring and the local market trend using equation 7. The result is shown in Table 9.

Table 9. Estimated contagion effect of abandoned properties by location and duration of abandonment[6] (*N*=101,497)

		Contagion effect	*t*-Statistics	*p*>|t|
P1: abandoned ≤ 1 year	R1: located at 0-250 ft.	- 0.512***	- 4.58	0.000
	R2: located at 251-500 ft.	0.087	1.11	0.267
	R3: located at 501-1,000 ft.	- 0.011	- 0.29	0.775
	R4: located at 1,001-1,500 ft.	- 0.042	- 1.36	0.175
P2: abandoned 1-3 years	R1: located at 0-250 ft.	- 0.716***	- 7.65	0.000
	R2: located at 251-500 ft.	- 0.034	- 0.52	0.605
	R3: located at 501-1,000 ft.	0.008	0.24	0.810
	R4: located at 1,000-1,500 ft.	- 0.020	- 1.81	0.416
P3: abandoned > 3 years	R1: located at 0-250 ft.	- 0.964***	- 13.03	0.000
	R2: located at 251-500 ft.	- 0.266***	- 4.93	0.000
	R3: located at 501-1,000 ft.	- 0.045*	- 1.90	0.057
	R4: located at 1,000-1,500 ft.	- 0.143***	- 9.05	0.000
Foreclosure in R1		- 1.374***	- 9.70	0.000
Foreclosure in R2		- 0.213*	- 2.25	0.024
Foreclosure in R3		- 0.303***	- 6.57	0.000
Foreclosure in R4		- 0.118***	- 3.53	0.000

Note: Coefficients of slopes are scaled by 100: *t*-ratios are based on robust standard errors. Regression output includes the -1, 0, 1 dummy variables from the repeat sales model as additional regressors, but coefficients on those variables are not reported here to save space. *$p < 0.1$. **$p < 0.01$. ***$p < 0.001$.

Earlier, I found that the negative contagion effect of abandoned properties on nearby property value grows in magnitude as properties are abandoned for a longer time. I also found that the impact of abandoned properties on nearby property values decreases as the distance between the abandoned property and the nearby property increases. Furthermore, as shown in Table 5, the

[6] The recent foreclosure crisis, however, created a very different housing market. Therefore, to test the robustness of the data, I reestimated the final model using the data excluding the 2009 and 2010 transactions. I find the estimated coefficients are almost identical to those reported in Table 9.

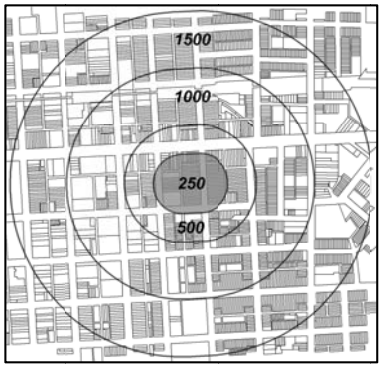
abandoned properties in every ring had a statistically significant negative impact on nearby property values when the duration of abandonment was not considered. However, as shown in Table 9, when both the location and the duration of abandoned properties are considered, the model yields different measurements.

Table 9 suggests that when properties have been abandoned for less than three years, only those abandoned properties located within 250 ft. have a significant impact on nearby property values. Properties that are abandoned for less than three years and are located beyond 250 ft do not have a significant negative impact on nearby property values. However, when properties have been abandoned for more than three years, abandoned properties in every ring have a significant impact on nearby property values. As shown in Table 9, by the time properties have been abandoned for more than three years, the nearby property value within 250 ft. is reduced by roughly 1% when other factors are held constant. And although the magnitude is smaller, properties that have been abandoned for longer than three years but located beyond 250 ft. had significant negative impact: roughly 0.27% in ring 2, 0.05% in ring 3, and 0.14% in ring 4. This model's findings are illustrated in Figure 3.

Figure 3. Impact of abandoned properties depending on the duration of abandonment

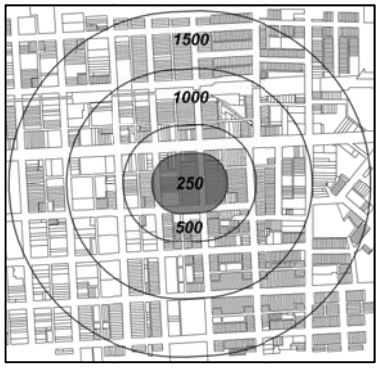
When properties are abandoned for (a) less than 1 year, (b) more than 1 year but less than 3 years, and (c) more than 3 years.

(a)



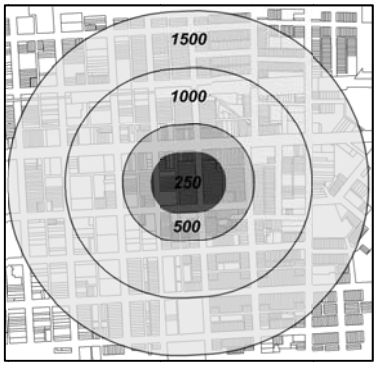
(Contagion effect: - 0.51% in R1)

(b)



(Contagion effect: - 0.72% in R1)

(c)



(Contagion effect: - 0.96% in R1, - 0.27% in R2, - 0.05% in R3, and - 0.14% in R4)

5. Conclusion

For decades, many older industrial cities in the United States, such as Baltimore, have struggled with a housing abandonment problem. Now, with a foreclosure crisis, housing abandonment is no longer confined to older industrial cities in the United States, but rather is appearing in small towns and suburbs across the country. Scholars have long argued that housing abandonment can cause neighborhood decline and there is, though limited, empirical evidence to support this argument. Despite of the extent of the housing abandonment problem, research on this topic and the development of effective policies has not been at the forefront of urban research or policymaking. This was, in part, due to considering abandonment as an inevitable result of urban disinvestment or market failure, rather than viewing it as a problem itself. This view has recently changed; many scholars and policymakers began to see the housing abandonment as a cause of urban disinvestment or market failure, rather than as a symptom. Thus, this study attempts to extend the current level of understanding of the relationship between housing abandonment and neighborhood decline for more effective policymaking.

Past researchers have demonstrated that the presence of abandoned properties reduces nearby property values, and have confirmed the distance decay impact – the impact of abandoned properties declines as the distance from the abandoned property increases. However, many abandoned properties sit unoccupied and unmaintained for years. Yet no research has examined how the duration of abandonment affects the impact of abandonment on nearby property values. In addition, most studies estimated the impact of abandonment through cross-sectional analysis without controlling for nearby foreclosures or local housing market level. Without such controls, the estimated impact of abandonment on nearby property values would simply mean that abandonment occurs in areas with relatively lower-valued properties. It also becomes unclear

whether nearby abandoned properties caused a decline in nearby property values or whether abandoned properties are caused by a general decline in property values in the area. Therefore, this research attempts to use analytical models that represent methodological improvements over earlier research efforts to yield a more concrete understanding of the relationship between housing abandonment and neighborhood decline. This research uses a longitudinal data of housing abandonment while controlling for nearby foreclosures and local housing market level and estimates the impact of abandonment with weighted repeat sales methodology.

This research examined the housing abandonment in Baltimore, Maryland, to estimate its impact on nearby property values. Housing abandonment is concentrated in a number of neighborhoods in Baltimore City. In fact, housing abandonment is often disproportionally distributed across a city in the U.S. Therefore, it is possible that housing abandonment is correlated with specific spatial characteristics, leading to spatial dependency or spatial auto correlation. Yet, this research did not estimate the impacts in a spatial econometric framework. Regression analysis such as spatial regression models that compensate for spatial dependency may provide more reliable measurements of the impacts of housing abandonment. In addition, the issue of spatial variability implies that estimated magnitudes of the impacts of housing abandonment might be different depending on the neighborhood characteristics. These issues should be addressed in the future research.

This research finds that the presence of abandoned properties does have a negative contagion effect on nearby property values and confirms the distance decay impact. Furthermore, it finds that that the duration of housing abandonment significantly affects the extent to which abandoned properties impact nearby property values. When properties are abandoned for relatively short period of time, they affect the value of other property that is located within the same block or

in such close proximity that the abandoned property is visible. However, when abandoned properties sit unoccupied and unmaintained for longer periods of time, their impact on nearby property values not only increases in magnitude but also goes farther in distance. This suggests that when properties are abandoned for long periods of time, even when these abandoned properties are not visible from the subject property, it appears to affect the potential buyer's perception of entire neighborhood thus affecting properties located farther away.

This finding implies that immediate intervention to have an abandoned property re-occupied and maintained is important to mitigate the negative impact of housing abandonment. One abandoned property is bad enough, but the longer it sits unoccupied and unmaintained the greater its negative impact on nearby property values as well as the values of other properties in the neighborhood. Estimates of the impact of abandonment on nearby property values provide a basis to project the potential benefits of renovating abandoned properties. Therefore, neighborhoods blighted by properties that have been abandoned for long periods should be targeted for immediate intervention for greater potential benefits.

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PAPER 2:

EXPLORING THRESHOLD EFFECTS IN THE IMPACT OF HOUSING ABANDONMENT ON NEARBY PROPERTY VALUES

1. Introduction

The current foreclosure crisis has greatly affected today's housing market and is clearly evident in the dilapidated, boarded-up homes in many neighborhoods across the country. Many foreclosed properties are likely to sit vacant for prolonged periods, fall into disrepair and neglect, and end up abandoned. In fact, many recent abandoned properties are a result of foreclosures, particularly in new suburban developments that have an excess housing supply and in weak housing market areas (Kingsley, Smith, & Price, 2009). Scholars have long argued that abandoned properties contribute to neighborhood decline by lowering nearby property values, promoting criminal activities, and posing fire safety hazards (Greenberg, Popper, Schneider, & West, 1993; Greenberg, Popper, & West, 1990; Spelman, 1993). While most attention has been focused on the foreclosures lately, many poor, minority, urban neighborhoods in old industrial cities such as Philadelphia, Pennsylvania; Detroit, Michigan; or Baltimore, Maryland, have been struggling with chronic housing abandonment problems for decades. And it is likely that the foreclosure crisis would exacerbate the housing abandonment problems in these neighborhoods.

Prior to the current foreclosure crisis that began in early 2007, there were a number of reports that warned about increasing foreclosures and documented the foreclosure problems with

subprime loans (Immergluck, 2009). But, there was little research documenting the impact of foreclosures especially on the foreclosure discount (foreclosure properties sold at discounted price) and spillover estimates (properties sold at discounted price because of nearby foreclosures) before the foreclosure crisis (Frame, 2010). Understandably, the recent foreclosure crisis led to a significant amount of research on the causes and impacts of foreclosures and vacancy. And there are ample empirical studies that estimated the negative spillover effects of foreclosures on the housing market – specifically on housing prices (Frame, 2010). These studies found that not only are foreclosed properties sold at discount prices but also, more importantly, they appear to lower the sales prices of nearby non-distressed properties. In contrast to a significant volume of research on foreclosure externalities, there are only a limited number of studies that analyzed the degree to which abandoned properties can affect value of nearby non-distressed properties. Yet their findings are consistent with those of the research on foreclosure externalities; abandoned properties significantly reduce nearby non-distressed property values.

Furthermore, these past empirical studies that estimated the spillover effects of distressed properties (foreclosed or abandoned properties) also found that the magnitude of the impact of distressed properties on nearby property values did not seem to increase proportionally to the number of distressed properties (Been, 2008; Rogers & Winter, 2009; Schuetz, Been, & Ellen, 2008; Shlay & Whitman, 2006; Simons, Quercia, & Levin, 1998). In other words, they found evidence indicating that the impact of distressed properties on nearby property values appeared to be not linear. For example, Shlay and Whitman (2006) estimated the impact of the number of abandoned properties on a block on sales prices in Philadelphia and found that houses on blocks with one abandoned property experienced a net loss in value of $6,468 whereas houses on blocks with 5 abandoned properties experienced a net loss in value of $10,043. In addition, they found that blocks

with more than seven abandoned properties did not have statistically significant impact on nearby property values (Shlay & Whitman, 2006).

That the impact of distressed properties on nearby property values is not linear is plausible. In planning literature, there are theories and empirical evidence that indicate that the process by which neighborhoods change may not be linear and suggest the possible presence of threshold effects in neighborhood change attributes (Quercia & Galster, 2000). Quercia and Galster (2000) defined thresholds as the critical points in triggering stimulus at which there was a significant change in the magnitude of response. Based on an exhaustive literature review on threshold effects, they claimed that existing theory supported the claim that thresholds existed in neighborhood effect (Quercia & Galster, 2000). They argued that when a certain indicator reached a critical point, it generated abrupt changes in neighborhood environment (Galster, Quercia, & Cortes, 2000).

Then, based on above theories and evidence from a number of empirical studies on externalities of distressed properties, there is a possibility that threshold effects may exist in the impact of housing abandonment on nearby property values. Exploring whether a threshold effect exists in the impact of housing abandonment on nearby property values has important policy implications. Understanding how the magnitude of the impact of abandonment changes as the number of nearby abandoned properties increases would expand our understanding of externalities of distressed properties and offer guideposts for strategic policy interventions. Often public resources are constrained, so there is a strong need to strategically allocate these resources (Thomson, 2011). If a threshold in the impact of housing abandonment on nearby property values exists, it may be economically beneficial to target limited resources to areas that are close to reaching that threshold.

Therefore, the purpose of this research is to explore whether thresholds exist in the impact of housing abandonment on nearby property values. That is, does the impact of housing abandonment experience an abrupt change in magnitude if the increase in the number of nearby abandoned properties exceeds some critical point? Furthermore, some empirical studies on the impact of distressed properties found that once the number of distressed properties reaches a certain point, additional properties did not increase the impacts. There may be a second threshold in the increase in housing abandonment where the impact of abandonment may no longer increase dramatically. I answer these research questions by exploring the presence of threshold effects in the impact of housing abandonment on nearby property values in Baltimore, Maryland, from 1991 to 2010. I use weighted repeat sales methodology to construct a model to estimate the impact of housing abandonment on nearby property values and a piecewise linear regression with spline functions to estimate threshold values and the magnitude of the impact before and after threshold values.

The remainder of this article is organized as follows. I begin by briefly examining the extent of housing abandonment and its problems in U.S. cities. In the following section, the relevant theories on threshold effects in neighborhood environment and the past empirical studies on nonlinearity of the impact of distressed properties are discussed. After presenting the research objectives and questions, I present the research data and methodologies used to answer the research questions followed by research findings. This article concludes with a discussion of the scholarly significance and policy implications of this research.

1.1. Problems of U.S. Housing Abandonment

What defines a property as abandoned is not consistent among government officials or scholars (Cohen, 2001; Sternlieb, Burchel, & Paulus, 1972). However, a property is commonly considered abandoned if the owner has removed the property from housing stock by neglecting the duty of property ownership regarding the property's functional, financial, and physical maintenance (Sternlieb, Burchell, Hughes, & James, 1974). Functional abandonment means a property is not suitable for residency as the property lacks sealed doors or windows. Financial abandonment occurs when an owner stops meeting his financial responsibilities such as making mortgage or tax payments. And physical abandonment refers to a property that is unlivable because the owner did not maintain the property. Often abandoned properties refer to properties that are unlivable with either boarded up or missing doors or windows and severely dilapidated. They often show the obvious sign of neglect and become eyesores in neighborhoods.

There have been only a few attempts to measure the extent of housing abandonment in the United States because the lack of a shared definition of abandonment often complicates efforts by researchers or government officials to count the number of abandoned properties (Pagano & Bowman, 2000). A number of studies estimate the extent of housing abandonment. A survey by Pagano and Bowman (2000) at the Brookings Institution in 2000 found an average of 2.63 abandoned structures for every 1,000 residents in 60 U.S. cities with populations over 100,000. The cities in the Northeast region reported the highest average number of abandoned structures per 1,000 residents: 7.47 (Pagano & Bowman, 2000). The high average for the Northeast is caused by a few cities with exceptional statistics: Philadelphia with 36.5 abandoned structures per 1,000 residents, and Baltimore with 22.2 abandoned structures per 1,000 residents, for example (Pagano & Bowman, 2000). Allan Mallach (2006), using the 2000 U.S. Census Bureau data, estimated an

average of about 10,000 abandoned residential properties per city in 19 cities with populations over 100,000. Many old industrial cities have suffered from housing abandonment for decades. For instance, as early as in 1979, the Comptroller General's Report to the Congress reported that 113 large U.S. cities had housing abandonment problems to some degree; 55 of these cities acknowledged substantial to moderate housing abandonment problems (U.S. General Accounting Office, 1979).

An abandoned property is a waste of a housing resource. Furthermore, scholars argue that abandoned properties harm neighborhoods and governments. Studies have shown that housing abandonment can contribute to neighborhood decline by lowering neighborhood property values and increasing crime rates (Goetz, Cooper, Thiele, & Lam, 1998; Keenan, Lowe, & Spencer, 1999; Shlay & Whitman, 2006; Skogan, 1990; Spelman, 1993; Sternlieb & Burchell, 1973). Shlay and Whitman (2006), for example, examined the impact of vacant housing units on nearby property values in Philadelphia in 2000 and found that the presence of a vacant property on a block reduces the value of all the other property by an average of $6,715. In another study, Mikelbank (2008) examined the impact of both foreclosures and vacant/abandoned properties in Columbus, Ohio, in 2006, and concluded that for a property located near foreclosed and vacant/abandoned properties the price value is reduced by an average of $8,600 – $4,256 by foreclosed properties and $4,411 by vacant/abandoned properties. Griswold and Norris (2007) in their study of Flint, Michigan, also found that an additional abandoned structure within 500 ft would reduce the sale price of a property by 2.27%. Regarding the impact of housing abandonment on crime, Spelman (1993) examined 59 abandoned residential properties in a low-income neighborhood in Austin, Texas. Of these buildings, he found that 34% were being used for illegal activities, and of the 41% of abandoned buildings that were unsecured, some 83% were being used for illegal activities. This study also found that the crime rates on blocks with unsecured abandoned buildings were twice as

high as the rates on matched blocks with secured abandoned buildings (Spelman, 1993). Another study on the relationship between foreclosure, vacancy, and crime in Pittsburgh by Cui (2010) also found that violent crime increases by more than 15% when foreclosed homes become vacant. Immergluck and Smith (2006) examined neighborhood foreclosures and crime in Chicago and found that higher foreclosure levels contribute to higher levels of violent crime. Moreover, lowered property values generate lower property taxes, which in turn generate fewer financial resources for local governments when abandoned properties in fact increase costs for local governments that must expend resources to inspect, secure, and even demolish abandoned properties that pose health or safety hazards (U.S. Government Accoutability Office, 2011).

1.2. Neighborhood Change Thresholds

The concept of a threshold, often called the "tipping point," refers to a critical point when unprecedented changes occur rapidly and more frequently (Bhatanacharoen, Greatbatch, & Clark, 2011). This concept was first introduced in 1957 by the sociologist Martin Grodzins from the University of Chicago in an article in *Scientific American* (Bhatanacharoen, Greatbatch, & Clark, 2011). Grodzins studied American neighborhoods in the early 1960s and discovered that most of the white families remained in the neighborhood as long as the number of black families in the same neighborhood remained small, but white families would move out en masse when the number of black families reached a certain point. He called this point the "tipping point" (Grodzins, 1957). This tipping point was later adopted by Thomas Schelling (1972) in his pioneering work to explain the patterns of residential segregation; he used the term "tipping" to describe the point of a certain race composition in a neighborhood that leads one or more white residents to move out of the neighborhood. This concept of a tipping point or a threshold has been providing a useful framework

to explain how the actions of individuals are connected to general population processes in a wide range of social phenomena (Bruch & Mare, 2006).

There are also theories and empirical evidence that document threshold effects in dynamics of neighborhood environment in planning literature. The neighborhood change thresholds can be defined as the process by which the neighborhood environment experiences a significant and abrupt change when a certain neighborhood indicator exceeds some critical value (Galster, Quercia, & Cortes, 2000). Quercia and Galster (2000) examined existing literature concerning thresholds related to neighborhood change and concluded that threshold effects exist in dyamics of neighborhood environment. They examined, specifically, studies that investigated the existence of threshold effects in the following four dimensions of neighborhood quality of life: racial group composition, income group composition, social and economic conditions, and housing investment (Quercia & Galster, 2000).

Regarding racial group composition of the neighborhood, Quercia and Galster (2000) found racial change thresholds. However, the threshold values for neighborhood racial composition varied among studies. For instance, Ellen (2000) in her study on neighborhood racial stability in racially integrated census tracts (1970-1990) found that growth in the black population was positively correlated with white population decline and actual mobility decisions and that threshold value appeared to be roughly 10 % black. On the other hand, Galster (1990) in his study on residential turnover rates for white households in census tracts (1970-1980) in Cuyahoga County, Ohio, found that threshold values varied from 2 % to 47 % black within one standard deviation of the mean level of estimated whites' aversion to residential integration. As for the case of income group composition, Quercia and Galster (2000) found only one empirical study that addressed thresholds in income group composition and the methodology of that study was weak. Carter, Schill, and

Wachter (1998) examined the neighborhood poverty rate on census tracts (1950-1990) in Boston, Cleveland, Detroit, and Philadelphia and found strong evidence that changes in neighborhood poverty rates were influenced in a nonlinear way by the poverty rate a decade earlier, the stock of public housing units a decade earlier, and the change in the stock of public housing units during the prior decade.

Regarding social and economic conditions of the neighborhoods, Quercia and Galster (2000) examined a number of studies that investigated the presence of threshold effects in various social and economic conditions of neighborhood. They found the presence of neighborhood thresholds in welfare use, teen childbearing, educational attainment, income, employment, and crime, all of which were impacted by threshold values for various neighborhood social and economic characteristics (Quercia & Galster, 2000). Studies found that above neighborhood thresholds were impacted by threshold values for various neighborhood social and economic conditions such as neighborhood poverty rate, unemployment rates, and proportion of professional workers (Quercia & Galster, 2000). For instance, South and Crowder (1999) found the neighborhood disadvantage has a significant nonlinear impact on the risk of premarital childbearing among white women and a significant nonlinear effect on the probability of marriage prior to first birth among black young women. In another study by Thomas Vartanian (1999) on the impact of childhood neighborhood conditions on economic well-being as adults found that thresholds persisted for average labor income, average wage rate, average family income to needs ratio, and percentage of time below poverty line associated with growing up in the lowest quality of neighborhoods.

A homeowner's decision on housing investment is often impacted by a neighbor's housing investment activities. Taub, Taylor, and Dunham examined the threshold levels in home investment and concluded that threshold levels differed by the race of the homeowner and the racial

composition of neighborhoods (Quercia & Galster, 2000). This study found that black and Hispanic owners in mostly white neighborhoods required that 33 percent of other owners on their block be currently reinvesting before they would do the same (Taub, Taylor, & Dunham, 1984). However, this investment threshold increased to 54 percent in more mixed neighborhoods (Taub, Taylor, & Dunham, 1984). The threshold level was higher for white owners: 55 % in white neighborhoods and 76 % in nonwhite neighborhoods (Taub, Taylor, & Dunham, 1984). Galster (1987), on the other hand, examined how the levels of social cohesion in neighborhood impacted the levels of home upkeep and found that the level of neighborhood social cohesion and individual attachment had a threshold effect on the levels of home upkeep.

Regarding the impact on property values, Galster, Santiago, Smith and Tatian (1999) investigated the impacts of a range of federal housing subsidy programs on neighboring property values and found that threshold effects exist. They found that assisted housing had positive or insignificant impacts on neighboring property values when the assisted housing was relatively dispersed, but the impacts became negative once the number of assisted housing units reached a threshold in terms of spatial concentration or facility scale in a neighborhood (Galster, Santiago, Smith, & Tatian, 1999).

Finally, regarding housing abandonment, a 1973 study by the Department of Housing and Urban Development identified a threshold for abandoned properties of between 3 and 6% of the structures in a neighborhood (Kraut, 1999). This study found that once 3 to 6% of buildings in a neighborhood became vacant, the neighborhood residents began leaving at an accelerated pace. (Kraut, 1999).

1.3. Nonlinearity of the Impact of Distressed Properties

Most prior research examining the impact of distressed properties – foreclosures or vacant/abandoned properties – on nearby property values assumed that each additional distressed property had the same effect on nearby property value as the prior distressed property. That is, these studies assumed that the impact of distressed properties on nearby property values was linear.

Several studies have, however, attempted to explore the nonlinearity of the impact of distressed properties on nearby property values. Specifically, those studies examined how the magnitude of the impact of distressed properties changes when the number of nearby distressed properties increases. Overall findings are overall consistent; they found that the marginal impact of each additional distressed property on nearby property value seemed to decline with an increase in the number of distressed properties; that is, the magnitude of the impact of distressed properties did not appear to increase proportionally to the number of distressed properties (Been, 2008; Rogers & Winter, 2009; Schuetz, Been, & Ellen, 2008; Shlay & Whitman, 2006). Furthermore, some studies overall indicated that the threshold value where the impact of distressed properties increases significantly was very small, whereas others also suggested that the threshold value could be just one distressed unit because dramatic declines in nearby property values occurred after just one distressed unit.

For instance, Been et al. examined whether foreclosures have a nonlinear effect on property values in their research on the impact of the filing of a foreclosure notice (a "*lis pendens*", or LP) on nearby sales in New York City. They suggested that there may be a threshold effect because being near a small number of foreclosures did not appear to consistently depress property values, but that beyond a threshold there was a statistically significant negative effect of foreclosures on property values (Been, 2008; Schuetz, Been, & Ellen, 2008). Furthermore, they found that the magnitude of

the impact of foreclosures on nearby sales generally increased with the number of nearby foreclosures (Been, 2008; Schuetz, Been, & Ellen, 2008). However, this research also found that the marginal impact of each additional foreclosure decreased once there was a concentration of foreclosures in a neighborhood (Been, 2008; Schuetz, Been, & Ellen, 2008). In a neighborhood with only a few foreclosures, the magnitude of impact of a foreclosed property on nearby property sale price was 1.8% when there were just one or two foreclosed properties within 500 ft. (Been, 2008; Schuetz, Been, & Ellen, 2008). However, in the same neighborhood, this research found that the sale price of a property within 500 ft. of three to five foreclosed properties was reduced by 2.8% (Been, 2008; Schuetz, Been, & Ellen, 2008). In a neighborhood with a higher number of foreclosures, this research found similar results; the sales price of a property near nine to nineteen foreclosures was decreased 2.5% less while the sales price of a property near twenty or more foreclosures was 3.7% less (Been, 2008; Schuetz, Been, & Ellen, 2008). This suggests that the first few foreclosures generate a larger impact on nearby property sales price and subsequent foreclosures have a much smaller marginal impact.

Another study by Rogers and Winter (2009) examined the impact of foreclosures on the neighboring housing sales prices in St. Louis County, Missouri, from 1998 through 2007. Although their study demonstrated that the marginal impact of foreclosures on the sales price of neighboring sales seemed to decline with an increase in the number of foreclosures, they stated that there did not appear to be a tipping point in the number of foreclosures where the neighboring housing sales prices decline rapidly (Rogers & Winter, 2009). And they suggested that declining marginal impact with an increase in the number of foreclosures might suggest that once a neighborhood reaches a certain level of foreclosures, the neighborhood may be self-stabilizing (Rogers & Winter, 2009).

A study by Shlay and Whitman (2006) on the impact of the number of abandoned properties on a block on sales prices in Philadelphia in 2000 did not explore the nonlinearity of the impact but found that the magnitude of the impact of abandoned properties on nearby property values in a neighborhood block did not seem to increase proportionally to the number of abandoned properties. Furthermore, their findings suggested that there might be a threshold where the impact of abandoned properties may be no longer significant once the number of abandoned properties exceeds a certain level in a block. For example, this study found that houses on blocks with one abandoned property experienced a net loss in value of $6,468 while houses on blocks with 5 abandoned properties experienced a net loss in value of $10,043 (Shlay & Whitman, 2006). However, Shlay and Whitman (2006) found that blocks with more than seven abandoned properties did not have statistically significant impact on nearby property values. They explained that this might be because the market value of property in a block with this magnitude of abandonment had already been deeply weakened (Shlay & Whitman, 2006).

1.4. Why Does It Need Scholarly Attention?

Policy Implications

The research on foreclosures and vacancy suggested that an increasing number of distressed properties has an adverse effect on neighborhood quality, including weakening the local housing market and increasing neighborhood crime rates, and that the effects are amplified in poor neighborhoods and when distressed properties are highly concentrated (Joice, 2011). These findings provided a justification for policymakers to develop government initiatives in the past few years to prevent foreclosures and vacancy and deal with the problems of foreclosed or vacant/abandoned properties (Frame, 2010). For instance, Congress established the Neighborhood Stabilization Program (NSP) in 2008 to help local governments to address the problems of the foreclosed and abandoned residential properties – specifically purchase, rehab, or demolish foreclosed and abandoned properties (Joice, 2011). However, while the local governments agree that the NSP program is very beneficial, the funds are typically insufficient given the significant volume of rapidly increasing foreclosed and abandoned properties (U.S. Government Accoutability Office, 2011). For instance, a massive demolition program is one of the major approaches Baltimore City adopted to deal with severely blighted abandoned properties. However, demolishing abandoned properties is very expensive, especially for Baltimore, because most its abandoned properties are row houses; it could cost Baltimore City between $13,000 and $40,000 to demolish a single row house, depending on the size and number of walls (U.S. Government Accoutability Office, 2011). And Baltimore officials estimated that it would cost the city approximately $180 million just to demolish the most unsafe and unattended properties in the city (U.S. Government Accoutability Office, 2011).

Therefore, local governments need to be strategic in their allocation of limited resources (Thomson, 2011). Concentrating resources in limited geographic areas to enhance the impact of

public intervention, commonly known as strategic geographic targeting, has become an increasingly common tool among local governments (Thomson, 2011). For instance, Baltimore City, as part of its "Vacants to Value" program, identifies areas with high concentration of abandoned properties and targets their investment for redevelopment projects nearby in order to generate the interest from private developers to rehabilitate some of the highly concentrated abandoned properties (U.S. Government Accoutability Office, 2011).

Understanding of how the magnitude of the impact of abandoned properties on nearby property values changes as the number of nearby abandoned properties increases may inform strategic geographic targeting. If the magnitude of the impact of abandoned properties increases dramatically beyond a certain threshold, then it would be beneficial for local governments to target their resources to areas that are close to that threshold or to areas that have recently passed the threshold.

1.5. Research Objective and Questions

The primary purpose of this article is to explore the presence of threshold effects in the impact of housing abandonment on nearby property values. First, it attempts to contribute to the current literature on the externalities of distressed properties by exploring whether threshold effects exist in the impact of abandoned properties on nearby property values. And if there are indeed threshold effects in the impact of housing abandonment on nearby property values, what are those critical threshold values? And how does the impact of abandoned properties on nearby property values change as the increase in the number of abandoned properties exceeds these threshold values? Second, this research hopes that the understanding of threshold effects in the

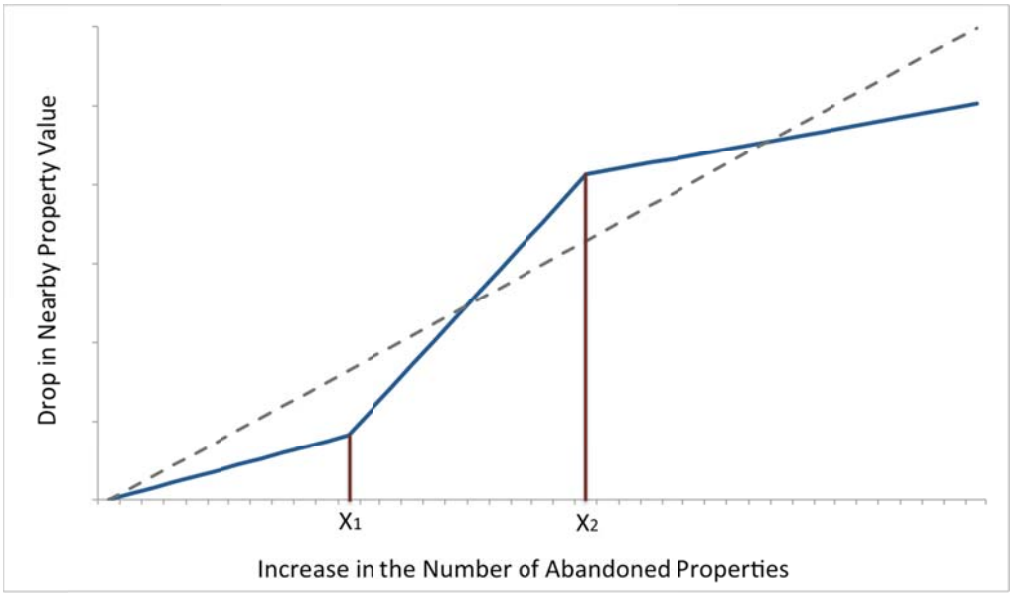
impact of abandoned properties would help policymakers to develop more effective policy strategies to address the problems of foreclosures and housing abandonment.

To achieve these research objectives, this research examines the impact of housing abandonment on nearby property values in Baltimore, Maryland, from 1991 to 2010 and answers the following research questions:

1. Does the impact of housing abandonment on nearby property values experience an abrupt change in magnitude when the increase in the number of nearby abandoned properties reaches some critical point?
2. Furthermore, is there a second threshold in the increase in the number of abandoned properties when nearby property values do not drop dramatically any longer?

Figure 1 illustrates the threshold effects in the impact of housing abandonment on nearby property values. If we assume that the impact of housing abandonment may be nonlinear (as shown in blue line in Fig. 1), once the increase in the number of nearby abandoned properties reaches a certain threshold shown as X_1 in Figure 1, the impact of housing abandonment may experience an abrupt increase. Likewise, it may be possible that once there is a critical mass of abandoned properties, as shown as X_2 in Figure 1, the additional impact of abandonment on nearby property values may no longer be large in magnitude or nonexistent.

Figure 1. Threshold-like effect of housing abandonment on nearby property values



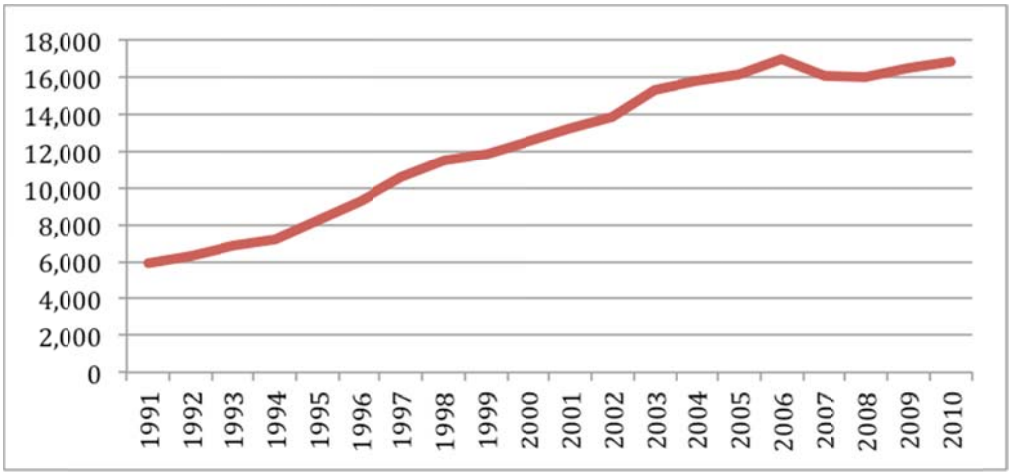
2. Research Site and Data

2.1. Research Site: Baltimore, Maryland

To answer these research questions, I investigated the impact of housing abandonment on nearby property values in Baltimore, Maryland, between 1991 and 2010. Baltimore was selected as a study area because the city has suffered from a substantial amount of housing abandonment over several decades due, in part, to deindustrialization and the subsequent loss of jobs and population (Levine, 2000). The deindustrialization in Baltimore that began in the 1960s caused a decline in the manufacturing industry. Between 1950 and 1995, Baltimore lost more than 100,000 manufacturing jobs, representing 75% of its industrial employment (Levine, 2000). As the manufacturing jobs disappeared, the city's population declined. According to the U.S. Census, after reaching its peak population of 949,708 in 1950, Baltimore continued to lose its population at an average rate of 7% per decade, reaching a population of 620,961 in 2010 – a loss of about one-third since 1950 (U.S. Census 2010). This loss of population and jobs contributed to a large amount of vacant, abandoned, and underutilized residential and commercial properties in the city.

Although there is no generally agreed upon definition of abandonment, the Baltimore City defines a property as *abandoned* if it is boarded up, or if it is unboarded but the conditions are unlivable and severely dilapidated, or if it is unboarded or inadequately secured to prevent unauthorized entry or use of the building by uninvited persons, regardless of the property's status on mortgage or tax delinquencies. The Baltimore City considers a property simply *unoccupied* if it is livable and uninhabited (U.S. Government Accoutability Office, 2011). According to the City's vacancy data, there were 16,850 abandoned residential properties as of 2010, compared to 5,925 in 1991 - an increase of more than 10,000 in just two decades (see Figure 2).

Figure 2. Number of abandoned residential properties in Baltimore, Maryland, 1991 – 2010



Source: Compiled using the Vacant House File data provided by the Baltimore City Department of Housing and Community Development, 2011.

2.2. Data Source

To explore the presence of threshold effects in the impact of housing abandonment on nearby property values in Baltimore, Maryland, between 1991 and 2010, the following data were obtained for the study period: (1) abandoned properties data; (2) residential property sales data; and (3) foreclosure data.

(1) Abandoned properties data

Since the 1970s, Baltimore City has tracked the number and geographic location of abandoned residential properties using the city's "The Vacant House File," a database ancillary to the city's real property database (The Baltimore City Department of Housing and Community Development). This database contains the list of every abandoned property identified by the city's Code Enforcement Office and properties that have had an outstanding Vacant House Notice, and it is updated monthly (The Baltimore City Department of Housing and Community Development). The

provided data contains the parcel identification number (block and lot number), full address, the dates the Vacant House Notice was first issued and re-issued, the type of structure, the tax payment status, and the lot size.

(2) Residential property sales data

Residential property sales data was obtained from the Baltimore City Department of Housing and Community Development. This data contains a list of all of the residential properties that were sold from January 1, 1991, to December 31, 2010. Each residential property sale had the following information: parcel identification (block and lot number), date of sale (transaction date), deed date, a type of transaction, full address, sales price, and LUC (land use code). Between January 1, 1991, and December 31, 2010 there were a total of 312,813 residential property transactions in Baltimore.

(3) Foreclosure data

The Circuit Court of Baltimore City provided the list of foreclosure filing case numbers documented between January 1, 1991, and December 31, 2010. For each case number, the address of the property and the date each filing was initiated were scraped from the Baltimore City Circuit Court website. A foreclosure filing may or may not result in an actual foreclosure; the owner may be able to prevent foreclosure by becoming up-to-date on the delinquent mortgage, selling the property, or modifying the loan. This research considers every filed foreclosure case regardless of

outcome. Between January 1, 1991, and December 31, 2010, there were 54,852 foreclosure filings initiated and processed in Baltimore.

Finally, GIS data was downloaded from the Baltimore City website to identify the locations of all of the abandoned properties, sold residential properties, and foreclosed properties.

3. Methodology

I use weighted repeat sales methodology to construct a model that estimates the impact of abandoned properties on nearby property values. Then, I modify the repeat sales methodology model to fit to a piecewise linear regression model with spline functions to estimate the threshold values and the magnitude of each spline (the magnitude of the impact before and after threshold values).

3.1. Weighted Repeat Sales Methodology

I first used weighted repeat sales methodology to construct a model that estimates the impact of abandoned properties on nearby property values while controlling for nearby foreclosures and local housing market trends. There have been two major empirical models used to estimate the spillover effects of distressed properties on nearby property values: hedonic price models and a repeat sales approach. A repeat sales approach was used to construct a model in this research as scholars argue that it substantially reduces the omitted variable bias problem of hedonic price models and is better suited to estimate and control for the separate effects of the nearby foreclosures and overall market trend of a longitudinal data set (Harding, Rosenblatt, & Yao, 2009).

Repeat sales methodology was originally derived by Bailey et al. (1963) and later by Case and Schiller (1989). The repeat sales method uses data on properties that have been sold at least twice and estimates the price change of a property between two sales as shown in equation 1.

$$\ln(P_{it}) - \ln(P_{i\tau}) = \sum_{t=1}^{T} \alpha_t G_{it} + (X_{it} - X_{i\tau})\beta + (\varepsilon_{it} - \varepsilon_{i\tau}) \quad (1)$$

where $P_{i\tau}$ and P_{it} equals the purchase price of a property at the first and second sale, respectively, G_{it} = a time dummy equal to 1 at the second sale date, -1 at the first sale date, and 0 otherwise,

α_t = overall annual market price level,

X_τ, X_{it} = property and neighborhood characteristics that affect a property price at the first and second sale date,

β = implicit prices of X_{it} and X_τ and,

$\varepsilon_{i\tau}$, ε_{it} = error terms at the periods of the first and the second sale, respectively, with zero means, equal variances, and uncorrelated with each other. The error term is assumed to be independent and identically distributed and captures pure random shocks to the transaction price.

The repeat sales methodology assumes the characteristics (X_{it} and X_τ) and their implicit prices (β) of a property do not change between the first (τ) and second sale date (t); $X_t = X_\tau$ and $\beta_t = \beta_\tau$. Therefore, equation 1 becomes:

$$\ln\left(\frac{P_{it}}{P_{i\tau}}\right) = \sum_{t=1}^{T} \alpha_t G_{it} + (\varepsilon_{it} - \varepsilon_{i\tau}) \quad (2)$$

Now, I expand equation 2 to include the both the nearby abandoned properties and the foreclosed properties.

$$\ln(\frac{P_{it}}{P_{i\tau}}) = \sum_{t=1}^{T} \alpha_t G_{it} + a(N_{it} - N_{i\tau}) + b(F_{it} - F_{i\tau}) + (\varepsilon_{it} - \varepsilon_{i\tau}) \quad (3)$$

N_{it} is the number of nearby abandoned residential properties present at the time of the second sale and $N_{i\tau}$ is the number of nearby abandoned residential properties present at the time of the first sale, and similarly,

F_{it} is the number of nearby foreclosed properties present at the time of the second sale and $F_{i\tau}$ is the number of nearby foreclosed properties present at the time of the first sale.

This research used three-stage generalized least squares (GLS) estimation procedure to estimate equation 3. Case and Shiller (1989) proposed the GLS estimation procedure to control for heteroskedastic errors. They argued that that the variance in the repeat sales model might not be

constant but related to the holding period between transactions. They stated that the longer the time between sales, the greater the chance that the price changes for each house were likely to be caused by factors other than market forces (Standard & Poor's, 2008): for example some houses may have been well maintained while others may have deteriorated. Such pricing errors will accumulate over time. In other words, the repeat sales regression model will have heteroskedastic errors. Therefore, Case and Shiller controlled for heteroskedastic errors by weighting the repeat sales observations by a function that declines with the length of time between the transactions. This method is called three-stage generalized least squares (GLS) estimation procedure.[1]

3.2. Piecewise Linear Regression Models with Spline Functions

I modified equation 3 to fit to a type of spline model known as a piecewise linear regression model with spline functions to estimate the regression coefficients for the threshold values (as shown X_1 and X_2 in Figure 1) and the slope and level of each of three splines. The slope and level of each spline represents the magnitude of the impact of housing abandonment on nearby property values before and after threshold values. I assumed that the housing abandonment has one linear effect on nearby property values within a certain range of its values, but a different linear effect at a different range. Piecewise linear regression models with spline functions provide a means for assessing this.

[1] In the first stage, the repeat sales model of Bailey et al. is estimated using the ordinary least squares (OLS) method. Next, the squared residuals obtained from the first stage are regressed on a constant term and the time interval between sales. In the final stage, the repeat sales are re-estimated using GLS regression where the weights are inversely proportional to the fitted values of residuals obtained in the second stage (Case & Shiller, 1989).

A piecewise linear regression model with spline functions is a statistical technique effective in modeling thresholds and is commonly used for nonparametric data analysis. Piecewise linear spline models are regression models where two or more lines (spline) are joined at unknown points, often called "breakpoints," representing thresholds (Toms & Lesperance, 2003). They consist of a continuous explanatory variable defined over specified segments of the domain of that variable and a dependent variable that is a continuous function of that explanatory variable over all segments, but with different slopes in each of the separate segments (Marsh & Cormier, 2002). In simpler terms, the regression of dependent variable on continuous explanatory variable follows a particular linear relation in some range of explanatory variable, but follows a different linear relation in some other range (Neter, Kutner, Nachtsheim, & Wasserman, 1996). This statistical procedure allows the regression line fitted to the scatter of data points to break into a series of linear segments, each of which may have a distinct slope and level. Therefore, a large increase in the slope from one piece to the next would indicate a rise in the estimated impact of abandonment at a particular threshold point of abandonment – specifically, an increase in the number of abandoned properties.

To estimate the threshold values, X_1 and X_2 and the slope and level of each of three splines, equation 4 was modified to fit to a piecewise linear regression with spline functions and became as follows:

$$\ln\left(\frac{P_{it}}{P_{i\tau}}\right) = \sum_{t=1}^{T} \alpha_t G_{it} + \beta_1 N_i + \beta_2 (N_i - X_1) D1_i + \beta_3 (N_i - X_2) D2_i + \delta F_i + (\varepsilon_{it} - \varepsilon_{i\tau}) \quad (5)$$

where α_t= overall annual market price level,

G_{it}= the standard matrix of indicators that identify sales dates, a time dummy equal to 1 at second sale date, -1 at the first sale date, and 0 otherwise,

N_i = the change in the number of abandoned residential properties within 250 ft from a subject property between sales,

$D1_i$= 1 if $N_i > X_1$ or 0 if otherwise,

$D2_i$= 1 if $N_i > X_2$ or 0 if otherwise, and

F_i = the change in the number of foreclosed properties within 250 ft from a subject property between sales, and

ε_{it} and $\varepsilon_{i\tau}$ are the error terms at the periods of the first and the second sale, respectively, with zero means, equal variances, and uncorrelated with each other. The error term is assumed to be independent and identically distributed and captures pure random shocks to the transaction price.

When the locations of threshold values are unknown, the regression model becomes nonlinear in its parameters. Consequently, a nonlinear estimation method such as nonlinear least squares must be used. Therefore, I used nonlinear least squares to estimate the location and the regression function simultaneously.

3.3. Data Construction

Constructing accurate repeat sales data is critical to calculating the impact of abandoned property on nearby property values. Therefore, I applied three stages of filtering to the Baltimore City Department of Housing and Community Development's residential property sales data. In the first stage, I extracted a list of transactions of single-family houses that were sold at least twice between January 1, 1991, and December 31, 2010, in Baltimore. After extraction, I created sales pairs while ensuring that two transactions were indeed about the same property by comparing the addresses, block lot number, size of the lot, and land use code. The repeat sales data include only

true market transactions. Therefore, in the next stage, I excluded non-representative transactions like non-arm's-length transactions such as lease, gift, auction, foreclosure, straw deed, tax sales, and confirmation deed. In the final stage, I filtered the repeat sales pairs to eliminate any flipped properties and outliers that violate the repeat sales methodology assumption that property and neighborhood characteristics have not changed between transactions. Clapp and Giacotto (1999) suggested that flipped properties refer to properties that are improved and resold after a short period of time (within one or two years). These flipped properties, therefore, have much higher price appreciation and can cause biased repeat sales index as well as other estimated coefficients. Examining Baltimore residential property sales data, transactions with less than a one-year holding period showed abnormally high price appreciation. Thus any transactions with a holding period shorter than one year were eliminated from the dataset. Finally, outliers - properties with abnormal price increases - were identified. Abnormal price increases suggest properties that are likely altered or improved, which violates the repeat sales methodology assumption that property characteristics remain the same between transactions. In addition, such abnormal price increases might be indicative of mortgage fraud. In order to identify outliers, quarterly price appreciation was calculated for all the transactions for abnormality and less than 1% of the total remaining transactions that were identified as outliers were eliminated from the dataset. After the three stages of filter, the final dataset had a total of 101,497 repeat sales pairs. The average price at the time of the initial purchase in the repeat sales pair was $79,885.14, whereas the average price at the time of the second sale was $116,338.30. The mean holding period between the transactions was 1,761 days (4.83 years).

Finally, I identified all of the abandoned and foreclosed properties within 250 ft[2] present at each sale date of each repeat sale pair (see the size of the area in Figure 3). The distance between each abandoned property and subject property as well as each foreclosed property and subject property was calculated using the Generate Near Table tool in ESRI ArcGIS software.

Figure 3. 250 ft ring around the repeat sales pair property in typical Baltimore neighborhood

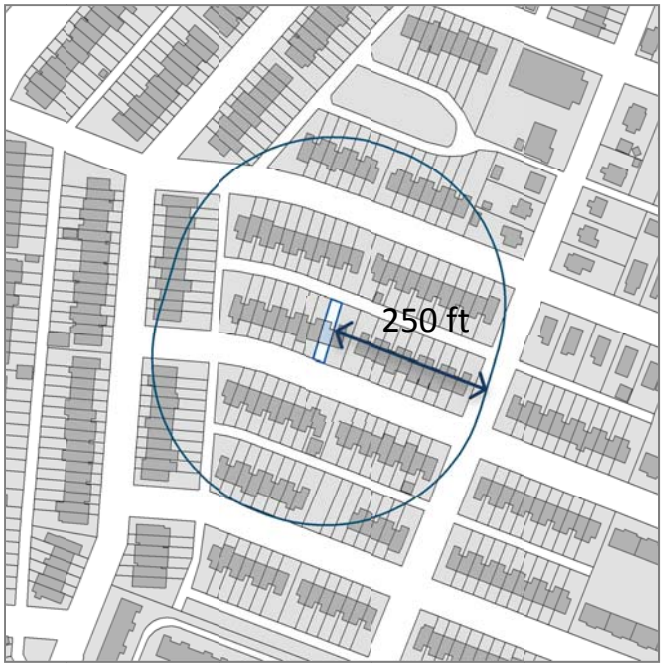


Figure 3 is from an actual Baltimore neighborhood. A 250 ft. ring is drawn around the boundary of the subject property – a sample of repeat sales pair –, which is located at the center of the ring. On average, there are 101 housing structures in a 250 ft. radius ring in the data sample (N=101,497).

[2] In a previous study the author examined the impact of housing abandonment on nearby property values depending on the location of abandoned properties and the duration of abandonment. The author found that only the properties abandoned within 250 ft had a statistically significant impact on nearby property values regardless how long the properties have been abandoned. Therefore this study only considers abandoned properties within 250 ft.

4. Results

4.1. Descriptive Statistics

Change in the extent of housing abandonment between sales

The final data set had a total of 101,497 repeat sales pairs between January 1, 1991, and December 30, 2010, in Baltimore, MD. Approximately 61% of these repeat sales pairs, 61,993 pairs, had housing abandonment within 250 ft. to some degree at either sale date or both sale dates. Between the sale transactions among these 61,993 repeat sales pairs, there was, on average, an increase of 2.81 abandoned properties at the second sale date compared to the first one (as shown in Table 1). The average increase in the number of abandoned properties was modest given the significant increase in housing abandonment during the data period in Baltimore, although a few repeat sales pairs saw a large increase in the number of abandoned properties at the second sale (see Table 2). The standard deviation indicated that the change in housing abandonment at the second sale ranges from approximately 12 less abandoned properties to 18 more new abandoned properties. This is a significant change given there are roughly 101 residential properties in 250 ft. radius.

Table 1. Change in the number of abandoned properties between sales (1991 – 2010) (within 250 ft.; N=61,993)

	Mean	Standard Deviation	Minimum	Maximum
Change in the number of abandoned properties	2.81	7.37	-40	88

Table 2 shows the distribution of the change in the number of abandoned properties between sales. As Table 2 shows, only 13.6% of 61,993 pairs had no change in the number of

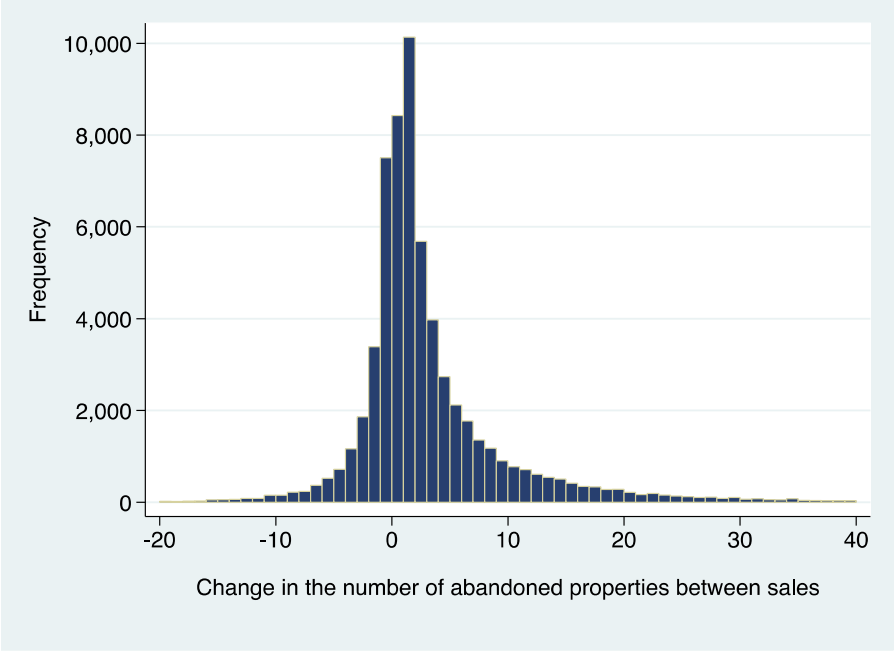
abandoned properties between sales. And approximately 60% of the properties that had some extent of housing abandonment within 250 ft. at the first sale saw an increase in the number of abandoned properties at the second sale. And only 27% of the properties that had some extent of housing abandonment at the first sale saw a decrease in the housing abandonment at the second sale.

Table 2. Distribution of the change in the number of abandoned properties between sales (1991 – 2010) (within 250 ft.; N=61,993)

Change in the number of abandoned properties between	Frequency	Percent	Change in the number of abandoned properties between	Frequency	Percent
-40 – -11	629	1.01	5	2,117	3.41
-10 – -6	1,494	2.41	6	1,770	2.86
-5	714	1.15	7	1,352	2.18
-4	1,163	1.88	8	1,178	1.90
-3	1,858	3.00	9	899	1.45
-2	3,387	5.46	10	772	1.25
-1	**7,504**	**12.10**	11	708	1.14
0	**8,422**	**13.59**	12	609	0.98
1	**10,129**	**16.34**	13 – 14	1,047	1.69
2	**5,682**	**9.17**	15 – 19	1,651	2.66
3	3,973	6.41	20 – 29	1,390	2.24
4	2,735	4.41	30 – 88	810	1.31

Furthermore, Table 2 and Figure 4 show that there were more than 6,000 repeat sales pairs that had as many as 11 to 88 more new abandoned properties at the second sale, whereas only 629 repeat sales pairs saw a very significant decrease in housing abandonment by the time the property was sold again. This significant decrease in housing abandonment may be due to a large demolition of abandoned properties by Baltimore City.

Figure 4. Distribution of change in housing abandonment at the second sale compared to the first sale (1991 – 2010) (within 250 ft.; N=61,993)



4.2. Estimation of Thresholds

4.2.1. Estimation of Impact of Abandoned Properties Assuming the Impact Is linear

First, I present the average impact of an additional abandoned property within 250 ft. at the second sale compared with the first one, assuming the impact of abandonment is linear. Using the repeat sales methodology model, equation 3, the result is shown in Table 3.

Table 3. Estimated contagion effect of abandoned properties within 250 ft. (1991-2010) (within 250 ft.: N=101,497)

	Contagion Effect	*t*-Statistics	*p*>|t|
Abandonment	-1.496***	-38.27	0.000
Foreclosure	-2.400***	-20.13	0.000

Note: Coefficients of slopes are scaled by 100: *t*-ratios are based on robust standard errors. Regression output includes the -1, 0, 1 dummy variables from the repeat sales model as additional regressors, but coefficients on those variables are not reported here to save space. ***$p < 0.001$.

Table 3 demonstrates that an additional abandoned property within 250 ft. at the second sale reduces the nearby property value by approximately 1.496% when nearby foreclosures within 250 ft. and market level are held constant. It also shows that a foreclosed property has a greater impact on nearby property values compared to an abandoned property; an additional foreclosed property within 250 ft. reduces the nearby property value by approximately 2.4% when nearby abandoned properties within 250 ft. and market level are held constant.

4.2.2. Estimation of Impact of Abandoned Properties Assuming the Impact Is Nonlinear

This section presents the results of the piecewise linear regression models with spline functions. The threshold values and the magnitude of each spline are estimated using equation 4. The result – the regression output showing the estimated coefficient values for two thresholds X_1 and X_2 and the estimated coefficient values for the slopes of three splines – is shown in Table 4. I used nonlinear least squares regression and after 8 iterations, the nonlinear least squares procedure successfully converged to the spline regression results.

Table 4. Estimated thresholds and contagion effects (1991-2010) (within 250 ft.; N=101,497)

	Estimated Coefficients	*t*-Statistics	$p > \|t\|$
X_1 (first threshold = change in abandonment)	2.101*	1.90	0.058
X_2 (second threshold = change in abandonment)	13.807***	16.69	0.000
Slope of spline 1 (impact when increase in abandonment < X_1)	-0.974***	-8.38	0.000
Slope of spline 2 (impact when $X_1 \leq$ increase in abandonment < X_2)	-2.661***	-27.93	0.000
Slope of spline 3 (impact when increase in abandonment ≥ X_2)	-0.429***	-4.59	0.000
Foreclosure impact	-2.591***	-21.59	0.000

Note: Coefficients of slopes are scaled by 100: *t*-ratios are based on robust standard errors. Regression output includes the -1, 0, 1 dummy variables from the repeat sales model as additional regressors, but coefficients on those variables are not reported here to save space. *$p < 0.1$. ***$p < 0.001$.

As shown in Table 4, the piecewise linear regression models with spline functions find the first threshold value to be roughly 2.1 and the second threshold value to be roughly 13.8. The estimated coefficients for the slopes indicate that when the number of increase in abandoned properties is less than 2, on average for each additional abandoned property, the nearby property value is expected to decrease by 0.97% when nearby foreclosures and market price level are controlled. However, when the number of abandoned properties increased by more than 2 properties at the second sale compared to the first sale, the impact of abandoned properties increases more significantly in magnitude. As shown in Table 4, when the increase in the number of nearby abandoned properties at the second sale is between 2 and 14, for each additional abandoned property, nearby property value is expected to decrease by 2.66%. However, it also finds that when the number of increase in housing abandonment exceeds approximately 14, the nearby property values do not drop dramatically as the number increases; the magnitude of the impact of each additional abandoned property is substantially reduced to 0.43% from 2.66%.

Figure 5 illustrates the research findings, how the impact of housing abandonment changes as the number of increases in housing abandonment exceeds the threshold values, approximately 2.1 and 13.8 abandoned properties respectively.

Figure 5. Nonlinear impact of housing abandonment

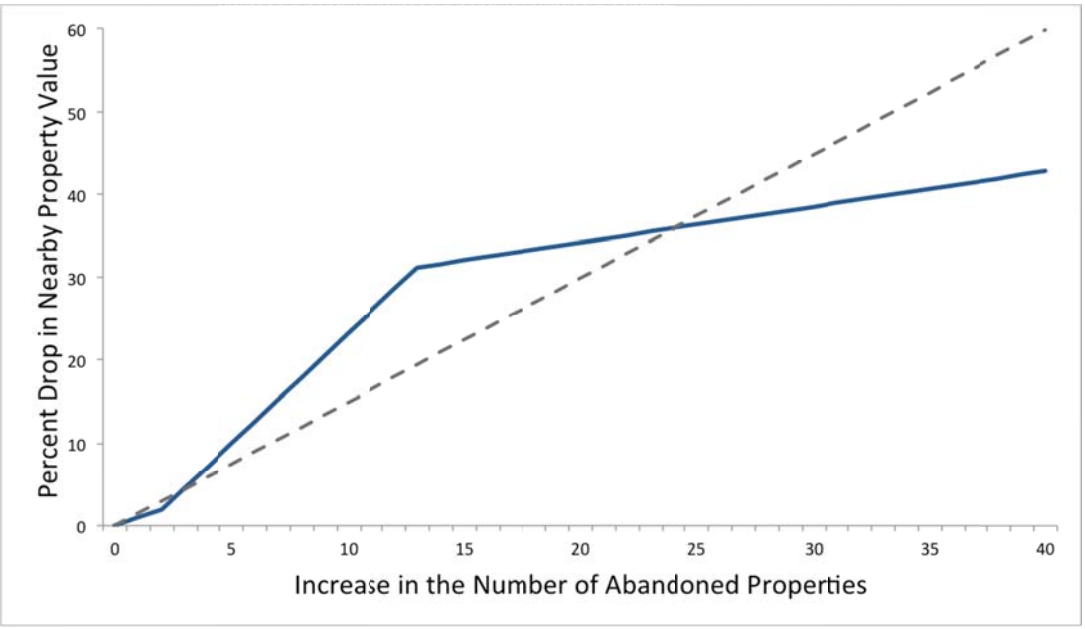


Figure 5 also shows that the impact of housing abandonment on nearby property values has overall very low threshold values. On average, there are approximately 101 residential properties in a 250 ft. radius and Table 1 and 2 showed that the increase in housing abandonment ranged from just one more abandoned property in a 250 ft. radius to as many as 88 more abandoned properties. Yet, the research findings indicate that just two more abandoned properties can significantly increase the negative impact of abandoned properties on nearby property values. This is consistent with what has been suggested by previous researchers: that the threshold value where the impact of distressed properties increases significantly may be very small or just one distressed property.

Furthermore, this research finds that once there are about 14 more abandoned properties within a 250 ft. radius, the impact of additional abandoned property on nearby property value is significantly reduced. This is also consistent with the past research findings that the magnitude of the impact of distressed properties did not appear to increase proportionally to the number of distressed properties. It could be that the market value of property in the vicinity of this magnitude of housing abandonment had already been significantly depressed.

Finally, Figure 5 compares the magnitude of linear impact to the magnitude of nonlinear impact of housing abandonment; a dotted line shows the increase in magnitude when the impact is assumed to be linear. As shown in Figure 5, the previous research which estimated the impact of abandoned properties assuming linear impact may have overestimated or underestimated the actual impact of housing abandonment on nearby property values. When the impact of housing abandonment is assumed to be linear, equation 3 demonstrated that one additional abandoned property reduces nearby property value by roughly 1.5%. Therefore, as shown in Figure 5, the net negative impact of housing abandonment would be actually larger in magnitude than predicted in areas where there are relatively few abandoned properties. Likewise, the net negative impact of housing abandonment would be smaller than predicted in areas where there are a significant number of distressed properties.

5. Conclusion

The manner in which the foreclosure crisis has affected our neighborhoods is clearly evident in the dilapidated, boarded-up homes in many neighborhoods across the country. Many foreclosed properties are likely to sit vacant for prolonged periods and end up abandoned. The problem of chronic vacant and abandoned properties is one of the critical issues Baltimore, Maryland, has been facing in many of its neighborhoods for decades. Unfortunately, Baltimore is not alone; many poor, minority, urban neighborhoods in old industrial cities such as Philadelphia, Detroit, and Cleveland have been suffering from chronic housing abandonment problems for decades, long before today's foreclosure crisis. With the recent foreclosure crisis, this problem is now spreading to small town and suburbs across the country.

Increasing number of foreclosures, vacant, and abandoned properties across the country led to a significant volume of research and empirical studies that estimate the negative spillover effects of such distressed properties on neighborhood quality (Frame, 2010; Joice, 2011). These studies found that these distressed properties have a significant adverse effect on neighborhoods, including weakening the local housing market, lowering nearby non-distressed property values, and increasing crime rates (Joice, 2011). Therefore, a number of government initiatives were developed in the past few years to deal with foreclosed and vacant, abandoned properties – specifically to purchase, rehab, or demolish these properties. However, the funds available through government initiatives are typically insufficient given the insignificant volume of distressed properties in many U.S. cities (U.S. Government Accoutability Office, 2011). Therefore, local governments need to be very strategic in their allocation of limited resources (Thomson, 2011). The primary policy objective of this research was to help governments do just that – effectively target funds to address housing abandonment.

Identifying thresholds would provide guideposts for strategic geographic planning. If past a certain threshold the magnitude of the impact of abandoned properties on nearby property values increases dramatically, local governments should target their resources to areas that are close to reaching that threshold or to areas that have recently passed the threshold.

This research explored the presence of threshold effects in the impact of housing abandonment on nearby property values in Baltimore, Maryland from 1991 to 2010. Using longitudinal data on housing abandonment and nearby property values, this research first used weighted repeat sales methodology to construct a model that estimates the impact of abandoned properties on nearby property values within 250 ft. while controlling for nearby foreclosures and local market trends and then used a piecewise linear regression model with spline functions to explore threshold effects. Specifically, based on a theory of threshold effects in dynamics of neighborhood environment, this research explored how and whether the impact of abandoned properties on nearby property values changes as the increase in the number of nearby abandoned properties exceeds some critical points.

This research found that when the number of nearby abandoned properties increases by more than two between the first and second sale, the marginal impact of abandoned properties on nearby property values increased from 0.97% to 2.66%. Furthermore, it also found that when the increase in housing abandonment between the first and second sale exceeds approximately 14, the marginal impact on the nearby property values dropped: the magnitude of the impact of each additional abandoned property was reduced to 0.43% from 2.66%. However, housing abandonment is disproportionally distributed across Baltimore City and the distribution of abandoned properties and the sales of properties vary among its neighborhoods. Therefore, the estimated thresholds in

the increase in housing abandonment and the magnitudes of the impacts may vary based on the neighborhood characteristics. This should be the subject of the future research.

These research findings provide empirical evidence to support the previous claims that the magnitude of the impact of distressed properties does not appear to increase proportionally to the number of distressed properties. Furthermore, the nonlinearity of impact of housing abandonment suggests that the previous research, which estimated the contagion effect of distressed properties assuming linear impact, may have overestimated or underestimated the actual effect of distressed properties. The net negative effect of distressed properties would be actually larger in magnitude than predicted in areas where there are relatively few distressed properties. Likewise, the net negative effect of distressed properties would be smaller than predicted in areas where there are a significant number of distressed properties.

This research demonstrated that only two more abandoned properties within 250 ft. between sales would significantly increase the magnitude of the impact of abandoned properties on nearby property values, however the magnitude of the impact would be no longer significant after the area experiences a critical volume of housing abandonment. Therefore, for policy implications, this research suggests that government efforts are more effective when focused in carefully selected areas with relatively small numbers of abandoned properties, where the government interventions could help reoccupy as many as possible of the abandoned properties – if not all of abandoned properties – rather than spreading resources thinly across entire neighborhoods or cities.

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PAPER 3:

NEIGHBORHOOD CHARACTERISTICS AND RESILIENCY TO THE IMPACTS OF HOUSING ABANDONMENT

1. Introduction

Studies have shown that abandoned properties harm cities by lowering nearby property values (Griswold & Norris, 2007; Mikelbank, 2008; Shlay & Whitman, 2006). Housing abandonment, however, is often unevenly distributed in cities with abandonment problems. Abandoned properties are often concentrated in low-income and minority urban neighborhoods. In some neighborhoods, vacant properties are reoccupied quickly, minimizing any ill effects on the neighborhood, whereas in other neighborhoods, vacant properties sit abandoned for years.

In an attempt to explain why housing abandonment is concentrated in a number of neighborhoods, previous studies have found that several socio-economic and spatial characteristics play an important role (Bassett, Schweitzer, & Panken, 2006; Hillier, Culhane, Smith, & Tomlin, 2003; Silverman, Yin, & Patterson, 2012; Sternlieb & Burchell, 1973; Wilson, Margulis, & Ketchum, 1994). If the spread of housing abandonment correlates with specific neighborhood characteristics, it is possible that the magnitude of impact of housing abandonment is also correlated with neighborhood characteristics. However, there has been no investigation into whether and how the impact of housing abandonment might vary among neighborhoods with different social and geographic characteristics. Furthermore, if the

magnitude of impact of housing abandonment does differ depending on the neighborhood, what would account for such variability?

As geographic targeting has become a common strategy for governments facing widespread foreclosures and housing abandonment, a better understanding of the impacts of abandonment, particularly how they vary among neighborhoods, would help those governments improve their geographic targeting strategies. When abandonment becomes severe, and governments resort to taking ownership of and demolishing abandoned structures, it comes at great cost to the government and the community. Strategic demolition and acquisition of abandoned structures is difficult and expensive, but it is inevitable and necessary for some areas. If we have an understanding of what neighborhood characteristics mitigate the negative impact of housing abandonment, then, rather than treating abandonment as only a problem affecting the housing market, cities could begin to view improving neighborhood characteristics as an integral part of their efforts in fighting abandonment.

Therefore, the purpose of the research described in this paper is to explore whether the magnitude of impact of housing abandonment on nearby property values differs among neighborhoods with different social characteristics, and if so, explore what accounts for such variability. Deriving from the neighborhood effect theory, this research is particularly interested in exploring whether neighborhood disadvantage and social organization would influence the impact of housing abandonment. I answer these research questions by examining the impact of housing abandonment on nearby property values in Baltimore neighborhoods between 2001 and 2010. I use latent growth curve modeling to analyze and compare the magnitude of impact of housing abandonment among different neighborhoods.

The remainder of this article is divided into five sections. I begin by examining relevant theories and previous empirical studies that have explored why neighborhood effects matter and what neighborhood characteristics are associated with housing abandonment. Next, I discuss the policy implications and scholarly contribution of this research, followed by research objective and research questions. Next, I describe the research data and methodology used to answer the research questions. After presenting the research findings, this article concludes with a discussion of the scholarly contribution and policy implications of this research.

1.1. What May Explain the Variability of the Impact of Housing Abandonment among Neighborhoods?

This section examines the theories and past empirical studies that may provide a clue to what explains this disproportionate housing abandonment pattern and its impacts among different neighborhoods.

Neighborhood Effect

The Neighborhood effect is commonly defined as an impact of a group of neighborhood residents or the characteristics of an individual's neighborhood on individual behavior or socioeconomic outcome. The sociologist, William Julius Wilson, has been a major figure in popularizing the concept of neighborhood effect. Through his books, *The Truly disadvantaged* and *When Work Disappears*, he contended that living in a primarily minority poor urban neighborhood has detrimental effects on a wide range of individual outcomes including health, education, victimization, wealth, and job opportunities (Wilson W. J., 1987; Wilson W. J., 1997). Although some researchers have challenged his idea noting the lack of accounting for the role of

individual selection effects (resident choice in neighborhood selection) and noting the general uncertainty in defining the geographical boundary of any neighborhood, researchers have consistently found that a number of neighborhood characteristics were associated with individual outcomes. Most recently, another sociologist, Robert J. Sampson, demonstrated in his book*, Great American City: Chicago and the Enduring Neighborhood Effect*, that exposure to severely disadvantaged neighborhoods have persistent negative effects on individual outcomes, even after subjects move to better-off neighborhoods, as well as rates of behavior across neighborhoods (Sampson, 2012). From extensive analysis of data on Chicago neighborhoods, Sampson found that living in severely disadvantaged neighborhoods affected joblessness, poverty, verbal ability of children, violence, incarceration, and collective efficacy (Sampson, 2012). In addition, Sampson argued that individual selection was itself a neighborhood effect; he contended that neighborhoods affect individual choice in neighborhood and perceptions, which in turn influenced mobility and neighborhood composition and social dynamics (Sampson, 2012).

Most neighborhood effect research has focused primarily on neighborhood disadvantage on child and adolescent development outcomes including infant mortality, teenage pregnancy, dropping out of high school, and adolescent delinquency (Brooks-Gunn, Duncan, & Aber, 1997; Brooks-Gunn, Duncan, Klebanow, & Sealand, 1993; Crane, 1991; Ellen & Turner, 1997; Sampson, Morenoff, & Gannon-Rowley, 2002). There is also socio-ecological literature that, moving beyond traditional neighborhood characteristics such as concentrated poverty, examined neighborhood characteristics such as residential stability and home ownership. Their findings are consistent with the literature on neighborhood disadvantage; they found a considerable social inequality among neighborhoods and, though the evidence is mixed, they found a correlation between residential stability or home ownership and a number of adolescent problem behaviors including poor academic performance and dropping out of high

school (Astone & Mclanahan, 1994; Brooks-Gunn, Duncan, & Aber, 1997; Pribesh & Downey, 1999; Sampson, Morenoff, & Gannon-Rowley, 2002).

Social Disorganization Theory, Collective Efficacy, and Social Capital

More recently, scholars began to examine how neighborhood-level social and institutional processes such as social control, mutual trust, and institutional resources influence the well-being of children and adolescents (Sampson, Morenoff, & Gannon-Rowley, 2002). This approach drew its motivation from Shaw and McKay's seminal work published in *Juvenile Delinquency and Urban Areas* in 1942. Shaw and McKay (1942) conducted a research on criminal behavior in the City of Chicago and found that crime rates were not evenly dispersed across time and space in the city but rather concentrated and persistent in specific areas of the city, regardless of what racial or ethnic group happened to reside there. Therefore, they argued that crime was more likely a function of neighborhood dynamics, not necessarily a function of the individuals in that neighborhood (Shaw & McKay, 1942). Furthermore, they found that low economic status, ethnic heterogeneity, and residential instability led to socially disorganized neighborhoods that in turn tend to produce "criminal traditions" that could be passed down to successive generations (Shaw & McKay, 1942). Sampson (2012) defined this social disorganization concept which grew out of Shaw and McKay's study as "the inability of a community to realize the common values of its residents and maintain effective social controls." However, some scholars challenged the idea of social disorganization noting that high crime areas often were both organized and disorganized simultaneously because criminal networks, organized gangs, and strong social ties existed even in many so-called disorganized slums (Sampson, 2012).

Sampson and his colleagues proposed a theory of collective efficacy to address the conceptual issues of social disorganization theory. They defined "collective efficacy" as social cohesion or trust among neighbors combined with their willingness to intervene in social control (Morenoff, Sampson, & Raudenbush, 2001; Sampson, Raudenbush, & Earls, 1997; Sampson, 2012). Sampson et al. (1997) tested the idea of collective efficacy studying Chicago neighborhoods and found that collective efficacy was negatively associated with violence when individual-level characteristics and prior violence were controlled. Morenoff et al. (2001) studied homicides in Chicago neighborhoods between 1996 and 1998 and concluded that concentrated disadvantage and low levels of social control and social cohesion predicted higher homicide rates.

Recently, the idea of *social capital* became popular among planning scholars, especially community development theorists and practitioners (DeFilippis, 2001; Hutchinson, et al., 2004). Although there are many definitions of this term, social capital is commonly defined as a resource embodied in the social ties among people. Kruger, Hutchison, Monroe, Reischl, and Morrel-Samuels (2007) examined the association between social capital and fear of neighborhood crime and found that community interventions promoting communication and cooperation among neighbors, thereby enhancing social capital, was likely to be effective in reducing fear of crime and the actual level of crime.

Temkin and Rohe (1996) reviewed three major schools of thought on how neighborhoods change – ecological, subcultural, and policy economy – and presented a synthetic model of neighborhood change. Temkin and Rohe (1998) argued that neighborhood change was a function of external sources of financial, political, and social factors as well as internal physical, social, and locational characteristics. They presented a social capital model of

neighborhood change. In that model, they expanded on the concept of social capital to include sociocultural milieu and institutional infrastructure. They supported their model by analyzing neighborhood change in Pittsburgh between 1980 and 1990. They found that higher levels of social capital played a significant role in neighborhood stability.

Property and Neighborhood Characteristics Associated with Housing Abandonment

A number of studies have attempted to identify the property and neighborhood characteristics which are linked to property abandonment. Sternlieb and Burchell (1973) attempted to explain what buildings are likely to become abandoned by examining abandonment in Newark, NJ. They found that the prior tax delinquency of a building was the most significant predictor of abandonment (Sternlieb & Burchell, 1973). In addition, they found that absentee landlords, professional managers or rent collectors, nonwhite tenants, white owners, no mortgage, adjacent deteriorated housing, and location within the urban core were other significant predictors of abandonment (Sternlieb & Burchell, 1973).

In another study, Scafidi, Schill, Wachter, and Culhane (1998) examined the residential properties in New York City and found that when the sum of all municipal liens against a property exceeded its market value, the property owner would choose to abandon the property. Hiller, Culhane, Smith, and Tomlin (2003) examined housing data in Philadelphia and found that a number of different characteristics of the property – including whether the property was vacant, had outstanding code violations, or had tax arrearages – were strong predictors of housing abandonment. Hiller et al. also found that proximity to neighborhood blight, such as a dangerous structure, or a demolished structure, and location in a neighborhood with a high

number of tax delinquencies or outstanding code violations predicted which properties were most likely to be abandoned (Hillier, Culhane, Smith, & Tomlin, 2003).

Wilson, Margulis, and Ketchum (1994) examined the patterns of housing abandonment in Cleveland Ohio in 1980 and again in 1990. This study found that two neighborhood types – owner occupied moderate-income and low-income black – were strongly associated with high rates of housing abandonment in 1980 (Wilson, Margulis, & Ketchum, 1994). In contrast, the study also found that, in 1990, newly arrived high unemployment, owner occupied moderate-income, and low-income black were strongly associated with high rates of housing abandonment (Wilson, Margulis, & Ketchum, 1994). This study also found that the spread of housing abandonment was not random; in contrast to a common belief, housing abandonment did not correlate highly with only dilapidated and low-income neighborhoods but instead, diverse types of neighborhoods experienced growing rates of abandonment (Wilson, Margulis, & Ketchum, 1994).

Bassett, Schweitzer and Panken (2006) examined the housing abandonment in Flint, Michigan in three time periods: years 1980, 1990, and 2000. They found that a wide range of socio-economic and spatial characteristics were strongly correlated with vacancy at each census tract level. Specifically, this study found that higher unemployment and poverty rates led to higher vacancy whereas higher home ownership, median housing value, and median household income led to lower vacancy rates (Bassett, Schweitzer, & Panken, 2006). More recently, Silverman, Yin, and Patterson (2012) performed the same analysis for a different city (Buffalo, New York) and found that the percent of abandoned residential properties increased in census tracts with highly concentrated black populations, elevated poverty rates, long-term vacancies, and a higher percentage of business addresses (Silverman, Yin, & Patterson, 2012).

Government Intervention to Address Housing Abandonment Problems

To mitigate the impact of housing abandonment on its surroundings, local governments and partner community organizations engage in a variety of efforts to address abandonment. One of the common strategies is to acquire and rehabilitate abandoned properties, often using federal funds (U.S. Government Accoutability Office, 2011). As funds are often limited, cities often target areas of greatest need or areas where they are thought to have the most impact (U.S. Government Accoutability Office, 2011). Baltimore City's most recent initiative, "Vacants to Value" program is a good example. This program focuses on abandoned properties in emerging market areas. This program targets areas near redevelopment projects to incentivize private developers to rehabilitate nearby properties (U.S. Government Accoutability Office, 2011). However, a number of factors often complicate the effort at the local level: insufficient funds or lack of expertise in real estate deals, cost of rehabilitating properties in very poor condition, substantial volume of properties, and a lack of interested buyers (U.S. Government Accoutability Office, 2011).

Prior to "Vacants to Value" initiative, Baltimore City pursued demolition and revitalization programs to address its severely blighted properties. The City demolished many of its worst structures or refurbish abandoned properties through *Project 5000*, and it seized abandoned tax-delinquent properties through *Project SCOPE*. However, the City's efforts could not adequately respond to the enormous volume of abandoned properties. Moreover, demolishing abandoned properties is very expensive because most of Baltimore's abandoned properties are row houses and share walls with adjacent units. It costs Baltimore City between $13,000 and $40,000 to demolish a single row house, depending on the size and the number of walls (U.S. Government Accoutability Office, 2011). Baltimore officials estimated that it would

cost approximately $180 million just to demolish the most unsafe abandoned properties (U.S. Government Accoutability Office, 2011).

Concentrating resources in limited geographic areas to enhance the impact of public intervention, commonly known as strategic geographic targeting, has been a popular tool for cities with substantial housing abandonment problems. For instance, Baltimore City has been prioritizing its investments in redevelopment projects of abandoned properties near large public investments such as HOPE VI developments or East Baltimore's Biotech Park revitalization project, in transitioning neighborhoods, or areas near the city's major amenities such as its transportation hubs (Institute for Policy Studies, the John Hopkins University, 2006). By targeting their investments in these areas, the City hopes to generate interest from private developers to acquire and rehabilitate other abandoned properties.

Spatial Trends in Housing Abandonment over Time

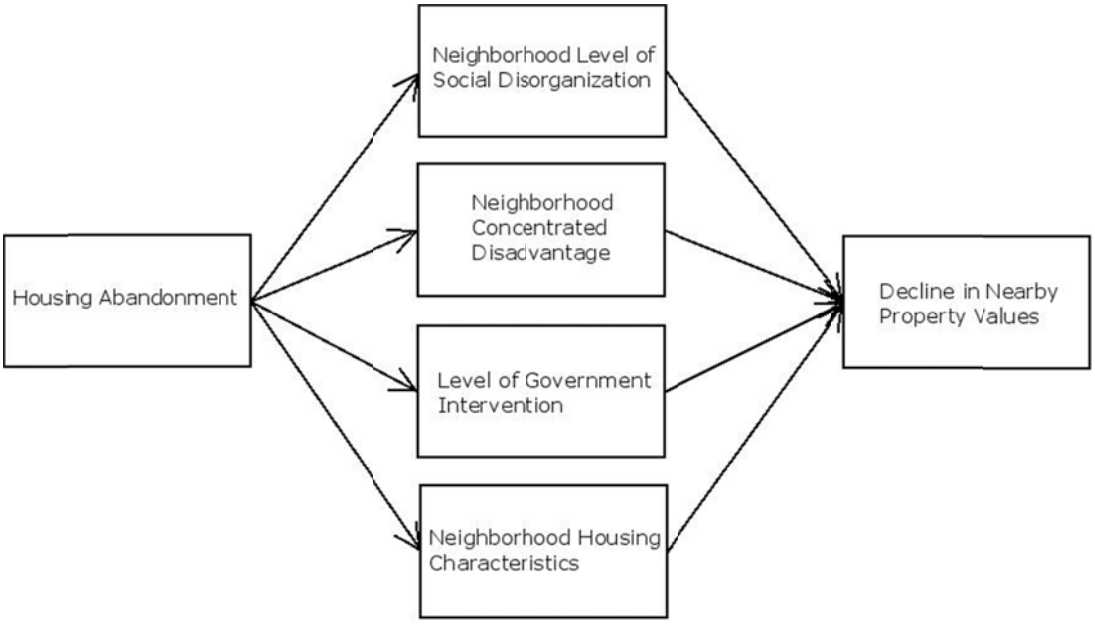
Prior research has not examined whether trends in neighborhood quality and trends in abandonment over time parallel each other. The only findings on abandonment over time indicate that abandonment spreads from a core to adjacent areas. Odland and Balzar (1979) studied the effects of abandoned properties on adjacent housing in Indianapolis and developed the contagion diffusion model. According to this model, there was a disease-like spread of abandonment within 400 meters of an abandoned property over a 6-month period (Odland & Balzer, 1979). Another study by Wilson et al. (1994) examining the spatial pattern of housing abandonment also found that abandonment spread to adjacent areas over time. In Cleveland between 1980 and 1990, they found widespread abandonment in a core area penetrated

neighborhoods more than 0.5 miles from the core (Wilson, Margulis, & Ketchum, 1994). This study also found that while neighborhoods from 0.25 to 0.5 miles to the core had an increase in abandonment of 16 percent, neighborhoods less than 0.25 miles from the core had an increase in abandonment of 21 percent. Neighborhoods beyond 0.5 miles from the core had a decrease in abandonment of 11 percent (Wilson, Margulis, & Ketchum, 1994). Taken together, these studies imply that over time abandonment does spread into surrounding areas.

Conceptual Framework

The conceptual model underlying this research suggests that housing abandonment negatively affects nearby property values. It further hypothesizes that the impact of abandonment on nearby property values is mediated through the neighborhood characteristics shown in Figure 1.

Figure 1. Conceptual framework



Based on the literature review, the model suggests that there are four categories of mediating variables at neighborhood level: neighborhood social disorganization, neighborhood concentrated disadvantage, level of government intervention in a neighborhood, and neighborhood housing characteristics. This model suggests that higher level of neighborhood social disorganization or neighborhood concentrated disadvantage may exacerbate the magnitude of impact of housing abandonment on nearby property values. In contrast, higher level of government intervention in a neighborhood may mitigate the degree abandonment impacts nearby property values. Finally, poor neighborhood housing conditions may account for the variability in the extent to which housing abandonment impacts nearby property values among neighborhoods.

1.4. Why Research on the Variability in the Impact of Housing Abandonment?

Policy Implications

Abandoned properties are a waste of housing resources. At the same time, for governments, they mean lost tax revenues. Economic loss is not confined to abandoned properties themselves; they weaken the neighborhood housing market by lowering nearby property values, as studies have shown. Yet, for most cities with housing abandonment, government resources are limited, thus it becomes necessary for governments to be strategic in their decisions about where and how to allocate their resources. Therefore, if there were evidence to support that the magnitude of impact of housing abandonment varies among different neighborhoods depending on the neighborhood characteristics, then such understanding would help governments to improve their geographic targeting strategies to maximize the impact of public intervention. Moreover, demolition and acquisition of abandoned properties is a costly and a difficult task (Mallach, 2012; U.S. Government Accoutability Office, 2011). But it is inevitable and necessary for some areas. If we have an understanding of what neighborhood characteristics mitigate the negative impact of housing abandonment, then, rather than treating abandonment as only a problem affecting the housing market, cities could begin to view improving neighborhood characteristics as an integral part of their efforts in fighting abandonment.

1.5. Research Objective and Questions

The primary purpose of this research is to explore whether and why some neighborhoods are more resilient than others to the negative impacts of housing abandonment.

First, it attempts to explore whether the impact of an abandoned property on nearby property values does vary among different neighborhoods. Second, if there is variability in the degree of impact of housing abandonment among neighborhoods, this research will explore what accounts for such variability. Deriving from the neighborhood effect theories, this research is particularly interested whether concentrated disadvantage within a neighborhood as well as factors affecting the neighborhood social dynamics – level of social organization, for example – would affect the degree to which housing abandonment affects nearby property values.

To achieve these research objectives, this research examines the impact of housing abandonment on nearby property values in Baltimore city neighborhoods from 2001 to 2010 and attempts to answer the following research questions:

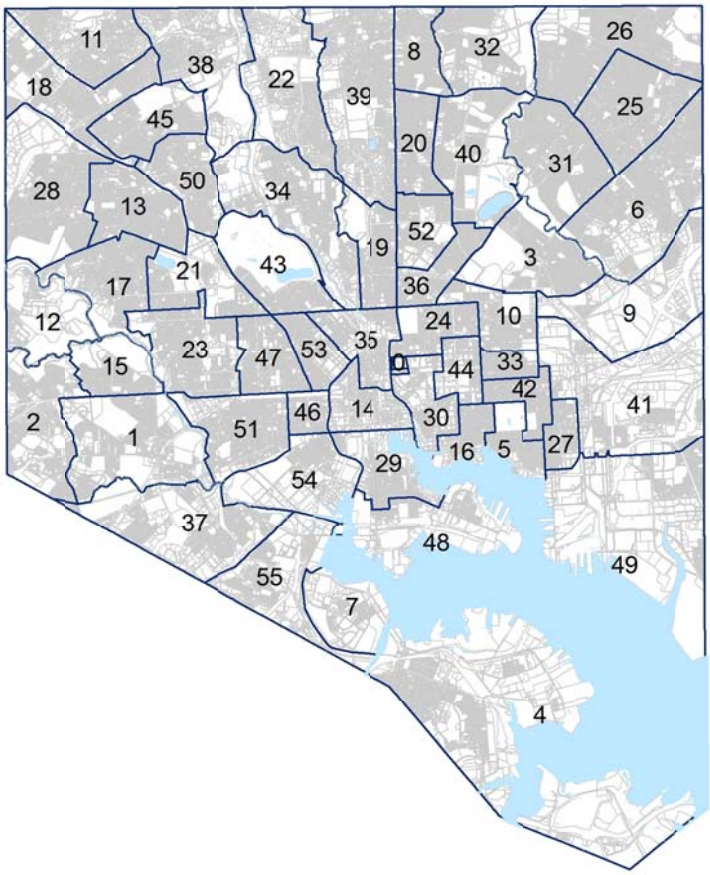
1. Does the impact of housing abandonment on nearby property values vary among different Baltimore neighborhoods?
2. If there exists variability in the degree of impact of housing abandonment among different neighborhoods, what neighborhood characteristics explain such variability?
    1) Is a neighborhood with a relatively high level of neighborhood-level social organization more resilient than a neighborhood with a relatively low level?
    2) Is a neighborhood with a relatively high level of concentrated disadvantage less resilient than a neighborhood with a relatively low level?

2. Data and Variables

Unit of Analysis: Baltimore Neighborhood

In this research, the unit of analysis is neighborhood in Baltimore City. This research used the 55 Community Statistical Areas (CSAs) as its definition of neighborhoods (see Fig 2). CSAs are aggregations of United States Census Tracts. The CSAs were originally created by the Baltimore City Department of Planning in conjunction with the Jacob France Institute's Baltimore Data Collaborative (Baltimore Neighborhood Indicators Alliance - Jacob France Institute, 2012).

Figure 2. The City of Baltimore divided into 55 Community Statistical Areas (CSAs)



Source: Created using GIS data available and retrieved Baltimore Neighborhood Indicators Alliance – Jacob France Institute, www.bniajfi.org/gis_shapefiles.
Note: The names of CSAs are provided in appendix A.

Like many of the old industrial cities in the United States, Baltimore, Maryland, has been grappling with chronic property abandonment for decades. Baltimore's housing abandonment has two major causes: economic decline and population loss (Cohen, 2001). Historically, Baltimore was a home to a vibrant manufacturing and shipping industry (EIR Economics Staff, 2006). In the late 1950s, Baltimore was the sixth-largest city in the U.S. and supported the region with more than 75% of its jobs, more than 34% of which were in manufacturing (Levine, 2000). However, the deindustrialization that began in the 1960s caused a large decline in the manufacturing industry. Between 1950 and 1995, Baltimore lost more than 100,000 manufacturing jobs, representing 75% of its industrial employment (Levine, 2000). As the manufacturing jobs disappeared, the city's population declined. According to the U.S. Census, after reaching its peak population of 949,708 in 1950, Baltimore continued to lose population at an average rate of 7% per decade, reaching a population of 620,961 in the year 2010 – a loss of about one-third since 1950[1]. This loss of population and jobs has resulted in a large amount of vacant, abandoned, and underutilized residential and commercial property in the city.

Although there is no generally agreed upon definition of abandonment, Baltimore City defines a property as *abandoned* if it is boarded up, or if it is unboarded but the conditions are unlivable and severely dilapidated, or if it is unboarded or inadequately secured to prevent unauthorized entry or use of the building by uninvited persons, regardless of the property's status on mortgage or tax delinquencies. Baltimore City considers a property simply *unoccupied* if it is livable and uninhabited (U.S. Government Accoutability Office, 2011). According to the

[1] Source: 1) U.S. Census Bureau. (2010). 2010 Census Summary File 1, Table DP-1. Retrieved from http://factfinder2.census.gov. 2) U.S. Census Bureau. (2010). Population of the 100 Largest Urban Places:1950. Internet Release Date: June 15, 1998. Retrieved from http://www.census.gov/population/www/documentation/twps0027/tab18.txt.

City's vacancy data, there were 16,850 abandoned residential properties as of 2010, compared to 5,925 in 1991 - an increase of more than 10,000 in just two decades[2].

Distribution of housing abandonment in Baltimore shows that not only is there a large quantity of abandoned properties, but that it is unevenly distributed across the city. Abandoned properties are often concentrated in low-income minority neighborhoods (see Figure 3 and 4). Baltimore City has adopted various approaches to address housing abandonment problems in its neighborhoods, which included strategic demolition and rehabilitation of vacant houses, historic preservation, and a number of neighborhood revitalization initiatives (Cohen, 2001). However, there were a number of factors that complicated the city's efforts to address its abandoned housing problem: the need for more comprehensive approach; the financial cost of taking a comprehensive approach; the difficulty of reaching consensus on the optimal strategy in a given area; and limited administrative and the financial resources for acquisition and demolition of abandoned properties (Cohen, 2001). Since the early 1990's, Baltimore City has concentrated on improvements and investments in downtown areas, which attracted more visitors to downtown area and generated high-end residential development in and around downtown. During this time however, conditions of blight and deterioration in many neighborhoods were worsening (Kromer, 2002).

[2] Source: The Vacant House File 1991 to 2010, provided by Baltimore Department of Housing and Community Development

Figure 3. Housing abandonment and percent minority residents in Baltimore CSAs 2010

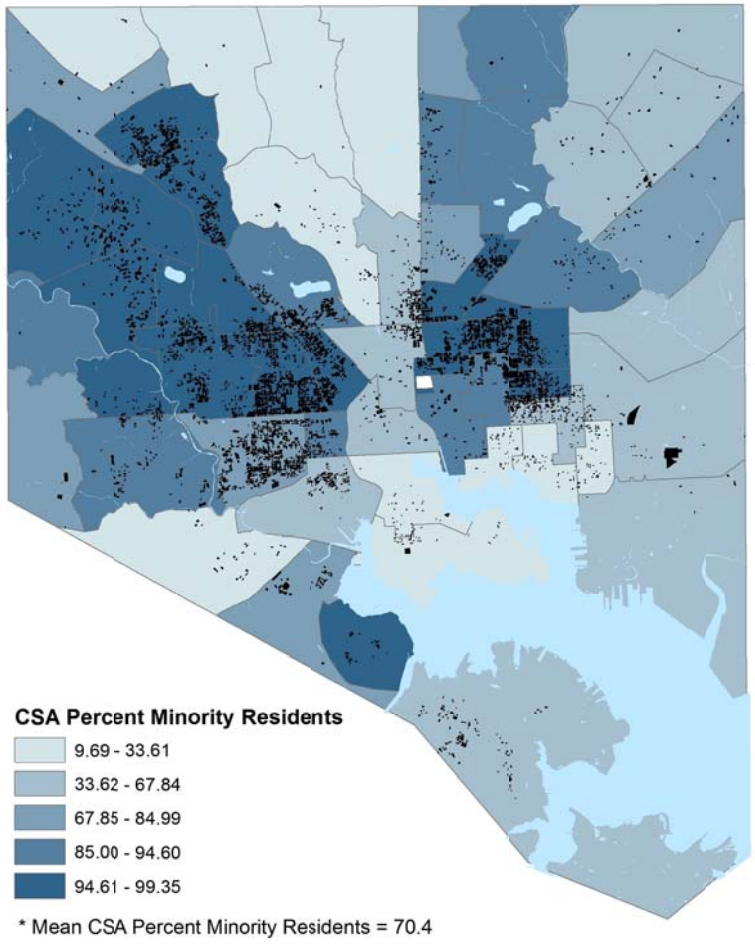
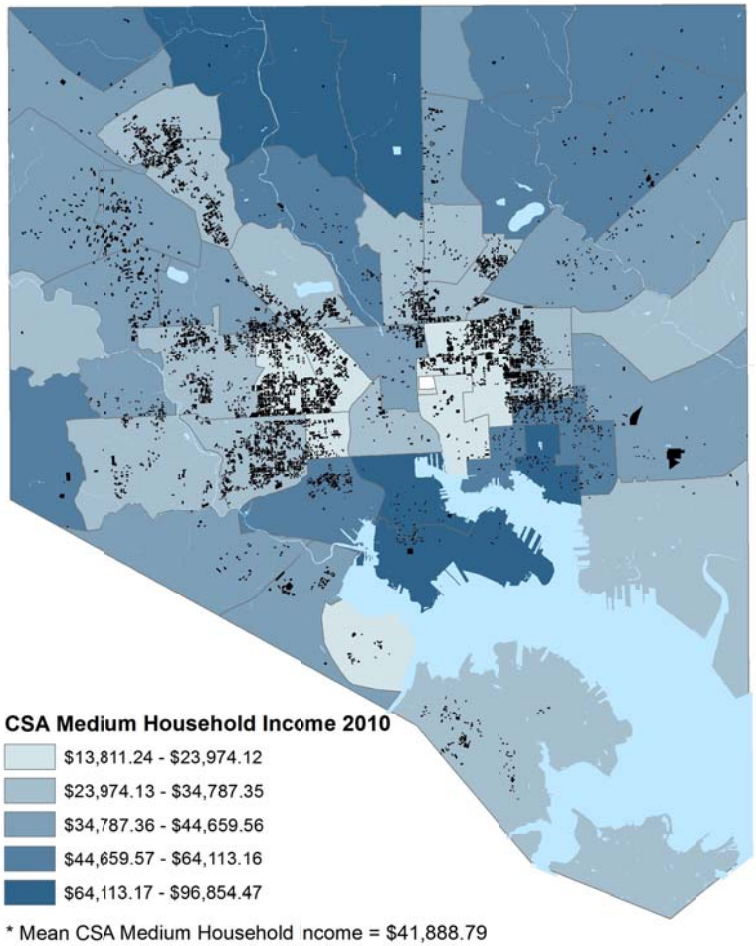


Figure 4. Housing abandonment and medium household income in Baltimore CSAs 2010



Note: * A black dot represents the abandoned property in both Figure 3 and 4.

Source: Created using The Vacant House File provided by Baltimore Department of Housing and Community Development, U.S. Census data, and GIS data available and retrieved Baltimore Neighborhood Indicators Alliance – Jacob France Institute, www.bniajfi.org/gis_shapefiles.

Data Variables

The dependent variable is the annual average impact of an abandoned property on nearby property values in each of Baltimore neighborhoods from 2001 to 2010. Specifically, the annual average impact of an abandoned property is the average incremental impact of an additional abandoned property on nearby property values within 250 feet[3] while controlling for nearby foreclosures and local market trends. The annual average impact of an abandoned property is estimated using a weighted repeat sales methodology, which will be discussed below. To estimate the impact of an abandoned property, the following data were obtained for the study period: (1) abandoned properties data; (2) residential property sales data; (3) foreclosure data; and (4) GIS data (see Table 1).

Table 1. List of data and sources

Data	Description	Source
Abandoned residential properties	List of every abandoned property identified by the Baltimore City's Code Enforcement Office and properties that has had an outstanding Vacant House Notice between January 1, 2001, to December 31, 2010. Updated monthly. Contains the parcel id, full address, dates of notice, tax payment status and lot size.	The Vacant House File provided by Baltimore Department of Housing and Community Development
Residential property sales	List of every residential property that was sold between January 1, 2001, and December 31, 2010. Contains the parcel id, transaction date, transaction type, full address, sales price, and land use code.	Property Sales data provided by Baltimore Department of Housing and Community Development

[3] In a previous study, the author examined the impact of housing abandonment on nearby property values depending on the location of abandoned properties and the duration of abandonment. The author found that only the properties abandoned within 250 ft. had a statistically significant impact on nearby property values regardless how long the properties have been abandoned. Therefore, this study only considers abandoned properties within 250 ft.

Foreclosed residential properties	List of foreclosure filing case numbers documented between January 1, 2001, and December 31, 2010. Contains case number, full address, filing dates.	Circuit Court of Baltimore City and Maryland Judiciary Case Search website (http://casesearch.courts.state.md.us/inquiry/inquiry-index.jsp)
GIS files	Baltimore city parcel map.	http://data.baltimorecity.gov/

Explanatory Variables

To examine what may account for the variability in the degree of the impact of housing abandonment among different Baltimore city neighborhoods, a number of neighborhood characteristics are examined as possible predictors (see Table 2). There are four types of indicators: (1) level of social organization; (2) neighborhood disadvantage; (3) level of government intervention; and (4) neighborhood housing characteristics. These variables are measured for each year of the study period.

To test the hypothesis that neighborhoods with a relatively high level of social organization are more resilient than a neighborhood with a relatively low level, a number of neighborhood level social organizations are included in the model. Specifically, those neighborhood characteristics include (1) neighborhood associations and block clubs; (2) neighborhood umbrella organizations; (3) neighborhood parks and environmental stewardship groups; (4) percentage of the neighborhood residents registered to vote; and (5) percentage of the neighborhood residents who voted. Using factor analysis, these five measures are combined to create a single index labeled “neighborhood social organization.” The number of community

development corporation (CDCs) for each neighborhood is included as an additional variable.[4] The neighborhood level social organization measurements for the study period are obtained from three different sources: Baltimore Neighborhood indicators Alliance – Jacob France Institute; Maryland Center for Community Development; and Baltimore City Department of Planning.

To test the hypothesis that a neighborhood with a relatively high level of concentrated disadvantage is less resilient than a neighborhood with a relatively high level, the following measures were included in the model: (1) neighborhood crime rate; (2) percent of residents who are minority; (3) median household income; (4) unemployment rate; (5) home ownership rate; (6) poverty rate; and (7) housing unaffordability rate. The measurements on neighborhood disadvantage are obtained from Baltimore City Police Department and U.S. Census data.

Two types of additional neighborhood level measures are included in the model that may affect the degree of the impact of housing abandonment at the neighborhood level: level of government intervention and neighborhood housing characteristics. Three government programs including Healthy Neighborhood Initiative, HUD's HOPE VI redevelopment projects, and Main Street programs may play a role in mitigating the impact of housing abandonment. These government programs are combined to create a single index for the government intervention measure. The government intervention data are obtained from Baltimore City Department of Housing and Community Development. Additionally, the neighborhood housing characteristics include: (1) median sales price; (2) total number of housing units sold; (3) percent of residential properties with housing violations; (4) percent of rehabbed residential properties;

[4] Exploratory factor analysis revealed that the number of CDCs was not strongly inter-related and did not represent the underlying "neighborhood social organization" factor. Correlation matrix showed that the number of CDCs lacked sufficient correlation with other variables.

(5) percent of properties under mortgage foreclosure; and (6) increase in housing abandonment. The neighborhood housing characteristics are obtained from three different sources: Baltimore Neighborhood indicators Alliance – Jacob France Institute; Circuit Court of Baltimore City; and Baltimore City Department of Housing and Community Development. Finally, the total number of neighborhood residents and the total number of neighborhood residential properties are included in the model as control variables.

Table 2. List of variables (Measured for each of Baltimore city neighborhoods every year between 2001 and 2010)

Variable	Description	Source
Dependent Variable		
Impact of housing abandonment	Magnitude of impact of an additional abandoned property on nearby property sales price (% discount)	Estimated using sources from Baltimore City Department of Housing and Community Development and Circuit Court of Baltimore City
Explanatory Variables		
(1) Social Organization		
Neighborhood associations and block clubs	Number of neighborhood association and block clubs, defined as groups of residents or property owners who advocate for or organize activities, share information, and act collectively to improve the quality of life in their neighborhoods	City of Baltimore's Community Association Directory maintained by the Baltimore City Department of Planning; Baltimore Neighborhood Indicators Alliance - Jacob France Institute
Umbrella organizations	Number of non-profit community based organizations that work with and support the neighborhood associations and neighborhood initiatives	City of Baltimore's Community Association Directory maintained by the Baltimore City Department of Planning; Baltimore Neighborhood Indicators Alliance - Jacob France Institute
Parks/environmental stewardship groups	Number of groups of residents or property owners who organize to improve and maintain the quality of parks, and watersheds	City of Baltimore's Community Association Directory maintained by the Baltimore City Department of Planning; Baltimore Neighborhood Indicators Alliance - Jacob France Institute
Voter registration	Percentage of neighborhood residents aged 18 and over who are registered to vote	Baltimore Neighborhood Indicators Alliance - Jacob France Institute
Voting participation	Percentage of neighborhood residents aged 18 and over who actually voted in the general election	Baltimore Neighborhood Indicators Alliance - Jacob France Institute
Community Development Corporations (CDCs)	Number of CDCs that perform work for given neighborhood. CDCS are non-profit organizations that work to revitalize and rebuild a number of neighborhoods in a defined geographic area.	Maryland Center for Community Development: Community Association Directory; Baltimore Neighborhood Indicators

		Alliance - Jacob France Institute
(2) Neighborhood Disadvantage		
Crime Rate	Neighborhood crime rate is calculated as a number of reported Part I criminal offenses per 1,000 people in the neighborhood. Part I offenses include murder, aggravated assault, rape, attempted rape, burglary, larceny, and auto theft.	Baltimore City Police Department
Minority Population	Proportion of neighborhood residents who are minority	U.S. Census, American Community Survey
Median Household Income	Median income earned by all persons in a household in an area.	U.S. Census, American Community Survey
Unemployment Rate	The number of people ages 16-64 who are in the labor force (are looking for work), but are not employed.	U.S. Census, American Community Survey
Homeownership Rate	Percentage of homeowners who are the principal residents of the home	U.S. Census, American Community Survey
Poverty Rate	Percentage of residents whose income in the past 12 months is below the poverty level	U.S. Census, American Community Survey
Housing Unaffordability Rate	Percentage of homeowners paying more than 30% of income for housing costs and percentage of rents paying more than 30% of income on rents	U.S. Census, American Community Survey
(3) Government Intervention		
Healthy Neighborhood Initiative Program	Neighborhood with a Healthy Neighborhood Initiative Program focusing on the strengthening the housing market and ensuring stability of a few blocks within a neighborhood area.	Healthy Neighborhoods Inc.(www.healthyneighborhoods.org) Directory maintained by the Baltimore City Department of Housing and Community Development
HOPE VI Redevelopment Program	Neighborhood with HUD's HOPE VI redevelopment program that improved physically deteriorated public housing projects.	Baltimore City Department of Housing and Community Development
Main Street Program	Neighborhood with neighborhood commercial revitalization programs known as Baltimore Main Streets which is part of the City of Baltimore Development Corporation contracted with the City of Baltimore. This program focuses on economic development services.	City of Baltimore Development Corporations (BCD) (www.baltimoremainstreets.com)

(4) Neighborhood Housing Characteristics		
Median Sales Price	Median sales price of a home in the neighborhood.	Baltimore City Department of Housing and Community Development
Total Housing Units Sold	Number of single family and condos sold in the neighborhood	Baltimore Neighborhood Indicators Alliance - Jacob France Institute
Housing Violation Rate	Percent of residential properties with housing violations (excluding vacant) whose residential building façade, structure, and/or surrounding area violate Baltimore City Housing Code.	Baltimore Neighborhood Indicators Alliance - Jacob France Institute
Residential Rehabilitation Rate	Percent of residential properties that undergo rehabilitation investment above $5,000	Baltimore Neighborhood Indicators Alliance - Jacob France Institute
Foreclosure Rate	Percentage of properties under mortgage foreclosure	Estimated using data provided by Circuit Court of Baltimore City
Housing Abandonment Increase (within 250 ft.)	Average increase in the number of abandoned properties within 250 feet of properties that are sold twice	Estimated using data provided by Baltimore City Department of Housing and Community Development

3. Methodology

I used a weighted repeat sales methodology to estimate the annual mean magnitude of impact of housing abandonment on nearby property values in each of Baltimore neighborhoods and used latent growth curve modeling to explore whether the impact of housing abandonment differs among different Baltimore neighborhoods and, if so, what may account for such variability.

3.1. Weighted Repeat Sales Methodology to Estimate the Annual Mean Impact of Abandonment

Two major empirical models have been used to estimate the spillover effects of distressed properties on nearby property values in scholarship: a hedonic price model and a repeat sales approach. This research used a repeat sales approach to construct a model to estimate the impact of housing abandonment at neighborhood level. Scholars argue that a repeat sales approach substantially reduces the omitted variable bias problem of hedonic price models and is better suited at estimating and controlling for the separate effects of the nearby foreclosures and overall market trend of a longitudinal data set (Harding, Rosenblatt, & Yao, 2009). In this research, I used a weighted repeat sales methodology to measure the annual mean magnitude of impact of an additional abandoned property on nearby property values within 250 ft. for each Baltimore neighborhood every year from 2001 to 2010.

Repeat sales methodology was originally derived by Bailey et al. (1963) and later by Case and Schiller (1989). The repeat sales methodology uses data on properties that have been sold at least twice and estimates the price change of a single property between two sales as shown in equation 1.

$$\ln(P_{it}) - \ln(P_{i\tau}) = \sum_{t=1}^{T} \alpha_t G_{it} + (X_{it} - X_{i\tau})\beta + (\varepsilon_{it} - \varepsilon_{i\tau}) \quad (1)$$

where $P_{i\tau}$ and P_{it} equals the purchase price of a property at the first and second sale, respectively,

G_{it} = a time dummy equal to 1 at the second sale date, -1 at the first sale date, and 0 otherwise,

α_t = overall annual market price level,

X_τ, X_{it} = property and neighborhood characteristics that affect a property price at the first and second sale date,

β = implicit prices of X_{it} and X_τ and,

$\varepsilon_{i\tau}$, ε_{it} = error terms at the periods of the first and the second sale, respectively, with zero means, equal variances, and uncorrelated with each other. The error term is assumed to be independent and identically distributed and captures pure random shocks to the transaction price.

The repeat sales methodology assumes the property and neighborhood characteristics (X_{it} and X_τ) and their implicit prices (β) of a property do not change between the first (τ) and second sale date (t); $X_t = X_\tau$ and $\beta_t = \beta_\tau$. Therefore, equation 1 becomes:

$$\ln\left(\frac{P_{it}}{P_{i\tau}}\right) = \sum_{t=1}^{T} \alpha_t G_{it} + (\varepsilon_{it} - \varepsilon_{i\tau}) \quad (2)$$

Now, I expand equation 2 to include the both the nearby abandoned properties to estimate the impact of housing abandonment and the foreclosed properties as a control variable.

$$\ln(\frac{P_{it}}{P_{i\tau}}) = \sum_{t=1}^{T} \alpha_t G_{it} + a(N_{it} - N_{i\tau}) + b(F_{it} - F_{i\tau}) + (\varepsilon_{it} - \varepsilon_{i\tau}) \quad (3)$$

N_{it} is the number of nearby abandoned residential properties present within 250 ft. at the time of the second sale and $N_{i\tau}$ is the number of nearby abandoned residential properties present within 250 ft. at the time of the first sale,

F_{it} is the number of nearby foreclosed properties present within 250 ft. at the time of the second sale and $F_{i\tau}$ is the number of nearby foreclosed properties present within 250 ft. at the time of the first sale, and

a_{it} is the impact of housing abandonment for the repeat sales pair$_{it}$.

Next, I extracted repeat sales pairs from the Property Sales data[5] and sorted the repeat sales pairs into 55 CSA neighborhood by its address and into 10 yearly group (annually between 2001 and 2010) by the second sales date. The final repeat sales pairs, therefore, were sorted into 550 different groups depending on its neighborhood designation and second sale date. The last step was then to use equation 3 to estimate the mean a_{it} for every neighborhood for every year to construct a dependable variable, the annual mean magnitude of impact of an additional abandoned property on nearby property values at neighborhood level.

This research used a three-stage generalized least squares (GLS) estimation procedure to estimate equation 3. Case and Shiller (1989) proposed the GLS estimation procedure to control for heteroskedastic errors. They argued that the variance in the repeat sales model might not be constant but related to the holding period between transactions. They stated that the longer the time between sales, the greater the chance that the price changes for each house were likely to be caused by factors other than market forces (Standard & Poor's, 2008): for

[5] Construction of accurate repeat sales data that does not violate the repeat sales methodology assumption that property and neighborhood characteristics have not changed between sales is critical. First, the repeat sales methodology includes only true market transactions. Therefore, non-representative transactions such as non-arm's-length transactions are excluded. Second, the data is filtered to eliminate any possible flipped properties and outliers – properties with abnormal price change – that may violate the repeat sales methodology assumption. For more detailed explanation on construction of repeat sales data, see Paper 1, section 3.2. Repeat Sales Data Construction.

example some houses may have been well maintained while others may have deteriorated. Such pricing errors will accumulate over time. In other words, the repeat sales regression model will have heteroskedastic errors. Therefore, Case and Shiller controlled for heteroskedastic errors by weighting the repeat sales observations by a function that declines with the length of time between the transactions. This method is known as the three-stage generalized least squares (GLS) estimation procedure.[6]

3.2. Latent Growth Curve Modeling to Explore the Variability in the Degree of the Impact of Housing Abandonment among Neighborhoods

Given the dynamic nature of neighborhood changes over time, I used longitudinal data (2001 to 2010) and used latent growth curve modeling which is particularly effective in investigating changes over time. Latent growth curve modeling allows us to examine the process of change, the nature of the change over time, and what explains the change. Specifically, latent growth curve modeling allows us to examine both the initial magnitude of impact of housing abandonment at neighborhood level, and the derivative of the magnitude of impact of housing abandonment at neighborhood level over time. In addition, time-varying covariates (which may account for variability in the magnitude of impact among neighborhoods) can be incorporated to explain neighborhood-level variability over time.

First, to examine if there is variability in the degree of annual mean impact of housing abandonment among different neighborhoods both at the initial level (year=2001) and over

[6] In the first stage, the repeat sales model of Bailey et al. is estimated using the ordinary least squares (OLS) method. Next, the squared residuals obtained from the first stage are regressed on a constant term and the time interval between sales. In the final stage, the repeat sales are re-estimated using GLS regression where the weights are inversely proportional to the fitted values of residuals obtained in the second stage (Case & Shiller, 1989).

time (from 2001 to 2010), I used the following unconditional latent curve model as shown in equation 4 (Bollen & Curran, 2006).

$$Y_{it} = \beta_{0i} + \beta_{1i}(Time) + \beta_{2i}(Time)^2 + \varepsilon_{it} \quad (4)$$

Where Y_{it} is the dependent variable, mean impact of an additional abandoned property on nearby property values in neighborhood *i* at time *t* (year),

β_{0i} is the estimated intercept, which reflects the initial level of impact at the beginning of the time series (2001 to 2010) for neighborhood *i*,

β_{1i} captures the linear changes (increase or decrease) in the level of impact over time, and

β_{2i} captures the nonlinear changes (acceleration or deceleration) in the level of impact over time.

Therefore, the degree of change in the magnitude of impact of housing abandonment is a function of the mean initial level of the impact of housing abandonment at the beginning of the study period (Time = 2001), as well as the linear and nonlinear effects of Time, indicated by βs. And any discrepancies between the predicted and the observed levels of the impact of housing abandonment on nearby property values are assumed to be caused by unknown variables subsumed by ε_{it}.

Whether there exists variability in the magnitude of impact of an additional abandoned property on nearby property values among different neighborhoods is answered by the variance of the intercept (β_{0i}). The variance of the intercept reflects the variation of individual neighborhood intercepts. For instance, if all of Baltimore neighborhoods had an intercept that is close to mean intercept, the variance of the intercept would be small. In contrast, the large and statistically significant variance of the intercept indicates that Baltimore neighborhoods have

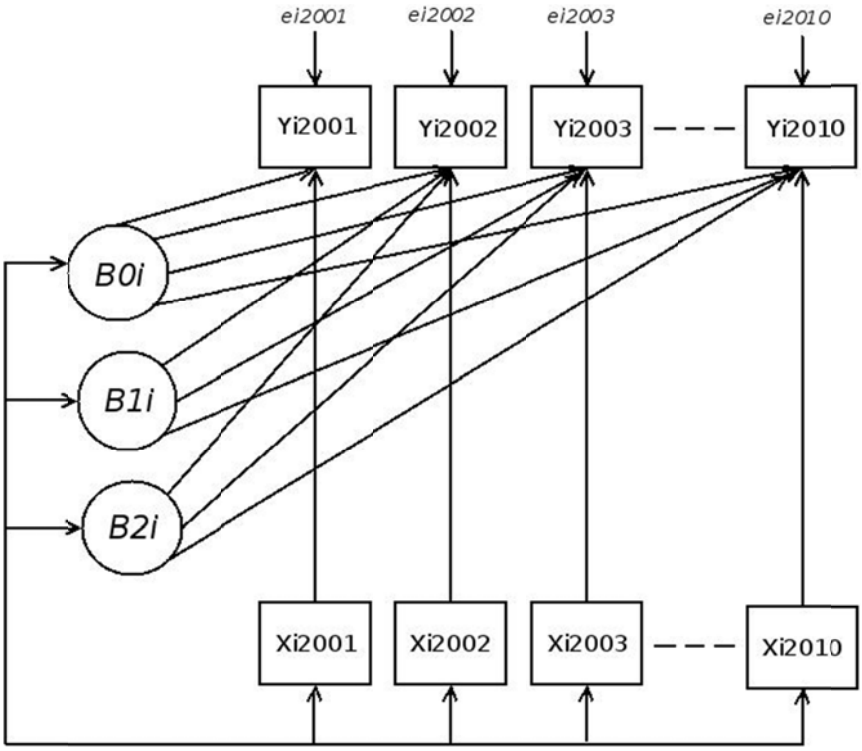
very different mean magnitude of impact of housing abandonment in year 2001. Likewise, whether there exists variability in the rate of change in the impact of housing abandonment on nearby property values among neighborhoods over time can be answered by the variance of the slopes (β_{1i}) and (β_{2i}). The variances of the slope reflect the extent to which neighborhoods have different slopes. Therefore, large variance for the slope indicates that the magnitude of impact of housing abandonment changed at substantially different rate over time among neighborhoods.

To answer what may account for such variability, I introduced time-varying covariates (time-specific explanatory variables) that may have affected the change in the magnitude of impact of housing abandonment over time. One method to do this is by regressing the repeated measures of the dependent variable (mean magnitude of impact of housing abandonment for a given neighborhood) directly on the time-varying covariates (annually measured explanatory variables) (Bollen & Curran, 2006). To accomplish this, equation 4 was modified to construct the following conditional multivariate latent curve model as shown in equation 5 (Bollen & Curran, 2006).

$$Y_{it} = \beta_{0i} + \beta_{1i}(Time) + \beta_{2i}(Time)^2 + \beta_t(X_{it}) + \varepsilon_{it} \quad (5)$$

This equation indicates that the mean magnitude of impact of housing abandonment at neighborhood *i* at time *t* is an additive combination of an individually varying intercept (β_{0i}) , an individually varying slopes (β_{1i}), (β_{2i}) multiplied by (Time) and (Time)^2 respectively, time-specific influence (β_t) of the explanatory variables (X_{it}) , and the usual individual and time-specific disturbance, (ε_{it}) (See Figure 5) (Bollen & Curran, 2006).

Figure 5. Path diagram of unconditional time-varying covariate model (Fixed effect)



4. Results

4.1. Descriptive Statistics

To explore which neighborhood characteristics may explain the variability in the mean magnitude of impact of housing abandonment among neighborhoods, this research examined four possible neighborhood characteristics as possible indicators: (1) level of social organization; (2) neighborhood disadvantage; (3) level of government intervention; and (4) neighborhood housing characteristics.

There are total 55 Baltimore neighborhoods known as Community Statistical Areas (CSAs) within Baltimore City. However, this research examined only 51 CSAs because 4 CSAs – Claremont/Armistead, Cross-Country/Cheswolde, Dkckeyville/Franklintown, and Southeastern – did not have enough repeat sales pair samples in proximity to abandoned properties. Since it was not possible to estimate the mean impact of housing abandonment, these four neighborhoods were excluded. The mean neighborhood characteristics for the remaining 51 CSAs are provided in Table 3.

Reviewing the neighborhood social organization measures, every Baltimore CSA neighborhood had some type of neighborhood social organization in any given year during the study period, 2001 to 2010. Neighborhood associations and block groups were the most common social organization types; there were total 638 neighborhood associations and block groups in Baltimore City in 2010. On average, there were approximately 11 neighborhood associations and block groups per neighborhood in any given year. However, the range of the total number of neighborhood associations and block groups greatly varied among neighborhoods. For instance, in 2010, The Waverlies neighborhood only had 1 neighborhood

association whereas Medfield/Hampden/Woodberry neighborhood had 29 neighborhood associations and block groups. Compared to neighborhood associations and block groups, there were a limited number of umbrella organizations and parks/environmental stewardship groups in Baltimore City. In terms of voting, the percentage of residents aged 18 and over who are registered to vote or actually voted varied greatly among neighborhoods. Yet, the mean percentage of the neighborhood residents who are registered to vote increased from 57.37% in 2001 to 76.95% in 2010. Similarly, the mean percentage of the neighborhood residents who voted in the general election varied between 34.94% in 2001 and 43.55% in 2010.

The biggest change among the neighborhood disadvantage measures from 2001 to 2010 was the mean neighborhood Part 1 crime rate. From 2001 to 2010, the Part 1 crime rate has declined significantly. Specifically, the number of reported Part 1 crime incidents has decreased by over 45%; the Part 1 crime rate in Baltimore City declined from 101.1 offenses per 1,000 persons in 2001 to 61.4 offenses per 1,000 persons in 2010[7]. However, not all of the City's neighborhoods benefited equally; while neighborhoods such as Downtown/Seton Hill or Fells Point experienced greatest decline in Part 1 crime rate, it remained almost the same in the neighborhoods such as Greater Mondawmin and Hartford/Echodale (Baltimore Neighborhood Indicators Alliance - Jacob France Institute, 2012). Examining the neighborhood demographics, Baltimore has high rates of income and racial segregation. African American residents in Baltimore neighborhoods outnumbered residents of all other races by nearly 2:1; in 2010, more than 50% of neighborhood residents were African American in 36 Baltimore CSAs, and over 90% of residents were African American in 18 Baltimore CSAs. (Baltimore Neighborhood Indicators Alliance - Jacob France Institute, 2012). Similarly, only a few neighborhoods had significantly

[7] Source: Baltimore City Police Department, Part 1 Crime Data from 2001 to 2010.

higher than median household income, and more than half of Baltimore neighborhoods (30 out of 55) had household income lower than the Baltimore mean.

The government intervention measure examined three governmental programs: the Healthy Neighborhood Initiative Program, HUD's HOPE VI redevelopment projects, and Baltimore Main Street Program.[8] Although these programs focus on the strengthening the neighborhood housing market and economic development, very few Baltimore neighborhoods benefited from these programs as the number of neighborhoods with these programs was very limited. For instance, although the number of neighborhoods having Healthy Neighborhood Initiative Program steadily increased between 2001 and 2010, only 22 neighborhoods had Health Neighborhood Initiative Program as of 2010.

Reviewing neighborhood housing characteristics, the overall housing market was appreciating until 2006 when the foreclosure crisis began. The median sales price of homes sold in Baltimore City increased by 10% annually from $69,000 in 2001 to $162,500 in 2006. The median sales prices continuously declined, however, after that time, reaching $115,000 in 2010 (Baltimore Neighborhood Indicators Alliance - Jacob France Institute, 2012). Similarly, the total quantity of homes sold increased until 2005 then declined steadily, although there was a slight increase in home sales between 2009 and 2010. As shown in Table 3, the mean number of homes sold in 51 Baltimore CSAs (that were examined out of total 55 Baltimore CSAs) was 148 homes in 2001 and declined to 113 in 2010. The rate of housing abandonment slowed from

[8] There are additional governmental programs that aimed at improving the neighborhood quality, such as Project 5000 and TEVO (for Targeted Enforcement Toward Visible Outcomes). However, the actual locations that these projects were pursued nor the data on the program progress were not available to be included in this research.

Table 3. Descriptive statistics of neighborhood characteristics (2001 to 2010) (N=510)

	Mean (2001 to 2010)	sd (2001 to 2010)	Mean (2001)	Mean (2010)
Social Organization				
Neighborhood associations and block clubs	10.64	7.04	10.98	12.43
Umbrella organizations	0.82	1.02	0.96	0.63
Parks/environmental stewardship groups	0.47	0.99	0.45	0.49
Voter registration (%)	64.98	10.64	57.37	76.95
Voter participation (%)	39.30	12.01	34.94	43.55
Community development corporations	0.92	1.06	0.91	0.92
Neighborhood Disadvantage				
Crime rate	79.60	73.18	110.73	69.75
Minority population (%)	63.05	33.61	62.51	63.60
Medium household income	$37,001.32	$15,018.11	$32,113.85	$41,888.79
Unemployment rate (%)	12.14	5.87	11.80	12.47
Home ownership (%)	60.97	17.49	63.93	59.08
Poverty rate (%)	25.65	13.25	28.99	22.32
Housing unaffordability (%)	37.65	5.17	34.46	40.84
Government Intervention				
Neighborhoods with Health Neighborhood Initiative Program, HOPE VI developments, and Main Street Program	0.23	0.32	0.21	0.27

Neighborhood Housing Characteristics				
Medium sales price	$124,010.90	$82,518.97	$75,579.90	$116,906.50
Total housing units sold	170.82	115.02	148.43	113.49
Housing violation (%)	3.21	2.90	6.68	3.92
Residential rehabilitation (%)	2.70	2.37	1.34	2.64
Foreclosure rate (%)	2.15	0.99	2.65	2.26
Increase in the number of abandoned properties (within 250 ft.)	1.36	2.33	1.43	0.53
Population	11,713.29	4,345.34	11,973.61	11,452.90
Total residential structures	3,851.36	1,622.19	3,865.24	3,848.61

Sources: Estimated using data listed in Table 2

2001 to 2010. As shown in Table 3, the mean increase in the number of abandoned properties within 250 ft. was 1.43 properties in 2001, but only 0.53 additional abandoned properties in 2010.

4.2. Does the Impact of Housing Abandonment on Nearby Property Values Vary Among Different Baltimore Neighborhoods?

The first research question examined the overall trajectory of the change in the magnitude of impact of housing abandonment over time for all 51 Baltimore CSA neighborhoods during the study period. I first examined whether there existed variability in the degree of the impact of an additional abandoned property on nearby property values among different neighborhoods at the initial level in 2001 by looking at the variance of intercept (β_{0i}). In addition, I examined whether there was variability in the rate of change in the magnitude of impact of an additional abandoned property on nearby property values among different neighborhoods over time (2001 to 2010) by looking at the variances of slopes, (β_{1i}) and (β_{2i}). Table 4 presents these findings - the latent growth curve modeling parameter estimates – from calculating equation 3.

Table 4 Latent growth curve modeling parameter estimates (2001-2010) (N=510)

	Coefficient	Standard error	$p>\|t\|$
Mean (fixed effect)			
Intercept	2.968***	0.403	0.000
Linear	- 0.329***	0.061	0.000
Quadratic	0.017**	0.005	0.009
Variability (variance)			
Intercept	8.4113***	1.7590	0.000
Linear	0.1999**	0.0619	0.001
Quadratic	0.0010*	0.0004	0.032

Note: *$p < 0.1$. **$p < 0.01$. ***$p < 0.001$.

With the estimated latent growth curve parameters for initial levels and nonlinear trends (as shown in Table 4), the magnitude of impact of an abandoned property on nearby property values can be summarized by the following equation:

$$Y = 2.968 – 0.329 (Time) + 0.017 (Time)^2$$

To illustrate, the intercept (2.968) represents the mean magnitude of impact of an additional abandoned property within 250 ft. on nearby property values across all of 51 Baltimore CSA neighborhoods in 2001. Additionally, two parameter estimates capture the mean rate of change over time. Mean linear change is reflected by the first coefficient, -0.329. Mean nonlinear change is reflected by the second coefficient, 0.017. All three parameter estimates are statistically significant at the 0.001 or 0.01 level, indicating that each is significantly different from zero. These latent growth curve modeling parameter estimates suggest that the mean magnitude of impact of housing abandonment on nearby property values initially declined, although the positive nonlinear effect indicates that the rate of decline became smaller over time (i.e. deceleration). Predicted mean level of the impact of housing abandonment for a specific year can be calculated by substituting appropriate values in the equation for Time, Time=0 for 2001, Time=1 for 2002, etc. For instance, the predicted mean level of the impact of housing abandonment in 2002 is $2.968 – 0.329 (1) + 0.017 (1)^2 = 2.656$. In 2010, the mean level of the impact of housing abandonment is significantly reduced to $2.968 – 0.329 (9) + 0.017 (9)^2 = 1.384$.

All of the variances associated with each of the latent growth curve modeling parameters – intercept and linear and quadratic components – were statistically significant at the 0.001, 0.01 or 0.1 level indicating that the mean magnitude of impact of housing abandonment varied considerably among different Baltimore neighborhoods. The statistically significant variance (8.41) around the mean intercept indicates there was considerable variability among neighborhoods in their level of

impact of housing abandonment in 2001. Furthermore, the statistically significant variance around the linear and nonlinear components (0.19 and 0.00 respectively) indicates there was variability in the rate the impact of housing abandonment changed across Baltimore CSA neighborhoods between 2001 and 2010.

4.3. What Neighborhood Characteristics May Account for the Variability in the Magnitude of Impact of Housing Abandonment among Neighborhoods?

Table 4 presented the evidence that the magnitude of impact of housing abandonment on nearby property values varied among different Baltimore neighborhoods. What may account for such variability among neighborhoods? In particular, does a neighborhood with a relatively high level of neighborhood social organization experience a smaller magnitude of impact of housing abandonment than a neighborhood with a relatively low level? In other words, is a neighborhood with stronger neighborhood social organization more resilient to the negative impact of housing abandonment than a neighborhood with weaker neighborhood social organization? In addition, is a neighborhood with a relatively high level of concentrated disadvantage less resilient than a neighborhood with a relatively low level? Furthermore, are there any other neighborhood characteristics that may affect the neighborhood's magnitude of impact of housing abandonment? These research questions were explored using a conditional multivariate latent curve model. Table 5 presents the conditional multivariate latent curve parameter estimates using equation 5.

First, this research tested the hypothesis that a neighborhood with a relatively high level of social organization experienced a smaller magnitude of impact of housing abandonment than a neighborhood with a relatively low level. In order to test this hypothesis, the effect of a

neighborhood social organization index and the level of community development corporations in a neighborhood on the neighborhood's mean magnitude of impact of housing abandonment were examined. This research found the quantity of community development corporations in a neighborhood had statistically significant impact on mitigating the magnitude of the neighborhood level of impact of housing abandonment. However, contrary to social disorganization theory, the neighborhood social organization index was not associated with the variability in the magnitude of impact of housing abandonment across neighborhoods (see Table 5).

Among neighborhood disadvantage measures, this research found that the level of neighborhood crime rate was strongly associated with the variability in the magnitude of impact of housing abandonment among neighborhoods (see Table 5). A neighborhood that had experienced a decline in neighborhood Part 1 crime rate saw a decrease in the neighborhood mean magnitude of impact of an additional abandoned property on nearby property values. As shown in Table 4, the magnitude of impact of housing abandonment across Baltimore neighborhoods experienced a decline over time. Meanwhile, a review of change in neighborhood characteristics over time showed that the neighborhood level crime rate has significantly decreased over study period. Therefore, it is very possible that the decline in neighborhood level crime rate was the strongest predictor that accounted for the decline in the magnitude of impact of housing abandonment in Baltimore neighborhoods over time. The other statistically significant predictor for the variability in impact of housing abandonment across Baltimore neighborhoods were neighborhood unemployment rate, neighborhood home ownership rate, and neighborhood housing unaffordability (see Table 5).

Table 5. Neighborhood characteristics as predictors of conditional multivariate latent curve model (2001 to 2010) (N=510)

	Coefficient	t-statistics	$p > \|t\|$
Social Organization			
Civic engagement	- 0.29047	- 1.16	0.248
Community development corporations	- 0.32188**	- 2.76	0.006
Neighborhood Disadvantage			
Crime rate	0.02572***	4.92	0.000
Minority population (%)	0.00416	0.32	0.749
Medium household income	- 0.00003	- 0.92	0.358
Unemployment rate (%)	0.13179*	1.75	0.080
Home ownership (%)	- 0.11098*	- 2.00	0.046
Poverty rate (%)	- 0.04137	- 1.03	0.301
Housing unaffordability (%)	0.05459*	2.30	0.021
Government Intervention			
Neighborhoods with Health Neighborhood Initiative Program, HOPE VI developments, and Main Street	- 0.13548	- 0.23	0.816
Neighborhood Housing Characteristics			
Medium sales price	- 0.00000	- 1.61	0.108
Total housing units sold	0.00004	0.03	0.976
Housing violation (%)	0.12646*	2.46	0.014
Residential rehabilitation (%)	- 0.00472	- 0.13	0.898
Foreclosure rate (%)	0.31273*	2.58	0.010
Increase in the number of abandoned properties (within 250 ft.)	0.04962	0.85	0.398
Population	0.00003	0.24	0.898
Total residential structures	- 0.00008	- 0.29	0.775

Note: *$p < 0.1$. **$p < 0.01$. ***$p < 0.001$.

While an increase in homeownership was associated with a decline in the magnitude of impact of housing abandonment, neighborhoods that experienced an increase in unemployment rate as well as home unaffordability measure saw an increase in the magnitude of impact of housing abandonment. At the same time, this research found no association between the change in the magnitude of impact of housing abandonment at the neighborhood level and a number of neighborhood disadvantage measures including proportion of neighborhood minority population, medium household income, and neighborhood poverty rate.

The results also show no association between whether a neighborhood had one or more of the governmental programs measured and the change in magnitude of impact of housing abandonment in that neighborhood. This could be because the number of neighborhoods with such governmental programs was very small. This research was also not able to include other governmental programs such as Project 5000 or TEVO that aim at improving the neighborhood housing market due to the unavailability of longitudinal data. Therefore, the question still remains whether the presence of governmental programs in a neighborhood played a role in mitigating the impact of housing abandonment.

Furthermore, this study found that two neighborhood housing characteristics were associated with the variability in the neighborhood level magnitude of impact of housing abandonment. The percentage of residential properties with housing violations (excluding vacant) in a neighborhood and higher rate of neighborhood foreclosure appeared to explain why some neighborhoods experience higher magnitude of impact of housing abandonment (see Table 5).

Finally, this research tested whether the neighborhood and housing characteristics in the previous year actually predict the variability in the magnitude of impact of housing abandonment at neighborhood level the following year. Studies have shown that it often takes some time for any

characteristics affecting property values to be fully diffused into a market price (Kilpatrick, 2006; Simons, 2002). It is plausible that, for instance, neighborhood crime rate in the previous year -- not the year the property is sold -- affected the magnitude of impact of housing abandonment the following year. Therefore, equation [5] is modified to include the previous year measurements of all of the explanatory variables and re-estimated the coefficients as shown in equation [6]

$$Y_{it} = \beta_{0i} + \beta_{1i}(Time) + \beta_{2i}(Time)^2 + \beta_t\left(X_{i(t-1)}\right)\varepsilon_{it} \quad (6)$$

This study found that estimated coefficients and their statistical significance were very similar to Table 5; the most significant predictor was the mean neighborhood Part 1 crime rate followed by the level of CDCs in the neighborhood.

5. Conclusion

In the latter part of the 20th century, economic decline caused by deindustrialization and the consequent job and population loss led to a chronic housing abandonment problem in many post-industrial cities in the United States including Detroit, Philadelphia, and Baltimore. As government resources were often insufficient to address all of the city's abandoned properties, cities have been adopting geographic targeting strategies – concentrating resources in limited geographic areas to maximize the impact of government interventions and investments (Thomson, 2011). Yet, the number of abandoned properties continued to increase over the last several decades, in part because massive demolition, acquisition, and sale of abandoned properties proved to be very expensive and difficult (U.S. Government Accoutability Office, 2011). Should cities adopt a different approach to dealing with abandoned properties? If we have an understanding of whether and what neighborhood characteristics – demographic, housing, and safety – affect the degree to which abandoned properties impact their surroundings, then that understanding could lead to an effective strategy to invest in what may mitigate the negative impact of housing abandonment along with ongoing city's efforts to reduce the extent of housing abandonment. This research aims to do just that.

Past research is in agreement that abandoned properties harm neighborhoods by threatening the local housing markets, increasing crime rates, and the increasing financial burden on local governments (Goetz, Cooper, Thiele, & Lam, 1998; Keenan, Lowe, & Spencer, 1999; Shlay & Whitman, 2006; Skogan, 1990; Spelman, 1993; Sternlieb & Burchell, 1973). However, past research has not thoroughly investigated whether the impact of foreclosed or vacant or abandoned properties on nearby non-distressed property values would vary in different neighborhoods. Our neighborhoods are not homogenous; each neighborhood has distinctive geographic, demographic,

and social characteristics. And housing abandonment is often disproportionally distributed, and grows at different rates across the city. It is plausible that, as the rate of housing abandonment differs among neighborhoods, the impact of housing abandonment on nearby property values may differ among neighborhoods. Therefore, this research examined whether the impact of housing abandonment would vary among different neighborhoods and, if so, what accounts for such variability. This research uses the latent growth curve modeling method to analyze longitudinal data of the impact of housing abandonment and a range of neighborhood level factors including the number of social organizations, number of government programs, and demographic, housing, and safety indicators in Baltimore neighborhoods between 2001 and 2010.

This research found that there was considerable variability in the mean magnitude of impact of housing abandonment on nearby property values among Baltimore's neighborhoods at the beginning of the study period, year 2001. This research also found that the mean magnitude of impact of housing abandonment changed at different rates among Baltimore's neighborhoods over time. To explore what may account for that variability, this research was focused on whether the level of neighborhood social organization may explain the variability. Surprisingly, this research did not find an association between the level of neighborhood social organization and the magnitude of impact of housing abandonment. However, the research did find that the number of neighborhood community development corporations (CDCs) had a statistically significant impact on the magnitude of impact of housing abandonment.

Examining other characteristics, the neighborhood crime rate was the strongest predictor of change in the magnitude of impact of housing abandonment. A neighborhood that had experienced a decline in neighborhood Part 1 crime saw a decrease in the neighborhood mean magnitude of impact of an additional abandoned property on nearby property values. The other statistically

significant predictors for the variability in the impact of housing abandonment were neighborhood unemployment rate, neighborhood home ownership rate, and neighborhood housing unaffordability. Not surprisingly, an increase in neighborhood unemployment and housing unaffordability were associated with an increase in the impact of housing abandonment whereas homeownership rate had a small but positive impact on the magnitude of impact of housing abandonment. Among neighborhood housing characteristics, the percentage of residential properties with housing violations and a high neighborhood foreclosure rate appeared to explain why some neighborhoods experience higher magnitude of impact of housing abandonment compared to others.

This research suggests that investing in improving neighborhood characteristics is an effective strategy to mitigate the negative impacts that abandoned properties have on their surroundings. As Temkin and Rohe (1996) argued, neighborhood policies that exclusively focus on the physical characteristics of a community will not be effective unless efforts to improve other factors that affect neighborhood stability are effectively addressed. This research finds that above all, rates of high neighborhood crime can exacerbate the impacts that abandoned properties have on neighborhood property values. Additionally, neighborhoods with high foreclosure and housing violation rate increase the impact of housing abandonment. Therefore, this research suggests that public investment to reduce the neighborhood crime, foreclosure rate, and the housing violation rate is critical to addressing housing abandonment problems. Finally, this study recommends the development of CDCs in neighborhoods with substantial housing abandonment. The presence of CDCs in the neighborhood is found to reduce the impact of housing abandonment on neighborhood.

APPENDIX A

A. Identity Number (ID) and Names of Baltimore Neighborhood Community Statistical Areas (CSAs)

ID	CSA Name	ID	CSA Name
1	Allendale/Irvington/S. Hilton	29	Inner Harbor/Federal Hill
2	Beechfield/Ten Hills/West Hills	30	Jonestown/Oldtown
3	Belair-Edison	31	Lauraville
4	Brooklyn/Curtis Bay/Hawkins Point	32	Loch Raven
5	Canton	33	Madison/East End
6	Cedonia/Frankford	34	Medfield/Hampden/Woodberry
7	Cherry Hill	35	Midtown
8	Chinquapin Park/Belvedere	36	Midway/Coldstream
9	Claremont/Armistead	37	Morrell Park/Violetville
10	Clifton-Berea	38	Mt. Washington/Coldspring
11	Cross-Country/Cheswolde	39	North Baltimore/Guilford/Homeland
12	Dickeyville/Franklintown	40	Northwood
13	Dorchester/Ashburton	41	Orangeville/East Highlandtown
14	Downtown/Seton Hill	42	Patterson Park North & East
15	Edmonson Village	43	Penn North/Reservoir Hill
16	Fells Point	44	Perkins/Middle East
17	Forest Park/Walbrook	45	Pimlico/Arlington/Hilltop
18	Glen-Falstaff	46	Poppleton/The Terraces/Hollins Market
19	Greater Charles Village/Barclay	47	Sandtown-Winchester/Harlem Park
20	Greater Govans	48	South Baltimore
21	Greater Mondawmin	49	Southeastern
22	Greater Roland Park/Poplar	50	Southern Park Heights
23	Greater Rosemont	51	Southwest Baltimore
24	Greenmount East	52	The Waverlies
25	Hamilton	53	Upton/Druid Heights
26	Harford/Echodale	54	Washington Village
27	Highlandtown	55	Westport/Mt. Winans/Lakeland
28	Howard Park/West Arlington	0	Unassigned - Jail

Source: Baltimore Neighborhood Indicators Alliance – Jacob France Institute, www.bniajfi.org/gis_shapefiles.

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CONCLUSION

1. What Is This Research About?

The recent foreclosure crisis exacerbated a problem of housing abandonment in the United States contributing to a total of more than 4.8 million vacant residential properties as of end of 2012[1]. However, for many post-industrial cities, housing abandonment is not new; they have been grappling with the problem of chronic housing abandonment for decades (U.S. General Accounting Office, 1979). Although there has been limited research on housing abandonment, past research has demonstrated that housing abandonment is harmful to our neighborhoods by lowering nearby property values, promoting criminal activities, and posing fire safety hazards (Greenberg, Popper, Schneider, & West, 1993; Greenberg, Popper, & West, 1990; Spelman, 1993). However, a number of questions are unanswered. This research sought to increase our understanding of the impact of housing abandonment by providing empirical findings on areas that have not been addressed by previous research. This research also employed a more rigorous analytical methodology compared to earlier research efforts in order to provide more accurate measurements of the impact of housing abandonment.

To achieve this research objective, this research examined the impact of housing abandonment in Baltimore City, Maryland, between 1991 and 2010. Three major research questions were addressed in three separate but related papers: (1) how does the location and duration of

[1] Source: HUD Aggregated USPS Administrative Data on Address Vacancies, Quarter 4 ending December 31, 2012, <http://www.huduser.org/portal/usps/home.html>

abandonment affect the impact of housing abandonment on nearby property values?; (2) are there threshold effects in the impact of housing abandonment?; and (3) what explains the variability in the magnitude of impact of housing abandonment among different neighborhoods?

All three papers relied on the analysis of data on housing abandonment and residential property sales from 1991 to 2010, collected by the Baltimore City Department of Housing and Community Development. Data on neighborhood characteristics including foreclosures were obtained from various sources including the Circuit Court of Baltimore City, Baltimore City Police Department, Jacob France Institute, and U.S. Census.

I used a weighted repeat sales method to estimate the impact of housing abandonment on nearby property values. To find threshold values in the number of abandoned properties and magnitude of impact of abandonment before and after threshold values, I employed a piecewise linear regression models with spline functions. Finally, I used latent growth curve modeling to assess the impact of housing abandonment among neighborhoods with different characteristics.

2. Summary of Research Findings

The question addressed in paper 1 was: How does the location and duration of abandonment affect the impact of housing abandonment on nearby property values? The results of the analysis conducted to address this question showed that the presence of abandoned properties had a negative contagion effect on nearby property values. Examining the location of abandoned properties alone, the research found that the impact of abandoned properties on nearby property values decreased as the distance between the abandoned property and the nearby property increased. When the duration of abandonment alone was examined, the negative contagion effect

of abandoned properties grew in magnitude as properties were abandoned for a longer time. However, when both the location and the duration of abandonment were considered, the research produced a different outcome. When properties have been abandoned for less than three years, only those abandoned properties located within 250 ft. had a significant impact on nearby property values. Properties that are abandoned for less than three years and located beyond 250 ft. did not have a significant negative impact on nearby property values. However, when properties have been abandoned for more than three years, all of the abandoned properties located within 1,500 ft. had a significant contagion impact on nearby property values.

These findings indicate that that the duration of housing abandonment significantly affects the extent to which abandoned properties impact nearby property values. When properties are abandoned for relatively short period of time, they affect the value of other property that is located within close proximity. However, when abandoned properties sit unoccupied and unmaintained for longer periods of time, their impact on nearby property values not only increases in magnitude but in distance.

The second paper addressed the question: Are there threshold effects in the impact of housing abandonment? The results of the analysis conducted to address this question showed that threshold effects existed in the impact of housing abandonment on nearby property values. It found two thresholds in the impact of housing abandonment. When the net of increase in abandoned properties within 250 ft. was fewer than two, for each additional abandoned property, the nearby property value decreased by 0.97%, after controlling for nearby foreclosures and market price level. However, when the number of abandoned properties increased by more than two properties at the second sale compared to the first sale, the impact of abandoned properties was greater. When the increase in the number of nearby abandoned properties at the second sale was between two and 14,

the nearby property values decreased by 2.66% for each additional abandonment. However, it also found that when the increase in housing abandonment exceeded 14, marginal increases had little impact on nearby property values. The magnitude of the impact of each additional abandoned property was substantially reduced to 0.43% from 2.66%.

This research also indicates that the impact of housing abandonment on nearby property values has very low threshold values. On average, there were approximately 101 residential properties in a 250 ft. radius in the study, and the increase in housing abandonment ranged from just one more abandoned property in a 250 ft. radius to as many as 88 more abandoned properties. Yet, the research findings indicates that just two more abandoned properties can magnify the negative impact of abandoned properties on nearby property values. Furthermore, once there were about 14 more abandoned properties within a 250 ft. radius, then abandonment reached a saturation point, and the incremental impact of each additional abandoned property on nearby property value was attenuated. These findings are consistent with past research findings which stated that the threshold value where the impact of distressed properties increases significantly may as low as a single distressed property, and also that the magnitude of impact of distressed properties did not appear to increase proportionally to the number of distressed properties.

The question addressed in paper 3 was: what explains the variability in the magnitude of impact of housing abandonment among different neighborhoods? The results of the analysis conducted to address this question found considerable variability in the mean magnitude of impact of housing abandonment on nearby property values among Baltimore neighborhoods at the beginning of the study period. This research also found that the mean magnitude of impact of housing abandonment changed at unequal rates among Baltimore neighborhoods over time. To explore what may account for the variability in the magnitude of impact of housing abandonment

among neighborhoods, this research tested whether the level of neighborhood social organization may explain the variability. Surprisingly, no statistically significant association was found between the level of neighborhood social organization and the magnitude of impact of housing abandonment. However, the number of community development corporations in a neighborhood did have a statistically significant impact on the impact of housing abandonment on nearby property values.

The examination of other neighborhood characteristics found that the neighborhood crime was the strongest predictor of change in the impact of housing abandonment on nearby property values. Neighborhood that experienced a decline in neighborhood Part 1 crimes tended to experience a decrease in the impacts of additional abandoned properties on nearby property values. The other statistically significant predictors of the impact of housing abandonment were neighborhood unemployment rates, neighborhood home ownership rates, and neighborhood housing unaffordability. Not surprisingly, an increase in neighborhood unemployment and housing unaffordability were associated with an increase in the impact of housing abandonment. A higher homeownership rate also slightly reduced the impact on the magnitude of impact of housing abandonment. Among neighborhood housing characteristics, the percentage of residential properties with housing violations and high rate of neighborhood foreclosure rate appeared to explain why some neighborhoods have a larger impact of housing abandonment on nearby property values than others.

3. Significance of This Research

Despite the prevalence of the housing abandonment problem, there is very limited research on the impact of housing abandonment. However, past research has demonstrated that housing abandonment is harmful to communities and governments by lowering nearby property values, promoting criminal activities, and posing fire safety hazards (Greenberg, Popper, Schneider, & West, 1993; Greenberg, Popper, & West, 1990; Spelman, 1993). Yet, a number of questions still remain unanswered. Most previous research used cross-sectional hedonic price models to estimate the impact of distressed properties on nearby property values. These studies have not been able to control for local market trends or preexisting information (previous housing abandonment or foreclosures, for example). Consequently, it was unclear whether distressed properties caused a decline in nearby property values, or whether a general decline in property value resulted in distressed properties in the area. Studies that estimated the impact of housing abandonment also did not control for nearby foreclosures, despite the fact that studies have shown that foreclosures have a contagion effect on nearby property values. In addition, there are areas previous research did not answer even though theories and empirical studies suggested the possibility of the following: (1) nonlinearity of the impact of housing abandonment; (2) duration of abandonment affecting the impact of housing abandonment; and (3) the degree to which the impact of housing abandonment varies with specific neighborhood characteristics.

Therefore, this research hoped to extend the current level of understanding of the impact of housing abandonment on nearby property values in two ways. First, this research employed more rigorous analytical methods to estimate the impact of housing abandonment more accurately. This research examined the impact of abandoned properties on nearby property values in Baltimore, Maryland, from 1991 to 2010 using longitudinal data sets while simultaneously controlling for both

nearby foreclosures and local housing market trends. Second, this research provided empirical findings on areas that have not been addressed by previous research. It examined how the duration of abandonment affected the magnitude of impact of housing abandonment, explored the threshold effects, and examined what neighborhood characteristics appear to mitigate or exacerbate the magnitude of impact of housing abandonment.

Turning to the policy implications of this research, in cities with large-scale housing abandonment and foreclosure problems, government resources are often not enough to address all of their distressed properties. Therefore, local governments need to be strategic in their decisions about which properties, in which neighborhoods to allocate their limited resources (Thomson, 2011). Concentrating resources in limited geographic areas to enhance the impact of public intervention, commonly known as strategic geographic targeting, has become an increasingly popular tool for local governments (Thomson, 2011). This research attempted to provide findings that would help governments in their decisions about where and how to allocate their limited resources and to maximize the effectiveness of government interventions and investments.

In particular, understanding how the duration of abandonment influences the magnitude of the impact of housing abandonment would help governments identify properties to target for immediate intervention. The finding that the impact of housing abandonment not only increases in magnitude but also reaches farther in distance implies that immediate intervention to have an abandoned property re-occupied and maintained is important to mitigate the negative impact of housing abandonment.

In addition, examining the threshold effects in the impact of housing abandonment found that when the number of nearby abandoned properties increases by more than two at the second sale compared to the first one, the marginal impact of abandoned properties on nearby property

values increased from 0.97% to 2.66%. Furthermore, it also found that when the number of nearby abandoned properties exceeded 14 at the second sale compared to the first one, the marginal impact on the nearby property values dropped significantly. This suggests that it would be beneficial for local governments to target their resources to areas that are close to reaching first threshold before the magnitude of the impact of abandonment increases significantly. Furthermore, this research informs that government efforts are more effective when focused in carefully selected areas with relatively small numbers of abandoned properties, where the government interventions could help reoccupy as many as possible of the abandoned properties – if not all of abandoned properties – rather than spreading resources thinly across entire neighborhoods or cities.

The research on what neighborhood characteristics mitigate or exacerbate the negative impact of housing abandonment suggests that investing on improving neighborhood characteristics is as effective a strategy as investing directly on abandoned properties in order to mitigate the negative impact which abandoned properties have on their surroundings. Rather than treating abandonment as a problem affecting only the housing market, cities could begin to view improving neighborhood characteristics as an integral part of their efforts in fighting abandonment. This research suggests that above all, high neighborhood crime could hinder government efforts to address housing abandonment problems. Furthermore, the percentage of residential properties with housing violations and high rates of neighborhood foreclosure rate appeared to explain why some neighborhoods experience higher magnitude of impact of housing abandonment compared to others. Therefore, this research suggests that government intervention to reduce the neighborhood crime rate, foreclosure rate, and the housing violation rate is critical for addressing housing abandonment problems.

4. Limitations of This Research

The main limitations of the research stem from lack of available data on a number of longitudinal measurements of neighborhood characteristics. For example, the research paper 1 does not control for nearby vacant lots that have increased or decreased between two sales of a nearby residential property. The repeat sales methodology used in this paper assumes that in most cases, the number of nearby vacant lots remains constant between sales, therefore the implicit prices does not change and eventually are differenced out when the model estimates the rate of price appreciation between two sales. However, it is plausible that there are cases where the number of nearby vacant lots has increased or decreased between sales. The absence of a control variable - change in the number of nearby vacant lots - in the analytical method indicates that the magnitude of the impact of abandoned properties on nearby property value may differ if a change in the number of nearby vacant lots is considered. However, this absence would not alter the research findings that (1) the greater the distance from the abandoned properties, the smaller the magnitude of the impact of abandoned properties on nearby property value, and (2) as the properties are abandoned for a longer time, the impact on nearby property value would increase.

In addition, deriving from theories such as social disorganization theory and collective efficacy, the research paper 3 was particularly focused on whether factors affecting the neighborhood social dynamics – level of social organization, for example – would affect the degree to which housing abandonment affects nearby property values. Furthermore, this research attempted to examine whether a number of Baltimore City's investments or programs were effective in mitigating the magnitude of impact of housing abandonment. However, data were limited or not available to fully explore the above research questions. For instance, there were additional governmental programs that aimed at improving the neighborhood quality, such as

Project 5000 and TEVO (for Targeted Enforcement Toward Visible Outcomes). However, neither the actual locations that these projects targeted, nor the projects' performance data were available to be included in this research. In addition, survey data to measure social control or collective efficacy was not available.

Finally, this research examined the housing abandonment in Baltimore, Maryland, to estimate its impact on nearby property values. Housing abandonment is concentrated in a number of neighborhoods in Baltimore City. In fact, housing abandonment is often disproportionally distributed across a city in the U.S. Therefore, it is possible that housing abandonment is correlated with specific spatial characteristics, leading to spatial dependency or spatial auto correlation. Yet, this research did not estimate the impacts in a spatial econometric framework. Regression analysis such as spatial regression models that compensate for spatial dependency may provide more reliable measurements of the impacts of housing abandonment. In addition, the issue of spatial variability implies that estimated magnitudes of the impacts of housing abandonment might be different depending on the neighborhood characteristics. These issues should be addressed in the future research.

5. Implications for Future Research

In this section, I discuss briefly a number of important areas to consider for additional future research, which, if carried out, have the potential to increase accuracy in the measurement of spillover effects of distressed properties – whether foreclosed or vacant/abandoned properties – and improve our understanding of the impact of distressed properties in our neighborhoods.

The lack of data containing longitudinal measurements of neighborhood characteristics limited the scope of the analysis in Paper 3. If available, that data could help isolate some of the neighborhood characteristics that cause variability in the magnitude of impact of housing abandonment among neighborhoods. Specifically, cities with large-scale housing abandonment have implemented different programs to address housing abandonment problem. One method to examine the effectiveness of these programs would be to estimate whether the level of such programs in neighborhoods influence the magnitude of impact of housing abandonment. Furthermore, examining whether the collective efficacy or social capital is associated with housing abandonment would extend our understanding of why housing abandonment is unevenly distributed across a city.

Housing abandonment is a spatially clustered phenomenon. Another topic for future research is an in-depth analysis into the spatial pattern of abandonment, with measurement of how abandoned properties are either clustered near each other, or are scattered. Just as housing abandonment is disproportionally distributed across a city, abandoned properties appear to be disproportionally distributed around non-distressed properties. Scholars argue that concentrated abandonment is worse than scattered abandonment in terms of its impact on surroundings. However, there has been no empirical evidence to support this statement. Therefore, future research that examines whether the impact of housing abandonment on nearby property values differs depending on the spatial distribution of housing abandonment would extend our understanding of the impact of housing abandonment. This research did not take spatial dependency of housing abandonment into consideration. As an additional analysis method, a spatial analysis of housing abandonment such as spatial regression methods that capture the spatial dependency of housing abandonment in regression analysis can provide more accurate measurement of the impact of housing abandonment.

This research explored the nonlinearity of the impact of housing abandonment and found the threshold values in the number of abandoned properties where the impact of housing abandonment suddenly increases or drops dramatically. Although this research provided evidence that threshold effects exist in the impact of housing abandonment, the estimated threshold values may be highly dependent on the extent of housing abandonment in the data set. It is quite plausible that an analysis of housing abandonment in different cities with different housing density and a different degree of abandonment may yield different threshold values. Although it is possible to simply benchmark the threshold values in other cities, one method to control for intrinsic differences between cities is to express the threshold values as a proportion of abandoned properties, as opposed to an actual count of abandoned properties. Therefore, further analysis on threshold effects while controlling for density is recommended, especially for the findings of threshold effects to support research more broadly applicable to other cities.

Finally, this research excluded vacant parcels (where abandoned properties have been demolished) when estimating the impact of housing abandonment on nearby property values. Such vacant parcels would dampen the market and need to be controlled for to accurately measure the impact of housing abandonment on nearby property values. Plus, cities with large-scale housing abandonment continue to pursue demolition on a massive scale to address housing abandonment problems. This increases the number of vacant parcels in these cities. How do vacant lots impact neighborhood, compared to abandoned structures? Therefore, further research that controls for changes in nearby vacant lots will yield (1) more accurate measurement of the impact of housing abandonment sans vacant lots and (2) measurement of the impact of vacant lots on nearby property values.

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