Estimating the Effect of Demolishing Distressed Structures in Cleveland, OH, 2009-2013:

Impacts on Real Estate Equity and Mortgage-foreclosure

Western Reserve Land Conservancy

Thriving Communities Institute

FROM VACANCY TO VITALITY

Thanks to those who made this study possible

Reducing blight in our cities and neighborhoods is of critical importance to each of us. Tens of thousands of vacant and abandoned structures exist in Ohio, and for many of these structures, demolition is the only option. But demolition is expensive. Municipalities and counties, with limited financial resources, are unable to keep pace with the need for removal of these blighted properties.

Thriving Communities Institute, a program of Western Reserve Land Conservancy, has actively pursued new sources of funding for demolition. Attorney General Mike DeWine recognized the critical role of demolition in revitalizing our communities and allocated $75 million of discretionary funds from a national bank settlement for this purpose. At the federal level, we met with the U.S. Department of the Treasury and the White House Advisory Council requesting the reallocation of a portion of the Hardest Hit Fund from foreclosure prevention to demolition. These agencies asked that we prove that demolition of blighted properties can be considered a foreclosure prevention method – that strategic demolition would reduce the number of foreclosures in our communities. We asked the sponsors listed below to support this research. The study is now complete and **$60 million** in demolition funding is **now** available to county land banks in Ohio.

Thank you to each of our sponsors. Your contributions brought us one step further toward eliminating blight in our neighborhoods. We could not have done it without you!

Jim Rokakis
Director, Thriving Communities Institute

Sponsors

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Cleveland Neighborhood Progress
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EXECUTIVE SUMMARY
Estimating the Effect of Demolishing Distressed Structures in Cleveland, OH, 2009-2013:

Impacts on Real Estate Equity and Mortgage-Foreclosure

A Report Produced by Griswold Consulting Group
Nigel G. Griswold[1], Benjamin Calnin, Michael Schramm, Luc Anselin & Paul Boehnlein

Introduction

This two-part empirical analysis focuses on the effect that residential demolition has had on real estate equity and mortgage-foreclosure rates in the Cleveland, Ohio area between 2009 and 2013. Part 1 of the analysis uses a spatially dynamic economic model of land use change to estimate varying levels of financial impact from demolition activity on real estate equity across four housing submarkets. Just over 6,000 demolitions were completed over the study period, costing roughly $56.3 million. Findings estimate total demolition benefits at $78.9 million, suggesting a $22.6 million net benefit attributed to demolition activity. Benefits from demolition activity were shown to accrue primarily in high and moderately functioning markets. Conversely, findings suggest that little real estate equity return is available from demolition activity in weak real estate markets.

Part 2 of the analysis uses a pattern-based approach to investigate the relationship between demolition activity and mortgage-foreclosure rates. Findings show a clear trend of decreasing mortgage-foreclosure rates in areas where demolition intervention activity took place. This is true for the study area as a whole as well as in low, moderate and high distress neighborhoods.

Background

Economies embedded in bygone industry sectors have experienced a slow transition into success within the fast-paced global economy. These “legacy cities,” are largely concentrated in the Midwest “Rust Belt,” and include the study area region. Economic exodus over the past 50 years has left vast inventories of vacant and blighted industrial, commercial and residential properties scattered across these urban landscapes. Disamenity properties are liabilities to neighborhoods, communities and municipal budgets.

As legacy cities gain control of their distressed property inventories, limited budgets demand optimal targeting of blight remediation funds for maximum impact. This study focuses on the community and market outcomes of demolishing distressed residential structures. Using sophisticated data systems,

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[1] Nigel G. Griswold can be reached at nigel@bigdataecon.com or the Griswold Consulting Group website - bigdataecon.com.

econometric modeling, pattern-based modeling and predictive analytics, this study investigates:

1) Property value impacts of nearby distressed properties;
2) The impact that demolition of distressed properties has on neighboring real estate equity;
3) The impact that demolition has on localized mortgage-foreclosure rates.

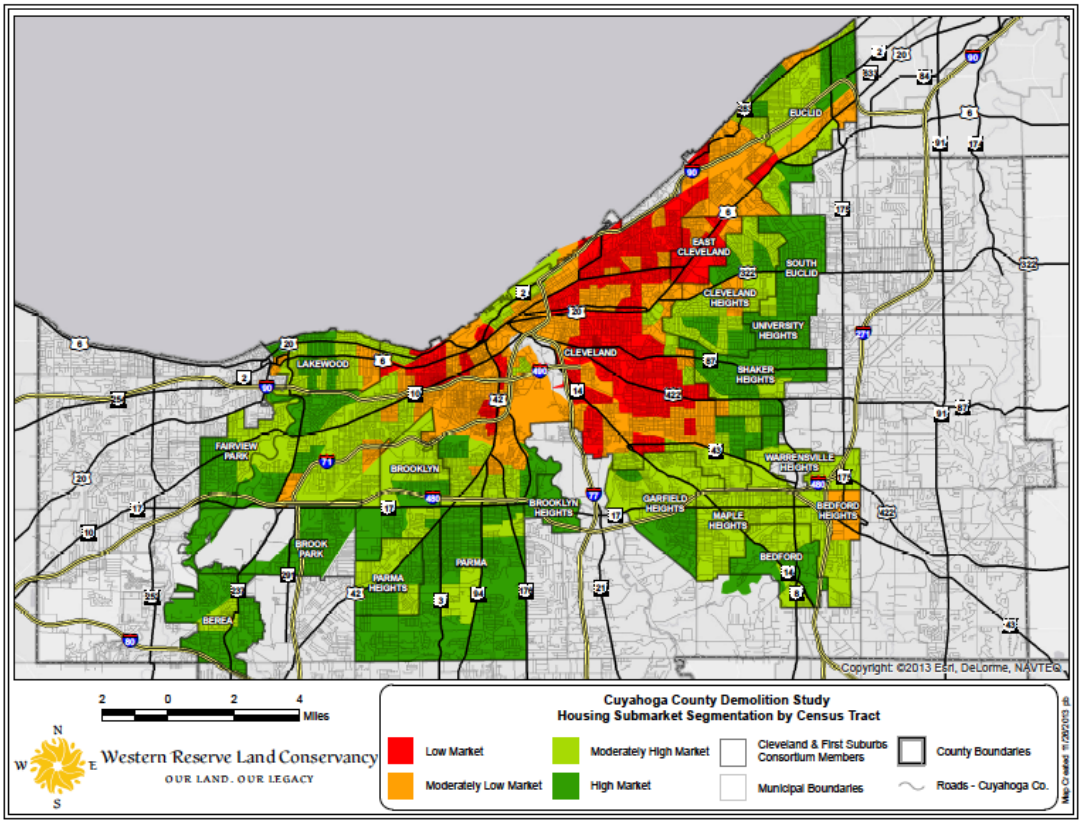
Part 1 of the report focuses on the research process and findings associated with estimating the real estate equity impacts on neighboring properties caused by demolition activity. Part 2 of the report focuses on the research process and findings associated with estimating the impact that demolition has on localized mortgage-foreclosure rates over time.

PART 1: Impact of Demolition on Real Estate Equity

Overview

Empirical data derived from the NEO CANDO[2] data system was used to econometrically model the impacts that distressed residential structures and vacant lots have on the value of nearby homes. Evidence strongly suggests that the impact of distressed properties varies across high, moderately high, moderately weak and weak functioning real estate submarkets in Cleveland and surrounding areas (See map below). It is further shown that property value impacts vary depending on the specific type of distress within each submarket. Key findings include consistent and significant positive value gaps between distressed residential structures and vacant lots. Given that demolition of distressed residential structures creates residential vacant lots, findings suggest an available hedge in real estate equity from strategic and targeted demolition activity in relevant markets. The research capitalizes on the equity hedge estimates to perform a counterfactual simulation that predicts residential property values as if zero demolition activity occurred across the space and time of the study. Status quo property value estimates are then compared with counterfactual property value estimates to quantify the net financial effect of demolition investments.

[2] See: http://neocando.case.edu



Findings

The necessary spatial corrections were made to reach the final empirical model. Identified as a "spatial regimes" approach, the model allows sales within the four identified submarkets to vary across space and time. The explanatory variables in the final model explain 56.5% of the variation in the models dependent variable, sales price.[3] The table below provides key findings from the final results of the regression analysis. Coefficient estimates, level of statistical significance, and the magnitude of the real estate equity hedge available to homes within 500 feet of demolishing the identified distressed structures are provided.

Coefficients are read as percentages, and are only valid if they are statistically significant – i.e. -0.016*** is interpreted as a -1.6% impact on home sales price if an additional blighted structure was within 500 feet of it. As mentioned above, the available equity hedge from demolition activity is quantified by calculating the difference between the impacts of a vacant lot on a home sales price (vacant lot impact is assumed zero if it is insignificant) and the impact of a particular type of blight on home sales price. After studying

[3] See Pg. 16-26 of the Full Report for details on the final empirical model.

the table below, it becomes clear that the majority of home equity benefits derived from demolition activity congregate in higher functioning markets. Further, the benefits that congregate in the stronger markets are relatively higher in financial terms, given that average sales prices are higher in stronger markets (See Table 2, Pg. 26 of Full Report).

Table 1: Regression Results and Associated Real Estate Equity Hedges Available from Demolition of Distressed Structures

	Extremely Weak Functioning Housing Markets		Weak Functioning Housing Markets		Moderately Functioning Housing Markets		High Functioning Housing Markets	
Distressed Properties Within 500 Feet[4]	**Coefficient**	**Hedge Value**	**Coefficient**	**Hedge Value**	**Coefficient**	**Hedge Value**	**Coefficient**	**Hedge Value**
Vacant Lots	-0.003		-0.012***	N/A	-0.010***	N/A	-0.010***	N/A
Tax Delinquencies	-0.016***	1.6%	-0.036***	2.4%	-0.040***	3.0%	-0.038***	2.8%
Vacant Tax Delinquencies	-0.028***	2.8%	-0.003	N/A	-0.051***	4.1%	-0.086***	7.6%
Vacancies	0.009	N/A	-0.003	N/A	-0.022***	1.2%	-0.026***	1.6%
Mortgage Foreclosures	0.041**	-4.1%	0.024**	-2.4%	-0.016***	0.6%	-0.026***	1.6%
Tax Delinquent Mortgage Foreclosures	0.006	N/A	-0.037	N/A	-0.042+	3.2%	-0.030	N/A
Vacant Mortgage Foreclosures	-0.017	N/A	-0.030	N/A	0.005	N/A	-0.009	N/A
Tax Delinquent Vacant Mortgage Foreclosures	-0.070+	7.0%	-0.004	N/A	-0.086*	7.6%	-0.060	N/A
Tax Foreclosures	0.013	N/A	-0.058	N/A	-0.052+	4.2%	-0.201***	19.1%
Vacant Tax Foreclosures	-0.031	N/A	-0.053	N/A	-0.065+	5.5%	-0.108+	9.8%

Coefficient Significance Key: + for p<.1; * for p<.05; ** for p<.01; and, *** for p<.001

Predictive analysis estimates the value of homes if demolition over the study time period had not been undertaken and compares it to current home values given the occurrence of demolition.[5] The table below provides the key findings from the analysis. Total cost of more than 6,000 demolitions is compared to total benefits of demolition in each submarket as well as in the aggregate regional market.

[4] See Appendix 1 from the full report for specific definitions of each spatial distress variable.

[5] See Pgs. 53-55 of the Full Report for a full explanation of the predictive analysis.

Table 2: Summary of Findings from Simulation for Cost-Benefit Analysis of Demolition Investments								
Submarkets	**Status Quo Value**	**Counter-Factual Value**	**Change**	**Total Demos**	**Hedge Per Demo**	**Total Demo Cost**	**Cost Benefit**	**Cost Benefit Ratio**
Extremely Weak	$449.7M	$447.5M	$2.22M	2,944	$754.16	$27.6M	-$25.4M	-0.92
Weak	$766M	$773M	-$7M	1,951	-$3,585	$18.3M	-$25.3M	-1.38
Moderately Functioning	$4.63B	$4.59B	$38.3M	776	$49,367	$7.3M	$31.0M	4.27
High Functioning	$8.43B	$8.38B	$45.4M	335	$135,475	$3.1M	$42.2M	13.45
TOTALS	**$14.27B**	**$14.19B**	**$78.9M**	**6,006**	**$13,140**	**$56.3M**	**$22.6M**	**1.40**

PART 2: Impact of Demolition on Mortgage-Foreclosure Rates

Overview

Pattern-based analysis strongly suggests that residential demolition activity lessens the mortgage-foreclosure rate across comparable neighborhoods. A neighborhood distress index was carefully constructed to categorize Census Blocks[6] into low, moderate and high distress tiers throughout the study area. Each tier of distress is divided between those neighborhoods that experienced demolition intervention and those that did not received demolition intervention. Demolition activity and property distress are measured for residential parcels only, specifically focused on the existence and demolition of tax-foreclosed, tax-delinquent, mortgage-foreclosed and vacant properties. Neighborhoods with similar levels of distress that experience demolition are consistently shown to have steeper declines in mortgage-foreclosure rates than those that do not experience demolition activity.

These findings provide federal policy makers with research evidence that supports increased spending of Troubled Asset Relief Program (TARP) housing resources[7] on demolition activity. Apples-to-apples neighborhoods are experiencing trends that suggest greater declines in mortgage-foreclosure rates when demolition activity is present. Therefore, these findings suggest that demolition is a preventative measure

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[6] U.S. Census Bureau on the web: http://www.census.gov/geo/maps-data/maps/block/2010/

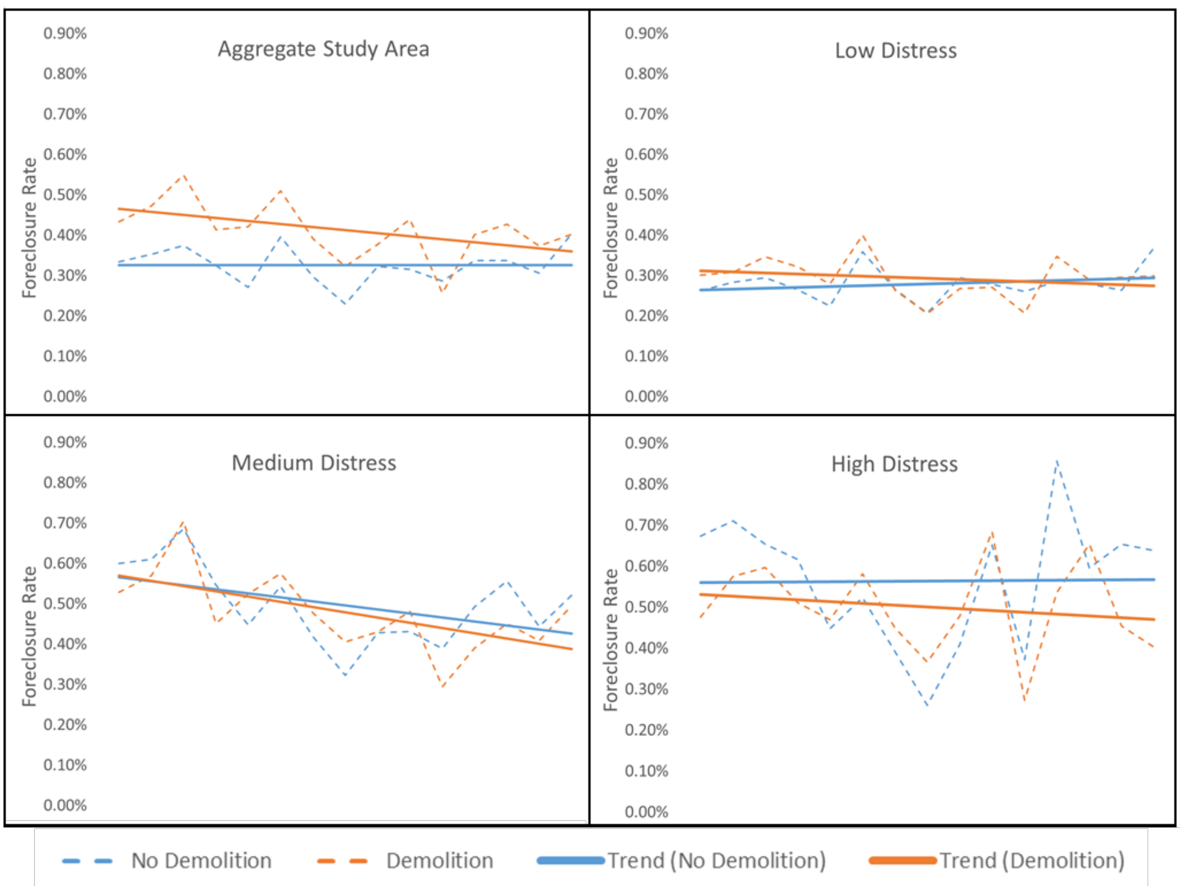
[7] The Troubled Asset Relief Program (TARP) is the primary policy response from the Federal Government related to the 2008 mortgage-foreclosure crisis. Of the total allocated funds, the U.S. Treasury provided $45.6 billion for housing support programs, which has been subsequently reduced to $38.5 billion. The status of the $7.1 billion reduction in funds remains unclear. Three main TARP housing support programs are the Home Affordable Modification Program (HAMP), Making Homes Affordable Program (MHA) and Hardest Hit Fund Program (HHF). HHF funds were given to select states formulaically based on how intensely the mortgage-foreclosure crisis impacted them and are designed to quell and prevent future mortgage-foreclosure in those states. Of the $38.5 billion allocated for these three programs, only $9.5 billion was spent as of September 30, 2013. The remaining $29 billion remains unspent.

for future mortgage-foreclosure. Given that neighborhood scale demolition activity is shown to meet the necessary outcome of TARP housing funds' programmatic spending, it offers the U.S. Treasury a prime opportunity to expedite the release of TARP housing funds for demolition activities before access to available resources expire on December 31st, 2017. The TARP housing funds are largely unspent for a simple reason: TARP housing funds currently must be spent to assist individual homeowners. Funds are not available to help communities address the foreclosure crisis at the neighborhood level.[8]

Findings

Cleveland Area Foreclosure Rates by Census Blocks

With and Without Demolition Intervention, 3rd Quarter, 2009 – 1st Quarter, 2013



As shown in the graphs above, the analysis provides evidence that demolition activity is associated with decreasing mortgage foreclosure rates in low, medium, high and aggregate neighborhood distress types. The neighborhood distress index was designed to control for differing types of neighborhoods. Although results show consistent positive benefits from demolition activity, the benefits received in low, medium and high distress areas differ. In contrast with results in Part 1, findings suggest that benefits in terms of

[8] Recent pilot programs allowing Michigan and Ohio to spend $100 million and $60 million of HHF on targeted demolition activity, respectively, are validated from these findings given that the use of these pilot funds meet HHF mission statement requirements.

decreasing mortgage foreclosure rates are greater in high distress areas as opposed to those experiencing low levels of distress. That said, taken together with the positive home equity returns that are hedged from demolition activity in strong markets, as laid out in Part 1, a double-bottom line of benefits is suggested to be available from demolition through the additional benefit of lower mortgage foreclosure rates in relevant stronger market areas.

Given that demolition is consistently shown to decrease mortgage foreclosure rates over time across the study area, and the dynamics of demolition are taken into account within these calculations, findings in this analysis suggest that demolition activity is a preventative measure of future mortgage foreclosure.

Conclusions

Part 1 of this analysis identifies that residential real estate equity can be hedged by demolition activity across Cleveland submarkets over the study time period. Specifically, statistically significant and higher magnitude benefits are shown to primarily accrue in stronger housing markets, which also have relatively higher housing prices. These findings suggest that optimal returns can be captured in the stronger submarkets of the study through targeted demolition in these areas. With that said, several limitations exist related to this approach. First, Part 1 primarily focuses on the financial outcomes associated with demolition activity. It has been shown that demolition impacts several other outcomes, including crime reduction, among others. Secondly, the spatial granularity of the housing submarkets is relatively course at the Census Tract level, meaning the number of submarkets within a single Census Tract is potentially greater than one. With that said, findings from Part 1 provide new economic insight into the differing financial impacts of distressed structures and demolition activity in differing housing submarkets, greatly impacting the policy dialogue surrounding the benefits and targeting of demolition activity.

Part 2 of this analysis uses a neighborhood distress index to compare mortgage foreclosure rates in Census Blocks which did experience demolition activity with those which did not. The visual and graphical analysis provides clear trends that suggest that neighborhoods that get demolition have better trends in terms of decreasing mortgage foreclosure rates. Given that the analysis is over time, demolition is suggested to be a preventative measure of future mortgage foreclosure. The primary caveat to the analysis in Part 2 is that it is pattern-based and the relationships are visually identified through their correlative differences. In other words, we define the differences between foreclosure rates in areas which did and did not receive demolition by controlling for similar neighborhoods and then placing rates on a graph and observing whether the respective trends appear differently to the eye of the observer. A cause-and-effect relationship may be reasonably implied but is not proven. Future research will focus on a more in depth analysis of the slopes of the individual trends and test for structural differences in the comparative.

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ABSTRACT

This two-part empirical analysis focuses on the effect that residential demolition has had on real estate equity and mortgage-foreclosure rates in the Cleveland, Ohio area between 2009 and 2013. Part 1 of the analysis uses a spatially dynamic economic model of land use change to estimate varying levels of financial impact from demolition activity on real estate equity across four housing submarkets. Just over 6,000 demolitions were completed over the study period, costing roughly $56.3 million. Findings estimate total demolition benefits at $78.9 million, suggesting a $22.6 million net benefit (1.40X per $1 invested) attributed to demolition activity. Benefits from demolition activity were shown to accrue primarily in high and moderately functioning markets, with financial multipliers of 13.45X and 4.27X return on investment per one demolition dollar invested, respectively. Conversely, findings suggest that little real estate equity return is available from demolition activity in weak real estate markets.

Part 2 of the analysis uses a pattern-based approach to investigate the relationship between demolition activity and mortgage-foreclosure rates. Findings show a clear trend of decreasing mortgage-foreclosure rates in areas where demolition intervention activity took place. This is true for the study area as a whole as well as in low, moderate and high distress neighborhoods.

[1] Nigel G. Griswold can be reached at nigel@bigdataecon.com or the Griswold Consulting Group website - bigdataecon.com.

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Background

The Cycle of Decline in Legacy City Real Estate Markets

Often referenced as one of the epicenters of the mortgage-foreclosure crisis, Cleveland, Ohio and the surrounding Cuyahoga County region experienced roughly 15,000 foreclosures in 2007 - a four-fold increase from 1995 (Coulton et al., 2008; Coulton, et al., 2010). Predatory lending and the fallout of the mortgage crisis hit Cleveland hard. That said, the region has experienced systemic economic decline for several decades caused by diminishing global competitiveness, largely due to historical reliance on the manufacturing sector. The mortgage crisis merely exacerbated a pre-existing condition for the Cleveland region and countless other older industrial cities across the American Midwest.

“Legacy City,” is an urban classification designated for older metros that are entrenched in historically declining industries. Economies embedded in bygone industry sectors have experienced a slow transition into success within the fast-paced global economy. American legacy cities are largely concentrated in the Midwest “Rust Belt,” and tend to have histories deeply rooted in manufacturing. While quality assets often remain, endemic decline in industry, employment and population have hollowed out the vitality in many neighborhoods and downtowns. Economic exodus over the past 50 years has left vast inventories of vacant and blighted industrial, commercial and residential properties scattered across the urban landscape. These disamenity properties are liabilities to neighborhoods, communities and municipal budgets. While the mortgage-foreclosure crisis increased vacancy and foreclosure rates nationwide, the endemic decline of legacy cities was intensified.

Limited options exist for these municipalities given the negative financial and social cost associated with distressed structures. Population loss and changing preferences for single-family homes significantly impacts demand for older housing stock in the core neighborhoods of legacy cities. Vacant residential properties caught in a cycle of decline often remain empty due to limited demand - adding to an oversupply of cheap housing that draws prices and rents down further. These properties are targets for speculators with little incentive to invest given declining neighborhood conditions. Speculators extract value from buying properties at low cost and never investing to maximize their returns, resulting in poor quality rentals. Loss of future equity potential in the housing stock creates fewer owner occupied units, and more speculators acting as slum lords in increasingly vacant neighborhoods. Neighborhoods with high vacancy rates and limited market incentive for investment result in a dilapidated and blighted housing stock as all interested parties divest.

Municipalities are burdened with “non-paying” properties that shrink the tax base while tax revenues are negatively impacted by increased delinquency and foreclosure, eroding critical support for municipal services. Service quality from police, fire, road maintenance and others is at risk as budgets become increasingly stretched. Vacant and abandoned structures open the door to criminal behavior such as storage of stolen goods, arson, drug abuse, prostitution, garbage dumping and other illegal activities. This cycle of municipal decline is a downward spiral for both property value and neighborhood quality that overtakes core areas of legacy cities and can quickly spread to adjacent areas.

Demolition as a Strategy to Disrupt Market Decline

Functional real estate submarkets exist in pocketed areas of many legacy city metro areas as they often remain regional hubs of economic activity. These housing markets do not experience systemic decline because the equity of a home is protected by its future value. Conversely, extremely depressed legacy city submarkets may be completely bottomed out in terms of market value. Legacy city real estate markets that lie between functioning and non-functioning markets have the potential to move in either a positive or negative direction. These in-between markets present the opportunity zones that can stem the spread of blight and protect real estate equity and neighborhood quality. Vacant and abandoned structures are scattered across divergent market landscapes and limited budgets must be used to strategically target and optimize outcomes of revitalization activities. With high social and financial costs, managing these distressed properties is a ubiquitous issue that decision makers in legacy cities face.

Also key for municipalities to manage the disposition of their vacant and abandoned properties is unencumbered access to property title such that appropriate action can be taken. Until recently, title access has been a significant barrier to effective management of the disposition of disamenity properties. Fortunately, contemporary advancements in land-banking legislation and other issue-relevant local policies have received broad attention and success, opening the door for municipal authorities to take control of their problem properties. Although this critical work is still incomplete, legal access to problem properties with local latitude for disposition of distressed properties is available within the study area of this research.

As legacy cities gain control of their distressed property inventories, limited budgets demand optimal targeting resulting in maximum impact. This study focuses on the community and market outcomes of demolition: a fundamental action that legacy cities must realistically encounter as they take responsibility for liability properties. Using sophisticated data systems, econometric modeling, pattern-based modeling and predictive analytics, this study investigates:

1) Property value impacts of nearby distressed properties;

2) The impact that demolition of distressed properties has on neighboring real estate equity;

3) The impact that demolition has on localized mortgage-foreclosure rates.

Part 1 of the report focuses on the research process and findings associated with estimating the real estate equity impacts on neighboring properties caused by demolition activity. Part 2 of the report focuses on the research process and findings associated with estimating the impact that demolition has on localized mortgage-foreclosure rates over time.

PART 1: Impact of Demolition on Real Estate Equity

Introduction

Key stakeholders in the Cuyahoga County, Ohio have focused blight remediation efforts on capturing and leveraging local, state and federal funds to demolish disamenity properties in Cleveland and its surrounding suburbs. With key stakeholder efforts and the help of the Cuyahoga Land Bank, roughly $56 million has been invested in demolition since mid-2009, bringing down over 6,000 problem properties. Justifying continued investment in demolition activity as a revitalization strategy calls for a clear understanding of the financial impact demolition has on nearby property equity across varying types of real estate markets in Cleveland and its surrounding suburbs. Estimating the existence and magnitude of these impacts to justify demolition funding is urgent given the current cycle of decline continually spreads more blight (Harding, et. al., 2009). Without increased demolition funding, the region will likely struggle to ever get ahead of the estimated 10-15,000 blighted structures it now has.

Empirical analysis identifies an academically defensible estimate of the net economic impact of distressed properties and demolition activity using sophisticated econometric modeling and predictive simulation techniques derived by detailed parcel-level data intelligence. Distress indicators include nearby mortgage-foreclosed, tax-foreclosed, tax-delinquent and vacant residential structures as well as vacant residential lots. The Northeast Ohio Community And Neighborhood Data for Organizing (NEO CANDO) resource provided the highly sophisticated parcel-level data intelligence that made this research possible.

Empirical evidence strongly suggests that the impact of neighborhood distress varies across high, moderately high, moderately weak and weak functioning real estate submarkets in Cleveland and its surrounding suburbs. It is further shown that property value impacts vary depending on the specific type of distress within each submarket. Key findings include consistent and significant positive value gaps between distressed residential structures and vacant lots. Given that demolition of distressed residential structures creates residential vacant lots, findings suggest an available hedge in real estate equity from strategic and targeted demolition activity in relevant markets. The research capitalizes on the equity hedge estimates to perform a counterfactual simulation that predicts residential property values as if zero demolition activity occurred across the space and time of the study. Status quo property value estimates are then compared with counterfactual property value estimates to quantify the net financial effect of demolition investments.

Part 1 of the study starts out with a literature review to understand the state of the art in terms of econometric modeling that helped guide our empirical process. The next section focuses on the theoretical framework of the hedonic price function and how the theory allows for welfare estimates to be calculated from an empirical model. Next, the empirical model is introduced in which the functional form, key hypotheses, spatial correction technique and data that was used for estimation is explained. Regression results from each individual submarket are then provided, along with a comparative analysis of the impacts of distress and demolition across submarkets. A section dedicated to cost-benefit estimates associated with demolition activity is then presented followed by a comprehensive overview of research findings.

Neighborhood Distress Literature

An outcome of the mortgage-foreclosure crisis has been increased research investment on the financial impacts related to distressed real estate environments and the policies that impact them. The value impacts of distressed residential structures and vacant lots on nearby housing can be measured using a *hedonic price function*, which estimates the marginal implicit value of structural and neighborhood characteristics associated with residential housing (Taylor, 2003). The hedonic price function is the econometric modeling tool of choice to measure spillover effects from distress in the housing market, and has been leveraged regularly to better understand the financial and market impacts of the mortgage crisis.

While specific methods vary, the negative spillover effects on real estate values from nearby distressed properties has been well established in the literature for over 15 years (Simons, Quercia and Maric, 1998; Immergluck and Smith, 2006; Griswold, 2006; Griswold and Norris, 2007; Schuetz, et al., 2008; Mikelbank, 2008; Leonard and Murdoch, 2009; Harding, et al., 2009; Rogers and Winter, 2009; Lin, Rosenblatt and Yao, 2009; Kobie 2003; Rogers, 2010; Hartley, 2010; Campbell et al., 2011; Groves and Rogers, 2011; Whitaker and Fitzpatrick, 2013). Yet, little work simulates the financial effects from land use changes in the distress environment. Griswold (2006) uses a hedonic price function to perform a counterfactual simulation that predicts home values near demolition sites both with and without actual demolition activity in Flint, Michigan between 2002 and 2005. The Griswold (2006) study found that 435 demolitions hedged nearly $109 million in nearby home equity over 3 years from a land use change that turned abandoned structures into vacant lots.

In essence, Griswold (2006) provides the method needed to value real demolition activity in Cleveland, Ohio and its first ring suburbs. While the empirical modeling approach in Griswold (2006) does not reflect the available sophistication of data or cutting edge research, the method of predictive simulation holds strong in its value for future application.

Several consistencies exist in the modeling processes of the distress literature. All studies identify some form of distance-to-hazard measure focused on “distressed properties” surrounding homes that have recently sold, including different distance buffers that aggregate and count the number of disamenities nearby. However, it must be clear that negative price effects may not necessarily be a function of “distressed structures”, per se, but rather a function of the problems that stem from these types of housing. Storage of stolen goods, drug activity, prostitution, arson, garbage dumping and overall increased criminal activity (Setterfield 1997; Funders’ Network, 2004) all emanate from these disamenity properties. Therefore, the location and number of abandoned structures and vacant lots surrounding residential homes is ultimately a proxy for the level of related disamenity characteristics.

Alexander’s (2005: 5) definition of abandonment is still at the heart of how distressed property is identified: “the owner has ceased to invest any resources in the property, is foregoing all routine maintenance, and is making no further payments on related financial obligations such as mortgages or property taxes.” That said, it is now becoming clear that a spectrum of impact from abandonment and disinvestment exists in which parsing out distressed structures by typology is critical to properly specifying models of distress. In other words, different indicators of distress cannot just be pooled together and be all be called “abandoned properties” because some are vacant, some are not, some are delinquent and some are not, etc., and the impacts of

these differences are shown to be significant in how they impact nearby value (Whitaker and Fitzpatrick, 2013).

Data driven advancement in modeling techniques has emerged in recent studies that expand the specificity of "distressed property" definitions. Mikelbank (2008) and Hartley (2010) acknowledged the need for increased specificity in "distress" measurements, working to bring property vacancy in as a variable, but data richness was non-optimal. The next scholarly step took the sophisticated NEO CANDO data system (also used for the current study) to measure real-time vacancy using US Postal Service data for the first time (Whitaker and Fitzpatrick, 2013). NEO CANDO further allowed researchers (Whitaker and Fitzpatrick, 2013) to measure whether nearby distressed properties were vacant or occupied, tax current or delinquent, mortgage-foreclosed or not, or any combination of the three. Research presented here takes this concept further by including tax-foreclosure, increasing the precision of comprehensively measuring distress near homes that are selling. Per consistency with Griswold (2006), vacant lots were also included as a distress variable to create the necessary juxtaposition of land use change between distressed structures and vacant lots. Contrasting vacant lots as a benchmark of distress with other distressed structures allows estimation of an available hedge in home equity through demolition activity, and further allows the associated counterfactual simulation that provides property value predictions in a world without demolition activity.

By providing evidence that distress impacts vary across real estate submarkets, Whitaker and Fitzpatrick (2013) demonstrated that a single model representing an entire city as one market, "obscures important differences between the widely varied housing markets." In other words, the impact of mortgage-foreclosure in weak and dysfunctional markets is different than the impact of mortgage-foreclosure in strong and functional markets. Whitaker and Fitzpatrick measure the Cleveland housing submarkets into two markets: weak markets were represented by high poverty census tracts defined as >20% poverty; while low poverty census tracts had <20% poverty and represented strong markets (2013). This research significantly increases submarket specificity by introducing vacancy rates, income levels, and gross rents to the poverty measure at the census tract level. We further divided each variable into their respective quartiles and created index scores for each. Each census tract then received an overall index score that rounded up or down between one and four. Therefore, this study focuses on four established submarkets within the study area: extremely weak functioning, weak functioning, moderately functioning and high functioning.

Ultimately, this study aims to leverage the cutting edge of hedonic literature to produce the best possible model coefficients that can be used to predict housing values within the study region both with and without demolition activity. Critical to the modeling process was taking into account macro-scale transformations in local housing markets due to the mortgage-foreclosure crisis through distressed-sale categorical variables, designing highly sophisticated distressed property counting techniques, and optimizing the reality of submarkets across the study area. This scholarly adaptation improves upon the latest advances in distress variable specificity and submarket delineation in the modeling process offered by Whitaker and Fitzpatrick (2013). Further, it improves knowledge of the impacts of demolition activity by integrating these improved models into the sophisticated equity hedge and counterfactual simulation approach of Griswold (2006). The outcome is an ability to measure differing levels of hedged real estate equity from demolition activity in different Cleveland submarkets.

Theoretical Framework: the Hedonic Price Function

Hedonic Theory

The hedonic price function is based on the economic theory that goods are ultimately valued by way of their utility-bearing attributes (Lancaster, 1966; Rosen, 1974). Given a competitive market, specifically Cleveland's competitive housing market, buyers are assumed to sort themselves by deciding on a "bundle" of attributes (i.e. a house) that they are willing to purchase, given their income constraints and preferences. The implicit prices of attributes will be decided by the supply of and demand for those particular attributes within the specified area (Deaton, 2002). The intuitive idea is that a house is made of its physical and structural attributes, as well as all the attributes of its particular environment and location. According to economic theory, the positive and negative value effects of these attributes are what make the price of a home higher or lower, respectively.

Taylor (2003) suggests the following thought experiment to understand the hedonic theory: Imagine that there are two identical lakes, each with 100 identical homes surrounding them. All the homes are on the lakefront, and all characteristics of each home, the land and the neighborhoods are identical across properties. At the current equilibrium price of $200,000, all 200 homes are equally preferred on each lake. Now imagine that water clarity is improved on Lake A. We assume that all households prefer improved water clarity. In this circumstance, any house offered for $200,000 on Lake A would uniformly be preferred to a house on Lake B. At current prices, there is an excess demand for housing on Lake A, and so the price of these houses must rise to reach market equilibrium. The amount by which the value of the housing on Lake A increases is the "implicit value" of an incremental increase in water quality (Taylor 2003).

Within competitive markets, a hedonic equilibrium requires that a change in the price of a house in response to a change in any attribute of that house should exactly equal the marginal bid and marginal offer of buyers and sellers of that house (Smith and Huang, 1995). Given this assumption, we should be able to find people's marginal willingness to pay for non-market attributes, such as differing levels of disamenity structures and lots nearby, as well as other structural, neighborhood, and environmental characteristics.

If levels of non-market attributes (disamenities associated with distressed structures and vacant lots) can be measured correctly, a hedonic pricing model can be specified to examine the extent that variation in the non-market attribute is incorporated in the price of the final product (Deaton 2002). The general form of the hedonic price function is:

(Eq. 1) $$P_i = P(x_i)$$

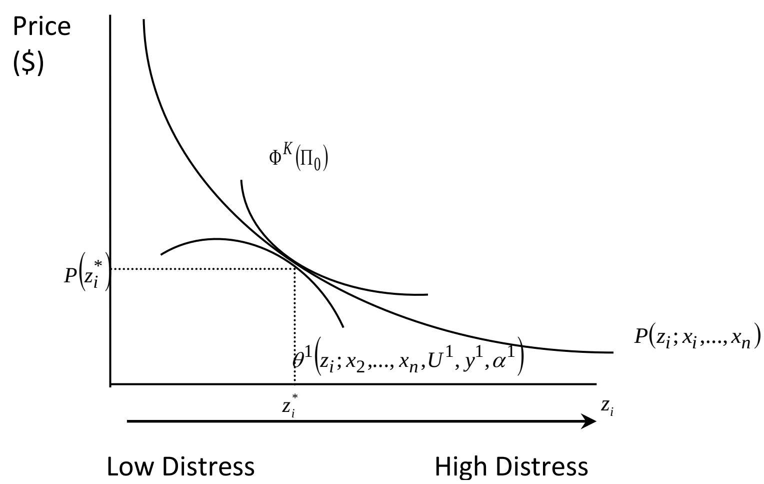
where price (P) of the *i*th housing unit is a function of a vector of attributes, x_i, of that house. Li and Brown (1980), Deaton (2002), Simons, Quercia, and Maric (1998), Hite, Chern, and Hitzhusen (2001), and Farber (1998) all explain how to separate these value-defining attributes. Variables associated with the hedonic price function typically fall into one of two categories. The most critical are the physical features of the house such as lot size, square footage, age of house, number of bathrooms and bedrooms, and other variables descriptive of the physical house and property. The other attributes describe the neighborhood, location and environment of the house such as neighborhood income levels, crime rates, school quality, racial

composition, poverty rate, distance from important destinations, and environmental measures such as proximity to hazards (Haab and McConnell 2002). The differentiated commodity is assumed sold in a competitive market where the interactions between producers and consumers together determine the equilibrium price schedule for the differentiated commodity (single-family residential housing) (Taylor, 2003).

Application of Theory to Derive Welfare Estimates

This study is concerned with the effects of vacant, tax-delinquent, tax-foreclosed, and mortgage-foreclosed structures and vacant lots on nearby housing values and the impacts of removing those structures and increasing vacant lots through demolition activity. As discussed earlier, distance-to-hazard measures will be derived for relative exposure to distressed structures and vacant lot disamenities. In this study, distance-to-hazard is measured by the number of vacant, tax-delinquent, tax-foreclosed or mortgage-foreclosed structures within a 500-foot distance ring surrounding a residential sale during the time period it sold. Vacant lots within 500 feet of a residential sale during the time period it sold is also considered a distance-to-hazard variable. Increases in the number of distressed structures or vacant lots within proximity to a residential housing sale are expected to lower property values, all else constant (Farber 1998).

Figure 1: Equilibrium Point of House Price and Distress Level in the Hedonic Price Function



Hedonic Price Function $P(x_i)$

$P(x_i)$

Figure 1 represents the equilibrium price schedule for the hedonic price function, $P(x_i)$, as it varies with changes in z_i, holding the level of all other explanatory variables constant. $P(x_i)$ is drawn to show the relationship between the selling price (P) of a house and the general effect of increasing the number of distressed structures (z_i) on the selling price of a home. Selling price is expected to decrease at a decreasing rate as distressed structures surrounding increase. This relationship of diminishing marginal returns is expected for variables in the hedonic price function. For example, if a house is 700 square feet in size and increases to 1000 square feet, a

larger price differential in the overall house price is expected compared with a house that increases in size from 4000 square feet to 4300 (Taylor 2003).

Applied Welfare Analysis

The attractiveness of the estimated hedonic price function for applied welfare analysis lies in the potential to aggregate marginal "willingness to pay" for households in a given area to derive benefit estimates (Deaton 2002; Freeman 1993). Small (1975) has shown that a marginal change, the partial derivative of the hedonic price function with respect to the environmental variable (distressed structures and vacant lots), is equivalent to marginal value or marginal willingness to pay. For this reason, aggregate estimates of marginal willingness to pay for changes in the environmental variable can easily be calculated.

"Interpreting the marginal implicit prices as households' marginal willingness to pay requires the assumption that each household is in equilibrium with respect to a given vector of housing prices and that the vector of housing prices is the one that just clears the market for a given stock of housing" (Freeman 1993; 382). To fully achieve these aspects of equilibrium requires that buyers have full information on all housing prices and attributes, transactions and moving costs are zero, and the price vector changes instantaneously in response to changes in either supply or demand (Freeman 1993). Clearly, the idealized theoretical model is a departure from the real-world housing market and the empirical data that represents it. As the hedonic price function is modeled empirically, there is an art to controlling for the realities of unique housing markets such that any significant departure from the theoretical framework is minimized.

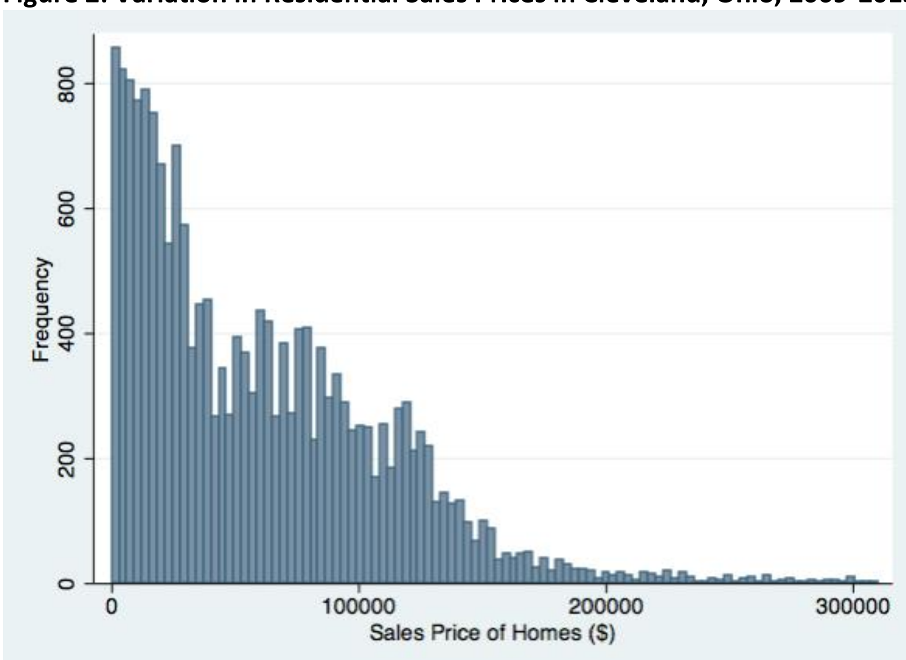
Specifically, Freeman (1993) suggests three distinct areas of concern when evaluating whether the market in question can provide sufficient information on implicit prices. Freeman's (1993) first concern is the accuracy of the price data itself. Given thorough coverage of all types of deed transactions in Cuyahoga County at the parcel level over the study time period, the accuracy of individual transactions is not an issue when using the NEO CANDO data resource. Therefore, identifying the "low hanging fruit" in terms of "conventional" and "arms-length" is not a problem for our study. Also, since Freeman (1993) wrote up his primary concerns, data capacity and sophistication has significantly increased. That said, our research team acknowledges that bank/real estate owned (REO sales) and other distressed property sales have been a major aspect of the housing market in a post-mortgage crisis America. Many of these sales are valid under the definition of "arms-length sale" as a willing buyer and seller with perfect information are represented. Measures have been taken in the modeling process to control for these types of sales through categorical variables. This activity did impact transactional price data, causing data processing to identify true arms-length sales and those that are special circumstances. A further explanation of how these issues were overcome will be described in the data section of this document.

Freeman's (1993) second issue concerns the speed with which a housing market adjusts to changes in supply of and demand for housing attributes. Broadly speaking, the entire U.S. is currently undergoing transition in the residential real estate market – potentially more so in the Cleveland region due to legacy city issues. If adjustments in the housing market are incomplete, the marginal implicit prices will not accurately measure households' marginal willingness to pay for housing attributes. For this study, the question is how quickly property values respond to changes in varying levels of distressed properties as land use dynamics like demolition turn distressed structures into vacant lots. Because demolition and other land use change is

constantly impacting neighborhood environments, there is an inevitable moving target in terms of supply of and demand for neighborhood attributes. That said, research is shedding light on the speed with which the market changes from distressed properties surrounding other residential properties. Kobie (2009) determined that more recent mortgage-foreclosures had less negative impact than older mortgage-foreclosures, with initial significant negative impact showing up after 1 year. Necessary time trend controls for this issue are explained in the empirical process section.

Freeman's (1993) third major concern lies with the use of marginal implicit prices as a measure of households' marginal willingness to pay for housing attributes. This issue is concerned with expectations about future levels of environmental amenities. Housing is seen as a long-term durable good, and current perceptions of a potential change in an environmental amenity can affect the present marginal implicit prices for that attribute, independent of the current level of the attribute in question. Given the differing levels of decline and improvement including demolition, vacant lot improvements and vacant homes being stripped, burnt and blighted occurring across many of Cleveland's neighborhoods, future levels of environmental amenities are a moving target, and introduce empirical issues to the theoretical principles, This remains a standing empirical issue, given that a method to capture buyers' perceptions of the future status of a neighborhood they buy a home in has not been developed.

Figure 2: Variation in Residential Sales Prices in Cleveland, Ohio, 2009-2013



Another requirement to allow the interpretation of marginal implicit prices as marginal willingness to pay is sufficient variation in housing prices such that every household is in equilibrium. The hedonic model is based on the assumption that the implicit price function is differentiable and continuous. Shown in Figure 2, large variation in prices of houses sold in Cleveland between 2009 and 2013 is represented in the data for this study. This variation aids in the assumption that all possibilities along the hedonic price function are possible within Cleveland, Ohio. That said, it is clear that the data is skewed left, with much variation in low sale

values and little variation in high sale values. This variation is intuitive given many low value markets, some middle and very few high value markets in the Cleveland real estate market over the study time period. Much of this variation is contained in individual submarkets and estimated in individual regimes in the final empirical model.

A large body of literature examines the difficulties of using coefficients from the hedonic price function to derive welfare measures (Freeman 1993). The locus of supply and demand is measured by the hedonic price function – an envelope of equilibrium points where individual consumers' bid schedules are just tangent to the offer schedules of sellers (Deaton 2002). As shown in Figure 1, the bid (θ^k) and offer (Φ^j) functions of two consumers, all points along the hedonic price function within a competitive market represent the tangency of a seller's offer curve and a buyer's bid curve. The equilibria represented by the tangencies along the hedonic price function pose potential problems of identification (Haab and McConnell 2002; Freeman 1993; Rosen 1974) and endogeneity (Bartik 1987). According to Palmquist (1992), these problems do not generally arise in cases where the change in the environmental variable in question is "localized" to a small area. The disamenity in question – distressed properties – are highly localized, as all variables count them within 500 feet.

In this case study, the demolition activity in Cleveland and its first ring suburbs is altering neighborhood environments in all housing markets under examination. As noted by Taylor (2003), when a non-localized (non-marginal) change in a housing market occurs, a shift in the overall supply is implied, and the entire hedonic equilibrium will shift. These cases call for second-stage demand analysis or estimation of uncompensated demand for characteristics of the differentiated good. However, as noted by Brown and Rosen (1982), and later by Hite et al. (2001), data from a single market (i.e. this case study) are inappropriate for second stage modeling because of the identification problem (see Freeman 1993). Therefore, in this empirical analysis, we assume that a large number of utility maximizing individuals (Cleveland citizens) are in short-run equilibrium with a fixed housing supply which offers enough variety so that each consumer can choose from a continuum of distressed structures and vacant lot levels, and can do so independent of other housing characteristics (Small 1975; Chattopadhyay et al. 2005). This assumption facilitates the use of marginal implicit prices of housing characteristics as the marginal willingness to pay for housing attributes.

Empirical Model

Functional Form

Research team deliberation and data processing led to the final boundaries of the research study area, the optimal time period to perform the empirical analysis, definitions and methods for counting distressed structures and vacant lots, and eventually a final count of arms-length sales for the hedonic price function. Boundaries of the research study area were identified as the City of Cleveland, Ohio and the members of its First Suburbs Consortium. The surrounding suburbs to the city were chosen for two reasons: 1) the First Suburbs Consortium are members of the Vacant and Abandoned Property Action Council (VAPAC), therefore making key data accessibility more straightforward due to direct working networks; and, 2) adjacent suburbs are the most direct housing markets that are used by the City of Cleveland's regional economy. The optimal time period was chosen as the period between 2009, 3rd quarter (July 1st, 2009) – 2013, 1st quarter (March 31st, 2013) due to data constraints for full specification of the desired empirical model.

Upon reaching a final dataset of arms-length sales for the hedonic price function, significant sensitivity analysis of individual variables was undertaken to identify any statistical issues before beginning the empirical modeling process. Given findings of Mikelbank (2008) and Whitaker and Fitzpatrick (2013), it was clear that modeling the impacts of unique distress types was critical to avoid over or under estimating the impacts of each. Therefore, parsing out unique distress variables was undertaken in the final empirical model. Some variations of unique distress types were nonsensical, such as those holding both a mortgage-foreclosed and tax-foreclosed status simultaneously. These distress variables were ultimately dropped because they had very low occurrence (variation) and a consistent process for identifying the "true" type of distress these "double-foreclosed" properties held was not recognized. Final definitions of key distress variables are shown in Table 1 below.

After performing sensitivity analysis on all housing attributes associated with the final dataset and several models of different spatial configurations of key data were complete, a hedonic price function was specified such that the price of a single-family residential housing unit is assumed to be a function of the bundle of attributes that characterize the house. The empirical specification of the hedonic price function is:

(Eq. 2) $$\ln\left(P_i\right) = \beta_0 + \beta_1\left(D_i^S\right) + \beta_2\left(D_i^{VL}\right) + \Theta X_i + \Phi Y_i + \Psi Z_i + u_i$$

Where natural log of housing price, P_i, is determined by: (1) a vector of variables measuring the aggregate count of multiple types of distressed single- and multi-family residential structures within 0-500 feet of a residential sale, D_i^S; (2) a vector of variables measuring density of vacant residential lots within 0-500 feet of a residential sale, D_i^{VL}; (3) a vector of variables describing the physical attributes of the house, X_i; (4) a vector of variables describing the year and quarter in which the house sold, Y_i; (5) and, given the distressed market, a vector of dummy variables

that account for the distress status and sale/deed type of the house that sold, Z_i. The error term, u_i, is assumed to have a conditional mean of zero and a constant variance.[2]

The functional form assumes a semi-log relationship between price of a house and the attributes that make up the value of the house.[3] In general, non-linear relationships between price and the physical and neighborhood attributes are expected. For this reason, a preponderance of studies use the semi-log functional form (Taylor 2003). Taylor (2003) states, "The semi-log allows for incremental changes in characteristics to have a constant effect on the percentage change in price and a non-linear relationship on the price-level" (Taylor 2003; 355). This output from the empirical modeling process is ideal as it offers the opportunity to compare percentage impact on property values from incremental changes in unique distress variables across and within submarkets. Key variables are provided in Table 1 below, and the full set of variables used to estimate the hedonic price function is provided in Appendix 1.

[2] This assumption is relaxed in the empirical process as the models all allow for heteroskedasticity. This means that the variance of the empirical model is more representative of reality.

[3] Taylor, Laura O. 2003. "The Hedonic Method." Chapter 10 in (Champ et al. eds.) A Primer for Non-Market Valuation. Kluwer Academic Publishers: Netherlands. pp. 331-393.

Table 1: Description of Key Variables Used for Regression Analysis

Variable	Description of Variable
Dependent Variable	
Price	Sales Price of Single-Family Residential Home
Distressed Property Count Variables Within 500 Feet	
OD_500 (Tax Delinquencies)	# single and multiple-unit residential properties within 500 feet that were >40% delinquent on their taxes during the quarter of sale.
ODPV_500 (Vacant Tax Delinquencies)	# single and multiple-unit residential properties within 500 feet that were >40% delinquent on their taxes AND at least 90 days vacant in the USPS vacancy data during the quarter of sale.
OPV_500 (Vacancies)	# single and multiple-unit residential properties that were within 500 feet that were at least 90 days vacant in the USPS vacancy data during the quarter of sale.
OF_500 (Mortgage Foreclosures)	# single and multiple-unit residential properties that were within 500 feet and had a filing, were in process or completed a mortgage-foreclosure during the quarter of sale.
OFD_500 (Tax Delinquent Mortgage Foreclosures)	# single and multiple-unit residential properties that were within 500 feet and had a filing, were in process or completed a mortgage-foreclosure AND were >40% delinquent on their taxes during the quarter of sale.
OFPV_500 (Vacant Mortgage Foreclosures)	# single and multiple-unit residential properties that were within 500 feet and had a filing, were in process or completed a mortgage-foreclosure AND were at least 90 days vacant in the USPS vacancy data during the quarter of sale.
OFDPV_500 (Tax Delinquent Vacant Mortgage Foreclosures)	# single and multiple-unit residential properties that were within 500 feet and had a filing, were in process or completed a mortgage-foreclosure AND were at least 90 days vacant in the USPS vacancy data AND were >40% delinquent on their taxes during the quarter of sale.
OT_500MERG (Tax Foreclosures)	# single and multiple-unit residential properties that were within 500 feet of property sold and also had a filing, were in process or completion of a tax-foreclosure OR had a filing, were in process or completion of a tax-foreclosure AND were >40% tax-delinquent during the quarter of sale.
OTPV_500ME (Vacant Tax Foreclosures)	# single and multiple-unit residential properties that were within 500 feet of property sold and also had a filing, were in process or completion of a tax-foreclosure AND were at least 90 days vacant in the USPS vacancy data OR had a filing, were in process or completion of a tax-foreclosure AND were >40% tax-delinquent AND were at least 90 days vacant in the USPS vacancy data during the quarter of sale.
RVL_500 (Vacant Lots)	# residential vacant lots within 500 feet of property sold.
Key Categorical Variables	
EXITREOCOMBO	= 1 if sold out of REO; 0 otherwise.
LW_DEED	= 1 if sold as Limited Warranty Deed; 0 otherwise.
QC_DEED	= 1 if sold as Quit Claim Deed; 0 otherwise.
OD	= 1 if sold as >40% tax-delinquent; 0 otherwise.
ODPV	= 1 if sold as >40% tax-delinquent AND >90 days USPS vacant; 0 otherwise.
OPV	= 1 if sold as >90 days USPS vacant; 0 otherwise.
OF_MERGE	= 1 if sold as filed/processing mortgage-foreclosure OR filed/processing mortgage-foreclosure AND >40% tax-delinquent; 0 otherwise.
OFPV_MERGE	= 1 if sold as filed/processing mortgage-foreclosure AND >90 days USPS vacant OR filed/processing mortgage-foreclosure AND >40% tax-delinquent AND >90 days USPS vacant; 0 otherwise.

Hypotheses

Of particular interest is the price effect associated with counts of distressed residential single- and multi-family structures and vacant lots within 0-500 feet proximities to sale observations. These abandoned structure and vacant lot variables, D_i^S and D_i^{VL}, respectively, measure the number of postal vacant, mortgage-foreclosed, tax-foreclosed or tax-delinquent residential structures (or some mix of the distress signals) and vacant lots within their respective distances from sale observations. These variables are used as proxy measures for exposure to the perceived disamenities associated with close proximity to distressed and vacant property. Reduced levels of distressed properties are expected to reduce exposure to disamenities associated with vacancy. Higher levels of D_i^S and D_i^{VL} are hypothesized to be associated with lower housing values, and thus their respective model coefficients are hypothesized to be negative.

Roughly 28% of final sales observations sold out of REO in the final study area between mid-2009 – early 2013. Further sensitivity analysis provided insight into large volumes of sales observations that held a specific distress status when sold (i.e. vacant and delinquent) and/or sold via quit-claim or limited warranty deeds. The comprehensive decline of the Cleveland market due to the mortgage-foreclosure crisis and other macroeconomic issues called for keeping these indicators of distressed sales as control variables in the final model because they are good representations of the locus of supply and demand in the Cleveland market during the study time period. Categorical variables associated with REO sales and quit claim/limited warranty deeds are indicators that a home sold under distress and are all expected to negatively impact sales price, and are therefore hypothesized to be negative.

Critical to the theoretical foundation of the hedonic method is that markets are in equilibrium. It is common sense that urban and suburban housing markets are stratified such that those that shop in neighborhoods where homes cost $20,000 do not shop in the same neighborhoods where homes cost $250,000. Subsequently, the marginal implicit prices of distressed structures, vacant lots and other hedonic price function variables would be hypothesized to have different impacts on home values in different submarkets. For this purpose, the empirical model was designed to test this hypothesis using submarket breakdowns at the census tract level, just as Whitaker and Fitzpatrick did (2013).

As discussed earlier, instead of two submarkets broken down by a single indicator at the census tract level (poverty rate), this analysis used an index score made up of poverty rate, vacancy rate, gross rents and income levels at the census tract level. Quartiles were created for each variable at the census tract level and statistically appropriate index scores were given to four identified submarkets – extremely weak, weak, moderately functioning, and high functioning. For the pooled model, Submarket 1 was withheld, meaning that coefficients represent the percent value difference between their respective submarket and the one omitted.

The submarket design allows for Chow (1960) tests of the statistical significance of submarket differentials, as well as an opportunity to run a pooled model for comparative analysis of overestimations and/or underestimations of key variables in their respective markets. The Chow test hypothesis is that variables throughout the four submarkets will be significantly different than one another across them. Further hypotheses include larger negative impacts from neighboring distress in stronger markets than in weaker markets because larger amounts of

value are available to be impacted. Further, the equity hedge associated with the gap between vacant lot impacts and distressed structure impacts is hypothesized to be larger in stronger markets for the same value differential purpose.

Although specific hypotheses associated with time dummies would traditionally expect that property values are appreciating over the 15 time periods, it remains to be seen given the intensive transformation that legacy city markets are undergoing since the mortgage-foreclosure crisis. Regardless, time dummies in both submarkets and pooled models will be tracked in the regression results to identify the trend of real estate values in each submarket areas. The omitted time dummy is 2009, 3rd quarter, meaning all coefficients will represent the level of difference between that time period and 2009, 3rd quarter.

Increases in house size, bathrooms (Li and Brown 1980), basement area (Simons, Quercia, and Maric 1998), and lot size (Kain and Quigeley 1970) of a home are expected to increase housing prices, all else constant. This is consistent with the standard assumption that more space is desirable (Deaton 2002). In an attempt to avoid collinearity problems (Haab and McConnell 2002) when choosing variables to explain the physical attributes of a home, all variables included in the empirical model count actual space of a house and lot only once. Other structural variables include number of fireplaces and central air conditioning, and these are hypothesized to have a positive impact on value, while age is hypothesized to have a negative impact.

Spatial Correction

Basic Regression Model

Upon specification of the hedonic price function, necessary spatial corrections were made to address issues of spatial dependence and spatial heterogeneity (Anselin, 1988). All the estimations were carried out by means of the open source GeoDaSpace and Geoda software packages, available from the GeoDa Center at Arizona State University.

The initial model specification was simplified somewhat from the baseline provided by replacing square footage variables for some of the house attributes (e.g., basement, attic space) by an indicator variable. Variables like total living area and lot size were rescaled – dividing by 1,000 square feet. The overall fit of the model was essentially unaffected.

The first step in the spatial analysis was to estimate the base model by means of Ordinary Least Squares (OLS), i.e., a specification that includes house characteristics, "distress" variables, indicator variables for each quarter and three "spatial fixed effects" indicators in a pooled model (Anselin and Arribas-Bel, 2013; Kuminoff, et al., 2010). The spatial fixed effects pertain to distinct submarkets within the sample. The spatial fixed effects indicator variables estimate the difference in overall "mean" (the intercept of the equation) between a given submarket and the reference case (in our application, Sumrank1 or Submarket 1, corresponding with the extremely weak market). Results from the pooled model, which assume a consistent market across the study landscape with spatial fixed effects dummy variables, are available in Appendix 2.

A more insightful method to assess the differences between the different submarkets is to estimate a so-called "spatial regimes model," in which all the coefficients of the model are allowed to vary between submarkets. This yields four estimates (and associated standard errors)

for each of the model coefficients, one for each submarket. A test for spatial heterogeneity, or Chow test (Chow 1960, Anselin 1990) is a formal test of the null hypothesis of coefficient stability across the four regimes. The test can be carried out for each individual coefficient separately, as well as for all the coefficients jointly. The results consistently point to strong coefficient heterogeneity across the submarkets, although for a few of the individual coefficients there is no such evidence (See Appendix 3 for Chow Test diagnostics). *The results of the Chow test strongly suggest the need to use spatial regime specifications throughout the analysis as the final modeling approach.* In other words, submarkets are well specified.

Testing for Spatial Autocorrelation

Each regression run was accompanied by a set of diagnostics, including a test for non-normality, several tests for heteroskedasticity (constant error variance) and tests for the presence of spatial autocorrelation (Anselin 1988). In order to carry out the tests for spatial autocorrelation (specifically, Lagrange Multiplier tests for spatial error autocorrelation and spatial lag correlation), a so-called spatial weights matrix is required, which formally expresses the “neighbor” relations between observations. Since the observations are point locations (latitude and longitude of the house location) at different points in time, there are several alternative approaches possible. We used a contiguity criterion (i.e., common borders and common vertices) between Thiessen polygons constructed around each house location. Thiessen polygons correspond to a notion of “market area” in the sense that all points within the polygon are closer to the house location than to any other house location. This approach avoids some of the problems associated with distance bands (uneven distribution of sales leads to an unbalanced spatial weights matrix) and k-nearest neighbors (yields an asymmetric spatial weights matrix).

In a space-time setting (multiple quarters of sales observations), there are many ways in which a space-time spatial weights matrix can be implemented. We chose a simple and robust approach by constructing a separate spatial weights matrix for all transactions in a given quarter and subsequently merging all these files to create an overall weights matrix for the complete data set. The rationale for limiting potential spatial spillovers to those transactions occurring in the same quarter is to avoid complications due to different space-time dynamics over the period of the study. In essence, we are interested in capturing un-modeled effects that show a spatial pattern in a given quarter, and thus will be revealed as spatial autocorrelation in the error term.

In addition, we also created so-called kernel weights, which are necessary to implement the spatial “HAC” method (Kelejian and Prucha 2007). The latter uses OLS estimates (unbiased and robust) but adjusts the standard errors for both heteroskedasticity and spatial autocorrelation. It is thus a non-parametric alternative to parametric spatial autoregressive models. An advantage of the HAC approach is that it maintains the optimal properties of the OLS estimator but adjusts the standard errors to reflect the effects of heteroskedasticity and spatial autocorrelation in the error terms. This procedure also avoids the need to estimate a spatial autoregressive parameter. The spatial effects are prevalent in all the analyses carried out. In each of the regressions, there is *consistent and strong evidence of a high degree of heteroskedasticity as well as of spatial autocorrelation*.

The kernel weights were constructed for each quarter separately, using an adaptive triangular kernel with the 30 nearest neighbors used to compute the kernel.[4] The kernel weights for each quarter were subsequently collapsed into one large file for the complete data set. As for the contiguity weights, the neighbors were restricted to those house sales locations occurring in the same quarter.

Final Model

The diagnostics suggested strong evidence of spatial autocorrelation. In addition to standard regimes models estimated by OLS, we estimated models that included a spatial autoregressive coefficient in the lag and in the error term. There was evidence in the diagnostics of a slight preference for the spatial lag specification, but comparison of the estimates and model fit revealed only minor differences.

The best model overall was the ***four regime model estimated by means of OLS with HAC standard errors***. It obtained the best fit among the different alternatives considered (although the difference in fit were marginal) and is most robust since it avoids relying on asymptotic properties and avoids the estimation of a spatial parameter (which would have to be included in the counterfactual simulation experiment). In other words, *the standard errors given by the HAC models properly reflect the additional uncertainty of the estimates due to the joint presence of heteroskedasticity and spatial autocorrelation*.

Data

The data used in this study are housed as part of NEO CANDO (http://neocando.case.edu). NEO CANDO (Northeast Ohio Neighborhood and Data for Organizing) is developed and maintained by the Center on Urban Poverty and Community Development (Poverty Center) in the Jack, Joseph and Morton Mandel School of Applied Social Sciences at Case Western Reserve University in Cleveland. The Poverty Center opened its doors in 1988 to look at issues of concentrated poverty using the neighborhood as the basic unit of analysis. Through research, the Poverty Center began to acquire and maintain a database across many domains. In 1992, the predecessor of NEO CANDO, CAN DO (Cleveland Area Network for Data and Organizing), came on line with the mission to democratize data. In 2005, CAN DO evolved to become NEO CANDO and parcel based data were added. Working with local stakeholders throughout Cuyahoga County, the parcel component of NEO CANDO has evolved significantly. In addition to research, the data are being utilized by the Cleveland’s Building and Housing Department, Cleveland’s Community Development Department, Cleveland City Council, the First Suburbs Consortium and their member cities, Cleveland Neighborhood Progress, the Federal Reserve Bank of Cleveland, the Cuyahoga Land Bank, and all of Cleveland’s neighborhood based community development corporations. The data used from NEO CANDO in this study are described below.

Data Sources and Individual Source Preparation

Property Transfers (Cuyahoga County Fiscal Officer)

Arms length property transfers were extracted using the same method established by the Federal Reserve Bank of Cleveland for use in their studies related to vacancy, foreclosure and

[4] Kelejian and Prucha (2007) suggest that the number of neighbors in the kernel should be at least the cube root of the number of observations. The data set had 18,860 observations, which suggests that 27 neighbors is a minimum.

demolition (Whitaker and Fitzpatrick, 2013). These data contain grantor, grantee, conveyance date, conveyance amount, and conveyance type.

Demolitions (City of Cleveland [city performed demolitions and demo permit file], First Suburbs Consortium members, Cuyahoga Land Bank, Cuyahoga County demo permit file, Cuyahoga County NSP1 demolitions)

Demolition data are regularly collected for the NEO CANDO system from the Cuyahoga Land Bank as well as both the City of Cleveland's internal demolition list and demolition permit information. The demolition permit information helps to supplement public demolitions performed by the City of Cleveland and the Cuyahoga Land Bank with private demolitions. This information was also supplemented by either actually demolitions performed by First Suburb Consortium municipalities or demolition permits obtained in First Suburbs Consortium municipalities. Data contained address and/or parcel number and date or quarter that the demolition was performed. Finally, a demolition permit file was obtained from the Cuyahoga County Fiscal Officer via the Federal Reserve Bank of Cleveland.

Foreclosure Filings (Cuyahoga County Common Pleas Court)

Foreclosure filings data were divided into mortgage foreclosure and tax foreclosure. The quarter a parcel started the foreclosure process was coded based on the foreclosure filing date. The parcel was considered to be in foreclosure process the filing quarter as well as the quarter the foreclosure was completed via Sheriff's sale or Foreclosure deed. The quarter of the Sheriff's sale or Foreclosure Deed recording is considered the completion quarter for foreclosure on that parcel. Also, if a foreclosure was dismissed, the quarter of the dismissal is flagged in both the foreclosure in process variable and a foreclosure completion variable.

Sheriff's Sales (Cuyahoga County Sheriff)

Foreclosure deeds were extracted from the Fiscal Officer transfer file to indicate the quarter that a foreclosure is completed. If this information was missing from the Fiscal Officer information, it was supplemented by the results of the weekly sheriff's sales posted on the Sheriff's website and captured in NEO CANDO.

Tax Billing File (Cuyahoga County Fiscal Officer)

The tax billing file which indicates delinquent taxes were obtained for every quarter of the study period. These data were used to determine if a parcel is tax delinquent in a given quarter. For the study, a parcel is considered to be delinquent if the delinquency is 40% of total tax charges. This was to reduce incidental delinquencies, which are in essence cases where only a few dollars are owed due to clerical error.

Postal Vacancy (Semaphore United States Postal Service Address Scrubber)

Since the third quarter of 2009, all addresses in Cuyahoga County Fiscal Officer records were scrubbed in the Semaphore USPS Address Scrubber to determine vacancy status approximately every quarter.

Property Characteristics (Cuyahoga County Fiscal Officer)

Property Characteristics data were used to determine if a parcel was a residential structure, residential vacant lot, non-residential structure or non-residential vacant lot. Information on building value and tax abatement was used to determine whether or not a parcel was a structure or a vacant lot. Land use codes were used to distinguish between residential and non-residential parcels. A parcel was considered to be residential if it was either single family or multifamily up to 4 units. Demolition data was used to supplement the building value and tax abatement data. If a parcel was demolished during a time increment in the study the parcel became a vacant residential lot on the first day of the following time increment. Also, the building value and tax abatement data were used to supplement the demolition data. If the property characteristics indicate a building on a parcel in a particular tax year, but no building on that same parcel in the following tax year, that parcel gets added to the demolition file and given the demo quarter value of the last quarter of the given tax year.

If key property characteristics necessary for the hedonic model were missing for a given tax year, the missing information were supplemented by looking at previous tax years. For example, the number of fireplaces and the number of units were missing for some parcels. The missing data were replaced by looking at the values for the parcel in the previous tax year.

Reaching a Final Dataset

The final dataset for this analysis required a cross-sectional snapshot of neighborhood distress during each 3-month quarterly time period between 1st quarter 2007 and 1st quarter 2013. The distress status on the first day of each time period is used as the distress status given to a property for the entire 3-month time period. A dynamic parcel-level matrix of the locations of every type of distress across each quarterly time period was then created. Distress variables chosen for the final empirical model are identified in Table 1 above.

Upon identification of the roughly 66,000 property sales transactions occurring within the study boundaries during each quarter in the study period, a counting process was undertaken using the "Generate Near Table," tool in ArcMap.[5] Distress "count" variables for each sales transaction represent the number of a given type of distressed structure or lot within a given distance from a home that sold. Other distress variables created from this process included categorical variables that identified whether the property that sold was under distress itself.

Upon receipt of a fully functional dataset of all 66,000 sales transactions (including housing attributes and environmental distress variables), data processing was undertaken to identify true arms-length sales for use as observations in the final empirical model. This process included initially limiting sales records to warranty, limited warranty and quit claim deeds. The latter two received categorical variables, as they tend to be non-traditional sales. With that said, evidence of arms-length sales activity was found in both limited warranty and quit claim deed sales. The dataset was further reduced to only represent a single sale for each parcel. In cases where properties sold more than once, only the most recent sales was used for analysis. It was further decided that postal vacancy data was critical to be included in the final model. Given that quality data for postal vacancy began on July 1st, 2009, all sales transactions before the 3rd quarter of

[5] Where noted, maps and analyses for this paper were created using ArcGIS® software by Esri. ArcGIS® and ArcMap™ are the intellectual property of Esri and are used herein under license. Copyright © Esri. All rights reserved. For more information about Esri® software, please visit **www.esri.com.**

2009 were cut. Next, all sales transactions that were not single-family residential sales were omitted along with any outliers.[6] We also went through a expanded verification test for REO sales based on grantee name resulting in the identification of some increases in total REO sales, that resulted in a total number of sales observations of 18,860.

Demolition Data

The first step in creating the demolition dataset for the counterfactual simulation was to repeat the same distressed property counting process for every residential parcel that existed during the study period. To start this process a baseline of all residential structures with their distress characteristics, all vacant lots, and all demolished properties were placed into a dataset. The vacant lots, residential structures, and distress characteristics were then calculated based on the environment surrounding each property.

In essence, to perform the counterfactual it requires a dataset structure that simulates the rebuilding of distressed structures that were eliminated through demolition. This was done by flagging demolished parcels and then identifying its distress characteristics prior to demolition. When establishing a look back period to determine the distress characteristics for a particular parcel, three methods were used. First, if the Cuyahoga Land Bank performed the demolition on a parcel it owned, the distress status from the quarter before Land Bank acquisition was assigned. Second, for all other demolitions, the disamenity values were assigned based on one quarter before acquisition. Third, if the disamenity environment for either of the above scenarios involved pre-demo status ambiguity, an eight-quarter look back period was established to identify previous tax-delinquency, past mortgage-foreclosure or past tax-foreclosure. If no other distress measures were found on a demolished structure in the eight-quarter look back it was assigned a postal vacant status by default. Upon completion, counts of necessary property characteristics both pre- and post-demolition were summarized for each parcel to complete the dataset for the counterfactual simulation.

Study Area

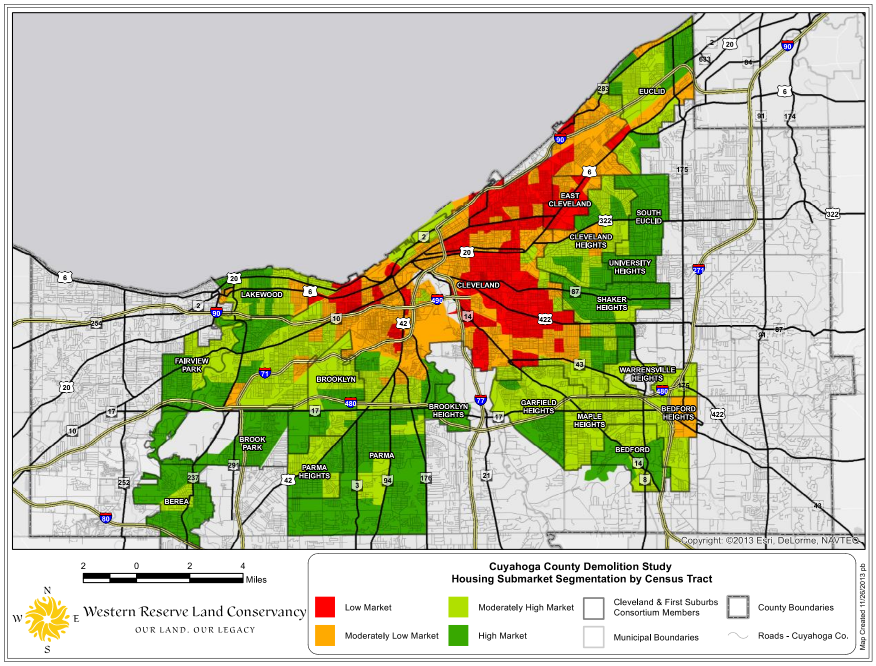
The study encompasses the City of Cleveland, Ohio and 19 of the surrounding municipalities directly adjacent to Cleveland. These municipalities make up the First Suburbs Consortium and consist of Bedford, Bedford Heights, Berea, Brook Park, Brooklyn, Brooklyn Heights, Cleveland Heights, East Cleveland, Euclid, Fairview Park, Garfield Heights, Lakewood, Maple Heights, Parma, Parma Heights, Shaker Heights, South Euclid, University Heights and Warrensville Heights. Because all municipalities are members of the First Suburbs Consortium demolition data access for this research was more straightforward. Therefore, the City of Cleveland and members of First Suburbs Consortium defined the geographical boundaries of the study area. Many other Cleveland suburbs are relevant housing markets within the Cleveland regional economy, but were not included as the detailed property data was not readily available in a timely manner.

All municipalities within the study area were broken down into census tracts and went through the submarket indexing process as explained above. Figure 3 below visually represents the study area and the outcome of the census tract submarket indexing process (See Appendix 4) for a blown up version of the submarket map). Red identifies extremely weak markets, orange

[6] Outliers were defined as anything above or below 3 times the Inter-quartile range of sales prices.

represents weak markets, light green represents moderately functioning housing markets and dark green represents high functioning real estate markets.

Figure 3: Map of Study Area With Color-Coded Submarkets



The study time period is 3rd quarter, 2009 - 1st quarter of 2013, with 18,860 arms-length sales observations occurring. Of the total sales, 2,122 were in the extremely weak market, 2,924 were in the weak market, 7,051 were in the moderately functioning market and 6,763 residential sales were in the high functioning market. These numbers reflect the economic intuition that more homes sell in higher functioning markets, helping solidify proper identification of the housing market splits within the study area. That said, it is ideal to have a large amount of variation in each market in an econometric modeling environment that is based on the housing market, such as the hedonic price function. This introduces a situation of weaker explanatory power and weaker significance in explanatory variables in the weaker markets of the spatial regimes models, which will be covered more thoroughly in the results section.

Table 2 below provides select descriptive statistics that can paint a picture of the different housing markets that make up the four regimes in the final spatial regimes model. The mean sales price of a home increases consistently as the functionality of the housing market increases. Mean prices over the study time period in the four submarkets are as follows: extremely weak market - $22,402; weak market - $32,834; moderately functioning market - $57,914; and high functioning market mean sales price was $85,888.

Table 2: Select Descriptive Statistics From the Four Housing Submarket Regimes

	Submarket 1: Extremely Weak Market (2,122 Obs)		Submarket 2: Weak Market (2,924 Obs)		Submarket 3: Moderately Functioning Mkt (7,051 obs)		Submarket 4: High Functioning Mkt (6,763 Obs)	
Variable	**Mean**	**Std. Dev.**	**Mean**	**Std. Dev.**	**Mean**	**Std. Dev.**	**Mean**	**Std. Dev.**
Price	$22,402.52	$32,906.74	$32,834.03	$39,522.56	$57,914.38	$45,814.71	$85,887.69	$48,929.85
Age	97.45	49.36	91.88	22.98	71.74	18.01	65.88	16.39
rvl_500	17.84	12.75	9.77	9.38	4.19	6.53	2.22	3.30
opv_500	8.43	5.15	6.94	4.93	5.29	3.90	3.49	3.02
of_500	3.25	2.58	3.94	2.99	3.84	2.89	2.69	2.32
ofd_500	0.47	0.83	0.35	0.66	0.22	0.51	0.15	0.41
ofpv_500	0.65	0.92	0.60	0.89	0.63	0.97	0.43	0.76
ofdpv_500	0.39	0.77	0.24	0.60	0.09	0.31	0.03	0.18
ot_500merge	0.63	0.93	0.34	0.66	0.10	0.33	0.05	0.23
otpv_500me~e	0.52	0.87	0.31	0.66	0.07	0.30	0.02	0.15
od_500	14.58	8.74	10.03	7.48	3.81	3.91	1.89	2.42
odpv_500	7.34	6.35	4.25	6.98	1.01	1.73	0.31	0.70
od	0.09	0.28	0.07	0.25	0.02	0.16	0.02	0.12
odpv	0.11	0.32	0.06	0.23	0.02	0.15	0.01	0.11
ofpv_merge	0.02	0.15	0.02	0.14	0.03	0.16	0.02	0.13
of_merge	0.03	0.17	0.04	0.20	0.04	0.20	0.03	0.18
opv	0.26	0.44	0.26	0.44	0.33	0.47	0.28	0.45
exitreocombo	0.25	0.43	0.30	0.46	0.32	0.47	0.24	0.43
LW_deed	0.16	0.36	0.20	0.40	0.21	0.41	0.16	0.37
QC_deed	0.37	0.48	0.24	0.43	0.08	0.27	0.03	0.17

Select descriptive statistics are shown to paint a picture of neighborhood distress and property sales environments in each submarket. Many intuitive market elements lie within a comparative analysis of these submarket descriptive statistics. First, the housing stock becomes newer as it transitions from weaker to stronger markets – with mean age moving from around 97 years old down to around 66 years old across the submarkets. Generally speaking, it becomes clear that the primary types of distress surrounding homes are residential vacant lots, vacant residential structures, tax-delinquent structures and vacant tax-delinquent structures. As the different types of distress surrounding homes are compared, there is a clear decrease in the mean level of distress surrounding each sale observation as the functionality of the market is increased. Further, properties that sell are more likely to sell under distress in lower functioning markets. That said, property sales such as REO are roughly constant across all markets, which makes sense given the mortgage-foreclosure crisis over the study time period that effected the market comprehensively. All in all, the descriptive statistics compared across the four submarkets all point to a strong intuition that submarkets are well identified at the mean.

Regression Results

Spatial Regimes Model Results

Overall model specification is good. Hypotheses amongst traditional variables that explain elements of the structure hold the expected sign and are statistically significant. Appendix 5 provides all coefficient results from the final model. Distress variables perform very well in stronger functioning markets and are shown to negatively impact value as expected. In general, all explanatory variables in the submarket regimes perform better in more functioning markets. This is intuitive given healthier market activity and variation in stronger markets and more associated home equity that can be impacted by the explanatory variables in the those areas in the spatial regimes model. The hedonic price function is a modeling technique that fundamentally performs better when markets are healthy, as it is a market-based model.

The R-squared for the final spatial regimes model with HAC standard errors is 0.5646, and is interpreted such that the explanatory variables (all model variables) in the final model explain 56.46% of the variation in the dependent variable (natural-log of sales price of homes) over the time period of the study. Key variables that may have increased the explanatory power of the model could include more proximity variables to key amenities and disamenities and/or the quality of municipal services and school districts. Major socioeconomic indicators such as poverty and income are controlled for through the submarket indexing process. Crime and the density of distressed structures have been shown to be highly correlated (Cui, 2010) and proximity of distressed property count variables are therefore designed as proxies for the negative attributes of neighborhoods, such as crime. Spatial relationships that can cause model bias between observations are accounted for through the HAC standard errors correction.

For interpretation purposes associated with reading the following tables, coefficients are read as percentage change in home price if a marginal unit of the variable were added. For example, a coefficient of -0.010 for vacant lots within 500 feet would be interpreted as -1.0% impact on home value from an additional vacant lot within 500 feet of a home. A coefficient of 0.134 would be interpreted as 13.4% change in value from a marginal increase of a variable, and so on.

As mentioned previously, the model was designed such that the difference between the impact of vacant residential lots and distressed residential structures could be captured across all housing submarkets in the study area. The resulting “equity hedge” is then defined when all else is held constant and the negative impact of an additional distressed residential structure is greater than the negative impact of an additional vacant lot and both are statistically significant. The difference between the two impacts is indeed the “equity hedge.” For a comprehensive look at the equity hedge associated with all submarket regimes and the pooled model, see Appendix 6. This potential equity capture available by turning distressed residential structures into residential vacant lots (i.e. residential demolition) is the critical element used to perform the predictive simulation that estimates the total cost benefit analysis for demolition investment in the study area over the research timeframe. This will be discussed in detail in the cost-benefit section.

High Functioning Market Results

Table 3 below offers model coefficients, standard errors and probabilities for all key variables in the high functioning market (Submarket 4) from the final spatial regime model. A look at the full high functioning market regression results is available in Appendix 5.

Table 3: Regression Results of Key Variables in High Functioning Market (6,763 Observations)

Variable	Coefficient	Standard Error	Probability
Key Distressed Property Variables			
4_OD_500	-0.038	0.005	0.000
4_ODPV_500	-0.086	0.014	0.000
4_OPV_500	-0.026	0.003	0.000
4_OF_500	-0.026	0.004	0.000
4_OFD_500	-0.030	0.027	0.268
4_OFPV_500	-0.009	0.010	0.348
4_OFDPV_500	-0.060	0.040	0.130
4_OT_500MERG	-0.201	0.058	0.000
4_OTPV_500ME	-0.108	0.057	0.057
4_RVL_500	-0.010	0.002	0.000
Key Categorical Variables			
4_EXITREOCOMBO	-0.544	0.026	0.000
4_LW_DEED	-0.223	0.028	0.000
4_QC_DEED	-0.666	0.097	0.000
4_OD	-0.322	0.073	0.000
4_ODPV	-0.381	0.086	0.000
4_OPV	-0.083	0.017	0.000
4_OF_MERGE	-0.280	0.032	0.000
4_OFPV_MERGE	-0.235	0.040	0.000
Categorical Time Variables			
4_RS093*			
4_RS094	-0.072	0.044	0.101
4_RS101	-0.036	0.038	0.331
4_RS102	0.034	0.034	0.321
4_RS103	-0.075	0.042	0.072
4_RS104	-0.095	0.047	0.042
4_RS111	-0.128	0.047	0.007
4_RS112	-0.106	0.044	0.016
4_RS113	-0.133	0.040	0.001
4_RS114	-0.237	0.047	0.000
4_RS121	-0.223	0.044	0.000
4_RS122	-0.243	0.046	0.000
4_RS123	-0.246	0.045	0.000
4_RS124	-0.293	0.043	0.000
4_RS131	-0.254	0.049	0.000

The impact of additional residential vacant lots is the benchmark of distress impact in our model, as it is compared to all nearby distressed residential structure count variables to estimate potential equity hedge from demolition. An additional residential vacant lot within 500 feet of a single family residential home in the high functioning market is shown to cause a 1.0% decline in housing value, all else equal, and is highly statistically significant in its impact.

- An additional residential tax-delinquent structure within 500 feet of a single family residential home in the high functioning market causes a 3.8% decline in housing value, all else equal, and is highly statistically significant in its impact on value.
    - These findings suggest that an estimated 2.8% home equity hedge is available for all single family residential homes in a high functioning market that are within 500 feet of a demolished tax-delinquent residential structure.

- An additional residential tax-delinquent structure that is also vacant within 500 feet of a single family residential home in the high functioning market causes an 8.6% decline in housing value, all else equal, and is highly statistically significant in its impact on value.
    - These findings suggest that an estimated 7.6% home equity hedge is available for all single family residential homes in a high functioning market that are within 500 feet of a demolished vacant tax-delinquent residential structure.

- An additional vacant residential structure within 500 feet of a single family residential home in the high functioning market causes a 2.6% decline in housing value, all else equal, and is highly statistically significant in its impact on value.
    - These findings suggest that an estimated 1.6% home equity hedge is available for all single family residential homes in a high functioning market that are within 500 feet of a demolished vacant residential structure.

- An additional residential mortgage-foreclosed structure within 500 feet of a single family residential home in the high functioning market causes a 2.6% decline in housing value, all else equal, and is highly statistically significant in its impact on value.
    - These findings suggest that an estimated 1.6% home equity hedge is available for all single family residential homes in a high functioning market that are within 500 feet of a demolished mortgage-foreclosed residential structure.

- An additional residential tax-foreclosed or tax-foreclosed and tax-delinquent structure within 500 feet of a single family residential home in the high functioning market causes a 20.1% decline in housing value, all else equal, and is highly statistically significant in its impact on value.
    - These findings suggest that an estimated 19.1% home equity hedge is available for all single family residential homes in a high functioning market that are within 500 feet of a demolished tax-foreclosed or tax-foreclosed and tax-delinquent residential structure.

- An additional residential vacant tax-foreclosed or vacant tax-delinquent and tax-foreclosed structure within 500 feet of a single family residential home in the high functioning market causes a 10.8% decline in housing value, all else equal, and is statistically significant at the 5.7% level in its impact.

    - These findings suggest that an estimated 9.8% home equity hedge is available for all single family residential homes in high functioning markets that are within 500 feet of a demolished vacant tax-foreclosed or vacant tax-delinquent and tax-foreclosed residential structure.

- An additional residential mortgage-foreclosed and tax-delinquent structure within 500 feet of a single-family residential home in the high functioning market is not shown to have a statistically significant impact on property value.

- An additional residential mortgage-foreclosed and vacant structure within 500 feet of a single-family residential home in the high functioning market is not shown to have a statistically significant impact on property value.

- An additional residential mortgage-foreclosed, tax-delinquent and vacant structure within 500 feet of a single-family residential home in the high functioning market is not shown to have a statistically significant impact on property value.

High levels of properties selling under some form of distress suggest a market in flux, which is logical given the mortgage-foreclosure crisis during the study time period. Our model does what it can to control for these elements of flux to properly determine the impacts of key variables in the bullet points above. Indeed, selling out of REO in this market produces a highly significant 54.4% discount on sales price. Since roughly 24% of sales in this market were out of REO over the study time period, it is no wonder they were included under the umbrella of arms-length sales for the study. 16% of sales were limited warranty deeds, and brought a highly significant 22.3% discount when sold. Quit claim deeds only accounted for 3% of sales in this market, but commanded a highly significant 66.6% decrease in sales price when sold. 28% of homes in this market sold when they were vacant. Vacant homes in this market receive a highly significant 8.3% discount. 8% of homes sold under some form of tax-delinquency or mortgage-foreclosure distress, commanded a range of 23.5-38.1% discounts, all of which were highly significant.

Other interesting findings in the results of the high functioning market are associated with the time trend. The time trend is made up of categorical variables that are designed to pick up the macroeconomic effects of the housing market during the time period that a property sold that impact its price. Our study has 15 time periods cut up by quarter. A reference period is chosen – specifically 3rd quarter 2009 in our model – and then time dummy coefficients represent how value changed over time based on the reference period. The time trend in the high functioning markets suggests a significant decreasing trend in value between 2009, 3rd quarter - 1st quarter of 2013. Home values appear to settle around 25% less value over the study time period.

Overall, given a mean sales price of over $85K in the high functioning market, research findings suggest that a large return on investment is available through hedged/protected home equity through demolition of distressed structures in this submarket. Highly significant equity hedges are available for neighboring properties from the demolition of distressed structures ranging from 1.6-19.1% per property. Many versions of mortgage-foreclosed structures are not shown to have a significant impact on property value in this market, suggesting no available hedge. This could largely be interpreted as the outcome of strategic bank activity protecting asset values juxtaposed with a healthy enough REO market, which subsequently creates low variation amongst vacant and/or tax-delinquent mortgage-foreclosures in this high functioning market.

Moderately Functioning Market Results

Table 4 below offers model coefficients, standard errors and probabilities for all key variables in the moderately functioning market (Submarket 3) from the final spatial regime model. A look at the full moderately functioning market regression results is available in Appendix 5.

Table 4: Regression Results of Key Variables in Moderately Functioning Market (7,051 Observations)

Variable	Coefficient	Standard Error	Probability
Key Distressed Property Variables			
3_OD_500	-0.040	0.004	0.000
3_ODPV_500	-0.051	0.008	0.000
3_OPV_500	-0.022	0.003	0.000
3_OF_500	-0.016	0.004	0.000
3_OFD_500	-0.042	0.022	0.051
3_OFPV_500	0.005	0.010	0.589
3_OFDPV_500	-0.086	0.041	0.037
3_OT_500MERG	-0.052	0.032	0.107
3_OTPV_500ME	-0.065	0.040	0.105
3_RVL_500	-0.010	0.002	0.000
Key Categorical Variables			
3_EXITREOCOMBO	-0.676	0.029	0.000
3_LW_DEED	-0.190	0.030	0.000
3_QC_DEED	-0.899	0.072	0.000
3_OD	-0.277	0.077	0.000
3_ODPV	-0.590	0.089	0.000
3_OPV	-0.134	0.020	0.000
3_OF_MERGE	-0.153	0.033	0.000
3_OFPV_MERGE	-0.216	0.046	0.000
Categorical Time Variables			
3_RS093*			
3_RS094	-0.036	0.057	0.531
3_RS101	-0.064	0.064	0.315
3_RS102	0.078	0.054	0.150
3_RS103	-0.047	0.053	0.381
3_RS104	-0.097	0.056	0.086
3_RS111	-0.123	0.074	0.095
3_RS112	-0.029	0.053	0.587
3_RS113	-0.150	0.057	0.008
3_RS114	-0.162	0.060	0.007
3_RS121	-0.146	0.060	0.015
3_RS122	-0.183	0.056	0.001
3_RS123	-0.272	0.056	0.000
3_RS124	-0.294	0.059	0.000
3_RS131	-0.317	0.064	0.000

The impact of additional residential vacant lots is the benchmark of distress impact in our model, as it is compared to all nearby distressed residential structure count variables to estimate potential equity hedge from demolition. An additional residential vacant lot within 500 feet of a single family residential home in the moderately functioning market is shown to cause a 1.0% decline in housing value, all else equal, and is highly statistically significant in its impact.

- An additional residential tax-delinquent structure within 500 feet of a single family residential home in the moderately functioning market causes a 4.0% decline in housing value, all else equal, and is highly statistically significant in its impact on value.
    - These findings suggest that an estimated 3.0% home equity hedge is available for all single family residential homes in a moderately functioning market that are within 500 feet of a demolished tax-delinquent residential structure.

- An additional residential tax-delinquent structure that is also vacant within 500 feet of a single family residential home in the moderately functioning market causes an 5.1% decline in housing value, all else equal, and is highly statistically significant in its impact on value.
    - These findings suggest that an estimated 4.1% home equity hedge is available for all single family residential homes in a moderately functioning market that are within 500 feet of a demolished vacant tax-delinquent residential structure.

- An additional vacant residential structure within 500 feet of a single family residential home in the moderately functioning market causes a 2.2% decline in housing value, all else equal, and is highly statistically significant in its impact on value.
    - These findings suggest that an estimated 1.2% home equity hedge is available for all single family residential homes in a moderately functioning market that are within 500 feet of a demolished vacant residential structure.

- An additional residential mortgage-foreclosed structure within 500 feet of a single family residential home in the moderately functioning market causes a 1.6% decline in housing value, all else equal, and is highly statistically significant in its impact on value.
    - These findings suggest that an estimated 1.6% home equity hedge is available for all single family residential homes in a high functioning market that are within 500 feet of a demolished mortgage-foreclosed residential structure.

- An additional residential mortgage-foreclosed and tax-delinquent structure within 500 feet of a single family residential home in the moderately functioning market causes a 4.2% decline in housing value, all else equal, and is statistically significant at the 5.1% level in its impact on value.
    - These findings suggest that an estimated 3.2% home equity hedge is available for all single family residential homes in a moderately functioning market that are within 500 feet of a demolished mortgage-foreclosed and tax-delinquent residential structure.

- An additional residential mortgage-foreclosed, tax-delinquent and vacant structure within 500 feet of a single family residential home in the moderately functioning market causes a 8.6% decline in housing value, all else equal, and is statistically significant at the 3.7% level in its impact on value.

  - These findings suggest that an estimated 7.6% home equity hedge is available for all single family residential homes in a moderately functioning market that are within 500 feet of a demolished mortgage-foreclosed, tax-delinquent and vacant residential structure.

- An additional residential tax-foreclosed or tax-foreclosed and tax-delinquent structure within 500 feet of a single family residential home in the moderately functioning market causes a 5.2% decline in housing value, all else equal, and is marginally statistically significant at the 10.7% level in its impact on value.
  - These findings suggest that an estimated 4.2% home equity hedge is available for all single family residential homes in a moderately functioning market that are within 500 feet of a demolished tax-foreclosed or tax-foreclosed and tax-delinquent residential structure.

- An additional residential vacant tax-foreclosed or vacant tax-delinquent and tax-foreclosed structure within 500 feet of a single family residential home in the moderately functioning market causes a 6.5% decline in housing value, all else equal, and is marginally statistically significant at the 10.5% level in its impact.
  - These findings suggest that an estimated 5.5% home equity hedge is available for all single family residential homes in a moderately functioning market that are within 500 feet of a demolished vacant tax-foreclosed or vacant tax-delinquent and tax-foreclosed residential structure.

- An additional residential mortgage-foreclosed and vacant structure within 500 feet of a single-family residential home in the moderately functioning market is not shown to have a statistically significant impact on property value.

High levels of properties selling under some form of distress suggest a market in flux, which is logical given the mortgage-foreclosure crisis during the study time period. Our model does what it can to control for these elements of flux to properly determine the impacts of key variables in the bullet points above. Indeed, selling out of REO in this market produces a highly significant 67.6% discount on sales price. Since roughly 32% of sales in this market were out of REO over the study time period, it is no wonder they were included under the umbrella of arms-length sales for the study. 21% of sales were limited warranty deeds, and brought a highly significant 19.0% discount when sold. Quit claim deeds accounted for 8% of sales in this market and commanded a highly significant 89.9% decrease in sales price when sold. 33% of homes in this market sold when they were vacant. Vacant homes in this market receive a highly significant 13.4% discount. 11% of homes sold under some form of tax-delinquency or mortgage-foreclosure distress in this market, commanding a range of highly significant 15.3-27.7% discounts, except for vacant tax-delinquent structures that sold at a highly significant 59% discount.

Other interesting findings in the results of the moderately functioning market are associated with the time trend. The time trend is made up of categorical variables that are designed to pick up the macroeconomic effects of the housing market during the time period that a property sold that impact its price. Our study has 15 time periods cut up by quarter. A reference period is chosen – specifically 3rd quarter 2009 in our model – and then time dummy coefficients

represent how value has changed over time based on the reference period. The time trend in the moderately functioning market suggests a significant decreasing trend in value between 2009, 3rd quarter - 1st quarter of 2013. Home values appear to settle around 30% less value over the study time period.

Overall, with a mean sales price of a single-unit residential home of about $58K in the moderately functioning market, research findings suggest that a large amount of home equity can be protected through the demolition of distressed structures in this submarket. Estimated coefficients associated with distressed structures and vacant lots specifically suggest that the equity of single-family homes can be hedged and protected by 0.6-7.6% through the demolition of distressed residential structures in this market.

Weak Functioning Market Results

Table 5 below offers model coefficients, standard errors and probabilities for all key variables in the weak functioning market (Submarket 2) from the final spatial regime model. A look at the full weak functioning market regression results is available in Appendix 5.

Table 5: Regression Results of Key Variables in Weak Functioning Market (2,924 Observations)

Variable	Coefficient	Standard Error	Probability
Key Distressed Property Variables			
2_OD_500	-0.036	0.004	0.000
2_ODPV_500	-0.003	0.006	0.612
2_OPV_500	-0.003	0.006	0.654
2_OF_500	0.024	0.009	0.012
2_OFD_500	-0.037	0.037	0.317
2_OFPV_500	-0.030	0.029	0.301
2_OFDPV_500	-0.004	0.045	0.925
2_OT_500MERG	-0.058	0.040	0.151
2_OTPV_500ME	-0.053	0.045	0.232
2_RVL_500	-0.012	0.003	0.000
Key Categorical Variables			
2_EXITREOCOMBO	-0.678	0.053	0.000
2_LW_DEED	-0.148	0.056	0.008
2_QC_DEED	-0.821	0.077	0.000
2_OD	-0.168	0.101	0.095
2_ODPV	-0.793	0.132	0.000
2_OPV	-0.225	0.054	0.000
2_OF_MERGE	-0.206	0.084	0.014
2_OFPV_MERGE	-0.475	0.113	0.000
Categorical Time Variables			
2_RS093*			
2_RS094	0.049	0.138	0.720
2_RS101	-0.232	0.131	0.077
2_RS102	0.116	0.132	0.376
2_RS103	-0.124	0.123	0.311
2_RS104	-0.190	0.156	0.225
2_RS111	-0.101	0.129	0.435
2_RS112	-0.017	0.135	0.898
2_RS113	-0.071	0.128	0.581
2_RS114	0.049	0.127	0.698
2_RS121	0.096	0.124	0.441
2_RS122	0.217	0.118	0.066
2_RS123	0.005	0.132	0.970
2_RS124	0.048	0.129	0.711
2_RS131	-0.061	0.121	0.613

The impact of additional residential vacant lots is the benchmark of distress impact in our model, as it is compared to all nearby distressed residential structure count variables to estimate potential equity hedge from demolition. An additional residential vacant lot within 500 feet of a single family residential home in the weak functioning market is shown to cause a 1.2% decline in housing value, all else equal, and is highly statistically significant in its impact.

- An additional residential tax-delinquent structure within 500 feet of a single family residential home in the weak functioning market causes a 3.6% decline in housing value, all else equal, and is highly statistically significant in its impact on value.
    - These findings suggest that an estimated 2.4% home equity hedge is available for all single family residential homes in a weak functioning market that are within 500 feet of a demolished tax-delinquent residential structure.

- An additional residential mortgage-foreclosed structure within 500 feet of a single family residential home in the weak functioning market causes a **2.4% increase** in housing value, all else equal, and is highly statistically significant at the 1.2% level in its impact on value.
    - These findings suggest that home equity hedge is lost for all single family residential homes in a weak functioning market that are within 500 feet of a demolished mortgage-foreclosed residential structure.
    - This finding reflects that of Whitaker and Fitzpatrick (2013) in the same Cleveland study area as it provides further evidence of selective bank foreclosure in weak markets. Selective foreclosure suggests that banks tend to pursue the mortgage-foreclosure process in weak markets when properties are relatively valuable compared to other mortgage delinquent properties in the area. If indeed this is the case, it would explain why mortgage foreclosures are associated with appreciating home values in the weak functioning market.

- An additional residential tax-delinquent structure that is also vacant within 500 feet of a single family residential home in the weak functioning market is shown to have no significant impact on home price.

- An additional vacant residential structure within 500 feet of a single-family residential home in the weak functioning market is shown to have no significant impact on home price.

- An additional residential mortgage-foreclosed and tax-delinquent structure within 500 feet of a single-family residential home in the weak functioning market is shown to have no significant impact on home price.

- An additional residential mortgage-foreclosed and vacant structure within 500 feet of a single-family residential home in the weak functioning market is shown to have no significant impact on home price.

- An additional residential mortgage-foreclosed, tax-delinquent and vacant structure within 500 feet of a single family residential home in the weak functioning market is shown to have no significant impact on home price.

- An additional residential tax-foreclosed or tax-foreclosed and tax-delinquent structure within 500 feet of a single family residential home in the weak functioning market is shown to have no significant impact on home price.

- An additional residential vacant tax-foreclosed or vacant tax-delinquent and tax-foreclosed structure within 500 feet of a single family residential home in the weak functioning market is shown to have no significant impact on home price.

High levels of properties selling under some form of distress suggest a market in flux, which is logical given the mortgage-foreclosure crisis during the study time period. Our model does what it can to control for these elements of flux to properly determine the impacts of key variables in the bullet points above. Indeed, selling out of REO in this market produces a highly significant 67.8% discount on sales price. Since roughly 30% of sales in this market were out of REO over the study time period, it is no wonder they were included under the umbrella of arms-length sales for the study. 20% of sales were limited warranty deeds, and brought a highly significant 14.8% discount when sold. Quit claim deeds accounted for 24% of sales in this market and commanded a highly significant 82.1% decrease in sales price when sold. 26% of homes in this market sold when they were vacant. Vacant homes in this market receive a highly significant 22.5% discount. 19% of homes sold under some form of tax-delinquency or mortgage-foreclosure distress in this market, commanding a range of statistically significant 16-47.5% discounts, except for vacant tax-delinquent structures that sold at a highly significant 79.3% discount.

Although categorical distressed sale variables are shown to be statistically significant, which suggests a market in flux, the time trend in the weak functioning market suggests that prices were stable over the time period of the study. Specifically, sale prices during all time periods except for two following the 3rd quarter of 2009 are shown to not statistically vary from the original time period. Further, the two that did significantly vary from the reference time period were -23.2% and 21.7%, which essentially cancel each other. Therefore, significant evidence exists that the weak functioning market has reached some type of price stability over the study timeframe.

Overall, empirical evidence does not suggest that a high return on investment is available through hedged/protected home equity from demolition activity in the weak functioning market. It is shown that the benchmark distress variable of vacant lots does have a significant negative impact, but all except one distressed type (tax-delinquent structures) are shown to have an insignificant impact on sales price. This finding suggests that marginal increases in distress in the weak markets do not impact neighboring values. With that said, it is easy to see with the naked eye in Appendix 4 that many submarket census tracts in the weak functioning market are adjacent to the moderately and high functioning markets. Because these markets share boundaries, and because demolition in moderate and high functioning markets create a strong return on investment, it is extremely valuable to further investigate the value of demolition activity in these targeted boundary zones. These specific boundary zones are likely to be the optimal target zones where demolition is in high demand and a strong return on investment could be captured.

Extremely Weak Market Results

Table 6 below offers model coefficients, standard errors and probabilities for all key variables in the extremely weak functioning market (Submarket 1) from the final spatial regime model. A look at the full extremely weak functioning market regression results is available in Appendix 5.

Table 6: Regression Results of Key Variables in Extremely Weak Functioning Market (2,122 Observations)

Variable	Coefficient	Standard Error	Probability
Key Distressed Property Variables			
1_OD_500	-0.016	0.005	0.001
1_ODPV_500	-0.028	0.006	0.000
1_OPV_500	0.009	0.007	0.200
1_OF_500	0.041	0.013	0.002
1_OFD_500	0.006	0.041	0.877
1_OFPV_500	-0.017	0.048	0.721
1_OFDPV_500	-0.070	0.041	0.088
1_OT_500MERG	0.013	0.033	0.691
1_OTPV_500ME	-0.031	0.036	0.393
1_RVL_500	-0.003	0.002	0.271
Key Categorical Variables			
1_EXITREOCOMBO	-0.781	0.080	0.000
1_LW_DEED	-0.197	0.072	0.006
1_QC_DEED	-0.904	0.079	0.000
1_OD	-0.220	0.118	0.061
1_ODPV	-0.813	0.119	0.000
1_OPV	-0.360	0.069	0.000
1_OF_MERGE	-0.065	0.164	0.691
1_OFPV_MERGE	-0.550	0.170	0.001
Categorical Time Variables			
1_RS093*			
1_RS094	0.118	0.179	0.511
1_RS101	-0.146	0.228	0.522
1_RS102	0.386	0.168	0.022
1_RS103	0.370	0.163	0.023
1_RS104	0.433	0.185	0.019
1_RS111	0.111	0.189	0.559
1_RS112	0.796	0.155	0.000
1_RS113	0.612	0.189	0.001
1_RS114	0.335	0.173	0.052
1_RS121	0.595	0.168	0.000
1_RS122	0.569	0.182	0.002
1_RS123	0.631	0.160	0.000
1_RS124	0.352	0.157	0.025
1_RS131	0.535	0.165	0.001

The impact of additional residential vacant lots is the benchmark of distress impact in our model, as it is compared to all nearby distressed residential structure count variables to estimate potential equity hedge from demolition. An additional residential vacant lot within 500 feet of a single family residential home in the extremely weak functioning market is not shown to have a significant impact on sales price. Given that the vacant lot variable is insignificant and therefore vacant lots are not shown to impact housing values in the extremely weak market, quantifying any available equity hedge is estimated by comparing any statistically significant impact of distress structure type with zero.

- An additional residential tax-delinquent structure within 500 feet of a single family residential home in the extremely weak functioning market causes a 1.6% decline in housing value, all else equal, and is highly statistically significant in its impact on value.
    - These findings suggest that an estimated 1.6% home equity hedge is available for all single family residential homes in an extremely weak functioning market that are within 500 feet of a demolished tax-delinquent residential structure.

- An additional residential tax-delinquent structure that is also vacant within 500 feet of a single family residential home in the extremely weak functioning market causes a 2.8% decline in housing value, all else equal, and is highly statistically significant in its impact on value.
    - These findings suggest that an estimated 2.8% home equity hedge is available for all single family residential homes in an extremely weak functioning market that are within 500 feet of a demolished tax-delinquent and vacant residential structure.

- An additional residential mortgage-foreclosed, tax-delinquent and vacant structure within 500 feet of a single family residential home in the extremely weak functioning market causes a 7.0% decline in housing value, all else equal, and is marginally statistically significant at the 8.8% level in its impact on value.
    - These findings suggest that an estimated 7.0% home equity hedge is available for all single family residential homes in an extremely weak functioning market that are within 500 feet of a demolished mortgage-foreclosed, tax-delinquent and vacant residential structure.

- An additional residential mortgage-foreclosed structure within 500 feet of a single family residential home in the extremely weak functioning market causes a **4.1% increase** in housing value, all else equal, and is highly statistically significant in its impact on value.
    - These findings suggest that home equity hedge is lost for all single family residential homes in an extremely weak functioning market that are within 500 feet of a demolished mortgage-foreclosed residential structure.
    - This finding reflects that of Whitaker and Fitzpatrick (2013) in the same Cleveland study area as it provides further evidence of selective bank foreclosure in weak markets. Selective foreclosure suggests that banks tend to pursue the mortgage-foreclosure process in weak markets when properties are relatively valuable compared to other mortgage delinquent properties in the area. If indeed this is the case, it would explain why mortgage foreclosures are associated with appreciating home values in the extremely weak functioning market.

- An additional vacant residential structure within 500 feet of a single-family residential home in the extremely weak functioning market is shown to have no significant impact on home price.

- An additional residential mortgage-foreclosed and tax-delinquent structure within 500 feet of a single-family residential home in the extremely weak functioning market is shown to have no significant impact on home price.

- An additional residential mortgage-foreclosed and vacant structure within 500 feet of a single-family residential home in the extremely weak functioning market is shown to have no significant impact on home price.

- An additional residential tax-foreclosed or tax-foreclosed and tax-delinquent structure within 500 feet of a single-family residential home in the extremely weak functioning market is shown to have no significant impact on home price.

- An additional residential vacant tax-foreclosed or vacant tax-delinquent and tax-foreclosed structure within 500 feet of a single-family residential home in the extremely weak functioning market is shown to have no significant impact on home price.

High levels of properties selling under some form of distress suggest a market in flux, which is logical given the mortgage-foreclosure crisis during the study time period. Our model does what it can to control for these elements of flux to properly determine the impacts of key variables in the bullet points above. Indeed, selling out of REO in this market produces a highly significant 78.1% discount on sales price. Since roughly 25% of sales in this market were out of REO over the study time period, it is no wonder they were included under the umbrella of arms-length sales for the study. 16% of sales were limited warranty deeds, and brought a highly significant 19.7% discount when sold. Quit claim deeds accounted for 37% of sales in this market and commanded a highly significant 90.4% decrease in sales price when sold. 26% of homes in this market sold when they were vacant. Vacant homes in this market receive a highly significant 36.0% discount. 25% of homes sold under some form of tax-delinquency or mortgage-foreclosure distress in this market, commanding a range of statistically significant 22-55% discounts, except for vacant tax-delinquent structures that sold at a highly significant 81.3% discount.

Unique to the extremely weak market is the insignificant mortgage-foreclosure categorical variable. This variable measures whether homes sold in this market that are somewhere in the mortgage-foreclosure process are significantly different than those that are not in the mortgage-foreclosure process. The proper interpretation is that homes in the mortgage-foreclosure process are not selling at any different price than those that are not in the mortgage-foreclosure process in the extremely weak market. This further validates the hypothesis of selective foreclosure activity from banks in weak markets as originally posited by Whitaker and Fitzpatrick (2013).

The time trend in the extremely weak market clearly exhibits that property sales prices are increasing between 3rd quarter 2009 and 1st quarter 2013. Value increases are statistically significant in a very consistent fashion across time periods, and suggest the level of increases to be between 35-60%. It must be noted that the mean value of a home in the extremely weak

housing market is about $22,500, meaning equity increases are estimated between $8-13,000 on average. This trend suggests that housing values in the weakest markets hit bottom quickly after the onset of the mortgage-foreclosure crisis in 2008 and from then on experienced property value increases that are likely due to low-end speculation that bumped up prices over time.

Overall, empirical evidence does not suggest that a high return on investment is available through hedged/protected home equity from demolition activity in the extremely weak functioning market. That said, several distressed structure types are shown to have significant negative impacts on neighboring properties, including occupied and vacant tax-delinquent structures and mortgage-foreclosed tax-delinquent and vacant structures within 500 feet of homes. While vacant lots are not shown to significantly impact nearby home prices, turning some distressed structures that have negative impacts into lots that have no impact can return positive financial results. While this may be true, it must be noted that home values are low in this market, therefore creating relatively low financial returns in terms of equity hedged.

The majority of distressed structure variables are insignificant in their impact on value in this market. Although this is true, it is easy to see with the naked eye in Appendix 4 that many submarket census tracts in the extremely weak functioning market are adjacent to the moderately and high functioning markets. Because these markets share boundaries, and because demolition in moderate and high functioning markets create a strong return on investment, it is extremely valuable to further investigate the value of demolition activity in these targeted boundary zones. These specific boundary zones are likely to be the optimal target zones where demolition is in high demand and a strong return on investment could be captured.

Comparative Analysis of Regression Results Across Submarket Regimes

The comparative analysis of descriptive statistics across submarkets in the study area (see Table 2) provides insight into the statistical differences between the four submarkets. Trends show that mean sales price and number of sales increase as market functionality increases. Descriptive evidence provides intuition that submarkets are well defined. A Chow test (Chow, 1960) was undertaken of the spatial regimes which further validated that submarkets were correctly defined by testing whether explanatory variables were statistically significantly different from one another (see Appendix 3).

Regression results from each individual market have been presented. The next step is taking a big picture look at how key regression findings compare across submarkets to build on the intuition that the real estate equity and financial impact from demolition activity varies across housing markets is the next step (See Appendix 7 for full comparative statistics of all variables). Table 7 below provides a comparative look at key variables and their associated coefficients with levels of significance across each of the four submarkets from the final spatial regimes model. To appropriately compare significance and coefficients, different levels of significance have been highlighted in green. The more dark green the probability the more highly significantly it impacts value in that respective market. Looking from left to right for each individual variable allows the reader to see the differential impacts across submarkets for each key variable as market functionality increases. A thorough comparative analysis of each key variable accompanies findings below Table 7.

Table 7: Comparative Look at Coefficients and Significance of Key Variables from Final Spatial Regimes Model

	Submarket 1 - Extremely Weak Functioning Market		Submarket 2 - Weak Functioning Market		Submarket 3 - Moderately Functioning Market		Submarket 4 - High Functioning Market	
Variable	**Coefficient**	**Probability**	**Coefficient**	**Probability**	**Coefficient**	**Probability**	**Coefficient**	**Probability**
Key Distressed Property Variables								
OD_500	-0.016	0.001	-0.036	0.000	-0.040	0.000	-0.038	0.000
ODPV_500	-0.028	0.000	-0.003	0.612	-0.051	0.000	-0.086	0.000
OPV_500	0.009	0.200	-0.003	0.654	-0.022	0.000	-0.026	0.000
OF_500	0.041	0.002	0.024	0.012	-0.016	0.000	-0.026	0.000
OFD_500	0.006	0.877	-0.037	0.317	-0.042	0.051	-0.030	0.268
OFPV_500	-0.017	0.721	-0.030	0.301	0.005	0.589	-0.009	0.348
OFDPV_500	-0.070	0.088	-0.004	0.925	-0.086	0.037	-0.060	0.130
OT_500MERG	0.013	0.691	-0.058	0.151	-0.052	0.107	-0.201	0.000
OTPV_500ME	-0.031	0.393	-0.053	0.232	-0.065	0.105	-0.108	0.057
RVL_500	-0.003	0.271	-0.012	0.000	-0.010	0.000	-0.010	0.000
Key Categorical Variables								
EXITREOCOMBO	-0.781	0.000	-0.678	0.000	-0.676	0.000	-0.544	0.000
LW_DEED	-0.197	0.006	-0.148	0.008	-0.190	0.000	-0.223	0.000
QC_DEED	-0.904	0.000	-0.821	0.000	-0.899	0.000	-0.666	0.000
OD	-0.220	0.061	-0.168	0.095	-0.277	0.000	-0.322	0.000
ODPV	-0.813	0.000	-0.793	0.000	-0.590	0.000	-0.381	0.000
OPV	-0.360	0.000	-0.225	0.000	-0.134	0.000	-0.083	0.000
OF_MERGE	-0.065	0.691	-0.206	0.014	-0.153	0.000	-0.280	0.000
OFPV_MERGE	-0.550	0.001	-0.475	0.000	-0.216	0.000	-0.235	0.000

Comparative Analysis of Key Model Variables Across Submarket Regimes

Using Table 7 above, regression results from key variables in the final spatial regimes model are compared and contrasted below.

Residential Vacant Lots Within 500 Feet of Homes

The mean number of residential vacant lots surrounding single-family homes consistently declines as market functionality increases. Specifically, extremely weak markets average about 18 vacant lots within 500 feet; weak markets average about 10 vacant lots within 500 feet, moderately functioning markets average about 4 vacant lots within 500 feet; and, high functioning markets average about 2 vacant lots within 500 feet.

Given high counts of vacant lots and low sales prices in extremely weak markets, a marginal increase in vacant lots is not shown to significantly impact sales prices. This makes intuitive sense. If one lived in an area with high distress and low market values, the price of that home would likely be very low. If the 17 vacant lots within that immediate area turned into 18 vacant lots, a lot of change in the home value would not be expected. The model suggests this scenario.

On the contrary, all other submarkets suggest that vacant lots have a consistent and statistically significant negative impact between 1.0-1.2% on nearby home values. Intuitively, if the value of a home is higher because market functionality is better and the number of vacant lots surrounding a home is smaller, a marginal increase in this type of distress is more likely to impact home value. Further, the significance of the vacant lot variable is critical to approximate the value of demolition programs because residential vacant lots are often the outcome of demolishing blighted structures. Although the impact of additional vacant lots is shown to be negative, the impact is only around 1.0% as compared to much larger impacts from nearby distressed structures. The difference between distressed structures and vacant lots is demolition, and demolition activity offers an opportunity to capture this equity hedge in homes near the demolition. Hence the term "blight light" for vacant lots because they still have a negative impact on value, it is just significantly smaller than that of blighted structures.

Tax-delinquent Residential Structures Within 500 Feet of Homes

The mean number of residential tax-delinquent structures surrounding single-family homes consistently declines as market functionality increases. Specifically, extremely weak markets average about 15 tax-delinquencies within 500 feet; weak markets average about 10 tax-delinquencies within 500 feet, moderately functioning markets average about 4 tax-delinquencies within 500 feet; and, high functioning markets average about 2 vacant tax-delinquencies within 500 feet.

Across the board, a marginal increase in the number of tax-delinquent structures within 500 feet of a single-family residential home is shown to have a significant negative impact on property value. As a reminder, note that "tax-delinquent," in our model is interpreted as at least 40% delinquency in the tax bill during the time period of interest. A clear trend of increasing negative impact exists as market functionality increases. In extremely weak markets there is a -1.6% impact on all single family residential homes within 500 feet of a tax-delinquent structure,

offering a 1.6% equity hedge from demolition. Marginal increases in tax-delinquent structures in weak markets see a 3.6% decline in home values with a 2.4% equity hedge from demolition; moderately functioning markets see a 4.0% decline in home values with a 3.0% equity hedge available from demolition; and, high functioning markets see a 3.8% decline in homes values from a marginal increase in tax-delinquent structures with a 2.8% equity hedge available from demolition.

Overall, the final model suggests that the demolition of tax-delinquent structures in all markets offers a positive return on investment captured through the home equity of other single-family homes near the removal of the distressed property. That said, the size of the equity hedge is smaller in weaker markets and home values are also lower in weaker markets. This translates into smaller "bang for your demolition buck" in weaker markets due to the smaller financial returns. The paradox that many cities will encounter is that needed demolitions tend to accumulate in the weaker markets, causing unique implications from these findings in each municipality.

Tax-delinquent and Vacant Residential Structures Within 500 Feet of Homes

The mean number of residential vacant tax-delinquent structures surrounding single-family homes consistently declines as market functionality increases. Specifically, extremely weak markets average about 7 vacant tax-delinquencies within 500 feet; weak markets average about 4 vacant tax-delinquencies within 500 feet, moderately functioning markets average about 1 vacant tax-delinquency within 500 feet; and, high functioning markets average less than 1 vacant tax-delinquency within 500 feet.

Three of the four market zones experience a significant negative impact on property value from a marginal increase in the number of vacant tax-delinquent structures within 500 feet of a single-family residential home. As a reminder, note that "tax-delinquent," in our model is interpreted as at least 40% of the tax bill is delinquent during the time period of interest. Similar to tax-delinquent structures, a clear trend of increasing negative impact from vacant tax-delinquencies exists as market functionality increases. In extremely weak markets there is a -2.8% impact on all single family residential homes within 500 feet of a tax-delinquent structure, offering a 2.8% equity hedge from demolition. Marginal increases in tax-delinquent structures in moderately functioning markets see a 5.1% decline in home values with a 4.1% equity hedge available from demolition while high functioning markets see a 8.6% decline in homes values from a marginal increase in tax-delinquent structures with a 7.6% equity hedge available from demolition. Equity hedges move from 2.8% up to 4.1% and then up to 7.6% as market functionality and associated averages sales prices increase.

Overall, the final model suggests that the demolition of vacant tax-delinquent structures offers a positive return on investment in most markets. These returns can be captured through home equity protection in nearby single-family homes if the distressed property is demolished – i.e. turned into a vacant lot. That said, the size of the equity hedge is smaller in weaker markets and home values are also lower in weaker markets. This translates into smaller "bang for your demolition buck" in weaker markets due to smaller financial returns. The paradox that many cities will encounter is that needed demolitions tend to accumulate in the weaker markets, causing unique implications from these findings in each municipality.

Vacant Residential Structures Within 500 Feet of Homes

The mean number of residential vacant structures surrounding single-family homes consistently declines as market functionality increases. Specifically, extremely weak markets average about 8 vacant structures within 500 feet; weak markets average about 7 vacant structures within 500 feet, moderately functioning markets average about 5 vacant structures within 500 feet; and, high functioning markets average between 3-4 vacant structures within 500 feet.

Structures that are only vacant and have no other indicators of distress are only significant in their negative impact in the moderate and high functioning markets. These properties are simply empty homes with current taxes paid and no existing foreclosures. In weak markets, these properties still being invested in by owners have no impact on nearby home prices, therefore suggesting that investment matters more than occupancy in weak markets. In stronger markets, occupancy is suggested to matter more as discounts are shown to be statistically significant and negative when vacant structures are present. Marginal increases in vacant structures in moderately functioning markets see a 1.6% decline in home values with a 0.6% equity hedge available from demolition while high functioning markets see a 2.6% decline in homes values from a marginal increase in vacant structures with a 1.6% equity hedge available from demolition.

Overall, the final model suggests that demolition of tax current vacant structures that are not in any foreclosure process only have negative impacts on surrounding home values in the most functional markets. Positive return on investment can be captured through home equity protection in nearby single-family homes by demolishing these properties – albeit smaller than taking down most other types of distress. These vacant structures are the likely indicator of a supply side issue – specifically empty homes that are still being invested in in hopes of selling at some point in time. Given that owners are paying taxes and mortgages and the equity hedge through demolition is relatively low, these properties may not be the optimal target for demolition activity if maximum financial return is the goal. The only place where positive returns from demolition can be seen is in functional markets where the density of vacant structures is relatively low. This suggests that demolishing these structures would create a few bigger yards in a well-occupied housing market and values would then have an uptick because the empty homes are gone. Outcomes will vary and highly depend on local housing policies and initiatives.

Mortgage-Foreclosed Residential Structures Within 500 Feet of Homes

The mean number of residential structures that are in the mortgage-foreclosure process surrounding single-family homes is quite steady across housing markets. This finding suggests that the mortgage-foreclosure crisis and associated Great Recession swept across all housing markets somewhat evenly. Specifically, all markets are shown to experience between 3-4 mortgage-foreclosed structures within 500 feet in the descriptive statistics. That said, descriptive statistics can be misleading as regression results consistently point out evidence of selective foreclosure in weak markets. This means that the actual number of homeowners in default may be underrepresented in the data in weak markets because banks act strategically and do not want low-valued liabilities on their ledger.

Across the board it is shown that structures that are filed, processing or completed in the mortgage-foreclosure process have a significant impact on the value of nearby single-family

homes. While this is true, a unique inflection point of both significant positive and significant negative impacts from these properties is shown across markets. In other words, these properties are shown to have a positive and significant impact on nearby home values in weak markets while they are simultaneously shown to have significant negative impacts on nearby home values in stronger markets.

Mortgage-foreclosed structures are shown to have a **positive 4.1%** impact on neighboring home values in extremely weak functioning markets and a **positive 2.4%** impact on neighboring home values in weak functioning markets. This counterintuitive finding suggests that the homes that banks are foreclosing on in weak markets are more valuable in comparison to other homes in these markets. This is not to say mortgage foreclosures are good for a neighborhood, it suggests that banks tend to foreclose on properties that are in pockets of higher market functionality nested within weaker markets. The potential existence of "mini-markets" within weak submarkets suggests that banks may believe a better opportunity to sell a home out of REO exists in select pockets of these areas. Further, bank activity in weak markets suggests a market signal to buyers of asset value, potentially setting off more competitive behavior. With that said, relative prices are much lower in weak functioning markets, and a small percentage increase in value likely translates into a small real price increase.

Findings suggest that demolishing these properties in weak markets would actually devalue neighboring properties. These findings also suggest that weaker markets could benefit from a further analysis that takes into account the differing impacts of demolition intervention in nested mini-markets. These same property types are shown to have significant negative impacts in stronger markets. In moderately functioning markets, mortgage-foreclosed structures are shown to have a -1.6% impact on neighboring values, offering a 0.6% hedge from demolition, and a subsequent -2.6% impact on neighboring values in high functioning markets, offering a 1.6% hedge from demolition.

It is clear from these findings that mortgage-foreclosed structures impact neighboring properties differently in different markets due to strategic bank activity. In weak markets, it would appear that a demolition strategy may try to avoid these properties as they are likely valuable in the eyes of the bank and the market, and are shown to actually create home equity in these markets. In stronger markets, some equity is available to be hedged through demolition of these structures, albeit relatively low. The strategic bank activity in these stronger environments is likely focused on preserving value potential because returns through REO sales is more likely. That said, there is a likely time trend associated with blight impact based on how long a home has been mortgage-foreclosed that was not included in this model (Kobie, 2009).

As shown below in the REO sales categorical variable comparative, a high level of REO sales are occurring – between 25-32% of all sales over our time period. This means strategic bank activity is in order to optimize returns from assets that are quickly turning into liabilities. Discounts are lower in stronger markets, ranging from 54.4%-67.6%, increasing incentive to foreclose if the owner is in default. Discounts that banks take from REO sales in weaker markets range from 67.8-78.1%, therefore incentivizing selectivity in taking full title because returns and relative prices are much lower.

Mortgage-foreclosed Structures With Additional Distress Indicators Within 500 Feet of Homes

Mortgage-foreclosed structures with additional distress measures include those with tax-delinquency, vacancy, and tax-delinquency and vacancy combined in addition to the mortgage-foreclosure. The addition of more distress indicators to mortgage-foreclosure suggests specific behavior from the banks and their tenure as caretakers of a given property. Evidence suggests that banks take care of their mortgage-foreclosures differently across different markets. For example, while the number of mortgage-foreclosures overall tends to hold steady across submarkets, the number of tax-delinquent mortgage-foreclosures is shown to decrease as market functionality increases. This suggests that banks are more likely to pay taxes on the homes they have foreclosed on in stronger markets than weaker ones. Descriptive statistics show that levels of tax current vacant mortgage-foreclosures stay roughly constant through markets until the highest functioning market is reached – suggesting more leniencies for defaulters and/or renting of mortgage-foreclosures in higher value markets. In terms of vacant and tax-delinquent mortgage-foreclosures, there are almost none in strong markets, while there are 3 to 4 times as many one average in weak markets. Overall, the descriptive statistics suggest that banks are investing more in their assets in stronger markets and more willing to let properties they have foreclosed on go in weaker markets. Regression results from these three distress variables find similar results when compared across submarkets.

Tax-delinquent and Mortgage-foreclosed Structures Within 500 Feet of a Home

Tax-delinquent mortgage-foreclosures are more common in weaker markets, and are shown to have no significant impact on nearby housing values. Tax current mortgage-foreclosures in weaker markets are shown to have a positive impact on nearby home values, while tax delinquencies are shown to have a negative impact, potentially cancelling out a significant effect from tax delinquent mortgage foreclosures in weaker markets. These properties potentially started out nice through selective foreclosure but then did not sell in to REO, at which time bank disinvestment from forgoing property tax payments eventually caused tax delinquency.

In the moderately functioning market an estimated decline of 4.2% is expected for homes within 500 feet of a tax-delinquent mortgage-foreclosure, offering a 3.2% equity hedge from demolition activity. Tax-delinquent mortgage-foreclosures are not shown to have a significant impact on value in the high functioning market, likely due to near non-existence in those markets. Overall, findings would suggest that the identification of these properties in a moderately functioning environment are strong targets for demolition activity and strong returns in the form of protected home equity, as they have likely been passed over by the REO market and are divested in and/or blighted.

Vacant Mortgage-foreclosed Structures Within 500 Feet of a Home

Properties that are vacant and are either undergoing or completed mortgage-foreclosure are not shown to have a significant impact on property value in any market. These are properties that are likely still receiving some caretaking, as they are tax current. This reverts them to behaving similarly to mortgage-foreclosures alone or postal vacancies alone. Although these different distress measures have differing level of impact on value across submarkets, low variation in all markets likely renders them insignificant.

Vacant and Tax-delinquent Mortgage-foreclosed Structures Within 500 Feet of a Home

As shown by the significant equity hedges available, tax-delinquency is a strong indicator of distressed properties. Mortgage-foreclosed and tax-delinquent suggests a property has been abandoned. Vacancy suggests properties have either been past over for REO sale or otherwise abandoned. Only two of the four markets identify these distressed properties as significantly impacting nearby homes negatively. The extremely weak market identifies a -7.0% decline in nearby home values from a vacant and tax-delinquent mortgage-foreclosure, offering a 7.0% equity hedge for nearby home through demolition of these properties. In the moderately functioning market an estimated 8.6% decline in home values is expected from one of these properties, offering a 7.6% equity hedge from demolition. While technically insignificant at the 13% level, the high functioning market coefficient is very close to suggesting a 6.0% decline in nearby home values from an additional one of these distressed structures.

Overall, these properties offer large equity hedges for nearby homes if demolished in the markets where they are shown to be statistically significant. Although inconclusive, these properties are likely producing similar negative issues in markets that do not pick up significant results. Therefore, these properties with these distress indicators are strong candidates for targeted demolition and return on investment. Further, identifying these properties in zones where the extremely weak markets come in physical contact with the moderately functioning markets is a clear opportunity for strong returns on investment from demolition investment.

Tax-foreclosed OR Tax-foreclosed & Tax-delinquent Residential Structures Within 500 Feet of Homes

Although it is clear that as time progressed over the study period there is a smaller and smaller volume of tax-foreclosed structures in stronger markets, the negative value effects of these structures is only found in the stronger markets. Only marginally significant at the 10.7% level in the moderately functioning market, a 5.2% decline in neighboring property values is expected from nearby tax-foreclosed structures, offering a 4.2% equity hedge for neighbors if these structures are demolished. A highly significant 20.1% decline in property values is shown for properties near tax-foreclosed structures in the high functioning market, suggesting a 19.1% equity hedge for those homes near the demolition of these structures. Because of the policy environment in the Cleveland study area, tax-foreclosures are relatively uncommon. That said, when these properties do pop up, especially in strong housing market environments, study findings suggest a strong return on investment captured in nearby real estate equity through demolishing these structures.

Tax-foreclosed and Vacant OR Tax-foreclosed and Vacant and Tax-delinquent Residential Structures Within 500 Feet of Homes

A smaller and smaller volume of vacant tax-foreclosed structures are located in stronger markets, yet the negative value effects of these vacant structures are only found in the strong markets. Only marginally significant at the 10.5% level in the moderately functioning market, a 6.5% decline in neighboring property values is expected from nearby vacant tax-foreclosed structures, offering a 5.5% equity hedge for neighbors if these structures are demolished. A significant 10.8% decline in property values is shown for properties near vacant tax-foreclosed

structures in the high functioning market, suggesting a 9.8% equity hedge for those homes near the demolition of these structures. Because of the policy environment in the Cleveland study area, tax-foreclosures are relatively uncommon. That said, when these properties do pop up, especially in strong housing market environments, study findings suggest a strong return on investment captured in nearby real estate equity through demolishing them.

Single Family Residential Home Sales While In Distress

As discussed throughout this document, a large percentage of properties across all markets sold under some form of distress during the study timeframe. Controlling for these factors proved to be highly important to the model specification, as the majority of these categorical indicator variables were statistically significant in their impact on sales price across all markets. The following analysis compares properties that sold out of distress across submarkets.

Real Estate Owned (REO) Home Sales

REO sales accounted for 24-32% of sales across the four submarkets. All categorical variables that indicated an REO sale were highly statistically significant in every market, with a decreasing trend in the total discount rate as market functionality increased. REO sales caused a 78.1% discount in sales price in the extremely weak market, a 67.8% discount in the weak market; a 67.6% discount in the moderately functioning market; and, a 54.4% discount in the high functioning market.

Limited Warranty Deed Home Sales

The number of Limited Warranty Deed sales stayed roughly consistent across markets, ranging between 16-21% of total sales. Discounts on Limited Warranty Deed sales were roughly consistent as well and were highly significant across the board. Discounts on Limited Warranty Deed sales were 19.7% in the extremely weak market; 14.8% in the weak market; 19.0% in the moderately functioning market; and 22.3% discount for a limited warranty deed sale in the high functioning market.

Quit Claim Deed Home Sales

Numbers of Quit Claim Deeds were much higher in the weaker markets, with 37% and 24% of sales in the extremely weak and weak markets, respectively. These deeds accounted for only 8% of sales in the moderately functioning market and 3% of sales in the high functioning market. That said, these deed types were strong indicators of deep discounts on sales prices that were highly significant across all submarkets. Extremely weak market discount for a Quit Claim Deed was 90.1%; 82.1% discount in weak market; 89.9% discount in moderately functioning market; and, 66.6% discount in the high functioning market.

Tax-delinquent Home Sales

All homes selling under at least 40% tax-delinquency did have a significant discount on sales price – although the level of significance in the discount was much more clear in the higher functioning markets. Number of tax-delinquent sales was quite low across all markets, but a decreasing trend in these sales types is recognizable as market functionality increases. A 22.0%

discount from a tax-delinquent home sale is experienced in the extremely weak market, a 16.8% discount in the weak market; a 27.7% discount in the moderately functioning market; and, a 32.2% discount is expected in the high functioning market.

Tax-delinquent and Vacant Home Sales

As market functionality increases a clear decreasing trend in the number and discount rate associated with the sale of tax-delinquent and vacant homes is shown. All highly significant, a 81.3% discount is shown for the sale of vacant tax-delinquent homes in the extremely weak market; a 79.3% discount is experienced in the weak market; a 59.0% discount is expected in the moderately functioning market; and, a 38.1% discount is expected in high functioning markets.

Vacant Home Sales

Selling tax current homes while vacant is not uncommon - it describes many housing sales scenarios. This interpretation is suggested through the descriptive statistics of the four housing submarkets, as the number of sales under vacancy range between 26-33%. All discounts when vacant homes sell are found to be highly statistically significant and show a decreasing discount rate trend as market functionality increases. Extremely weak markets show a 36.0% discount when homes sell while vacant; weak markets show a 22.5% discount; moderately functioning markets show a 13.4% discount; and, high functioning markets show a 8.3% discount when sold as a vacant home.

Mortgage-foreclosure in Process Home Sales

Although most markets show a highly significant discount for the sale of a property while it is in the foreclosure process, the extremely weak functioning market suggests otherwise. In the weakest market the coefficient for this variable is highly insignificant, suggesting that mortgage-foreclosed properties selling in this market do not command any discount. This finding is further evidence that mortgage-foreclosed properties in the weaker markets are experiencing selective foreclosure activity from the banks. Other markets receive discounts when a home is sold when in the mortgage-foreclosure process. The weak market receives a 20.6% discount; the moderately functioning market receives a 15.3% discount and the high functioning market receives a 28% discount.

Mortgage-foreclosure in Process and Vacant Home Sales

The number of mortgage-foreclosed homes that are also vacant that surround sales properties in the study sample are roughly constant across all submarkets. While all discounts are highly significant, the expected trend of decreasing discounts as market functionality increases is experienced. The extremely weak market receives a 55.0% discount if the home sells while vacant and in the mortgage-foreclosure process; a 47.5% discount in the weak market; a 21.6% discount in the moderately functioning market and a 23.5% discount in the high functioning market.

Home Sales Price Trends Over the Study Time Period

Price trends across the four submarkets were quite interesting. Prices in the extremely weak market were shown to be appreciating – leveling off around 35-60% more valuable in 1st quarter 2013 than in 3rd quarter of 2009. Prices appeared to be quite stable in the weak market over the study time period, while prices were clearly depreciating in the moderate and high functioning market to the tune of roughly 25-35% loss. These time trend findings speak to the fluctuating markets that are the outcomes of the Great Recession and mortgage-foreclosure crisis. It is likely that the worst housing markets crashed quickly and then began to experience some recovery from speculative activity due to such low priced homes in those markets. Weak markets were the only market to appear stable over the time period, likely behaving as a marginal market between downward and upward mobility being experienced simultaneously as an outcome of the macroeconomic fluctuation over the study time period. Value depreciation in the stronger markets over the study time period is a likely outcome of a lagged price effect created by the recession. The suggested interpretation is that the value of home equity that accrued during the housing bubble is still normalizing toward stable pricing in stronger markets.

Cost-Benefit Analysis of Demolition Investment

An extremely valuable outcome of this research is that the estimated hedonic price function can predict market values for all single-family residential homes in their respective submarkets across the study area. This capability of the estimated model is the focal point of research findings that will be leveraged to perform a cost-benefit analysis of the outcomes from demolition activity. Because each model variable has an estimated coefficient in each submarket, all that is needed is the corresponding value for each single-family home in its respective submarkets to estimate status quo home value. With that said, the significance of coefficients in each submarket, R-squared/goodness of fit, and the quality of model specification are the critical foundation for these types of predictive estimations to be robust. As shown and interpreted in the previous section, the two more functional markets are clearly more robust in terms of their predictive power for this analysis.

Predictive Simulation

The concept of this cost-benefit analysis is to take advantage of the identified equity hedges available through demolition activity. Specifically, vacant lots are shown to have a smaller negative impact on nearby home values than distressed structures, and home equity is captured by nearby homes when distressed structures turn into vacant lots. This value is calculated using the estimated hedonic price function to compare the status-quo value of all homes that have been impacted by demolition activity with the re-estimated value of these homes as if demolition activity never occurred and more distressed structures exist.

Actual demolition data from the study time period was used to ascertain the pre-demolition distress status of demolished properties. First, the status-quo values of single-family homes within 500 feet of a demolition over the study time period were estimated in each submarket to provide a benchmark valuation of the housing stock for comparative analysis. Next, the counterfactual study environment was created by toggling vacant lot and corresponding distressed structure variables to reflect the pre-demolition status of properties. This equates to less vacant lots and more distressed structures. In essence, the land use change dynamics that demolition creates between vacant lots and distressed structures was reverse engineered. Counterfactual values of homes impacted by demolition were then estimated based on a scenario in which demolition of distressed properties had not occurred, simulating a landscape of no demolition activity over the study time period.

The process of estimating the counterfactual housing stock value includes many nuances. As noted above, the predictive power of model coefficients from the weaker markets are marginal at best. Weaker markets are loaded with low variation in many variables, low market activity, low values that are sluggish to change regardless of distress, and high levels of distress where marginal increases in distress are negligible in their impact on value are likely to blame for these predictive deficiencies. Because the majority of distress coefficients in the two weaker housing markets were largely insignificant, the outcome of toggling vacant lot and distressed structure variable creates perverse impacts that are not supported by statistically significant evidence. Further, as discussed in the data section, when the pre-demolition status of a demolished distressed structure could not be ascertained (~30% of the time), it was defaulted as a vacant structure. Vacant structures are not shown to have a large or significant impact in either of the weaker markets, further biasing predictive simulation results from those markets. All of that

said, the weak market models clearly suggest that minimal financial gain is available through demolition activity in those zones.

On the contrary, coefficients and predictive power associated with the functioning markets of the model are quite robust in their ability to produce concise financial estimates of the value of demolition activity from the predictive simulation. This strong predictive power is likely associated with the elements one would expect from a functioning housing market: strong variation in sales prices and other variables that impact price, high market activity and prices that are negatively impacted from localized distress.

Findings from Cost-Benefit Analysis of Demolition Activity

Table 8 below provides the critical outputs from the predictive simulation process. Between the 3rd quarter of 2009 and the 1st quarter of 2013, roughly 6,006 demolitions were carried out across the Cleveland study area. Of these, 2,944 were carried out in extremely weak markets, 1,951 in weak markets, 776 in the moderately functioning markets and 335 in the high functioning markets. These numbers reflect the supposition that more homes need to be demolished in weaker markets. While this may be true, findings from the cost-benefit analysis suggest that financial returns in the form of hedged home equity are much larger from demolition in functioning markets versus weaker markets.

Table 8: Summary of Findings from Simulation for Cost-Benefit Analysis of Demolition Investments

Submarkets	Status Quo Value	Counter-Factual Value	Change	Total Demos	Hedge Per Demo	Total Demo Cost	Cost Benefit	Cost Benefit Ratio
Extremely Weak	$449.7M	$447.5M	$2.22M	2,944	$754.16	$27.6M	-$25.4M	-0.92
Weak	$766M	$773M	-$7M	1,951	-$3,585	$18.3M	-$25.3M	-1.38
Moderately Functioning	$4.63B	$4.59B	$38.3M	776	$49,367	$7.3M	$31.0M	4.27
High Functioning	$8.43B	$8.38B	$45.4M	335	$135,475	$3.1M	$42.2M	13.45
TOTALS	**$14.27B**	**$14.19B**	**$78.9M**	**6,006**	**$13,140**	**$56.3M**	**$22.6M**	**1.40**

According to the empirical model, the estimated status quo value of the single-family residential housing stock impacted by demolition in 1st quarter, 2013 was $449.7 million in the extremely weak market; $766 million in the weak market; $4.63 billion in the moderately functioning market; and, $8.43 billion in the high functioning market – for a total housing stock value of $14.27 billion. [7]

All in all, an estimated $83.4 million in value was created from 1,111 demolitions performed in the moderately and high functioning markets. With an average marginal demolition cost of

[7] These findings are based on the mean point estimates of all model coefficients. 95% confidence intervals for each variable were run in the final spatial regimes model and estimated the status quo and counterfactual under each scenario. Due to large standard errors and insignificant coefficients associated with key variables in weaker markets, findings associated with the weaker markets were increasingly irrelevant in the predictive simulation. That said, 95% confidence intervals for the more robust stronger functioning markets produced logical results, providing nice intervals of benefit estimates. See Appendix 8 for 95% Confidence Interval findings.

$9,376 per demo, these numbers translate into multipliers of 4.27 and 13.45 for every demolition dollar invested in the moderately and high functioning submarkets, respectively. Demolition activity in the weaker markets yielded -$4.78 million from 4,895 demolitions, translating into roughly one dollar lost for every demolition dollar invested. Again, calculations in the weaker markets are not robust, and are more logically a zero return investment at the low end, as opposed to a negative investment. Total demolition costs were calculated over the time period, totaling $56.3 million. With the aggregate change in value caused by demolition estimated at $78.9 million, a net benefit from demolition activity in the Cleveland study area was estimated at $22.6 million. This net benefit translates into an aggregate estimate of 1.40 return on investment for every $1 spent on demolition in the Cleveland area over the study time period.

Summary of Findings

The purpose of this research was to investigate the existence and magnitude of differential financial impacts from demolition activity across housing submarkets in Cleveland, Ohio and its first ring suburbs between 3rd quarter, 2009 and 1st quarter, 2013. The estimation of the final hedonic price function as a spatial regimes model with four well-defined housing submarkets produced the necessary results to: 1) draw conclusions about the existence and magnitude of differing financial impacts caused by demolition activity across housing markets; and, 2) leverage findings from the model to estimate a financial cost-benefit analysis of all demolition activity in the study area over the study timeframe.

Conclusions drawn from the research suggest that financial return on investment from demolition of distressed properties is optimized in the form of hedged home equity and tax base protection in higher functioning markets. Research findings make it clear that distressed residential structures have a larger and more statistically significant negative impact on home values in stronger markets. Concurrently, home values tend to be higher in these markets as well, ultimately optimizing returns in terms of hedged home equity and tax base protection from demolition of distressed structures in these areas.

Findings from the model and predictive simulation further make it clear that a geographic boundary exists in terms of positive and negative return on investment from demolition activity in the study area. When reviewing the submarket boundaries in Appendix 4, the line between the extremely weak/weak markets and the moderately/high functioning markets defines the geographic zones where capturing positive or negative financial returns from demolition investment is decided. Moderate and high functioning markets are shown to provide $4.27-$13.45 per one dollar invested in demolition activity, while extremely weak/weak markets are shown to provide zero or negative financial impacts from demolition investments.

Although it is clear that the primary locations to protect home equity from demolition are in more functioning markets, it must be acknowledged that the majority of demolitions that occurred over the study time period were in the weaker market zones. The ratio of weak to strong market demolitions is roughly 5 to 1. This suggests that more blight is concentrated and associated demand for demolitions is higher in the weaker market areas. Since this is the case, and demolition dollars are limited, an optimal strategy emerges if demolition dollars are not exhausted after the "low hanging demolition fruit" is cleared in stronger markets. Targeting demolition in the boundary zones between moderate/high functioning markets and extremely weak/weak markets offers an opportunity to clear land for renewed market functionality of weaker markets due to adjacency and proximity to functioning markets.

These housing market juxtapositions can be recognized on the map in Appendix 4. This "fighting the fire from the edge of the fire" strategy is unique to specific communities and would demand decision making from stakeholders at the community level. The primary limitation associated with this conclusion and the research overall is spatial granularity. Many small islands of market health, or mini-markets, may exist within weaker markets that are smaller than census tracts, which were used to define markets for this study. Therefore, future research could focus on defining housing markets at a more localized level so that areas can be better targeted to achieve optimal outcomes from demolition activity.

Research Limitations

From a housing economics perspective, the primary limitation of this research is the unavailability of good variation in data that tracks other residential property dynamics over time. Specifically, residential improvements and rehabilitations of existing residential structures and construction of new residential structures are hypothesized to positively impact value. An empirical analysis of the impact of these phenomena demands good data. The Cleveland area housing market is shown to have a large inventory of vacant homes, suggesting a supply side issue of abundant available housing choices. Large volume vacancy draws prices down in any affected submarket, lowering the economic incentive for new construction or rehabilitation behavior. With that said, if good variation in rehabilitation and new construction activity did exist at the parcel level, it would make it possible to provide a comparison of potential home equity hedge across submarkets if either demolition or rehabilitation action was undertaken.

From an economic research perspective, this creates a chicken-or-egg scenario. Markets must be strong enough for rehabilitation/new construction investment to be viable, and the only way to research the impact of such market activity is to have a large amount of variation in that activity to test whether it significantly impacts value. Further, rehab and new construction would likely concentrate in stronger markets, creating even lower or non-existent variation in those markets, creating associated low economic insight.

With that said, some research strides related to taking a different direction than demolition when faced with distressed residential structures has been undertaken (Borowy, et. al., 2013). While findings from the study suggest that hedged home equity is available in homes near residential rehabilitation activity, market stratifications for differential impacts and targeting for optimal outcomes was not investigated. Clearly, research that helps provide insight into the decisions surrounding whether to demolish distressed structures and provide certainty in future costs to municipalities versus investing in select distressed structures for rehabilitation are ripe for future research opportunities. Hopefully, housing markets will soon recover, investment activity in the housing stock will resume, and the necessary data to perform such a study will become possible.

The primary questions that cities must ask themselves are: whether housing demand exists for rehabilitated/maintained older homes or for new homes in some submarkets; whether marketing could change demand; and whether the city is willing to bank-roll these types of investments in hopes that the housing market in some areas will get better in the future. While there is significant uncertainty associated with rehabilitation and new construction in many current housing markets, this study provides a clear analysis of the financial outcomes associated with demolition across housing submarkets.

PART 2: Impact of Demolition on Mortgage-Foreclosure Rates

Introduction

The Troubled Asset Relief Program (TARP) is the primary policy response from the Federal Government related to the 2008 mortgage-foreclosure crisis. Of the total allocated funds, the U.S. Treasury provided $45.6 billion for housing support programs, which has been subsequently reduced to $38.5 billion.[8] The three main TARP housing support programs are the Home Affordable Modification Program (HAMP), Making Homes Affordable Program (MHA) and Hardest Hit Fund Program (HHF). HHF funds were given to select states formulaically based on how intensely the mortgage-foreclosure crisis impacted them and are designed to quell and prevent future mortgage-foreclosure in those states.

Of the $38.5 billion allocated for these three programs, only $9.5 billion was spent as of September 30, 2013. The remaining $29 billion remains unspent. The TARP housing funds are largely unspent for a simple reason: all TARP housing funds currently must be spent to assist individual homeowners. Funds are not available to help communities address the foreclosure crisis at the neighborhood level.[9] The process of a homeowner applying for TARP housing assistance is akin to a loan application process: the homeowners must submit detailed financial information and await a response from the regulator, bank or program administrator. The process is slow and cumbersome, and decision-making authority often rests with the lenders or the lenders' loan servicers. It is estimated that at the current rate of expenditure TARP funds would not be fully expended for another decade, while different pools of funds are set to expire in both 2015 and 2017.

This section again focuses on the Cleveland, Ohio area between 2009 and 2013. The research and analysis in this section specifically focuses on how demolition activity impacts mortgage-foreclosure rates, as this information has not existed and can greatly impact the decision making environment surrounding demolition funding as related to the TARP housing funds. The hypothesis of this section is that demolition activity results in a reduction in mortgage-foreclosure rates over time. Therefore, under the rejection of the null hypothesis, demolition is a preventative measure of future mortgage foreclosure.

Evidence from objective analysis strongly suggests that residential demolition activity lessens the mortgage-foreclosure rate across comparable neighborhoods. A neighborhood distress index was carefully constructed to categorize Census Blocks[10] into low, moderate and high distress tiers throughout the study area. Each tier of distress is then divided between those that experienced demolition intervention and those that have not received demolition intervention. Demolition activity and property distress are measured for residential parcels only, specifically focused on the existence and demolition of tax-foreclosed, tax-delinquent, mortgage-foreclosed and vacant properties. The mortgage-foreclosure rate trends are compared graphically in those

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[8] The process and outcome of the decision to reduce TARP housing funds by $7.1 billion remains unclear.

[9] Recent pilot programs have allowed Michigan and Ohio to spend $100 million and $60 million of HHF on targeted demolition activity, respectively. The outcome of this research provides evidence that suggests demolition decreases mortgage foreclosure rates over time and therefore acts as a preventative measure of future mortgage foreclosure. This evidence supports the Michigan and Ohio expenditures of HHF resources as a valid use of funds.

[10] U.S. Census Bureau on the web: http://www.census.gov/geo/maps-data/maps/block/2010/

neighborhoods that experienced demolition intervention and those that did not. Neighborhoods with similar levels of distress which experience demolition are consistently shown to have steeper declines in mortgage-foreclosure rates than those that do not experience demolition activity.

These findings provide federal policy makers with research evidence that supports increased spending of Troubled Asset Relief Program (TARP) housing resources on demolition activity. [11] Apples-to-apples neighborhoods are experiencing trends that suggest greater declines in mortgage-foreclosure rates when demolition activity is present. Therefore, these findings suggest that demolition is a preventative measure for future mortgage-foreclosure. Given that neighborhood scale demolition activity is shown to meet the necessary outcome of TARP housing funds' programmatic spending, the demonstrated relationship between demolition activity and the lowering of foreclosure rates offers the U.S. Treasury an opportunity to expand the reallocation of TARP housing funds before access to available resources expire on December 31st, 2017.

[11] This analysis is visually correlative byway of graphically comparing the mortgage foreclosure rates of neighborhoods that did and did not receive demolition over time. Because controlling for the demolition variable in similar neighborhoods provides a visual difference in mortgage foreclosure rates, a cause-and-effect relationship may be reasonably implied but is not proven.

Method of Analysis

A pattern-based analysis was used to assess the potential impact of demolition activity on mortgage-foreclosure rates in Cleveland and its surrounding suburbs between 3rd quarter, 2009 – 1st quarter, 2013. "Pattern-based models describe meso- or macroscale correlations between observed patterns and other observable variables" (Irwin, 2010; 69). In short, a test to see if foreclosure rates decline at a faster rate in neighborhoods where demolition(s) of disamenity properties occur as opposed to neighborhoods where no demolition took place was undertaken. To achieve the pattern-based comparison we initially created a neighborhood distress index to control for differences in neighborhoods across the study area. With levels of distress controlled for, we compared mortgage foreclosure rates over time in neighborhoods that experienced demolition intervention with those that did not.

Data used for this analysis was created by NEO CANDO (See Part 1 data section for thorough overview) based on county level data at the Census Block level. Relevant distress and demolition data for this analysis was simply re-tabulated from data used in Part 1 into the Census Block level. Only those Census Blocks that experienced some level of mortgage foreclosure were included in the analysis because this analysis is not interested in the impact of demolition in Census Blocks that did not experience mortgage foreclosure. In other words, if an area has no mortgage foreclosure to speak of over the study time period then the process-based model used in this analysis is not equipped to show how demolitions impact the mortgage foreclosure rate in that area.

Estimating a Neighborhood Distress Index

A neighborhood distress index was calculated for each Census Block within the study area, and was used to separate Census Blocks in the study area into three aggregated tiers of distress (high, medium and low). This was done so that neighborhoods with similar levels of distress could be compared to each other in terms of mortgage foreclosure rates over time in the presence of demolition activity. The method used to create the neighborhood distress index is as follows:

1. Distress types were counted in each Census Block during the initial time period of the study – 3rd quarter, 2009 of the study. Neighborhood distress types include all tax-delinquent, tax-foreclosed, mortgage-foreclosed and vacant structures as well as vacant lots that were included in the pooled hedonic price function from Part 1 (See Appendix 2 for details).

2. Ratios for each distress type were calculated at the Census Block level using the total number of residential structures in each Census Block in 3rd quarter, 2009 as a denominator and counts of unique distress types as the numerator.

    a. Vacant lots were divided by the total number of residential structures summed with the total number of vacant lots at the Census Block level to properly reflect the true ratio of vacant land within each Census Block.

3. The distance based disamenity variable coefficients from the pooled model in Part 1 (See Appendix 2) provide a good representation of the relative impact of unique distress types in neighborhood environments. The variation between these coefficients is used

to provide unique distress type weights for each distress type.

4. Unique distress type ratios from Step 2 were then multiplied by the distress type weights from Step 3, resulting in a distress score for each distress type in each Census Block.

5. The neighborhood distress index was then created for each Census Block by aggregating all individual distress scores in that Census Block.

In functional form, the 5-step neighborhood index process can be described as follows:

Distress Type Count/Residential structures = **Distress Type Ratio**

Distress Type Ratio * Distress Type Weight = **Distress Type Score**

Distress Type Score$_1$ + Distress Type Score$_2$…+ Distress Type Score$_x$ = **Distress Index**

The resulting neighborhood distress index was then assessed using the k-means clustering method (MacQueen, 1967) and ultimately split in to 3 tiers of distress. The tiers represent neighborhoods with high, medium and low levels of distress. The table in Appendix 9 focuses on key descriptive statistics of each distress tier in an attempt to provide a feel of the average Census Block in each. Generally speaking across the tiers, as the level of distress increases the number of Census Blocks and residential structures decreases while the demolition and mortgage foreclosure rates both increase.

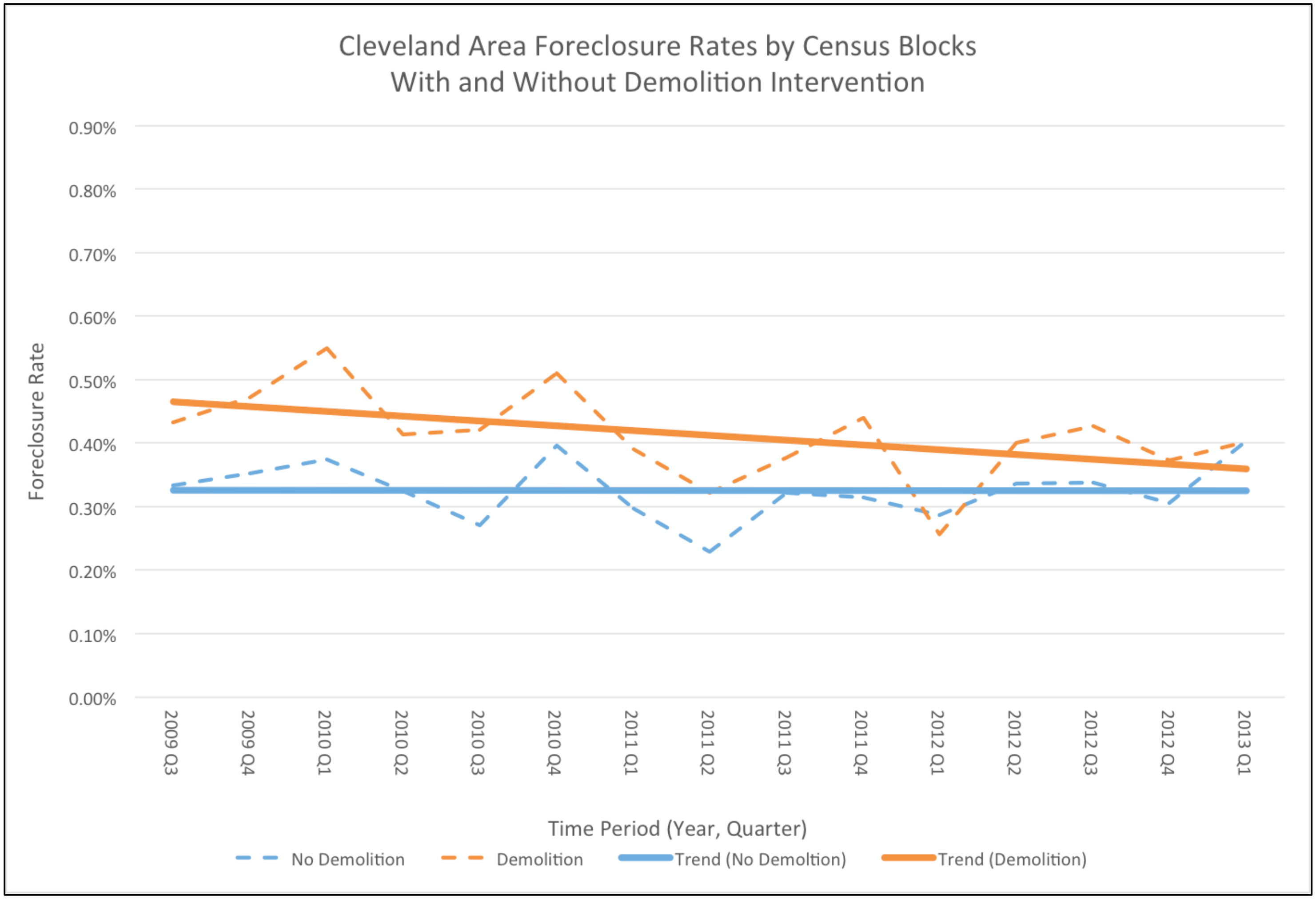
Estimation of Demolition Intervention Classifications

Census Blocks were divided into two groups after sensitivity analysis showed low variation in the level of intervention in any individual block that received demolition. The first group, or control group, is made up of Census Blocks in which no demolition was performed while the second group, or intervention group, received at least one demolition in the study period. Since there is likely a lag effect of removing a disamenity property through demolition, any Census Blocks that had a demolition performed within the last two quarters of the study period were not included in the intervention group and were instead included in the control group.

Analysis of Mortgage-Foreclosure Rates and Demolition Intervention Over Time

A dynamic mortgage foreclosure rate was estimated based on the number of mortgage foreclosures completed in a quarter and the total number of residential structures in a given quarter. Counts of residential structures for each quarter were adjusted for demolition or new build activity to make sure foreclosure rates for each quarter were accurate and not subject to bias. Trends of mortgage foreclosure were then graphed for the control and intervention groups in aggregate and by high, medium and low distress tiers. The results and interpretations are available in the results section below.

Aggregate Model

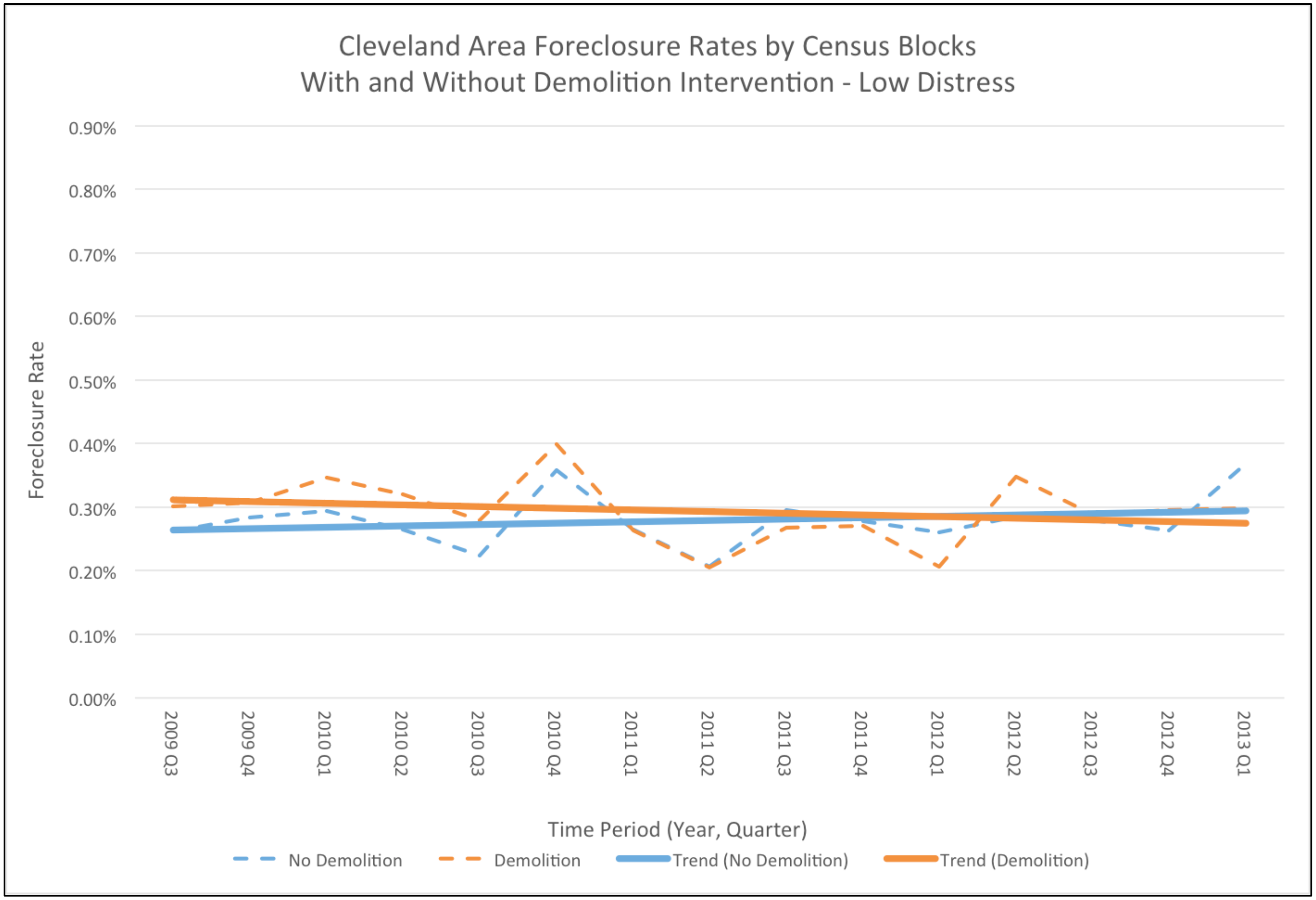


In the aggregate model, the graph represents a pooling of all census blocks across the entire study area that experienced mortgage foreclosure between 3rd quarter, 2009 – 1st quarter, 2013. The pooled census blocks are subdivided between those that received some level of demolition intervention (orange line) and those that did not receive any demolition intervention (blue line) over the time period. The quarterly mortgage foreclosure rates and associated trend lines within the two subdivisions are then graphed over time.

The aggregate model is provided to give a broad sense of the relationship between demolition activity and mortgage foreclosure rates over time in the entirety of the study area. Those Census Blocks that had mortgage foreclosure occurrences and did not receive any demolition activity show a flat trend line over the 3.5-year period, suggesting that mortgage foreclosure rates essentially stayed constant over time in these areas. Conversely, those Census Blocks that did receive demolition activity over the 3.5-year period show a clear decreasing trend in mortgage foreclosure rates over time. Although foreclosure rates in the aggregate tend to be lower in areas not receiving demolition activity, those receiving the demolition activity have a decreasing foreclosure rate trend, suggesting that the two lines will likely intersect over time.

Results suggest that the presence of demolition activity decreases the mortgage foreclosure rate over time more than in areas that did not receive demolition activity in the aggregate. Further, these findings suggest that demolition activity in a given area is likely to be a preventative measure of future mortgage foreclosure in that area.

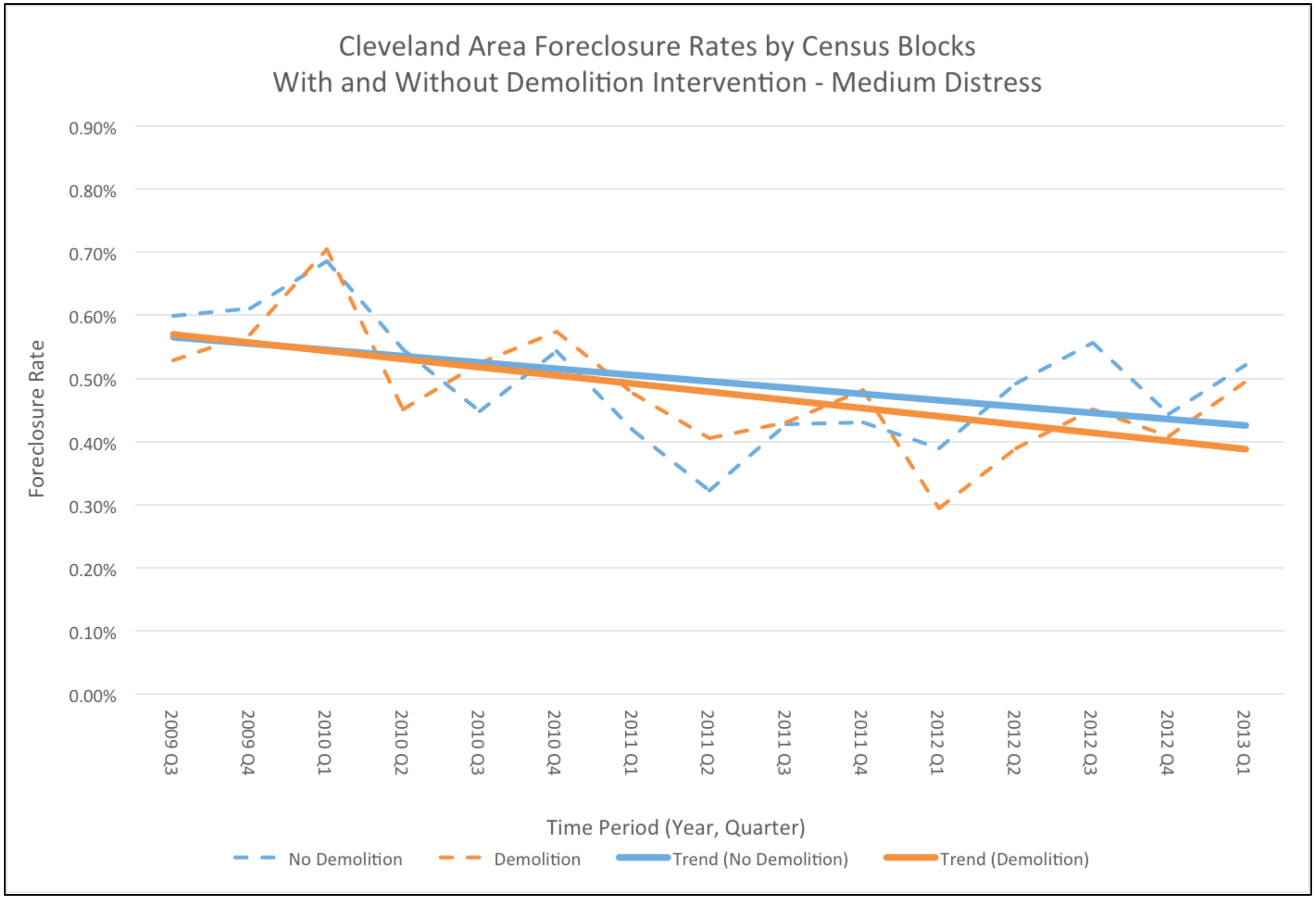
Low Distress Tier



In the low distress tier, the graph represents all non-contiguous Census Blocks across the study area that are considered low distress in the neighborhood distress index and experienced mortgage foreclosure between 3rd quarter, 2009 – 1st quarter, 2013. The low distress Census Blocks are subdivided between those that received some level of demolition intervention (orange line) and those that did not receive any demolition intervention (blue line) over the time period. The quarterly mortgage foreclosure rates and associated trend lines within the two subdivisions are then graphed over time.

Low distress Census Blocks that had mortgage foreclosure but did not receive any demolition activity show an increasing trend in line over the 3.5-year period. Conversely, those low distress Census Blocks that did receive demolition activity over the 3.5-year period show a clear decreasing trend in mortgage foreclosure rates over time. Visual analyses of the graphs show the two trend lines intersecting over the study time period. This phenomenon suggests that demolition activity in low distress areas results in a decrease in the rate of foreclosure while those without demolition may experience an increase in foreclosure. In other words, these findings suggest that demolition is a potential determinant in reversing increasing rates of mortgage foreclosure in low distress markets.

Moderate Distress Tier

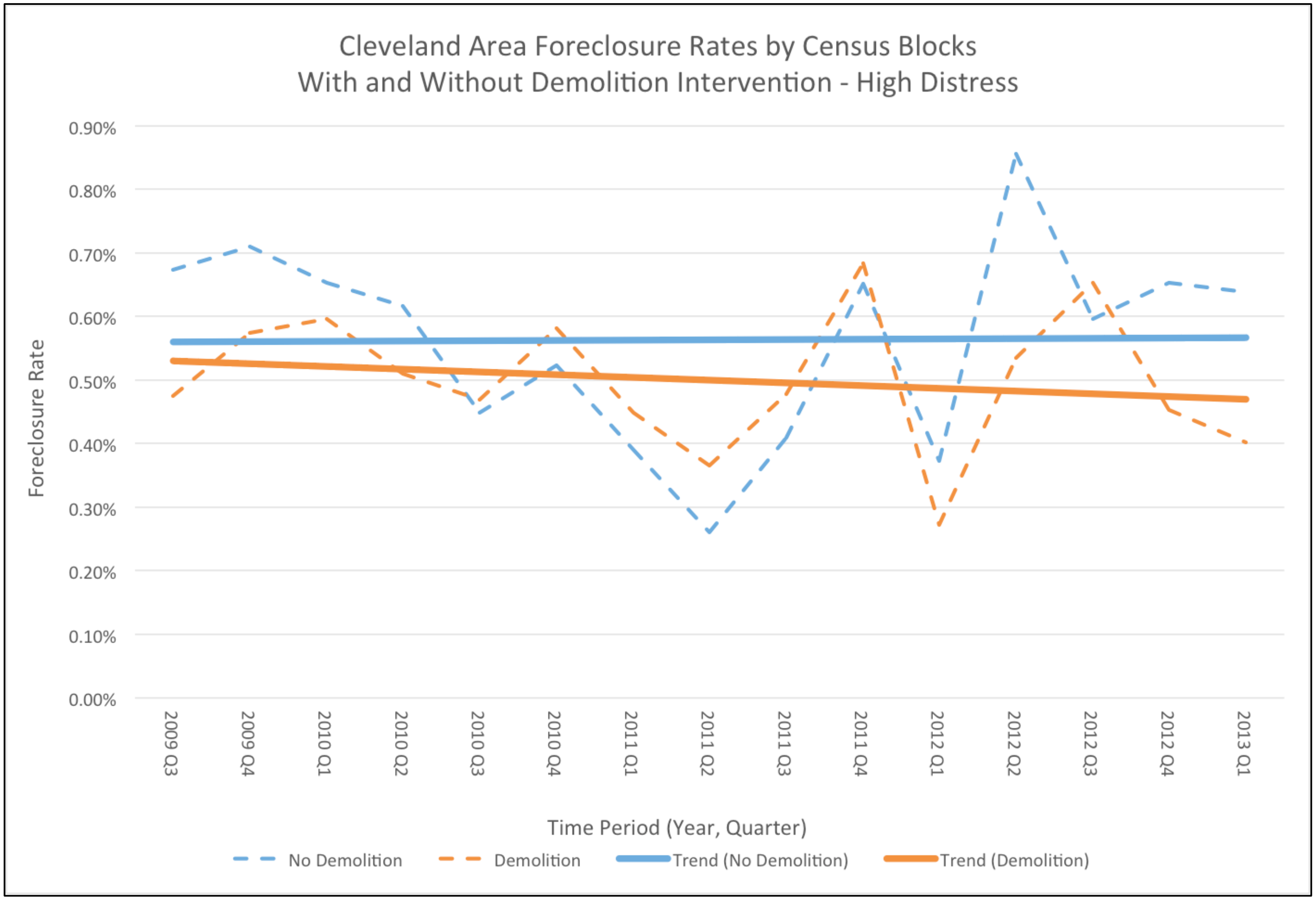


In the moderate distress tier, the graph represents all non-contiguous Census Blocks across the study area that are considered moderate distress in the neighborhood distress index and experienced mortgage foreclosure between 3rd quarter, 2009 – 1st quarter, 2013. The moderate distress Census Blocks are subdivided between those that received some level of demolition intervention (orange line) and those that did not receive any demolition intervention (blue line) over the time period. The quarterly mortgage foreclosure rates and associated trend lines within the two subdivisions are then graphed over time.

The comparative analysis between similar moderate distress neighborhoods that both did and did not receive demolition over the study time period allows insight into how effective demolition programs are at lowering mortgage foreclosure rates in middle-markets. As the graph above shows, the trends are largely moving together in a decreasing fashion. Although moderate distress Census Blocks that received demolition show a decreasing trend line that is lower than those that did not receive demolition, the actual mortgage foreclosure rates and trend lines are essentially tracking each other very closely.

In essence, these findings suggest that the presence of demolition activity in the moderate distress tier has roughly the same effect on the mortgage foreclosure rate over time as performing no demolition. This could be interpreted such that performing the necessary demolition in these markets is still wise, as it is shown that the demolition activity will not increase the mortgage foreclosure rate in those neighborhoods but on the contrary, will keep it moving at a decreasing rate. Further, the trend line is marginally lower in those areas that received demolition, suggesting increasing benefits from the diverging trend lines, and therefore lower mortgage foreclosure rates over time from demolition in the moderate distress tier.

High Distress Tier



In the high distress tier, the graph represents all non-contiguous Census Blocks across the study area that are considered high distress in the neighborhood distress index and experienced mortgage foreclosure between 3rd quarter, 2009 – 1st quarter, 2013. The high distress Census Blocks are subdivided between those that received some level of demolition intervention (orange line) and those that did not receive any demolition intervention (blue line) over the time period. The quarterly mortgage foreclosure rates and associated trend lines within the two subdivisions are then graphed over time.

The comparative analysis between similar high distress neighborhoods that both did and did not receive demolition over the study time period allows insight into how effective demolition programs are at lowering mortgage foreclosure rates in weak housing markets. High distress Census Blocks that did not receive any demolition activity show a flat trend line, suggesting that mortgage foreclosure rates had equal positive and negative volatility over the 3.5-year study period. Conversely, high distress Census Blocks that did receive demolition activity over the 3.5-year period show a decreasing trend in mortgage foreclosure rates over time. It is clear to see that significant volatility in mortgage foreclosure occurred in the high distress tier. With that said, those areas receiving demolition tended to have lower mortgage foreclosure rates during peaks and troughs of the volatility periods. In particular, mortgage foreclosure rates were lower in neighborhoods that experienced demolition at the end of the study's timeframe. In essence, results suggest that the presence of demolition activity over time in the high distress tier decreases mortgage foreclosure rates that would otherwise be higher and constant.

Another interesting finding in the high distress tier is that the mortgage foreclosure rate trend line in the no demolition subdivision is clearly higher than those receiving demolition. This is the only occurrence where areas receiving no demolition tend to have a higher ambient mortgage foreclosure rate across the board. This finding potentially adds to other findings throughout this report that point toward selective bank foreclosure activity in weaker market areas.

Summary of Findings

This pattern-based approach investigates the relationship between demolition and fluctuating mortgage foreclosure rates over time in varying types of distressed areas using a neighborhood distress index. The relationships are graphically presented by comparing mortgage foreclosure trends over time in neighborhoods that both did and did not receive demolition intervention, and then offers comparative visual analysis of the findings. The analysis provides consistent evidence that it can reasonably be implied that demolition activity is associated with decreasing mortgage foreclosure rates over time in all neighborhood distress types.

The neighborhood distress index was designed to control for differing types of neighborhoods, and appears to have done so effectively. Although results showed consistent positive benefits from demolition activity, the benefits received in low, medium and high distress areas differed. In contrast with results in Part 1, findings suggest that benefits in terms of decreasing mortgage foreclosure rates are greater in high distress areas as opposed to those experiencing low levels of distress. That said, taken together with the positive home equity returns that are hedged from demolition activity in strong markets, as laid out in Part 1, a double-bottom line of benefits is suggested to be available from demolition through the additional benefit of lower mortgage foreclosure rates in relevant stronger market areas.

Given that evidence is consistently shown that demolition decreases mortgage foreclosure rates over time across the study area, and the dynamics of demolition are taken into account within these calculations, findings in this analysis suggest that demolition activity is a preventative measure of future mortgage foreclosure.[12]

[12] The primary caveat to the analysis in Part 2 is that it is pattern-based and the relationships are visually identified through their correlative differences. In other words, the differences between foreclosure rates in areas which did and did not receive demolition are defined by controlling for similar neighborhoods and then placing rates on a graph and observing whether the respective trends appear differently to the eye of the observer. A cause-and-effect relationship may be reasonably implied but is not proven. Future research will focus on a more in depth analysis of the slopes of the individual trends and tests for structural differences in the comparative.

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Appendices

Appendix 1: Variable Descriptions Used in Regression Analysis

Variable	Description of Variable
Dependent Variable	
Price	Sales Price of Single-Family Residential Home
Distressed Property Count Variables	
OD_500	# single and multiple-unit residential properties within 500 feet that were >40% delinquent on their taxes during the quarter of sale.
ODPV_500	# single and multiple-unit residential properties within 500 feet that were >40% delinquent on their taxes AND at least 90 days vacant in the USPS vacancy data during the quarter of sale.
OPV_500	# single and multiple-unit residential properties that were within 500 feet that were at least 90 days vacant in the USPS vacancy data during the quarter of sale.
OF_500	# single and multiple-unit residential properties that were within 500 feet and had a filing, were in process or completed a mortgage-foreclosure during the quarter of sale.
OFD_500	# single and multiple-unit residential properties that were within 500 feet and had a filing, were in process or completed a mortgage-foreclosure AND were >40% delinquent on their taxes during the quarter of sale.
OFPV_500	# single and multiple-unit residential properties that were within 500 feet and had a filing, were in process or completed a mortgage-foreclosure AND were at least 90 days vacant in the USPS vacancy data during the quarter of sale.
OFDPV_500	# single and multiple-unit residential properties that were within 500 feet and had a filing, were in process or completed a mortgage-foreclosure AND were at least 90 days vacant in the USPS vacancy data AND were >40% delinquent on their taxes during the quarter of sale.
OT_500MERG	# single and multiple-unit residential properties that were within 500 feet of property sold and also had a filing, were in process or completion of a tax-foreclosure OR had a filing, were in process or completion of a tax-foreclosure AND were >40% tax-delinquent during the quarter of sale.
OTPV_500ME	# single and multiple-unit residential properties that were within 500 feet of property sold and also had a filing, were in process or completion of a tax-foreclosure AND were at least 90 days vacant in the USPS vacancy data OR had a filing, were in process or completion of a tax-foreclosure AND were >40% tax-delinquent AND were at least 90 days vacant in the USPS vacancy data during the quarter of sale.
RVL_500	# residential vacant lots within 500 feet of property sold.
Key Categorical Variables	
EXITREOCOMBO	= 1 if sold out of REO; 0 otherwise.
LW_DEED	= 1 if sold as Limited Warranty Deed; 0 otherwise.
QC_DEED	= 1 if sold as Quit Claim Deed; 0 otherwise.
OD	= 1 if sold as >40% tax-delinquent; 0 otherwise.
ODPV	= 1 if sold as >40% tax-delinquent AND >90 days USPS vacant; 0 otherwise.
OPV	= 1 if sold as >90 days USPS vacant; 0 otherwise.
OF_MERGE	= 1 if sold as filed/processing mortgage-foreclosure OR filed/processing mortgage-foreclosure AND >40% tax-delinquent; 0 otherwise.
OFPV_MERGE	= 1 if sold as filed/processing mortgage-foreclosure AND >90 days USPS vacant OR filed/processing mortgage-foreclosure AND >40% tax-delinquent

	AND >90 days USPS vacant; 0 otherwise.

Description of All Variables Used for Regression Analysis	
Variable	**Description of Variable**
Structure Variables	
AGE	# years since construction of the home during the time period of sale.
BATHCOMBO	Aggregate # of full and half baths in the home.
FIREPL	# of fireplaces in the home.
LIV1	Square footage of home divided by 1,000.
LOTSIZE	Square footage of lot that the home is on divided by 1,000
Other Categorical Variables	
AC	= 1 if home has air conditioning; 0 otherwise.
BASEMNT	= 1 if home has finished basement; 0 otherwise.
PORCH	= 1 of home has porch space; 0 otherwise
TERRAD	= 1 if home has terrace space; 0 otherwise.
TOTATTIC	= 1 if home has attic space; 0 otherwise
RS093*	= 1 if sold in 2009, 3rd Quarter; 0 otherwise.
RS094	= 1 if sold in 2009, 4th Quarter; 0 otherwise.
RS101	= 1 if sold in 2010, 1st Quarter; 0 otherwise.
RS102	= 1 if sold in 2010, 2nd Quarter; 0 otherwise.
RS103	= 1 if sold in 2010, 3rd Quarter; 0 otherwise.
RS104	= 1 if sold in 2010, 4th Quarter; 0 otherwise.
RS111	= 1 if sold in 2011, 1st Quarter; 0 otherwise.
RS112	= 1 if sold in 2011, 2nd Quarter; 0 otherwise.
RS113	= 1 if sold in 2011, 3rd Quarter; 0 otherwise.
RS114	= 1 if sold in 2011, 4th Quarter; 0 otherwise.
RS121	= 1 if sold in 2012, 1st Quarter; 0 otherwise.
RS122	= 1 if sold in 2012, 2nd Quarter; 0 otherwise.
RS123	= 1 if sold in 2012, 3rd Quarter; 0 otherwise.
RS124	= 1 if sold in 2012, 4th Quarter; 0 otherwise.
RS131	= 1 if sold in 2013, 1st Quarter; 0 otherwise.
SUMRANK1**	= 1 if sold in Submarket 1; 0 otherwise. (pooled model only)
SUMRANK2	= 1 if sold in Submarket 2; 0 otherwise. (pooled model only)
SUMRANK3	= 1 if sold in Submarket 3; 0 otherwise. (pooled model only)
SUMRANK4	= 1 if sold in Submarket 4; 0 otherwise. (pooled models only)

*RS093 is the indicator/reference variable in both models; **SUMRANK 1 is the indicator/reference variable in pooled model.

Appendix 2: Results of All Variables Used for Pooled Regression Model

Results of All Variables Used for Pooled Regression Analysis

Variable	Coefficient	Standard Error	Probability
CONSTANT	10.550	0.078	0.000
Key Distressed Property Variables			
OD_500	-0.028	0.002	0.000
ODPV_500	-0.010	0.004	0.017
OPV_500	-0.020	0.002	0.000
OF_500	-0.012	0.003	0.000
OFD_500	-0.041	0.016	0.011
OFPV_500	-0.014	0.010	0.158
OFDPV_500	-0.069	0.024	0.003
OT_500MERG	-0.036	0.020	0.074
OTPV_500ME	-0.048	0.023	0.037
RVL_500	-0.009	0.001	0.000
Key Categorical Variables			
EXITREOCOMBO	-0.649	0.020	0.000
LW_DEED	-0.200	0.020	0.000
QC_DEED	-0.882	0.040	0.000
OD	-0.226	0.049	0.000
ODPV	-0.708	0.060	0.000
OPV	-0.161	0.015	0.000
OF_MERGE	-0.222	0.028	0.000
OFPV_MERGE	-0.317	0.037	0.000
Structure Variables			
AGE	-0.006	0.000	0.000
BATHCOMBO	0.111	0.017	0.000
FIREPL	0.097	0.014	0.000
LIV1	0.420	0.028	0.000
LOTSIZE	0.002	0.001	0.024
Other Categorical Variables			
AC	0.106	0.013	0.000
BASEMNT	0.036	0.013	0.007
PORCH	0.024	0.013	0.078
TERRAD	0.112	0.014	0.000
TOTATTIC	0.114	0.017	0.000
Categorical Time Variables			
RS093*			
RS094	-0.015	0.044	0.742
RS101	-0.107	0.054	0.045
RS102	0.090	0.040	0.023
RS103	-0.045	0.043	0.296
RS104	-0.051	0.049	0.293

RS111	-0.116	0.053	0.028
RS112	-0.005	0.042	0.910
RS113	-0.084	0.044	0.058
RS114	-0.135	0.045	0.003
RS121	-0.119	0.043	0.006
RS122	-0.105	0.044	0.016
RS123	-0.166	0.043	0.000
RS124	-0.216	0.042	0.000
RS131	-0.238	0.046	0.000
Categorical Submarket Variables			
SUMRANK1**			
SUMRANK2	0.191	0.045	0.000
SUMRANK3	0.465	0.048	0.000
SUMRANK4	0.667	0.049	0.000

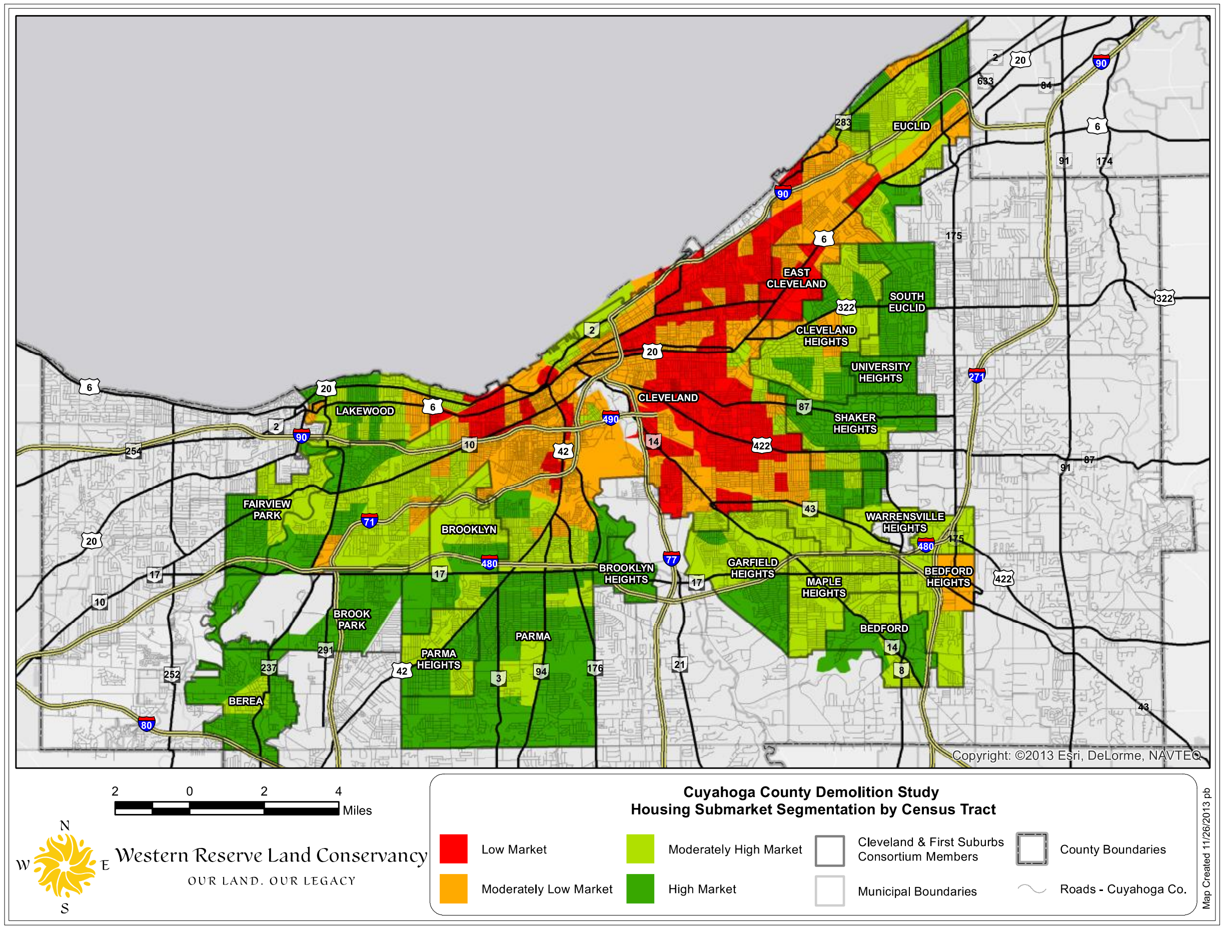
*RS093 is the indicator/reference variable in both models; **SUMRANK 1 is the indicator/reference variable in pooled model.

Appendix 3: Probabilities from Chow Test Diagnostics

Chow Test Diagnostics

Variable	Probability
GLOBAL TEST	0.000
CONSTANT	0.000
Key Distressed Property Variables	
OD_500	0.000
ODPV_500	0.000
OPV_500	0.000
OF_500	0.000
OFD_500	0.777
OFPV_500	0.568
OFDPV_500	0.578
OT_500MERG	0.016
OTPV_500ME	0.712
RVL_500	0.027
Key Categorical Variables	
EXITREOCOMBO	0.000
LW_DEED	0.647
QC_DEED	0.199
OD	0.626
ODPV	0.008
OPV	0.000
OF_MERGE	0.039
OFPV_MERGE	0.055
Structure Variables	
AGE	0.018
BATHCOMBO	0.500
FIREPL	0.519
LIV1	0.026
LOTSIZE	0.677
Other Categorical Variables	
AC	0.000
BASEMNT	0.494
PORCH	0.350
TERRAD	0.016
TOTATTIC	0.030
Categorical Time Variables	
RS094	0.662
RS101	0.530
RS102	0.214
RS103	0.057
RS104	0.021
RS111	0.681
RS112	0.000
RS113	0.002
RS114	0.005
RS121	0.000
RS122	0.000
RS123	0.000
RS124	0.000
RS131	0.000

Appendix 4: Map of Study Area With Census Tract Submarkets



Appendix 5: Regression Results of All Variables Used for Submarket Model

Regression Results of All Variables Used for Submarket Regimes Regression Analysis

Submarket 1 - Extremely Weak Functioning Market

Variable	Coefficient	Standard Error	Probability
1_CONSTANT	9.778	0.224	0.000
Key Distressed Property Variables			
1_OD_500	-0.016	0.005	0.001
1_ODPV_500	-0.028	0.006	0.000
1_OPV_500	0.009	0.007	0.200
1_OF_500	0.041	0.013	0.002
1_OFD_500	0.006	0.041	0.877
1_OFPV_500	-0.017	0.048	0.721
1_OFDPV_500	-0.070	0.041	0.088
1_OT_500MERG	0.013	0.033	0.691
1_OTPV_500ME	-0.031	0.036	0.393
1_RVL_500	-0.003	0.002	0.271
Key Categorical Variables			
1_EXITREOCOMBO	-0.781	0.080	0.000
1_LW_DEED	-0.197	0.072	0.006
1_QC_DEED	-0.904	0.079	0.000
1_OD	-0.220	0.118	0.061
1_ODPV	-0.813	0.119	0.000
1_OPV	-0.360	0.069	0.000
1_OF_MERGE	-0.065	0.164	0.691
1_OFPV_MERGE	-0.550	0.170	0.001
Structure Variables			
1_AGE	-0.006	0.001	0.000
1_BATHCOMBO	0.131	0.067	0.050
1_FIREPL	0.124	0.086	0.151
1_LIV1	0.389	0.082	0.000
1_LOTSIZE	0.000	0.007	0.970
Other Categorical Variables			
1_AC	0.494	0.120	0.000
1_BASEMNT	0.101	0.131	0.440
1_PORCH	-0.112	0.085	0.189
1_TERRAD	0.043	0.127	0.736
1_TOTATTIC	-0.057	0.067	0.391
Categorical Time Variables			
1_RS093*			
1_RS094	0.118	0.179	0.511
1_RS101	-0.146	0.228	0.522
1_RS102	0.386	0.168	0.022
1_RS103	0.370	0.163	0.023

1_RS104	0.433	0.185	0.019
1_RS111	0.111	0.189	0.559
1_RS112	0.796	0.155	0.000
1_RS113	0.612	0.189	0.001
1_RS114	0.335	0.173	0.052
1_RS121	0.595	0.168	0.000
1_RS122	0.569	0.182	0.002
1_RS123	0.631	0.160	0.000
1_RS124	0.352	0.157	0.025
1_RS131	0.535	0.165	0.001

Submarket 2 - Weak Functioning Market

Variable	Coefficient	Standard Error	Probability
2_CONSTANT	10.227	0.196	0.000
Key Distressed Property Variables			
2_OD_500	-0.036	0.004	0.000
2_ODPV_500	-0.003	0.006	0.612
2_OPV_500	-0.003	0.006	0.654
2_OF_500	0.024	0.009	0.012
2_OFD_500	-0.037	0.037	0.317
2_OFPV_500	-0.030	0.029	0.301
2_OFDPV_500	-0.004	0.045	0.925
2_OT_500MERG	-0.058	0.040	0.151
2_OTPV_500ME	-0.053	0.045	0.232
2_RVL_500	-0.012	0.003	0.000
Key Categorical Variables			
2_EXITREOCOMBO	-0.678	0.053	0.000
2_LW_DEED	-0.148	0.056	0.008
2_QC_DEED	-0.821	0.077	0.000
2_OD	-0.168	0.101	0.095
2_ODPV	-0.793	0.132	0.000
2_OPV	-0.225	0.054	0.000
2_OF_MERGE	-0.206	0.084	0.014
2_OFPV_MERGE	-0.475	0.113	0.000
Structure Variables			
2_AGE	-0.004	0.001	0.000
2_BATHCOMBO	0.152	0.059	0.010
2_FIREPL	0.035	0.057	0.535
2_LIV1	0.451	0.111	0.000
2_LOTSIZE	0.008	0.008	0.352
Other Categorical Variables			
2_AC	0.299	0.074	0.000
2_BASEMNT	0.109	0.091	0.234
2_PORCH	0.005	0.061	0.941
2_TERRAD	0.248	0.079	0.002

2_TOTATTIC	0.131	0.045	0.003
Categorical Time Variables			
2_RS093*			
2_RS094	0.049	0.138	0.720
2_RS101	-0.232	0.131	0.077
2_RS102	0.116	0.132	0.376
2_RS103	-0.124	0.123	0.311
2_RS104	-0.190	0.156	0.225
2_RS111	-0.101	0.129	0.435
2_RS112	-0.017	0.135	0.898
2_RS113	-0.071	0.128	0.581
2_RS114	0.049	0.127	0.698
2_RS121	0.096	0.124	0.441
2_RS122	0.217	0.118	0.066
2_RS123	0.005	0.132	0.970
2_RS124	0.048	0.129	0.711
2_RS131	-0.061	0.121	0.613

Submarket 3 - Moderately Functioning Market

Variable	Coefficient	Standard Error	Probability
3_CONSTANT	11.050	0.078	0.000
Key Distressed Property Variables			
3_OD_500	-0.040	0.004	0.000
3_ODPV_500	-0.051	0.008	0.000
3_OPV_500	-0.022	0.003	0.000
3_OF_500	-0.016	0.004	0.000
3_OFD_500	-0.042	0.022	0.051
3_OFPV_500	0.005	0.010	0.589
3_OFDPV_500	-0.086	0.041	0.037
3_OT_500MERG	-0.052	0.032	0.107
3_OTPV_500ME	-0.065	0.040	0.105
3_RVL_500	-0.010	0.002	0.000
Key Categorical Variables			
3_EXITREOCOMBO	-0.676	0.029	0.000
3_LW_DEED	-0.190	0.030	0.000
3_QC_DEED	-0.899	0.072	0.000
3_OD	-0.277	0.077	0.000
3_ODPV	-0.590	0.089	0.000
3_OPV	-0.134	0.020	0.000
3_OF_MERGE	-0.153	0.033	0.000
3_OFPV_MERGE	-0.216	0.046	0.000
Structure Variables			
3_AGE	-0.006	0.001	0.000
3_BATHCOMBO	0.096	0.024	0.000
3_FIREPL	0.110	0.023	0.000

3_LIV1	0.494	0.035	0.000
3_LOTSIZE	0.002	0.002	0.317
Other Categorical Variables			
3_AC	0.105	0.018	0.000
3_BASEMNT	0.055	0.022	0.012
3_PORCH	0.001	0.020	0.948
3_TERRAD	0.132	0.023	0.000
3_TOTATTIC	0.154	0.023	0.000
Categorical Time Variables			
3_RS093*			
3_RS094	-0.036	0.057	0.531
3_RS101	-0.064	0.064	0.315
3_RS102	0.078	0.054	0.150
3_RS103	-0.047	0.053	0.381
3_RS104	-0.097	0.056	0.086
3_RS111	-0.123	0.074	0.095
3_RS112	-0.029	0.053	0.587
3_RS113	-0.150	0.057	0.008
3_RS114	-0.162	0.060	0.007
3_RS121	-0.146	0.060	0.015
3_RS122	-0.183	0.056	0.001
3_RS123	-0.272	0.056	0.000
3_RS124	-0.294	0.059	0.000
3_RS131	-0.317	0.064	0.000
Submarket 4 - High Functioning Market			
Variable	**Coefficient**	**Standard Error**	**Probability**
4_CONSTANT	11.317	0.052	0.000
Key Distressed Property Variables			
4_OD_500	-0.038	0.005	0.000
4_ODPV_500	-0.086	0.014	0.000
4_OPV_500	-0.026	0.003	0.000
4_OF_500	-0.026	0.004	0.000
4_OFD_500	-0.030	0.027	0.268
4_OFPV_500	-0.009	0.010	0.348
4_OFDPV_500	-0.060	0.040	0.130
4_OT_500MERG	-0.201	0.058	0.000
4_OTPV_500ME	-0.108	0.057	0.057
4_RVL_500	-0.010	0.002	0.000
Key Categorical Variables			
4_EXITREOCOMBO	-0.544	0.026	0.000
4_LW_DEED	-0.223	0.028	0.000
4_QC_DEED	-0.666	0.097	0.000
4_OD	-0.322	0.073	0.000
4_ODPV	-0.381	0.086	0.000

4_OPV	-0.083	0.017	0.000
4_OF_MERGE	-0.280	0.032	0.000
4_OFPV_MERGE	-0.235	0.040	0.000
Structure Variables			
4_AGE	-0.003	0.001	0.000
4_BATHCOMBO	0.074	0.018	0.000
4_FIREPL	0.079	0.013	0.000
4_LIV1	0.368	0.025	0.000
4_LOTSIZE	0.000	0.001	0.774
Other Categorical Variables			
4_AC	0.049	0.013	0.000
4_BASEMNT	0.023	0.014	0.096
4_PORCH	0.025	0.013	0.059
4_TERRAD	0.065	0.015	0.000
4_TOTATTIC	0.134	0.020	0.000
Categorical Time Variables			
4_RS093*			
4_RS094	-0.072	0.044	0.101
4_RS101	-0.036	0.038	0.331
4_RS102	0.034	0.034	0.321
4_RS103	-0.075	0.042	0.072
4_RS104	-0.095	0.047	0.042
4_RS111	-0.128	0.047	0.007
4_RS112	-0.106	0.044	0.016
4_RS113	-0.133	0.040	0.001
4_RS114	-0.237	0.047	0.000
4_RS121	-0.223	0.044	0.000
4_RS122	-0.243	0.046	0.000
4_RS123	-0.246	0.045	0.000
4_RS124	-0.293	0.043	0.000
4_RS131	-0.254	0.049	0.000

Appendix 6: Equity Hedge Values By Distress Type – Submarket Regimes and Pooled Model

See next page.

Models	***Status of Neighborhood Distress***					***Coef.***	***Equity Hedge***
Submarket 4, Model 1 Measuring Distress from 0-500 Feet R-Squared = 0.5646	Vacant Lots					-0.010***	N/A
		Postal Vacant				-0.026***	1.6% hedge
			Mortgage-foreclosed			-0.026***	1.6% hedge
			Mortgage-foreclosed	Tax-delinquent		-0.030	N/A
		Postal Vacant	Mortgage-foreclosed			-0.009	N/A
		Postal Vacant	Mortgage-foreclosed	Tax-delinquent		-0.060	N/A
					Tax-foreclosed	-0.201***	19.1% hedge
		Postal Vacant			Tax-foreclosed	-0.108+	9.8% hedge
				Tax-delinquent		-0.038***	2.8% hedge
		Postal Vacant		Tax-delinquent		-0.086***	7.6% hedge
Submarket 3 Model 1 Measuring Distress from 0-500 Feet R-Squared = 0.5646	Vacant Lots					-0.010***	N/A
		Postal Vacant				-0.022***	1.2% hedge
			Mortgage-foreclosed			-0.016***	0.6% hedge
			Mortgage-foreclosed	Tax-delinquent		-0.042*	3.2% hedge
		Postal Vacant	Mortgage-foreclosed			0.005	N/A
		Postal Vacant	Mortgage-foreclosed	Tax-delinquent		-0.086*	7.6% hedge
					Tax-foreclosed	-0.052+	4.2% hedge
		Postal Vacant			Tax-foreclosed	-0.065+	5.5% hedge
				Tax-delinquent		-0.040***	3.0% hedge
		Postal Vacant		Tax-delinquent		-0.051***	4.1% hedge
Submarket 2, Model 1 Measuring Distress from 0-500 Feet R-Squared = 0.5646	Vacant Lots					-0.012***	N/A
		Postal Vacant				-0.003	N/A
			Mortgage-foreclosed			0.024*	-3.6% hedge
			Mortgage-foreclosed	Tax-delinquent		-0.037	N/A
		Postal Vacant	Mortgage-foreclosed			-0.030	N/A
		Postal Vacant	Mortgage-foreclosed	Tax-delinquent		-0.004	N/A
					Tax-foreclosed	-0.058	N/A
		Postal Vacant			Tax-foreclosed	-0.053	N/A
				Tax-delinquent		-0.036***	2.4% hedge
		Postal Vacant		Tax-delinquent		-0.003	N/A
Submarket 1, Model 1 Measuring Distress from 0-500 Feet R-Squared = 0.5646	Vacant Lots					-0.003	N/A
		Postal Vacant				0.009	N/A
			Mortgage-foreclosed			0.041**	-4.1% hedge
			Mortgage-foreclosed	Tax-delinquent		0.006	N/A
		Postal Vacant	Mortgage-foreclosed			-0.017	N/A
		Postal Vacant	Mortgage-foreclosed	Tax-delinquent		-0.070+	7.0% hedge
					Tax-foreclosed	0.013	N/A
		Postal Vacant			Tax-foreclosed	-0.031	N/A
				Tax-delinquent		-0.016***	1.6% hedge
		Postal Vacant		Tax-delinquent		-0.028***	2.8% hedge
Aggregate Model 1 Measuring Distress from 0-500 Feet R-Squared = 0.5429	Vacant Lots					-0.009***	N/A
		Postal Vacant				-0.020***	1.1% hedge
			Mortgage-foreclosed			-0.012***	0.3% hedge
			Mortgage-foreclosed	Tax-delinquent		-0.041*	3.2% hedge
		Postal Vacant	Mortgage-foreclosed			-0.014	N/A
		Postal Vacant	Mortgage-foreclosed	Tax-delinquent		-0.069**	6.0% hedge
					Tax-foreclosed	-0.036+	2.7% hedge
		Postal Vacant			Tax-foreclosed	-0.048*	3.9% hedge
				Tax-delinquent		-0.028***	1.9% hedge
		Postal Vacant		Tax-delinquent		-0.010*	0.1% hedge

Coefficient Significance Key: + for p<.1, * for p<.05, ** for p<.01, and *** for p<.001.

Appendix 7: Comparative Table of Coefficients and Level of Significance Across 4 Submarket Regimes

Coefficient Significance Key: lightest green for p<.1, semi-light green for p<.05, semi-dark green for p<.01, and dark green for p<.001.

	Submarket 1 - Extremely Weak Functioning Market		Submarket 2 - Weak Functioning Market		Submarket 3 - Moderately Functioning Market		Submarket 4 - High Functioning Market	
Variable	**Coefficient**	**Probability**	**Coefficient**	**Probability**	**Coefficient**	**Probability**	**Coefficient**	**Probability**
CONSTANT	9.778	0.000	10.227	0.000	11.050	0.000	11.317	0.000
Key Distressed Property Variables								
OD_500	-0.016	0.001	-0.036	0.000	-0.040	0.000	-0.038	0.000
ODPV_500	-0.028	0.000	-0.003	0.612	-0.051	0.000	-0.086	0.000
OPV_500	0.009	0.200	-0.003	0.654	-0.022	0.000	-0.026	0.000
OF_500	0.041	0.002	0.024	0.012	-0.016	0.000	-0.026	0.000
OFD_500	0.006	0.877	-0.037	0.317	-0.042	0.051	-0.030	0.268
OFPV_500	-0.017	0.721	-0.030	0.301	0.005	0.589	-0.009	0.348
OFDPV_500	-0.070	0.088	-0.004	0.925	-0.086	0.037	-0.060	0.130
OT_500MERG	0.013	0.691	-0.058	0.151	-0.052	0.107	-0.201	0.000
OTPV_500ME	-0.031	0.393	-0.053	0.232	-0.065	0.105	-0.108	0.057
RVL_500	-0.003	0.271	-0.012	0.000	-0.010	0.000	-0.010	0.000
Key Categorical Variables								
EXITREOCOMBO	-0.781	0.000	-0.678	0.000	-0.676	0.000	-0.544	0.000
LW_DEED	-0.197	0.006	-0.148	0.008	-0.190	0.000	-0.223	0.000
QC_DEED	-0.904	0.000	-0.821	0.000	-0.899	0.000	-0.666	0.000
OD	-0.220	0.061	-0.168	0.095	-0.277	0.000	-0.322	0.000
ODPV	-0.813	0.000	-0.793	0.000	-0.590	0.000	-0.381	0.000
OPV	-0.360	0.000	-0.225	0.000	-0.134	0.000	-0.083	0.000
OF_MERGE	-0.065	0.691	-0.206	0.014	-0.153	0.000	-0.280	0.000

OFPV_MERGE	-0.550	0.001	-0.475	0.000	-0.216	0.000	-0.235	0.000
	Submarket 1 - Extremely Weak Functioning Market		**Submarket 2 - Weak Functioning Market**		**Submarket 3 - Moderately Functioning Market**		**Submarket 4 - High Functioning Market**	
Structure Variables								
AGE	-0.006	0.000	-0.004	0.000	-0.006	0.000	-0.003	0.000
BATHCOMBO	0.131	0.050	0.152	0.010	0.096	0.000	0.074	0.000
FIREPL	0.124	0.151	0.035	0.535	0.110	0.000	0.079	0.000
LIV1	0.389	0.000	0.451	0.000	0.494	0.000	0.368	0.000
LOTSIZE	0.000	0.970	0.008	0.352	0.002	0.317	0.000	0.774
Other Categorical Variables								
AC	0.494	0.000	0.299	0.000	0.105	0.000	0.049	0.000
BASEMNT	0.101	0.440	0.109	0.234	0.055	0.012	0.023	0.096
PORCH	-0.112	0.189	0.005	0.941	0.001	0.948	0.025	0.059
TERRAD	0.043	0.736	0.248	0.002	0.132	0.000	0.065	0.000
TOTATTIC	-0.057	0.391	0.131	0.003	0.154	0.000	0.134	0.000
Categorical Time Variables								
RS093*								
RS094	0.118	0.511	0.049	0.720	-0.036	0.531	-0.072	0.101
RS101	-0.146	0.522	-0.232	0.077	-0.064	0.315	-0.036	0.331
RS102	0.386	0.022	0.116	0.376	0.078	0.150	0.034	0.321
RS103	0.370	0.023	-0.124	0.311	-0.047	0.381	-0.075	0.072
RS104	0.433	0.019	-0.190	0.225	-0.097	0.086	-0.095	0.042
RS111	0.111	0.559	-0.101	0.435	-0.123	0.095	-0.128	0.007
RS112	0.796	0.000	-0.017	0.898	-0.029	0.587	-0.106	0.016
RS113	0.612	0.001	-0.071	0.581	-0.150	0.008	-0.133	0.001
RS114	0.335	0.052	0.049	0.698	-0.162	0.007	-0.237	0.000
RS121	0.595	0.000	0.096	0.441	-0.146	0.015	-0.223	0.000
RS122	0.569	0.002	0.217	0.066	-0.183	0.001	-0.243	0.000
RS123	0.631	0.000	0.005	0.970	-0.272	0.000	-0.246	0.000
RS124	0.352	0.025	0.048	0.711	-0.294	0.000	-0.293	0.000

RS131	0.535	0.001	-0.061	0.613	-0.317	0.000	-0.254	0.000

Appendix 8: Welfare Estimates of Demolition Activity With 95% Confidence Intervals

Original

Submarket	Real Value	Counter Value	Real Average	counter average	Change
Extremely Weak	$449,681,748	$447,461,499	$21,256	$21,151	$2,220,249
Weak	$765,967,831	$772,962,608	$25,216	$25,446	-$6,994,777
Moderately Functioning	$4,629,627,181	$4,591,318,432	$57,095	$56,623	$38,308,749
High Functioning	$8,428,386,047	$8,383,002,033	$91,420	$90,928	$45,384,014
				Total	**$78,918,234**

95% Plus

Submarket	Real Value	Counter Value	Real Average	counter average	Change
Extremely Weak	$6,823,164,596	$8,458,150,756	$322,517	$399,799	-$1,634,986,161
Weak	$6,274,654,641	$6,785,584,392	$206,566	$223,386	-$510,929,751
Moderately Functioning	$10,458,673,823	$10,426,855,204	$128,982	$128,590	$31,818,619
High Functioning	$14,803,442,624	$14,757,403,754	$160,568	$160,069	$46,038,870
				Total	**-$2,068,058,423**

95% Minus

Submarket	Real Value	Counter Value	Real Average	counter average	Change
Extremely Weak	$39,438,224	$34,697,277	$1,864	$1,640	$4,740,947
Weak	$118,188,238	$113,834,024	$3,891	$3,747	$4,354,214
Moderately Functioning	$2,119,412,517	$2,092,730,513	$26,138	$25,809	$26,682,004
High Functioning	$4,891,862,616	$4,856,008,064	$53,061	$52,672	$35,854,552
				Total	**$71,631,718**

Appendix 9: Census Block Descriptive Stats from Neighborhood Distress Index

Distress Level	Group	Total Number of Census Blocks	Total Number of Residential Structures Q3 2009	Average Number of Residential Structures per Census Block Q3 2009	Total Number of Demolitions	Average Number of Demolitions Per Census Block	Demolition Rate	Mortgage Foreclosure Rate over Study Period (Q3 2009 Q1 2013)
Low	Total	3,984	200,369	50.3	609	0.15	0.30%	4.22%
	Control (No Demolition)	3,305	169,458	48.5	N/A	N/A	N/A	4.20%
	Intervention (Demolition)	679	30,911	63.3	609	1.25	1.97%	4.37%
Medium	Total	2,004	74,084	37.0	1,758	0.88	2.37%	7.25%
	Control (No Demolition)	979	38,506	33.5	N/A	N/A	N/A	7.47%
	Intervention (Demolition)	1,025	35,578	41.7	1,758	2.06	4.94%	7.02%
High	Total	706	21,319	30.2	1,178	1.67	5.53%	7.52%
	Control (No Demolition)	210	5,349	22.1	N/A	N/A	N/A	8.47%
	Intervention (Demolition)	496	15,970	34.4	1,178	2.54	7.38%	7.20%
Aggregate	***Total***	***6,694***	***295,772***	***44.2***	***3,545***	***0.53***	***1.20%***	***5.22%***
	Control (No Demolition)	***4,494***	***213,313***	***43.6***	***N/A***	***N/A***	**N/A**	***4.90%***
	Intervention (Demolition)	***2,200***	***82,459***	***45.7***	***3,545***	***1.96***	***4.30%***	***6.06%***

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