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Residential Vacancy and Crime in the Wake of Housing Crisis in Chicago

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**Residential Vacancy and Crime in the Wake of Housing Crisis in Chicago:
An Evaluation of the Micro Market Recovery Program**

A Dissertation

Presented in

Partial Fulfillment of the

Requirements for the Degree of

Doctor of Philosophy

By

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August, 2023

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Biography

The author was born in Elk Grove Village, Illinois on December 8, 1983. He graduated from James B. Conant High School in Hoffman Estates in 2002. He attended the University of Illinois at Urbana-Champaign where he earned his Bachelor of Science in Statistics and Psychology in 2006, and his Master of Science in Epidemiology in 2009. During his professional career, he has worked primarily as a quantitative researcher in industry, non-profit, government, and academic settings. The author currently resides in Chicago, Illinois, and his interests include attending concerts, reading, true crime, basketball, and spending time with his friends and eccentric dog Otis.

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Abstract

Trends of subprime and predatory mortgage lending were largely responsible for the housing crisis in the late 2000s. These circumstances resulted in a high concentration of home foreclosures, and subsequent vacant and abandoned housing, particularly affecting disadvantaged neighborhoods. There is evidence to suggest that neighborhood spaces characterized by blighted properties and other signs of physical disorder reduce collective efficacy and informal social control, leading to increases in crime. Despite US government efforts to support economic recovery following the housing crisis, interventions were largely not concentrated enough to match spatial patterns of foreclosure and vacancy, and as such, reductions of crime in these areas were not realized. Recent studies have indicated that governmental housing interventions that are holistic and precisely spatially targeted in areas with supportive infrastructure and investment may lead to significant reductions in neighborhood crime. As such, the current work was an evaluation of the Micro Market Recovery Program (MMRP), a housing initiative that began in Chicago in 2011. Using quarterly data (2018 – 2021) at the census block group level, this study examined the effect of the residential vacancy on violent and property crimes using fixed effects panel model designs. Though crime rates and residential vacancy rate showed similar decreasing trends during the study period, the effects of vacancy were found to not be significantly associated with crime rates using a fixed effects specification. After adjusting for an influx of new properties in the program in 2020, an increased vacancy rate was found to be associated with decreased crime rate ($\beta = -0.082$; $p = 0.009$), suggesting that a 10% increase in vacancy rate was associated

with a 0.8% decrease in property crime rate. These inverse study findings and future directions are discussed.

Keywords: housing foreclosure, housing vacancy, built environment, blight remediation, crime

**Residential Vacancy and Crime in the Aftermath of Foreclosure Crisis in Chicago:
An Evaluation of the Micro Market Recovery Program**

Chicago saw increases in crime and violence in 2020 and 2021, much like many other major metropolitan cities (King, 2021). From March 2020, the beginning of the COVID-19 Stay At Home Orders in Illinois, to early August 2020, Chicago experienced a 43% increase in the number of shooting victims when compared to the same period averaged over the previous three years (Abrams, 2021). Similar increases in shootings and other violent incidents were observed in New York, Philadelphia, and Los Angeles (Council on Criminal Justice, 2021). While these recent increases in crime may be partially attributed to the pandemic, crime and violence in Chicago have been a long-standing concern in the city, particularly among disadvantaged neighborhoods on the south and west sides.

In September 2020, the City of Chicago spotlighted 15 communities with the highest 3-year rates of “serious victimization” – all were located on the south and west sides of the city (City of Chicago, 2020). The public recognition of these long-term geographically disparate rates of violence coincided with the City unveiling a holistic multi-year violence reduction plan with a public health framework. Known as *Our City, Our Safety (OCOS)*, the plan was comprised of several “pillars,” including empowering and healing citizens; protecting and securing places; improving and advancing policing; affecting public policy; and planning and coordinating actionable strategy (City of Chicago, 2020). The emphasis of the “protecting and securing places” pillar was to help those communities most greatly affected by violence to reclaim their shared spaces, and support the development of infrastructure through stable housing, commerce, and other

opportunities (City of Chicago, 2022). As part of a 1-year evaluation of *OCOS*, the City used several survey indicators to estimate “place-based safety” in the city (Chicago Department of Public Health, 2023). The findings suggested experiential inequity, with Black and Latinx individuals reporting worse perceptions of safety, observed violence, and trust in government and law enforcement than White individuals (City of Chicago, 2022). In the face of these disparities, the City has invested millions of dollars into programs to improve neighborhood infrastructure and the physical environment, including \$186M to support small businesses, revitalize commercial corridors, and create local opportunities; \$16M to support the arts and culture; \$35.6M to improve local parks; \$87M to restore vacant lots; and \$241.4M to create and preserve safe and affordable housing (City of Chicago, 2022).

The recent commitment by the City to invest in disadvantaged neighborhoods, largely through revitalizing the physical space, is supported by tenets described in the environmental criminology field. As a discipline, environmental criminology largely shifts the focus of criminality away from the individual, instead focusing on spatial and temporal trends (e.g., yearly, seasonally, monthly) of crime in geographies (e.g., neighborhoods, administrative units, street segments) which ultimately may be useful in development, implementation, and evaluation of crime-based interventions (Andresen, 2020). As such, environmental criminology may be described using three fundamental principles: i) the immediate environment plays a dramatic role in shaping crime and criminal behavior, ii) crime, space, and time are non-randomly distributed, and iii) control and prevention of crime can be greatly influenced by understanding the criminogenic environment (Wortley & Townsend, 2016).

Though the earliest known examination of aggregated and spatial criminology is linked to French and English researchers (Andresen, 2020), sociologists from the University of Chicago (the “Chicago School”) were instrumental in laying the foundation for modern-day environmental criminology theory. Sociologists from the Chicago School borrowed the concept of ecology (i.e., the concept that individual organisms must be studied as part of a complicated whole) from the biological sciences, and applied it to human behavior and crime in Chicago (Wortley & Townsend, 2016). In 1916, Chicago School sociologist Ernest Burgess conducted what is believed to be the first large-scale study to describe delinquency in the US from a spatial perspective. In his study, Burgess (1916) highlighted macro-level processes as predictors for delinquency: poor housing conditions, poverty, and poor health conditions. Building upon the foundational work of Burgess and others, Chicago School sociologists Clifford Shaw and Henry McKay (1942) had two major contributions to spatially-oriented crime research in their study of juvenile delinquency in Chicago. Firstly, they used Burgess’ geographical conceptualization of concentric “zones,” characterized by various socioeconomic indicators, and described how interaction (i.e., migration patterns) between these areas could affect delinquency. The acknowledgment of these geographic interactions provided one of the earliest realizations of the concept of spatial dependency. Secondly, they embraced the integration of several secondary data sources into their work, now commonplace in modern social science research. Their study utilized court referrals, juvenile commitments, police contacts, and several other health and socioeconomic indicators. Over a four-decade span, the efforts of Shaw and McKay (1942) resulted in the mapping of nearly 25,000 youths’ households (Hart et al., 2020).

Despite spatially and temporally disparate and stable trends of crime and violence in Chicago, recent governmental investment efforts have, at the very least, demonstrated acknowledgment of a major social issue to the public. Additionally, and relevant to the current study, a key component of this spending has been steered towards efforts to improve the physical landscape of communities on the west and south sides of Chicago. Using the work of the Chicago School as a contextual backcloth, this study begins by reviewing the literature associated with the spatial dimension of crime. Specifically, the theoretical mechanisms underlying the crime-place connection are discussed, followed by empirical evidence from the extant literature, which suggests that community disinvestment, housing foreclosure/residential vacancy, and vacant lots facilitate increases in crime rates. Next, a rationale for the current study is provided, as well as an introduction to the Micro Market Recovery Program (MMRP), a multi-faceted housing intervention in Chicago's west and south sides, which began in 2011 and will be continuing indefinitely due to the aforementioned recent government funding. Then, guided by formulated hypotheses, the methodology used in the public safety evaluation of the MMRP is detailed, and finally, the results and a discussion of the evaluation are presented.

Literature Review

The current section begins by discussing the central environmental criminology theoretical mechanisms that describe the pathways between physical space and crime. Next, evidence is presented from empirical studies in the US that describe the association between crime and housing disinvestment, foreclosure/residential vacancy, and vacant lots.

Theoretical Mechanisms

Several inter-related theories form a framework to explicate the mechanisms behind crime reduction through the physical improvement of residential housing and vacancy. Broadly, these theories emphasize physical disorder and crime in space, and the protective effects of community guardianship on crime. To some degree, these theoretical frameworks are outgrowths of social disorganization theory.

The monumental social-ecological work of Shaw and McKay (1942) served as a foundation for what would become known as social disorganization theory. The theory sought to explain how neighborhood, not individual, characteristics could shape juvenile delinquency. Generally, social disorganization may be considered a neighborhood's lack of ability to self-regulate to achieve common goals (Bursick, 1988). Traits of social disorganization include racial and ethnic heterogeneity, poverty, and residential mobility (it is worth noting here that while racial and ethnic diversity can be a strength in communities, in the context of social disorganization, it may be a barrier for residences to coalesce and achieve common goals). Conversely, traits that facilitate social organization may be community organizational participation and strong neighborhood peer networks (Sampson & Groves, 1989). Despite being a major theory in the field of sociology for decades, social disorganization had not been empirically verified until a study conducted by Sampson and Groves (1989) using the 1982 British Crime Survey. Their findings suggested that low socioeconomic status, ethnic heterogeneity, residential mobility, urbanization, and family disruption were all related to various mediating factors associated with collective efficacy, which is described as the degree of social cohesion in a neighborhood and residents' willingness to intervene for the mutual good (i.e., sparse

local friendship networks, unsupervised teenage peer groups, low organizational participation). Many latent social disorganization factors and their mediators were related to various violent and property crimes (Sampson & Groves, 1989). A replication of this study using more recent British Crime Survey data produced similar findings (Lowenkamp et al., 2003).

Though social disorganization theory is not without its detractors (e.g., Bursick, 1988) for a variety of reasons (e.g., susceptibility to the ecological fallacy, the assumption of sociodemographic stability over time, concerns regarding measurement), it remains a foundational theory in neighborhood-based studies in sociology and criminology (Sampson et al., 2002). This, in part, is due to its influence and impact on subsequent theories. Wilson and Kelling (1982) introduced the broken window theory, which seeks to provide motivation for criminological events due to the physical deterioration and disorder in neighborhoods. The metaphorical “broken windows” may include several physical representations of a neighborhood’s disorder (MacDonald, 2015), leading to a lack of social capital and informal social control; in the context of residential housing, for example, the physical disorder can contribute to the “sorting” of residential communities by income, where those with fewer means are left in spaces of concentrated disadvantage. In turn, rental and mortgage prices may be affected by the negative perceptions of prospective residents, investors, and real estate agents – all of which can increase the frequency of vacant and abandoned buildings (Skogan, 2012). Further, a neighborhood with many vacant and/or dilapidated homes may signal potential offenders that the area is uncared for by residents, and therefore a potentially easy target for criminal behavior. Subsequent manifestations of crime and further deterioration of the

physical landscape may prompt residents to avoid outside interactions with their neighbors, thereby increasing isolation and reducing collective efficacy and overall attachment to their communities (Aiyer et al., 2015; Heinze et al., 2018; Wilcox et al., 2004). Studies have indicated that individuals who live in neighborhoods with high levels of disorder are less likely to report trust in others, and are more likely to be suspicious of others (Ross & Mirowsky; Taylor, 2010). The negative impact of the disorder on collective efficacy is of particular importance here; as previously noted, collective efficacy serves as an important mediator between latent social disorganization traits and crime in neighborhoods (Sampson et al., 1997). For example, in a study by Sampson and Raudenbush (1999), manifestations of physical disorder in Chicago (e.g., street trash) were found to be positively correlated with self-reported victimization and reported crimes to the police. Additionally, there has been evidence to suggest that the seriousness of crimes can escalate over time in spaces characterized by physical disorder and poor collective efficacy (Henry et al., 2014; Wilson & Kelling, 1982).

Similar to the broken window theory, the busy streets theory more explicitly emphasizes the benefits of collective efficacy. “Busy streets,” as described by Aiyer et al. (2015), imply heightened interactions among members of a community, which leads to increased social cohesion, social capital, trust, and collective efficacy. Busy streets theory uses a community empowerment framework, emphasizing social relationships among community members (i.e., intracommunity), social interactions between individuals and organizations to promote trust and social capital (i.e., interactional), and organizational collaborations between individuals and organizations within communities to foster meaningful change in neighborhoods (i.e., behavioral).

In addition to increasing community interaction and promoting collective efficacy (and thereby reducing crime and violence), reducing disorder in physical spaces increases neighborhood guardianship. Eyes on the street theory explicitly emphasizes neighborhood guardianship which results from informal social control and was first introduced by author and activist Jane Jacobs in her seminal work *The Death and Life and Death of Great American Cities* (1961). Jacobs stressed and encouraged neighborhood residents to be proprietors and guardians of their space to maintain social order. In the case of vacant lots, for instance, unkempt vegetation may serve as a marker to potential offenders that space is free from the eyes of guardians (Kuo & Sullivan, 2001).

Building upon the idea of guardianship stressed by Jacobs, crime prevention through environmental design ([CPTED]; Jeffery, 1971) is an architecture- and design-based approach to guardianship and crime prevention. Under this paradigm, the built environment can be designed such that certain spaces are made less attractive to offenders by providing natural surveillance, access control, and signals of territoriality (Cozens et al., 2015). As described by Armitage (2013), CPTED consists of four central principles. First, territoriality and defensible space suggest that the environmental design of a neighborhood can modify a resident's sense of ownership over their space (Newman, 1972). Second, the ability to minimize "through" movement is derived from crime pattern theory (Brantingham & Brantingham, 1991; Brantingham & Brantingham, 2016), and posits that maintaining access control (i.e., the ability to deny access to a crime target) and permeability (i.e., the extent to which a neighborhood is open to external pedestrian and vehicular traffic) to spaces acts as a deterrent to would-be offenders through the

rational choice perspective (Cornish and Clarke, 2016). Third, the design of the environment can be built in such a way as to promote formal (e.g., street cameras) and informal surveillance (e.g., street-facing windows so individuals can observe pedestrian traffic). Fourth, physical security (i.e., “target hardening”) refers to measures that are taken to secure and protect a space using physical features of a property (e.g., fences, doors, locks). In the case of vacant housing, for example, vacant residencies are less likely to have functioning locks or other security measures in place to deter criminal activity. The lack of guardianship in vacant homes can lead to easy opportunities for theft and victimization, and drug use (MacDonald, 2015). It is noteworthy that CPTED need not be limited to individual properties; for example, elements of CPTED can be translated into the design of wider landscapes, neighborhoods, and cities (Ekblom, 2011). The concept of neighborhood surveillance and guardianship are also key principles of situational crime prevention (Clarke, 1983) and routine activity theory (Cohen & Felson, 1979), which stress the importance of guardianship in reducing crime, and are two foundational frameworks of environmental criminology theory.

Housing Disinvestment and Crime

Jacobs (1961) noted that in some communities, particularly in those with low socioeconomic status, effective social control may be difficult to establish without the aid of external assistance. However, by drawing on “extralocal resources,” these communities may be able to engage in effective problem-solving (Carr, 2003). Hunter (1985) described three levels of social order – the private, parochial (i.e., the neighborhood), and public (i.e., the formal bureaucratic). Building upon this model, Carr (2003) proposed “new parochialism,” which emphasizes the interaction between the

parochial and public levels of social order. Though still organized and maintained by local organizations, crime control programs can be elevated through these partnerships and the resultant external support (Carr, 2003). Moreover, the long-term capacity for the maintenance of social control and neighborhood participation in interventions is increased (Skogan, 1988).

Beginning in the late 1980s, Seattle's Neighborhood Matching Fund (NMF) has provided matching funding for community organizations seeking to complete local community improvement projects, including the abatement of housing blight (Ramey & Shrider, 2014). In a longitudinal study (1993 – 2007) of the effects of "new parochialism" on crime, Ramey and Shrider (2014) investigated the role of NMF funding in reducing violent crimes (i.e., arrests for homicides, robberies, aggravated assaults, and forcible rapes). In addition to observing a protective effect of NMF funding on violent crime, the authors also noted particularly increased benefits in spaces with lower socioeconomic status, and that the NMF program was a cost-effective crime reduction strategy compared to increased investment in law enforcement. The mechanisms behind public investment and crime were further explored in a later longitudinal study using the NMF (1997 – 2007), which also incorporated private investment as another predictor theorized to reduce crime (Shrider & Ramey, 2018). The authors hypothesized that, in addition to public investment (i.e., NMF funding) acting to reduce crime, private investment, as estimated using mortgage lending dollars, would reduce crime. Additionally, Shrider and Ramey (2018) theorized that the relationship between NMF spending, which covers a range of neighborhood improvements beyond housing, and crime would be mediated by mortgage lending; that is, greater public investment into neighborhoods would prompt

banks to increase mortgage lending, thereby increasing residential stability and social order, and reducing crime. Broadly, the study found that increased NMF funding is directly and indirectly associated with lower rates of community violence. NMF funding indirectly impacted violence mediated through a positive relationship with mortgage lending and had a direct negative association with violence in spaces with high levels of disadvantage (Shrider & Ramey, 2018).

The observational research exploring crime and public investment operationalized through the NMF in Seattle is, to date, relatively novel. Presumably, there exist numerous ways in which public investment can be quantified, and there currently is not a well-recognized standard with which to do so. Comparatively, there have been several observational studies that have examined the role of private investment in housing in shaping crime outcomes using mortgage lending data acquired through the Home Mortgage Disclosure Act. Greater levels of homeownership have been recognized as a key feature in the stabilization of neighborhoods, as homeowners tend to move less frequently than those who rent (Dietz & Haurin, 2003; Rohe & Stewart, 1996). As a key component of social disorganization theory, residential stability is a marker in reducing crime in neighborhoods (Morenoff et al., 2001; Sampson et al., 1997). Further, homeowners have a greater investment (monetary and sentimental) in their neighborhoods and are more likely to be participants in local politics and organizations (McCabe, 2013; Rohe & Stegman, 1994), promoting collective efficacy and social cohesion. From an environmental perspective, private home loans can also reduce signs of physical disorder in neighborhoods, prompting increased neighborhood investment in areas such as police coverage (Squires & Kubrin, 2006). It follows, then, that individuals

who feel that they are safe in their neighborhoods are less likely to move (Ellen & O'Regan 2010), again promoting residential stability. For these reasons, mortgage lending serves as an ideal indicator for residential stability in neighborhoods, and several studies have explored the dynamics between crime and this type of housing investment.

Increases in home loans from private banks have consistently been associated with lower levels of crime in neighborhoods (Kubrin & Squires, 2006; Saporu et al., 2011; Vélez et al., 2012), for both violent crimes (Kubrin & Squires, 2006; Vélez, 2009) and property crimes (Peterson & Krivo, 2010). Over a 3-year period in 1990s Chicago, higher home mortgage loans were associated with decreases in the homicide rate. For neighborhoods (defined by census tract) with below-average homicide rates, the average annual home loan amount was approximately 7.9 million dollars. By comparison, in neighborhoods with above-average homicide rates, the average annual home loan amount was 3.1 million dollars. Additionally, a spatial diffusion of benefits effect was observed – homicides were less frequent in neighborhoods adjacent to areas with high bank investment compared to those adjacent to areas with more limited bank investment (Vélez & Richardson, 2012). Vélez et al. (2012) reported similar findings in a longitudinal study (1981 – 2007) of mortgage lending and violent crime in Seattle. Findings suggested that mortgage dollars and the number of mortgage loans per owner of occupied units were associated with decreased violent crime rates up to two years after housing investment. In San Diego County (2007 – 2013), increases in home mortgage loans were found to be significantly associated with a lower overall crime rate. Specifically, a ten percentage point increase in loan origination – the process beginning

with a borrower application and culminating in lender processing – was associated with a 2.75 percentage point drop in the number of crime incidents (Bunting, 2020).

It has been hypothesized that the protective effects of mortgage lending on crime may be differential based on the racial and socioeconomic composition of spaces (Shrider & Ramey, 2018). Mortgage investment in cities tends to be heterogeneously distributed, with White or more advantaged areas receiving a disproportionate number of loan dollars (Rothstein, 2017; Squires & Kubrin, 2006), and minority neighborhoods stigmatized and devalued as “risky investments” (Mallach, 2019; Rothstein, 2017). Further, compared to historically advantaged neighborhoods, disadvantaged neighborhoods have a greater “room for improvement;” for instance, improvements in housing in disadvantaged neighborhoods would produce a more noticeable difference in the physical landscape, and more advantaged areas might be more likely to have other mechanisms to facilitate social control (Boggess & Stucky, 2022). Empirical evidence suggesting a moderating effect of race/ethnicity and disadvantage in the crime-mortgage lending relationship has been mixed. In a nationwide study of mortgage lending and crime in the US, Saporu et al. (2011) found that, compared to predominantly White neighborhoods, the effect of residential lending on crime reduction in minority neighborhoods was substantially greater, particularly for violent crimes. Similar findings were observed when examining neighborhood disadvantage for both violent and property crimes. Conversely, in another nationwide study, Boggess and Stucky (2022) reported that census tracts that were predominantly White experienced greater decreases in violent crimes associated with mortgage lending compared to predominantly minority census tracts. These findings were

similar to those observed for home improvement loans and violent crime in Cleveland (Gill et al., 2023).

It should be noted that the aforementioned studies investigated the role of home mortgage lending on crime in the US, rather than the role of crime on home mortgage lending. From a theoretical perspective, it may be argued that both perspectives have merit, and in fact, there exists a feedback loop for these policy and social processes. In the studies discussed above, the hypothesized mechanisms suggest that increases in mortgage lending increase residential stability, collective efficacy, social cohesion, and physical order – all of which would lead to reductions in crime. Antithetically, in disadvantaged, minority spaces where crime is prevalent, private banks may assume that prospective mortgage applicants may lack the ability to successfully pay back a loan, and as such, are less likely to approve them (i.e., redlining; Lynch et al., 2021). For instance, over five years, Lacoë et al., (2018) examined the role of private investment (as measured using building permits) on crime in Chicago and Los Angeles (2006 – 2011). Study findings showed that increases in crime were significantly associated with reductions in private investment. The relationship between home mortgage lending and crime may be further complicated by gentrification and other urban renewal processes (Kreager et al., 2011).

Foreclosure, Residential Vacancy, and Crime

After a boom of subprime mortgage lending (i.e., high-interest lending generally offered to borrowers with low credit ratings), several cities in the US experienced concentrated levels of foreclosed properties and the social costs associated with them (Immergluck, 2009). Then, in the 2000s, the US experienced The Great Recession and a

subsequent housing/foreclosure crisis, which is generally dated to 2007, but began earlier in many cities (Immergluck, 2016). An estimated 3.5 million homes in the US were foreclosed between 2008 and 2010, subsequently increasing rates of housing vacancy (Mian et al., 2014). Between 2000 and 2010, the number of vacant housing units in the US increased by 44%, from 10.4 million units to 15 million units (US Government Accountability Office, 2011). Of the 75 largest metropolitan statistical areas (MSAs) in the US, 55 MSAs experienced increases in housing vacancy between August 2006 and August 2008, with 22 MSAs experiencing vacancy increases of at least two percentage points (Immergluck, 2016). The effects of the foreclosure crisis on vacancy were long-lasting, particularly for neighborhoods with low socioeconomic status. In a study by Immergluck (2016) examining US postal service vacancy data between 2011 and 2014 (a period of overall housing market recovery nationally), neighborhoods with high poverty rates and low median income saw 13% more vacancies at the end of the period.

Disentangling the effects of housing foreclosure and vacancy on crime is challenging, in part because existing research has generally hypothesized that foreclosure affects crime *through* creating vacancy, and subsequent residential instability and physical disorder (Boesson & Chamberlain, 2017). For instance, in Pittsburgh, Cui and Walsh (2015) found that though foreclosure alone did not affect crime, but once properties became vacant, significant increases in violent crimes (19%) were observed. However, Christie (2013) highlighted the importance of differentiating between foreclosure and vacancy, noting that nearly half of all foreclosed homes in the US are still occupied; therefore, a distinction of the theoretical pathways through which foreclosure and vacancy affect crime is necessary. As previously discussed, the effect of vacant

residential properties on crime tends to operate through opportunity mechanisms (e.g., lack of community guardianship). Boesson and Chamberlain (2017) posited that foreclosure could affect crime through the financial strain associated with the housing crisis. For those who believe that homeownership is a foundational element of the “American dream,” the prospect of losing their homes could result in stress and disillusionment (Messner & Rosenfeld, 2007). This may lead residents to withdraw from community activities and local institutions (Boesson & Chamberlain, 2017), damaging a neighborhood’s social cohesion and increasing the likelihood of crime. Jones and Pridemore (2012) examined the association between stress-related homeownership, and violent and property crime in the US using the Housing-Mortgage Stress Index. Though their findings across all crime categories were statistically insignificant, more research is needed to elucidate the mechanisms between crime, foreclosure, and housing vacancy. In their study in Cleveland (2006 – 2011), Boesson and Chamberlain (2017) posited that differentiating the pathways from foreclosure and vacancy to crime has a geographical dimension. They noted that foreclosed and vacant properties tend to be differentially distributed across space, with foreclosed properties tending to cluster with greater concentration than vacant properties. The explosion of subprime lending before the housing crisis disproportionately targeted neighborhoods characterized by the concentration of minority populations and poverty (Crossney, 2010). Once the housing bubble burst, foreclosures in these concentrated spaces followed suit (Gerardi & Willen, 2009). Conversely, the occurrence of vacant homes may be more attributed to changes in economic processes such as manufacturing. In Cleveland and other Rust Belt and legacy cities, for instance, manufacturing opportunities were once prevalent, with workers living

in homes scattered throughout cities (Holly & Warf, 1997). As the manufacturing economy floundered, residents were unable to fulfill their mortgage obligations, leaving their homes to seek other financial opportunities and resulting in a large scattering of vacant residences (Mallach, 2010). Accordingly, in their study of Cleveland, Boessan and Chamberlain (2017) observed differential effects of foreclosure and vacancy on crime, with foreclosures only affecting crime in broader nearby areas and vacancies only consequential to crime in the focal area.

Well before the housing crisis was in the national spotlight, a rise in predatory lending practices, particularly in disadvantaged areas, prompted a sharp increase in empirical research concerning the potentially harmful effects of foreclosure on crime in communities. In one of these earliest studies, Immergluck and Smith (2006) investigated the effects of single-family home foreclosure on violent and property crimes in Chicago using a cross-sectional design at the census tract level. Their analyses revealed that higher levels of foreclosure were significantly associated with violent crimes (no significant association was observed with property crimes); specifically, a one standard deviation increase in foreclosure rate was associated with a 6.7% increase in violent crimes. Several other cross-sectional studies found similar positive correlations between foreclosure and crime: increases in property crime in Atlanta (Acevedo, 2009), increases in larceny, burglary, drugs, and disorderly conduct in Akron (Teasdale et al., 2012), and increases in overall crime in 1,507 US counties (Arnio et al., 2012). Building upon the work of Immergluck (2006) in Chicago, Lacoé and Ellen (2015) integrated a longitudinal, difference-in-difference methodology, and block-faces as their spatial unit of analysis (a more refined unit of analysis than census tracts). Foreclosures were observed to be

significantly associated with increases in crime during the study period (2007 – 2011). The authors also noted the differential impact of foreclosure on the type of crime (i.e., violent, property, public order, other) and location of the crime (i.e., street, residence, vacant building, other). For all crime types, the effect of foreclosure was most prominent for incidents occurring inside residences (Lacoe & Ellen, 2015). Also in Chicago, Arnio and Baumer (2012) estimated the effects of foreclosure on crime using geographically weighted regression to adjust for spatial heterogeneity (i.e., accounting for spatial variations of effect sizes in the foreclosure-crime association). Foreclosure was found to be statistically associated with increases in robbery and burglary rates at the census tract level. In a longitudinal study in New York City (2004 – 2008), Ellen et al. (2013) found the effect of foreclosure to be greater for violent and public order crimes compared to property crimes (all statistically significant effects). Additionally, the authors made a persuasive case for causality through their incorporation of lagged foreclosure measures, the use of block-face fixed effects, and the inclusion of several time-variant neighborhood characteristics. Similar findings were supported in Indianapolis (2003 – 2008), where foreclosures were positively related to overall, property, and violent crimes, including rape, aggravated assault, and burglary (Stucky et al., 2012).

Many foreclosed residential properties, particularly in disadvantaged neighborhoods, will ultimately become long-term vacancies or permanently abandoned (Immergluck & Smith, 2006), diminishing a community's collective efficacy and informal social control. In a longitudinal study (2002 – 2006) of all census block groups in Philadelphia, Branas et al. (2012) investigated the role of vacancy on violent crimes. The study showed that for every one-unit increase in vacant buildings in a block group,

aggravated assaults (including those involving firearms) increased by 18%. The authors also suggest that other place-based factors (e.g., parks, liquor retailers) could modify this relationship, but only at low levels of vacancy. Notably, the effect size of vacancy on violent crime was substantially higher than several commonly used covariates in neighborhood and crime research (Branas et al., 2012). Branas et al. (2016) also reported that abandoned building remediation was associated with a significant reduction in firearm violence (39%) in Philadelphia. These findings coincided with the Doors and Windows Ordinance in Philadelphia, a citywide mandate that required property owners of abandoned buildings to install functional doors and windows in their structures. Between 2011 and 2013, Kondo et al. (2015) estimated the effects of the city ordinance on crime using a difference-in-differences approach. Comparing buildings that were remediated as a result of the ordinance to randomly-matched control buildings that were not yet remediated, remediations to the buildings were associated with decreases in overall crime, all assault, gun assaults, and nuisance crimes, and no evidence of crime displacement to adjacent spaces was observed. In another longitudinal study (2012 – 2018), the effect of housing vacancy on crime in New Orleans was assessed. In addition to a reported positive association between housing vacancy and property and violent crimes, findings from the study suggested a spillover effect, with elevated levels of drug, property, and violence offenses in areas near high-vacancy spaces (Chen & Rafail, 2020). Using a cross-sectional design and block levels in Detroit, Raleigh & Galster (2015) estimated the effects of land parcels categorized as vacant or DFV (“to-demolish, or fire-damaged, or vacant/open/dangerous”) on several crime outcomes. Housing vacancy and DFV were not found to be associated with assaults, robberies, or overall violent crimes.

Regarding other crimes, vacant housing was found to be significantly associated with burglary, drug/narcotic offenses, and larceny; and DFV was not found to be significantly associated with property crime. Similar findings were observed in a longitudinal nationwide study (2005 – 2009) using MSAs as the unit analysis. Vacant housing was found to be a significant predictor of burglary rates, but not robbery rates (Jones & Pridemore, 2016). Risk terrain modeling was utilized in St. Louis to determine if housing vacancy had a differential effect on violence in the city. Housing vacancy was observed to be strongly associated with homicide and aggravated assault, particularly in the predominantly African American and disinvested north part of St. Louis. The significant association between vacancy and violence in the south of the city was believed to be driven by high-density public spaces (i.e., crime generators) such as transportation hubs and schools (Fox et al., 2021).

Several studies have examined the role of housing vacancy through the lens of *removing* vacancy, specifically utilizing the demolition of vacant/abandoned properties as a situational crime prevention measure (Clarke, 1983). Between 2010 and 2014, Detroit demolished 9,398 properties, more than any other city during that span. Demolitions were significantly (and substantially) associated with reductions in total, violent, drug, and property crimes at the census block group level (Larson et al., 2019). Beginning in 2014, Detroit then launched a large-scale initiative, resulting in the demolitions of over 10,000 buildings in the first three years. Using propensity score matching, block groups with greater than five demolitions were observed to have an 11% reduction in firearm assaults compared to controls. The study did not find any significant association between demolitions and neighborhood drug violations, and no evidence supporting crime

displacement was observed (Jay et al., 2019). These findings were supported in a study conducted by Stacy (2016) in Saginaw, where building demolitions were associated with an 8% drop in overall crime at the block group level. Moreover, the study showed evidence of a diffusion of benefits, whereby crime was reduced by about 5% in neighboring block groups. Focusing specifically on demolitions of residences, Wheeler et al. (2018) examined the effects of over 2,000 housing demolitions in Buffalo between 2010 and 2015. Special attention was given to spatial considerations, including the use of micro places (i.e., individual land parcels) and spatial buffers. Housing demolitions were found to cause dramatic drops in crime within immediate proximity of a parcel and drops in crime up to a 1,000-foot buffer from a parcel. Also utilizing a refined geography, Porter et al. (2019) showed that demolitions in a mid-sized Ohio town significantly reduced crime (and calls for service) at the street segment level. Despite empirical evidence supporting the protective effects of vacant property demolition, in Kansas City (2012 – 2016), demolition of abandoned properties did not have any significant impact on nearby violent or property crimes. The study suggested that any observed changes in crime could potentially be attributed to socioeconomic or other housing characteristics (Han & Helm, 2023).

Vacant Lots and Crime

Similar to vacant/abandoned homes, the physical deterioration characterized by vacant lots signals a neighborhood's lack of social interaction and cohesion, collective efficacy, and mobility (Aiyer et al., 2015; Wilcox et al., 2004). Many vacant lots, particularly in metropolitan spaces, are characterized by unmanaged vegetation growth, illegal dumping, and/or abandoned cars (Branas et al., 2018). As such, there are several

studies, experimental and observational, that have indicated that remediation of vacant lots is an effective strategy to reduce crime in neighborhoods (Bogar & Beyer, 2015; Shepley et al., 2019). Here, experimental and quasi-experimental studies are reviewed, which provide the most salient casual evidence that the remediation of vacant lots reduces crime in communities.

A recent meta-analysis examined the effects of citywide vacant lot remediation interventions to quell firearm violence (Sadatsafavi et al., 2022). The analysis included programs that treated vacant lots with mowing, greening, and gardening interventions. Mowing interventions did not yield a significant pooled effect size in firearm violence reduction. However, greening and gardening interventions were found to significantly decrease firearm violence (reductions of 5.84% and 5.34%, respectively). Additionally, based on a supplementary probabilistic cost-to-benefit analysis extrapolated over 30 years, greening interventions were found to be the most cost-effective remediation programs for reducing firearm violence. Several of the studies encapsulated in the meta-analysis by Sadatsafavi et al. (2022) are featured prominently in the vacant lot remediation and crime literature, and will be discussed in more detail below.

In the 2010s, increases in violent crimes in Philadelphia prompted the need for cost-effective violence prevention/intervention strategies (Moyer et al., 2019). As such, a series of vacant lot remediation interventions (and subsequent evaluations) was conducted by the University of Pennsylvania's Perelman School of Medicine in collaboration with the Pennsylvania Horticulture Society. The remediation strategies in Philadelphia were diverse, consisting of trash and debris removal, lawn maintenance, grading land, tree planting, and installation of low wooden perimeter fences to signal

territoriality and deter illegal dumping (Branas et al., 2018). The first, and largest, of these trials, resulted in a decade-long green initiative (1999-2008), culminating in the greening of 4,436 vacant lots (7.8 million square feet) in four sub-regions of Philadelphia. Using a difference-in-differences analytic approach, gun assaults and vandalism close to vacant lot greening were significantly reduced compared to matched control lots (Branas et al., 2011). Overall, there was a statistically significant reduction of firearm violence in this sample (4.6%), though no significant reduction in non-firearm violence was observed. Following a cost-benefit analysis, the authors also noted that taxpayer and societal returns on investment in the prevention of firearm violence were \$26 and \$333 for every dollar spent on vacant lot remediation, respectively (Branas et al., 2016). In another randomized control trial, between 2013 and 2015, 541 vacant lots in Philadelphia were randomly assigned to one of three treatment conditions: an intensive greening intervention, a less intensive mowing and clean-up intervention, and a no-intervention control. Using a difference-in-differences approach, compared to the referent control group, both the greening and clean-up interventions were found to significantly reduce shootings during the study period by 6.8% and 9.2%, respectively (Moyer et al., 2019). Significant reductions were also observed for overall crime (13.3%), burglary (21.9%), and nuisance crime (30.3%). Additionally, findings from the randomized control trial revealed that participants living near treated vacant lots reported significantly reduced perceptions of crime, vandalism, and safety concerns when going outside, and increased use of outdoor spaces for socializing (Branas et al., 2018). These findings were similar to a previous randomized control trial in Philadelphia that showed that residents living near greened vacant lots had a greater perception of safety after greening compared to those

living near control condition vacant lots (Garvin et al., 2012). Studies of vacant lots and crime in Philadelphia have also underscored the importance of accounting for proximal environmental factors that could moderate the effects of vacant lot remediation on crime. For example, MacDonald et al. (2021) noted that the effects of remediating vacant lots on crime rate are moderated by their proximity to areas of active business (larger effects) and alcohol outlets (smaller effects), suggesting that the effect of vacant lot remediation on crime is more pronounced in spaces of greater social cohesion. Similarly, Cui et al. (2022) found that the effects of vacant lot greening in Philadelphia are greater in areas with high residential and high civic land use.

The promising effects of vacant lot remediation programs on crime have been observed in several cities beyond Philadelphia. In 2010, the Lots of Green program in Youngstown initiated vacant lot remediations, assigning lots to one of three treatment conditions: a cleaning and greening intervention (“stabilization treatment”), a community garden intervention (“reuse treatment”), and a combination of the two aforementioned treatments. For at least one treatment group, reductions in several crime classifications were observed, including robberies, felony assaults, burglaries, thefts, and motor vehicle thefts. Notably, the authors also observed a diffusion of benefits in areas surrounding lot remediation (Kondo et al., 2016). The Fight the Blight program in New Orleans was initiated in 2014 to address lot vacancy in the aftermath of Hurricane Katrina. Using a quasi-experimental design, crime near 204 remediated lots was compared against a set of 560 control lots. Additionally, within the treatment group, crime near vacant lots that received only one treatment was compared against lots that received two or more treatments. Though no significant differences between treatment and control lots were

observed for violent, property, or domestic crimes, drug crimes significantly decreased in treatment lots (5.7%) compared to control lots, which was particularly pronounced in spaces receiving two or more treatments (Kondo et al., 2018). Also using a quasi-experimental design, Beam et al. (2021) estimated the effect of converting vacant lots into community gardens in Milwaukee. Difference-in-differences analysis revealed that compared to 159 control lots, the 53 remediated community gardens were associated with a proximal reduction in violent crime rate, ranging from 3.7% to 6.4% across the study period. The Care-A-Lot (CAL) program incentivized community organizations to maintain and green vacant lots in Baltimore. Kvit et al. (2022) compared violent and property crime rates at the 2016 – 2017 baseline to 2018 and 2019 rates for block groups with the lot remediation treatment to matched block groups without the treatment. The program was associated with a significant reduction in violent crimes in 2018 only (8 crimes per km² for every one percent increase in CAL area), and a reduction in property crimes in 2019 only (9.8 crimes per km² for every one percent increase in CAL area). In Flint, the community-based Clean & Green program was initiated to encourage residents to engage in the regular maintenance of vacant lots. At the street segment level, crime near 216 maintained lots was compared against 446 unmaintained lots. Between 2009 and 2013, vacant lot maintenance was associated with a 40% reduction in assaults and other violent crimes (Heinze et al., 2018). Accordingly, in their crime hot spot evaluation of the Clean & Green program (2005 – 2014), Sadler et al. (2017) reported that the greening intervention in Flint was associated with diminishing crime hot spots and emerging cold spots. Finally, in Chicago, the Large Lot Program began in 2014 to remediate vacant lots and to allow residents to take ownership of their neighborhoods.

Qualified property owners in the city were allowed to purchase up to two vacant lots for \$1 per property (Hadavi et al., 2021), and to date, over 1,000 vacant lots have been purchased (Stern & Lester, 2021). Though owners of acquired vacant lots were not mandated by the city to remediate the spaces, Gobster et al. (2020) noted that transference of lot ownership to residents generally resulted in improved lot conditions and care. Regarding effects on crime, Hadavi et al. (2021) conducted a difference-in-differences analysis to determine if blocks on the west and south sides with at least one resident-purchased lot exhibited lower crime outcomes compared to a set of matched control blocks in the time following program implementation (2015 – 2018). Findings indicated that the Large Lots Program was significantly associated with overall crime reduction beginning in the second year of implementation. Additionally, using a derived visual assessment scale, the study showed that the visual condition of a lot also led to reductions in crime (Hadavi et al., 2021). Stern and Lester (2021) also note the impact of proximity from lot to owner. Same-neighborhood buyers accounted for 69% of purchased lots, and the effect on crime rate reduction at the block level was found to increase with same-neighborhood ownership (3.5% overall compared to 6.8% with same-neighborhood ownership).

Rationale

In the 1990s, private neighborhood investment in Chicago actualized through mortgage lending disproportionately favored advantaged areas (Vélez & Richardson, 2012). The boom of subprime and predatory lending practices that followed targeted neighborhoods characterized by concentration of minority populations and poverty (Crossney, 2010), and were instrumental precursors to the Great Recession and housing

crisis of the late 2000s. Once the housing bubble burst, foreclosures in these concentrated spaces of high disadvantage followed suit (Gerardi & Willen, 2009). Many foreclosed residential properties in these areas ultimately became long-term vacancies or permanently abandoned (Immergluck & Smith, 2006), increasing physical disorder, diminishing neighborhood collective efficacy and informal social control, and increasing crime in the city (Immergluck & Smith, 2006; Vélez & Richardson, 2012).

In response to the dramatic increases in home foreclosure (Mian et al., 2014) and housing vacancy nationwide (US Government Accountability Office, 2011), the US federal government launched the Neighborhood Stabilization Program (NSP) under the Housing and Economic Recovery Act in 2008. Across three waves of funding from 2009 to 2012, \$6.92 billion was allocated nationwide to aid state and local governments in supporting housing financing, acquisition and rehabilitation, land banking, demolition, and redeveloping (Bak & Hewings, 2017; US Department of Housing and Urban Development, 2023). Overall, Chicago received \$169 million in funding from NSP, among the top 10 cities in terms of volume of funding (Bak & Hewings, 2017), and the second largest award (\$98 million) during the second round of funding (City of Chicago, 2010). In addition to targeting spaces with high levels of foreclosure and vacancy, NSP funding was intended for areas characterized by overall economic and social distress (e.g., neighborhoods with high minority populations, and low household income and educational attainment; Schuetz et al., 2015). In a study by Spader et al. (2016), the effects of NSP on crime were evaluated in Chicago, Cleveland, and Denver. In Chicago between 2009 and 2013, fewer than 300 properties were treated (i.e., housing rehabilitations and demolitions) with NSP resources. Though funding was primarily in

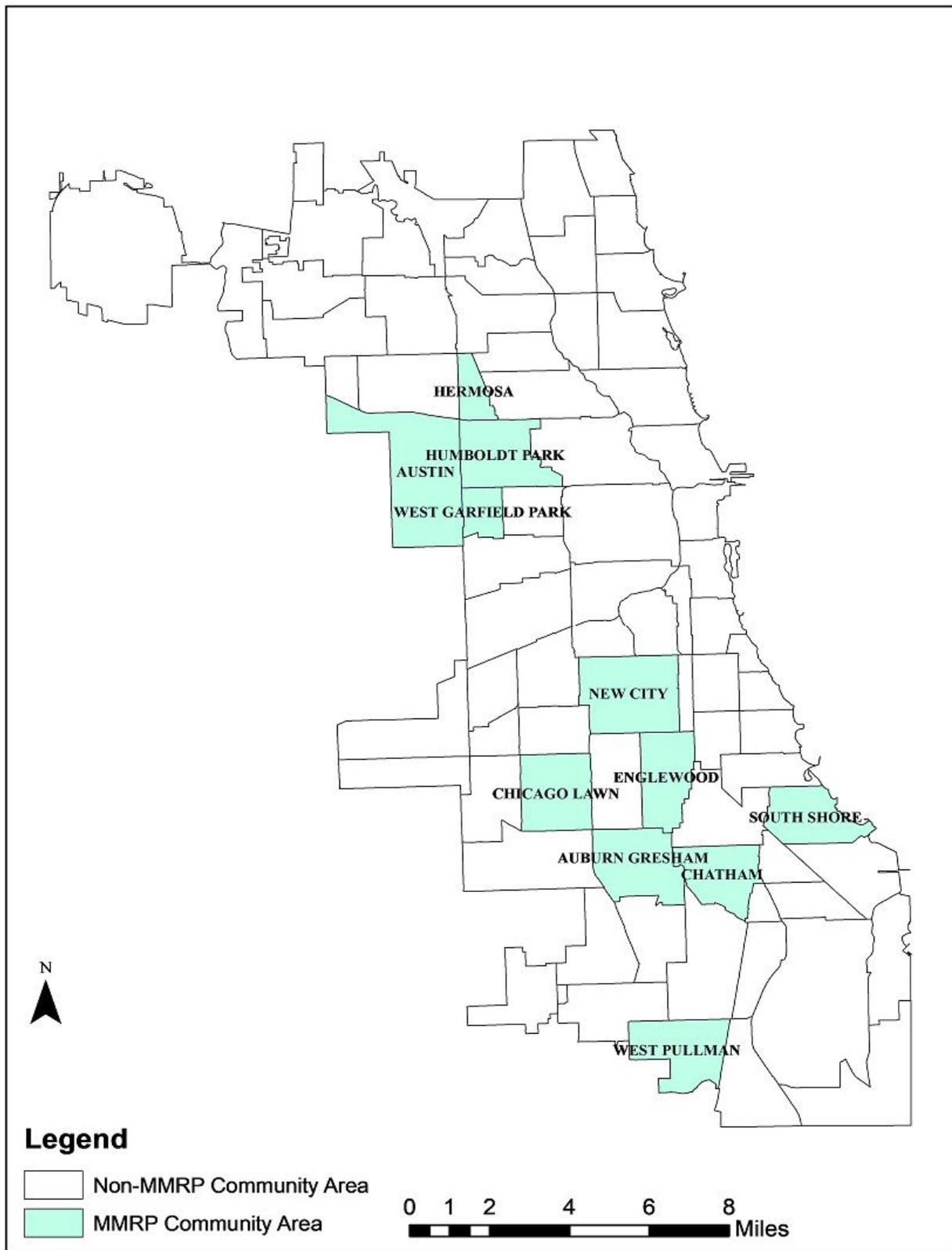
high-crime neighborhoods on the west and south sides of the city, NSP-treated properties tended not to cluster when considering more finely-grained geographies such as street segments (Spader et al., 2016). Using a difference-in-differences methodology, Spader et al. (2016) reported no significant reductions in crime attributed to NSP rehabilitations and demolitions in Chicago, including total violent and property crimes, burglary, theft, and auto theft (findings in Cleveland and Denver were mixed). The authors note that the lack of NSP public safety benefits in Chicago may have been attributed to heterogeneity in the types of services initiated by grantees. Following the third round of NSP funding in 2010, the US Congress halted housing resource allocation, and currently, most grantees are in the process of completing activities and closing their grants (US Department of Housing and Urban Development, 2023). In addition to mixed findings regarding crime reduction, O'Callaghan and Weech (2013) note that NSP could have benefited from strategies that were more community-driven, financial counseling programming, capacity building, and enhanced role for local non-profits.

In 2011, the Chicago Department of Housing initiated the Micro Market Recovery Program (MMRP), which sought to address several of the programmatic shortcomings of NSP, particularly through its reliance on collaboration with and investment from private, public, and non-profit organizations. Data collection for wave 1 of the MMRP ran from 2014 through 2017, and wave 2 began in 2018 and is still currently in operation, in part due to recent city funding allocated towards neighborhood infrastructure and investment, and housing remediation and other housing services (City of Chicago, 2022). The central goal of the MMRP is to provide rebuilding assistance in distressed neighborhoods by reducing home ownership costs and attracting new owners to vacant buildings in targeted

blocks in the community (City of Chicago, 2023b). Counter to NSP resource allocation, the MMRP strategically targets resources into small geographies (i.e., “micro markets”), of particular importance in terms of public safety outcomes. Till recently, the unit of analysis in the study of crime and neighborhoods received little systematic, theoretical, or empirical attention (Weisburd et al., 2009). Increasingly, there has been a shift in the environmental criminology field towards smaller and more precise units of analysis, in appreciation that crime is largely clustered in micro places (Weisburd, 2015).

Accordingly, citywide interventions that target changes to the physical landscape may be best served to emphasize concentrated spaces in their programming. As of 2021, the MMRP initiative was in operation in eleven “target” community areas on the west and south sides of the city (Figure 1), and the program is currently expanding to eighteen areas (Neighborhood Housing Services, 2023). Though some MMRP properties extend beyond the eleven target community areas, these properties and their intervention activities are still supported and managed by a centralized community organization located in each of the eleven target areas. These organizations aim to increase residential stability through reinvesting in vacant properties, and supporting current and new homeowners through a wide range of holistic housing services. Notably, the City offers \$15,000 for down payment assistance to eligible would-be homeowners, and forgivable loans to assist current homeowners in making home repairs (City of Chicago, 2023b). Further specifications of the MMRP are provided in the Methods section.

Figure 1. Target MMRP Chicago community areas, 2018 – 2021



Recent evidence supports the notion that city housing programs that i) are targeted in precise spaces, ii) have channels of community investment to help stabilize neighborhood infrastructure, iii) collaborate with community organizations, and iv) provide comprehensive services beyond physical repairs that may be successful in reducing crime. South et al. (2021) examined public safety outcomes associated with the City of Philadelphia Basic Systems Repair Program (BSPR), a block-level intervention (2006 – 2013) providing low-income homeowners with up to \$20,000 for structural home repairs. Using a difference-in-differences analytic strategy, the study compared blocks receiving the BSPR intervention with those on the waiting list for services. Through the program, 13,632 houses received the intervention, and BSPR was associated with an overall crime reduction of 22% (including significant reductions in assault, robbery, and homicide). In a south-side neighborhood in Columbus, the Nationwide Children’s Hospital and community partners launched the Healthy Homes initiative. In addition to providing repairs or renovations to 273 homes concentrated in 31 square blocks (2008 – 2019), the program also addressed education, health and wellness, neighborhood safety, and workforce development. Using the synthetic control methodology, a newly-popularized method used in quasi-experimental studies for making determinations of causal inference, study findings indicated a reduction in thefts due to the Healthy Homes intervention (Kondo et al., 2021).

Currently, the MMRP has been in operation for over a decade, providing economic relief to distressed, concentrated areas of Chicago with the intent of providing housing stability in these spaces. Explicitly, the current study seeks to examine a potential secondary effect of the program by building upon extant empirical literature

suggesting that housing remediation and reduction of housing vacancy leads to prosocial outcomes (e.g., residential stability, collective efficacy, and informal social control), leading to reductions in violent and property crime by evaluating the MMRP, 2018 – 2021. First, quarterly trends of vacancy and crime in spaces occupied by MMRP properties are explored. Next, an assessment of the impact of housing vacancy on crime outcomes in MMRP areas is conducted. Finally, a supplemental analysis to determine if the hypothesized beneficial effects of the intervention are visible in areas adjacent to MMRP-occupied spaces is carried out. Formally, these evaluative items are synthesized in the research questions that follow.

Hypotheses

Hypothesis 1 (H1)

From a visualization perspective, in census block groups (CBGs) occupied by properties that are part of the MMRP and in MMRP target areas (henceforth referred to as “MMRP properties”), trends of residential housing vacancy during the study period (2018 – 2021), and violent and property crime rates, respectively, will decrease at a similar rate.

Hypothesis 2 (H2)

Using longitudinal modeling, a higher proportion of vacant residential properties in CBGs with MMRP properties will be associated with higher rates of violent and property crime, respectively, after adjusting for CBG vacant lot density, during the study period, 2018 – 2021.

Hypothesis 3 (H3)

From a visualization perspective, in CBGs without MMRP properties that are adjacent to CBGs with MMRP properties, rates of violent and property crime, respectively, will decrease during the study period, 2018 – 2021, suggesting that the MMRP provides a potential spatial diffusion of benefits.

Method

The MMRP intervention is complex, including the involvement of several stakeholders. First, Neighborhood Housing Services (NHS), a Chicago-based non-profit organization that works closely with the Chicago Department of Housing, provided the raw housing data of all MMRP properties (i.e., all properties within MMRP target areas) and their quarterly statuses over time. These statuses were determinations made by NHS community partners residing in each of the eleven MMRP target areas. A property's status was recorded categorically (e.g., vacant, occupied, etc.), and once aggregated to CBGs, a calculation of a CBG's overall proportion of residential vacancy could be made. Next, these aggregated property data were integrated with archival data sources (i.e., crime and demographic data) for longitudinal evaluation. A summary of the data sources used for this evaluation can be found in Table 1.

In the sections that follow, further programmatic description of MMRP is provided. Next, demographic details describing CBGs containing MMRP properties are presented. A description of evaluative measures of interest and details concerning the procedure utilized for their integration follows. Finally, the analytic process used for this evaluation is provided.

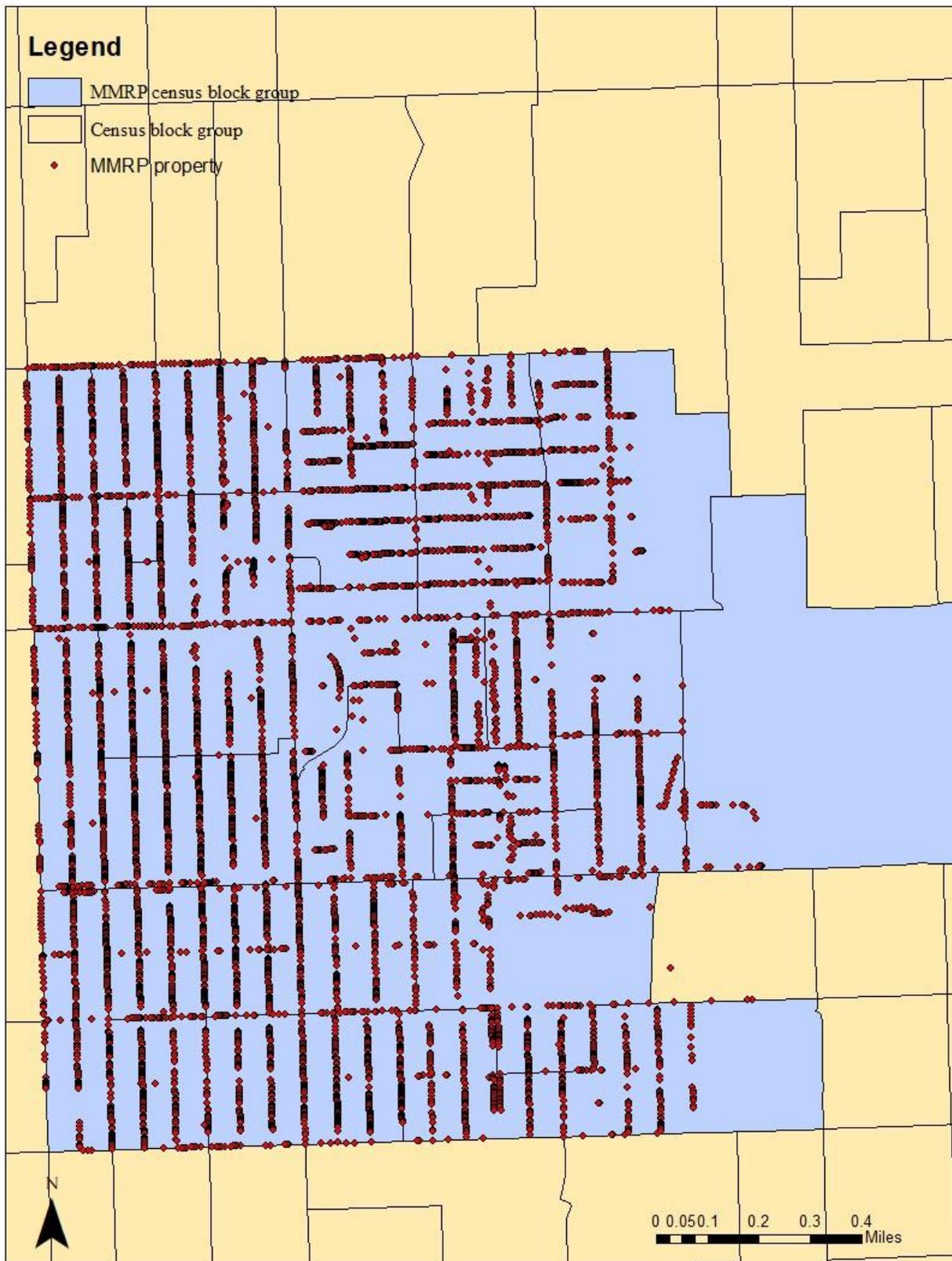
Program Description

Though the MMRP initiative began in 2011, the first wave (MMRP 1.0) of program intervention and data collection did not begin until 2014. The MMRP 1.0 ended in 2017, and the program expanded to eleven target areas beginning in 2018 (MMRP 2.0). The MMRP is a dynamic intervention, with catchment boundaries shrinking or expanding over time based on community needs and City resource availability. For example, at the start of the current study period (quarter 1, 2018), excluding non-residential properties, there were 16,651 properties with a non-missing status (i.e., a definitive status was documented by a community partner) in MMRP areas, and at the end of the study period (quarter 4, 2021) there were 27,253 residential properties. For the entire study period, 33,256 MMRP properties were in the program's catchment space at some point in time (Appendix D provides frequencies of MMRP properties and their statuses from 2018 to 2021). These property numbers will likely continue to increase as the intentions of the City are for the program to expand to eighteen target areas in 2023 – 2024 (NHS, 2023). The target areas were selected by the Chicago Department of Housing based on need and existing stabilized infrastructure, with resource allocation being favored in city blocks with a high density of foreclosed or vacant properties (e.g., Figure 2), and existing community investment (e.g., stable housing in surrounding areas, retail centers, schools, libraries, police and fire stations) to anchor a wider recovery (City of Chicago, 2010; City of Chicago 2023b; Local Initiatives Support Corporation, 2022).

Table 1. MMRP evaluative data sources

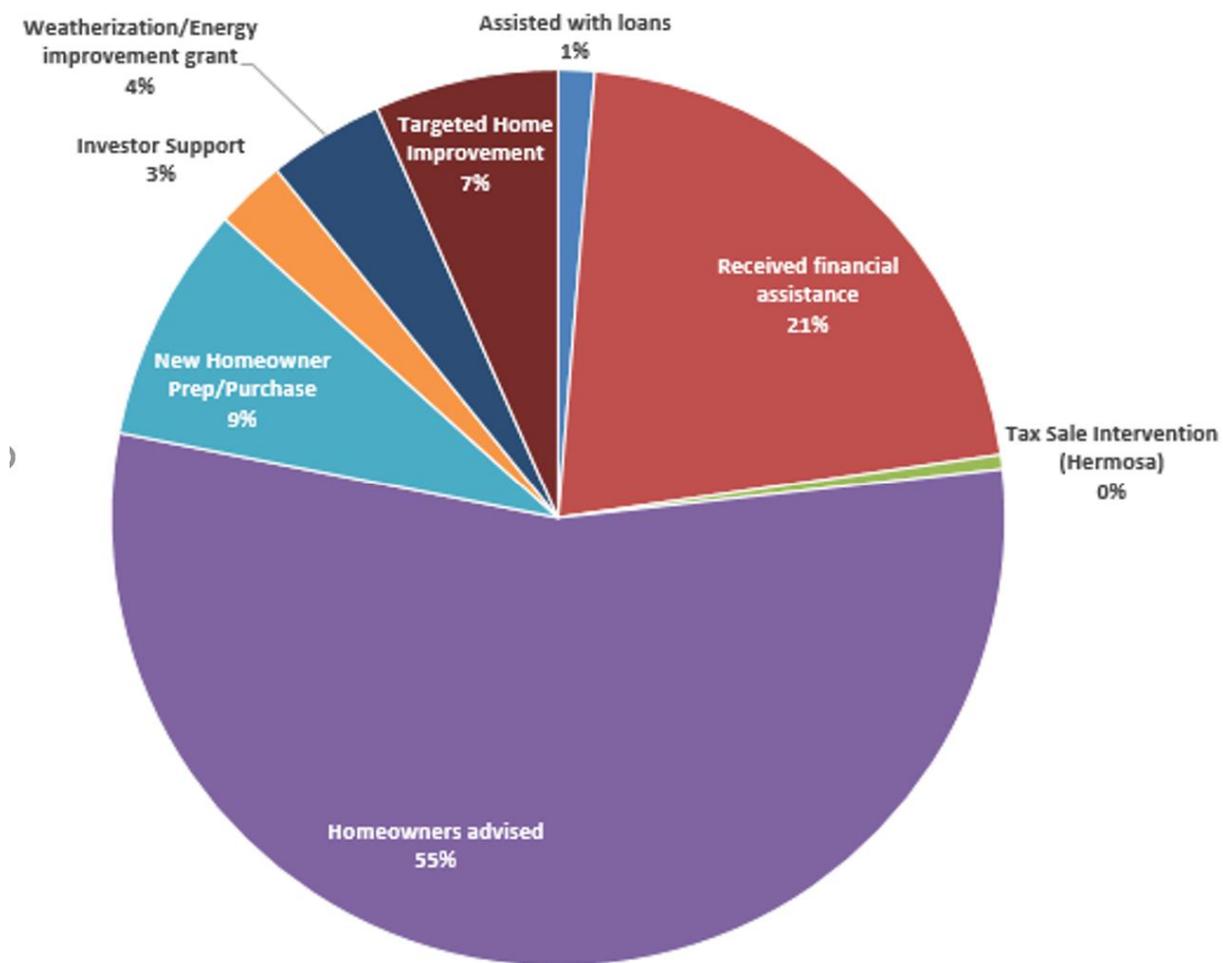
Source	Measures	Description
US Census Bureau	MMRP demographic data	American Community Survey 5-year estimates, 2017-2021 by census block group. Data includes race/ethnicity, poverty, education, household composition, unemployment, and renter-occupied housing.
Neighborhood Housing Services	MMRP raw property data	Individual parcel data containing quarterly housing status from 2018 - 2021 (“Occupied Stable Residential,” “Occupied Troubled Residential,” “Vacant Lot,” and “Vacant Residential”). Data were initially recorded by members of the eleven MMRP target area community organizations. Properties ultimately aggregated to MMRP census block groups.
Chicago Police Department via Chicago Data Portal	Violent and property index crimes	Incident crime data from 2018-2021. Data were aggregated quarterly and by census block group. Crime classifications collapsed into "violent" and "property" crime categories. Violent index crimes include aggravated assault, aggravated battery, criminal sexual assault, homicide, and robbery; property index crimes include arson, burglary, motor vehicle theft, and theft.

Figure 2. Concentration of MMRP properties in Englewood target area, 2018-21



The community organizations in each of the eleven target areas are at the core of determining the status of MMRP properties. Each quarter, members of the organizations conduct community assessments, which involve door-to-door determinations of status classification that best fits with a given property. The community organization members are embedded in the communities they are serving, presumably facilitating a climate of trust, and increasing ease of organization-resident interaction. This visibility is further enhanced by regular MMRP-sponsored social events in neighborhoods (e.g., block parties, barbecues) and routine informational flyer distribution. During the quarterly canvas, community organization members assign one of five statuses to a property: “Not Residential,” “Occupied Stable Residential,” “Occupied Troubled Residential,” “Vacant Lot,” and “Vacant Residential”. Based on the status of the property, the community organizations make determinations for the best course of action. For properties designated as “Occupied Stable Residential,” the central goal is the maintenance of that status and avoidance of foreclosure. For properties with a status of “Occupied Troubled Residential” or “Vacant Residential,” several project options are possible: assignment to an MMRP or private market inventory for rehabilitation and reoccupation, acquisition of the property through housing court, demolition, and others. Each of these project types entails a variety of specific services (Figure 3). Between 2018 and 2021, the most common service provided was homeowner advisement (55% of services), followed by financial assistance (22%), new homeowner preparation and purchase (9%), and targeted home improvement (7%). For properties designated as “Not Residential” and “Vacant Lot,” no MMRP actions are taken. Details of MMRP property statuses and corresponding project types and MMRP residential property assessment process are presented in

Appendix A and Appendix B, respectively. Once the status and recommended action of a property are established, community organizations log this information into a centralized database. Then, NHS collates these raw data files into quarterly reports for review by the Chicago Department of Housing.

Figure 3. MMRP types of homeowner assistance, 2018 – 2021

Sample

Each year, the American Community Survey ([ACS]; US Census Bureau, 2022) provides 5-year estimates for demographic attributes for several types of administrative geographies. Several neighborhood attributes have been described in the literature that relates to neighborhood crime rates (e.g., Kubrin & Squires, 2004; Morenoff et al., 2001). Based on 2017 – 2021 5-year estimates, the demographic characteristics of the CBGs in the eleven MMRP target areas are reported in Table 2. Overall, the eleven MMRP targeted areas cover 148 CBGs in Chicago, accounting for 6.3% of all CBGs in the city (Figure 4). The average MMRP CBG encompasses approximately 0.23 km² and contains 1,093 people. CBGs are the second smallest unit of geography recognized by the US Census Bureau behind census blocks, and the smallest unit for which population-level demographics are released yearly. Englewood and Hermosa accounted for the largest proportions of MMRP CBGs during the study period (18% and 16%, respectively), and the highest proportion of MMRP properties (21% and 15%, respectively). The highest proportion of Black residents was found in Auburn Gresham and Chatham (97% and 96%, respectively), and the highest proportion of Hispanic residents were found in New City and Hermosa (83% and 78%, respectively). Englewood was found to have the highest levels of poverty (39%), unemployment (25%), and renter-occupied housing (81%).

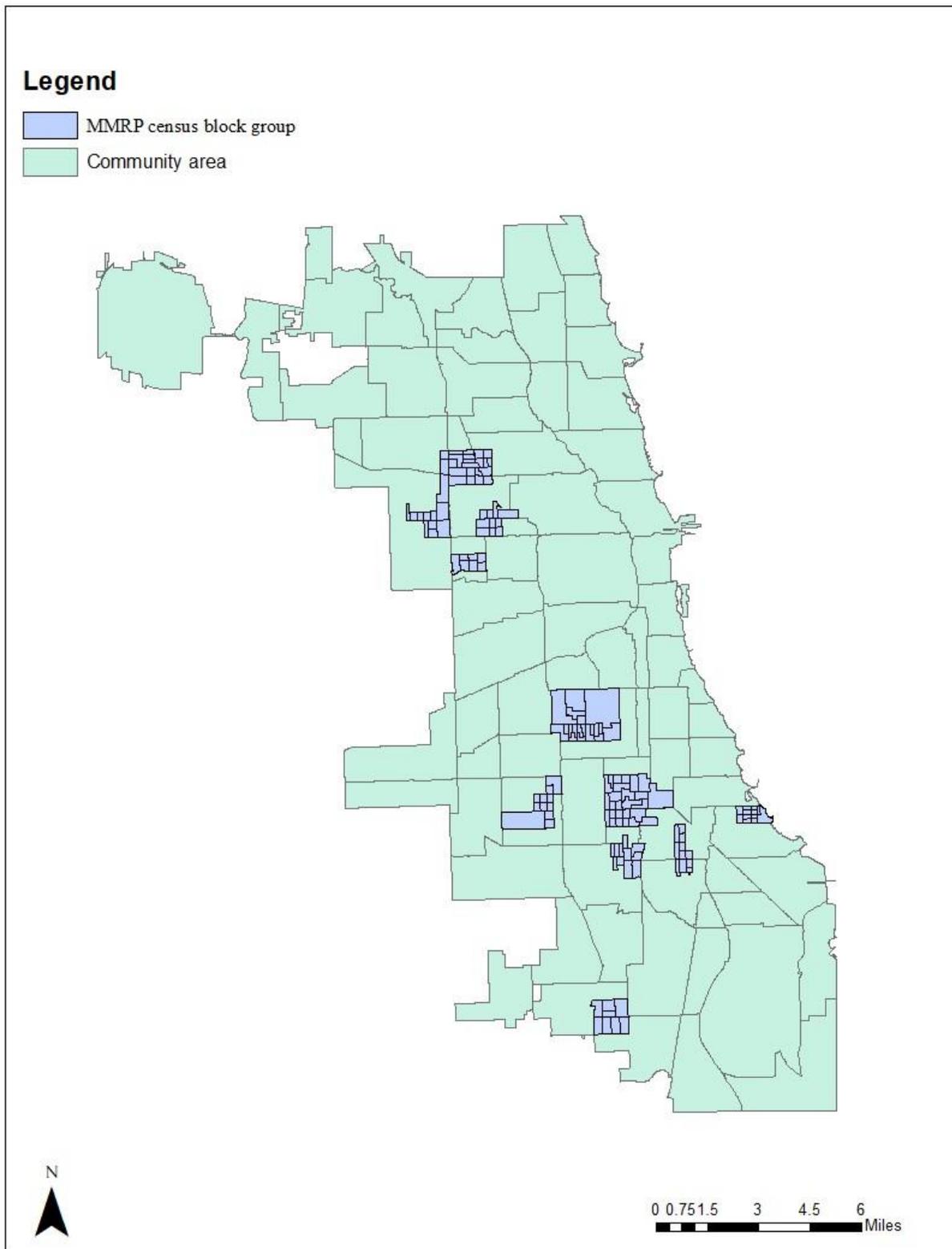
Table 2. Demographic characteristics of CBGs by MMRP target area, 2018-2021

Target Area	% of Total MMRP CBGs	% of Total MMRP Properties	% Black	% Hispanic	% Families Below Poverty Level	% Less than High School Education (age 25 and up)	% Single Mother-Headed Households	% Unemployed (age 16 and up)	% Renter-Occupied Households
Auburn Gresham	7.4	5.7	96.8	0.4	20.2	9.5	32.7	17.5	57.6
Austin	6.8	6.9	75.1	25.1	27.0	17.6	33.6	6.9	60.0
Chatham	7.4	7.0	95.9	0.7	34.0	11.9	33.9	15.5	68.2
Chicago Lawn	7.4	7.6	56.9	40.3	23.4	17.4	31.1	21.6	69.4
Englewood	17.6	20.7	93.1	3.3	39.1	18.7	35.6	25.4	80.6
Hermosa	15.5	14.7	7.0	77.6	12.3	27.6	18.3	5.4	56.4
Humboldt Park	6.8	6.4	65.0	29.5	28.8	25.9	40.2	21.5	67.0
New City	12.8	14.5	10.5	83.0	29.1	41.6	22.3	14.4	69.6
South Shore	8.1	1.6	90.7	2.1	20.2	9.1	13.8	11.6	72.4
West Garfield Park	4.7	5.3	94.2	2.5	31.2	25.7	34.9	29.3	66.9
West Pullman	5.4	9.4	93.8	1.7	12.9	11.7	25.0	10.5	32.8

Note. Values are based on 2017 – 2021 American Community Survey 5-year estimates. CBG = census block group, MMRP = Micro

Market Recovery Program.

Figure 4. MMRP census block groups in Chicago community areas, 2018-2021



Measures

Housing Vacancy

Measurement of residential status change (e.g., a property goes from vacant to occupied) could have been utilized at the parcel level (i.e., individual residency) to predict changes in crime associated with the MMRP intervention. However, the status data across time contained a high degree of missingness. Missingness for a property status could have occurred for several reasons. For instance, numerous properties in Englewood, New City, West Pullman, and South Shore were added to the program well after the start of the evaluation period (quarter 1, 2018). Additionally, there may have been instances in which community partners might have missed evaluating the status of a given property at a given time point. Generally, MMRP is somewhat of a decentralized program. And, as previously highlighted, its vast scope of services, geographic sprawl across Chicago, and the number of stakeholders involved pose complex challenges for data collection. As such, safeguards to ensure data vigilance are continuously being developed and refined. In the current study, strategies for missing data imputation were considered but would be too heavily reliant on assumptions of how property statuses changed over time, potentially biasing prediction model estimates. Deletion of properties with incomplete data was also a consideration. However, this would have eliminated a substantial portion of the entire MMRP property data set (approximately 50%). Given that an emphasis of this study is placed on the concentration of housing residencies, the removal of so many properties from the data set would have been counterproductive. Therefore, as a solution to these methodological challenges, residential vacancy was considered as a proportion that can be expressed over time by aggregating to MMRP

CBGs. Residential vacancy rate (*VR*) by CBG is thusly expressed in the following manner:

$$VR = \# \text{ Vacant residences} / (\# \text{ Vacant residences} + \# \text{ Occupied stable residences} + \# \text{ Occupied troubled residences})$$

Based on the skewness of the distribution, a log transformation of *VR* was conducted for analysis.

Crime

Chicago incident crime data was acquired through the City's public-use Chicago Data Portal (City of Chicago, 2023a) for the period 2018 – 2021. The data are indicative of reported crimes for which an incident report was written and are geocoded to the block level, timestamped, and current to the most recent seven days. It should be noted that the incident crime data encompassed founded crimes (i.e., based on available information, it is more than likely that a crime occurred) for which reports were generated, and were not a reflection of whether an individual was arrested or convicted of a crime. Using classification attributes, including Uniform Crime Reporting codes, crimes were categorized into violent and property index crimes. These categories were devised by the Federal Bureau of Investigation based on their level of seriousness and frequency of occurrence (Chicago Police Department, 2022). Violent index crimes include aggravated assault, aggravated battery, criminal sexual assault, homicide, and robbery; and property index crimes include arson, burglary, motor vehicle theft, and theft. Human trafficking also qualifies as a violent index crime. However, to date, this classification accounts for less than 0.1% of all violent index crimes (Chicago Police Department, 2022), and was not used in the current study. Descriptions of index crimes are presented in Appendix C.

For analyses, incident crime was converted to rates per 1,000, standardized to MMRP CBG population size using 2017 – 2021 ACS estimates for ease of interpretation. As incident crime data tend to be positively skewed, natural logarithmic transformations were performed on violent and property crime rate outcomes.

Frequencies of yearly crime incidents in MMRP CBGs may be seen in Table 3. Overall, there were 32,356 incident crimes during the study period, of which 38% were violent crimes. The highest frequency for both violent and property crimes occurred in 2018 (3,258 and 5,845, respectively). Overall, aggravated battery was the most common violent crime and theft was the most common property crime, accounting for 39.2% of all violent crimes, and 65.3% of all property crimes, respectively. Generally, yearly trends of index crimes stayed consistent. However, inconsistencies were particularly salient beginning in 2020 when COVID-19 and a period of civil unrest created novel patterns in crime occurrence. From 2019 to 2020 – 2021, incident spikes in violent crimes (aggravated assault, aggravated battery, and homicide) were apparent in MMRP CBGs. Conversely, there were dips in frequency in most property crimes (except for motor vehicle thefts) during this period.

Table 3. Index crime incidents, MMRP Chicago census block groups, 2018-2021

Crime	2018 %(n)	2019 %(n)	2020 %(n)	2021 %(n)	2018-21 %(n)
Violent ^a	100(3258)	100(3008)	100(3165)	100(3025)	100(12456)
Aggravated assault	23.4(763)	22.1(665)	24.8(784)	27.9(845)	24.5(3057)
Aggravated battery	36.8(1200)	40.7(1224)	41.2(1304)	38.2(1155)	39.2(4883)
Criminal sexual assault	4.6(150)	5.1(153)	2.9(92)	4.5(135)	4.3(530)
Homicide	2.6(85)	2.5(75)	3.8(121)	4.2(127)	3.3(408)
Robbery	32.5(1060)	29.6(891)	27.3(864)	25.2(763)	28.7(3578)
Property	100(5845)	100(5374)	100(4629)	100(4061)	100(19909)
Arson	0.8(49)	0.8(41)	1.7(81)	1.5(61)	1.2(232)
Burglary	16.3(955)	16.5(889)	16.4(761)	13.8(559)	15.9(3164)
Motor vehicle theft	14.7(857)	15.0(806)	20.8(965)	21.8(887)	17.7(3515)
Theft	68.2(3984)	67.7(3638)	61.0(2822)	62.9(2554)	65.3(12998)

a. Human trafficking also qualifies as a violent index crime, but accounts for < 0.1% of

all violent index crimes based on 2021 Chicago Police Department estimates.

Covariates

Vacant lots accounted for a substantial proportion of residential statuses in the MMRP (about 21% in quarter 4, 2021). The literature concerning crime and vacant lots suggests they are strongly associated with increased crime in neighborhoods (Bogar & Beyer, 2015; Sadatsafavi et al., 2022; Shepley et al., 2019), and therefore should be included in crime prediction models as a land use covariate. Vacant lots (*VL*) were expressed as a proportion of vacant lot count standardized to CBG land area in km², as data concerning the quantity of land area occupied by vacant lots in the MMRP were not available. It should be noted that it is unknown whether vacant lots in the MMRP status data pre-date the program, or are a result of the program following demolition, which as the literature suggests is protective against crime outcomes (e.g., Larson et al., 2019). Based on quarterly summary reports from NHS, the belief is that the number of pre-existing vacant lots in the data far exceeds the number of demolitions in the MMRP. Therefore, vacant lots were approached as a covariate rather than a component in the calculation of the residential vacancy rate. Based on the skewness of the distribution, a log transformation of *VL* was conducted for analyses.

Additionally, consideration was given to the inclusion of geographic demographic covariates (i.e., attributes found in Table 2). However, regression models did not include these variables for several reasons. First, this study estimated panel regression models that drop any parameters associated with time-invariance. The ACS provides 5-year estimates for demographics at the CBG-level. Thus, in this study, which encompasses the years 2018 – 2021, it would be feasible to include four years of the ACS 5-year estimates (i.e., 2014 – 2018, 2015 – 2019, 2016 – 2020, and 2017 – 2021) so demographic time

variance would be introduced, and used to adjust the relationship between *VR* and crime (for instance, as seen in Chen & Rafail, 2020). However, it is unknown how the inclusion of time points beyond this study's period could affect *VR* parameter estimates.

Additionally, the inclusion of demographic covariates in prediction modeling may not yield substantial explained variation in crime rates across CBGs over time. The block areas in this study were purposefully targeted by the Chicago Department of Housing based on similar profiles of economic distress and disadvantage. Therefore, there is some degree of assurance of demographic homogeneity (particularly as it pertains to disadvantage) across MMRP CBGs. Finally, as discussed in detail below, the analysis for this study included fixed effects at the place level (i.e., CBGs). In a panel model, these effects will account for time-invariant factors or factors that are slow to change over time, which likely applies to the demographic variables found in Table 2.

Procedure

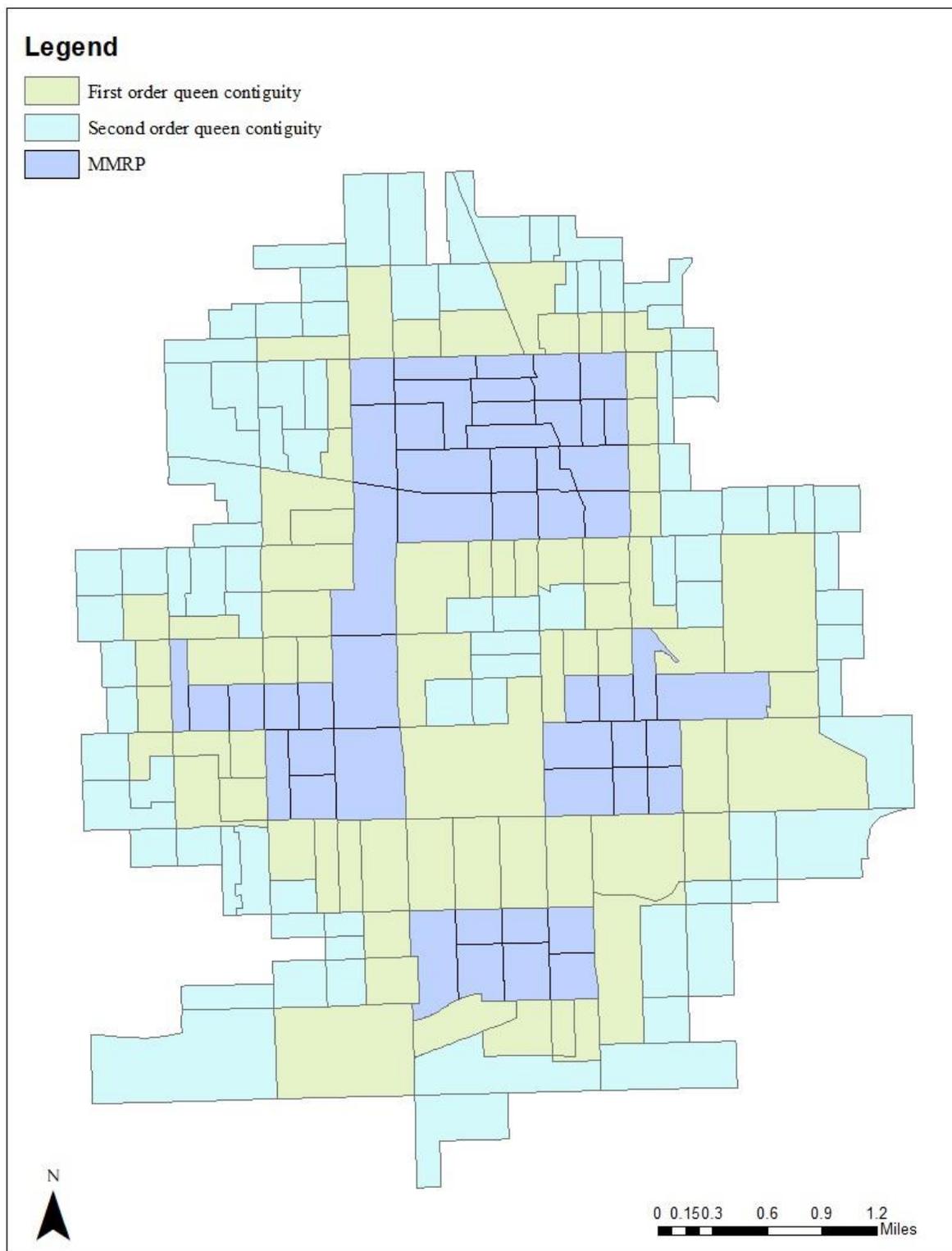
Raw MMRP quarterly property data files from quarter 1, 2018 through quarter 4, 2021 were received in 2022 from NHS. Each of the eleven target areas had a unique quarterly file associated with it, resulting in 163 files (South Shore joined MMRP in quarter 2, 2021, and therefore only had three files associated with it). The data files were ultimately cleaned and collated using R 4.0.3 (R Core Team, 2022) to create a single longitudinal panel data set of $T = 16$ quarters consisting of properties (rows) and housing statuses (columns). The addresses were then geocoded and mapped using ArcMap 10.8.2 (Environmental Systems Research Institute, Inc. [ESRI], 2022). Following this initial data cleaning phase, the process that followed was iterative, consisting of multiple correspondences with a NHS data manager to edit addresses, remove duplicate

properties, remove addresses outside of the MMRP catchment area, and address other data-oriented concerns. The final data set consisted of 33,256 properties.

With complete MMRP property and crime data, the next step in this study was to aggregate the data such that CBGs were the unit of analysis (i.e., the rows in the final data set). The property and crime data sets were spatially joined to a layer of Chicago CBGs using ArcMap 10.8.2 (ESRI, 2022). Across time (i.e., the columns of the final data set), the following attributes were measured quarterly, 2018 – 2021: Count/rate of violent index crime, count/rate of property index crimes, count of vacant residential properties, count of occupied stable properties, count of occupied troubles residencies, *VR*, and *VL*. The finalization of this data set enabled an exploratory analysis of the connection between crime and residential vacancy over time, as well as the regression modeling to determine if the program affected crime in CBGs containing MMRP properties. Finally, crime data points were also joined to CBGs adjacent to MMRP CBGs to estimate a potential diffusion of benefits of the program (i.e., crime reduction strategies in MMRP areas reduce crime in nearby spaces), a displacement of crime (i.e., crime reductions strategies in MMRP areas displaces crimes to nearby spaces), or neither. Note that for the diffusion of benefits or displacement of crime to take place, the MMRP would have to reduce crime in its immediate CBGs. Queen contiguity was used to locate these contiguous CBGs. Using this buffering technique, “adjacent” CBGs are those that share either a common edge or vertex with MMRP CBGs, and may be multi-ordered. That is, first-order contiguity refers to “neighbors” directly touching spaces of intervention (i.e., MMRP CBGs), and second-ordered contiguity refers to spaces that are one spatial unit removed from touching spaces of intervention. Overall, there were $N = 201$ CBGs that

were identified as first-order contiguous, and $N = 258$ CBGs that were identified as second-order contiguous. A visual example of first- and second-order queen contiguity in the Englewood MMRP target area may be seen in Figure 5.

Figure 5. MMRP census block groups on the west side of Chicago, and first- and second-order contiguous census block groups, 2018-2021



Analysis

In the sections that follow, the analytic strategy used in the evaluation of the public safety impact of the MMRP is presented. Where appropriate, hypotheses (i.e., *H1*, *H2*, and *H3*) that correspond to a given analytic process are noted.

Exploratory Data Analysis

To contextualize this study, several exploratory strategies using visualizations were implemented to understand the relationship between residential vacancy and crime in MMRP areas. First, quarterly time series charts examining property and violent crime, and vacancy rate in MMRP areas were developed (*H1*). Next, choropleth maps of rates per 1,000 population for violent and property crime in MMRP were constructed using ArcMap 10.8.2 (ESRI, 2022). Finally, quarterly time series charts highlighting trends of property and violent crime rates for MMRP CBGs, and first- and second-order contiguous CBGs were produced (*H3*).

Panel Model Specification

Panel regression models were utilized in the estimation of the effect of the residential vacancy on violent and property crime rates, respectively, in MMRP CBGs (*H2*). The complete panel data set consisted of $N = 148$ MMRP CBGs, and $T = 16$ quarters. Once in this “wide” data format, the data were transformed into “long format,” with each row representing a given CBG and a given time point, resulting in $N = 2,368$ observations. For analysis, the panel was unbalanced, meaning for every CBG there was not a complete set of explanatory variables with which to estimate crime rates. This was due to several CBGs which had an “undefined” value for vacancy rate (442 out of 2,368 possible calculated vacancy rates) for one or more quarters (i.e., for a given quarter, the

vacancy rate had a denominator of 0, meaning it had no residential properties in that space). It should be noted that for all model specifications that follow, variables are natural logarithmically transformed. CBGs with a missing vacancy rate in a given quarter were dropped from analysis. All models were estimated using the *plm* package in R (Croissant & Millo, 2008).

Several panel regression models of varying specifications were fit. For each of the specifications that follow, violent and property crime rates were separately predicted. As a reference point, pooled ordinary least squares (OLS) models were estimated, which consisted of stacking each of the 16 quarterly cross-sections. For $i = 1, \dots, N$ CBGs observed at quarterly time points $t = 1, \dots, T$, the model for vacancy rate (VR) and vacant lots (VL) predicting crime rate (CR) is specified as follows:

$$CR_{it} = \beta_0 + \beta_1 VR_{it} + \beta_2 VL_{it} + \varepsilon_{it}$$

Under the pooled model, there is an assumption of homoscedasticity and no correlation between a CBG's observations at different time points, or between different CBGs at the same time point. As such, fixed effects for CBGs, u_i , (which accounts for unobserved factors which may vary across CBG but are stable over quarter), and quarters, v_t , (which accounts for unobserved factors which may vary over quarter but are stable across CBG) are introduced in the second model specification:

$$CR_{it} = \beta_1 VR_{it} + \beta_2 VL_{it} + u_i + v_t + \varepsilon_{it}$$

During the study period, there were large increases in the number of properties that joined the MMRP, which could potentially create biased estimates for the two specifications described above. Between quarter 2, 2020, and quarter 3, 2020, a large influx of properties from Englewood, New City, and West Pullman increased the total

number of MMRP residential properties by 50.4%. To account for this jump in property frequency, the second model specification is extended by accounting for two distinct study periods using dummy variable SP , where $SP = 0$ refers to quarter 1, 2018 – quarter 2, 2020 (before new property additions, encompassing 10 quarters) and $SP = 1$ refers to quarter 3, 2020 – quarter 4, 2021 (following new property additions, encompassing 6 quarters). This may be achieved in two mathematically equivalent ways. The first is by including an interaction term with SP and VR :

$$CR_{it} = \beta_1 VR_{it} + \beta_2 VL_{it} + \beta_3 VR_{it} * SP + u_i + v_t + \varepsilon_{it}$$

Under this interaction specification, β_1 would be the effect of vacancy rate on crime rate during the first study period, and β_3 would be the difference of the effect of vacancy rate on crime rate between the first and second study periods. Therefore, the effect of vacancy rate on crime rate in the second study period would equate to $\beta_1 + \beta_3$. Alternatively, we may adjust for study period using a linear spline specification:

$$CR_{it} = \beta_1 VL_{it} + \beta_2 VR_{it}(SP = 0) + \beta_3 VR_{it}(SP = 1) + u_i + v_t + \varepsilon_{it}$$

Under this spline specification, β_2 would be the effect of the vacancy rate on the crime rate during the first study period, and β_3 would be the effect of vacancy rate on the crime rate during the second study period. Though mathematically equivalent, the two specifications accounting for the study period were investigated because the statistical significance of an interaction would not necessarily mean the effect of vacancy rate on crime rate in the second study period was statistically significant. However, in the spline specification, this information would be elucidated.

The aforementioned panel model specifications are aspatial in nature. That is, they do not account for spatial dependence that may exist between adjacent CBGs. As

such, consideration was given to estimating models that could account for this.

Additionally, there would be an added benefit, as a spatial specification could be used to estimate the diffusion of benefits or displacement of crime (*H3*). To achieve this, a fixed effects spatial lag, the average of neighboring CBGs' crime outcomes per quarter, would be added to the aforementioned aspatial models. Then, an interaction term with the spatial lag and *VR* would be added, and this interaction term would signify spatial spillover effects (i.e., diffusion or displacement) associated with the vacancy rate. A similar analytic strategy was proposed by Johnson et al. (2014) and has been utilized by Jay et al. (2018) in their study of demolitions and crime. The use of this methodology in the current study is problematic in two ways. Firstly, as described, the panel used in this evaluation is unbalanced, and spatial panel estimation methodology requires balanced panels. Secondly, from a conceptual perspective, this evaluation consisted of eleven [mostly] discrete, non-contiguous target MMRP regions, with an average of only about 13 CBGs per MMRP target area. Determination of the appropriateness of a spatial model first relies on the significance of a global spatial dependency statistic (e.g., Moran's *I*). Because these metrics are global in nature and the MMRP CBGs are non-contiguous, interpretation of the presence of spatial dependency would be challenging. For example, the global statistic may indicate the presence of spatial dependency, but this finding could be driven by only one of the eleven MMRP target areas. Therefore, use of a spatial dependency correction in a global regression model could produce biased parameter estimates. As a potential solution, global statistics could instead be calculated for *each* MMRP target area. However, due to the aforementioned small sample sizes of CBGs per MMRP target area, the reliability of global spatial dependency statistics would be

questionable. Therefore, for these reasons, only aspatial models were estimated, and diffusion of benefits/displacement of crime was only examined from the aforementioned exploratory perspective.

Results

Exploratory findings from the evaluation of the MMRP suggested that the property crime rate in MMRP CBGs had a downward trajectory during the study period (Figure 6). Comparatively, the violent crime rate remained fairly steady during the study period and displayed more seasonal variation. Violent and property crime rates tended to peak locally during the third quarter of every year (i.e., summer months). Choropleth maps display the geographical variation of quarterly averaged violent crime rates (Figure 7) and property crime rates (Figure 8). During the study period, violent crime rates varied across CBGs ranging from 0.3 to 68.4 per 1,000 population, while property crime rates varied from 1.1 to 75.3 per 1,000 population. For both violent and property crime rates, the lowest rates tended to be in Hermosa CBGs, the northernmost target MMRP area, and the highest rates tended to be in Englewood, a MMRP target area on the south side of the city, and also the area with the highest levels of disadvantage (Table 1). With some exceptions, adjacent CBGs within MMRP target areas tended to exhibit similar rates of violent and property crime rates. In Figure 9, the residential vacancy rate for MMRP CBGs shows a generally downward trend before and after the influx of MMRP properties were added to the program between quarter 2, 2020, and quarter 3, 2020 (because of these property additions the net trend of vacancy rate was near zero). The downward trajectory of the residential vacancy rate is much more consistent with the property crime rate decline compared to the violent crime rate decline.

Figure 6. Violent and property crime rates per 1,000 in MMRP census block groups, 2018 – 2021

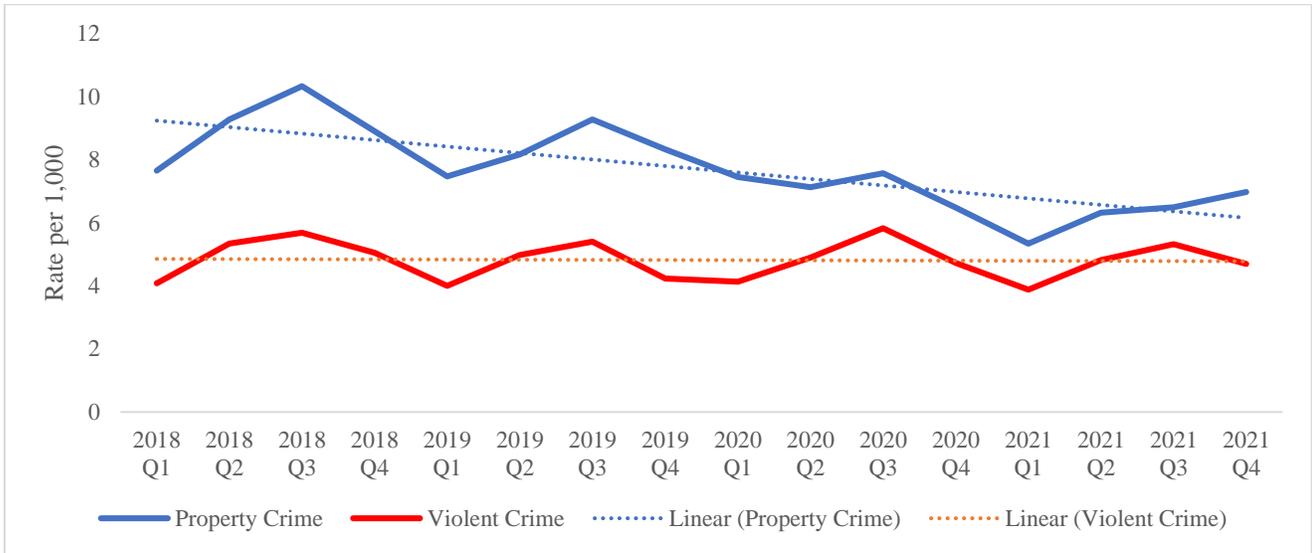


Figure 7. Violent crime rates per 1,000 in MMRP census block groups, 2018 – 2021

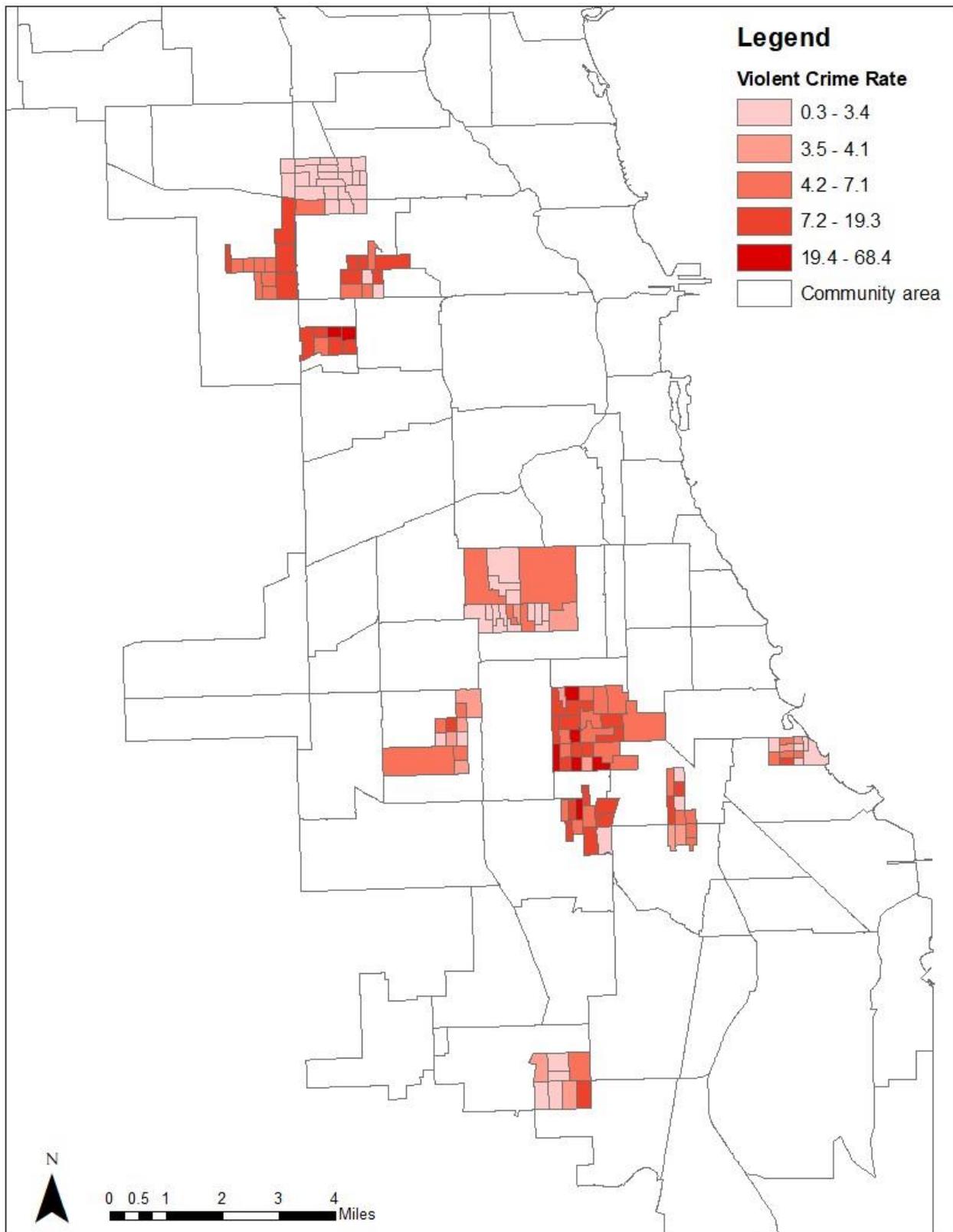


Figure 8. Property crime rates per 1,000 in MMRP census block groups, 2018 – 2021

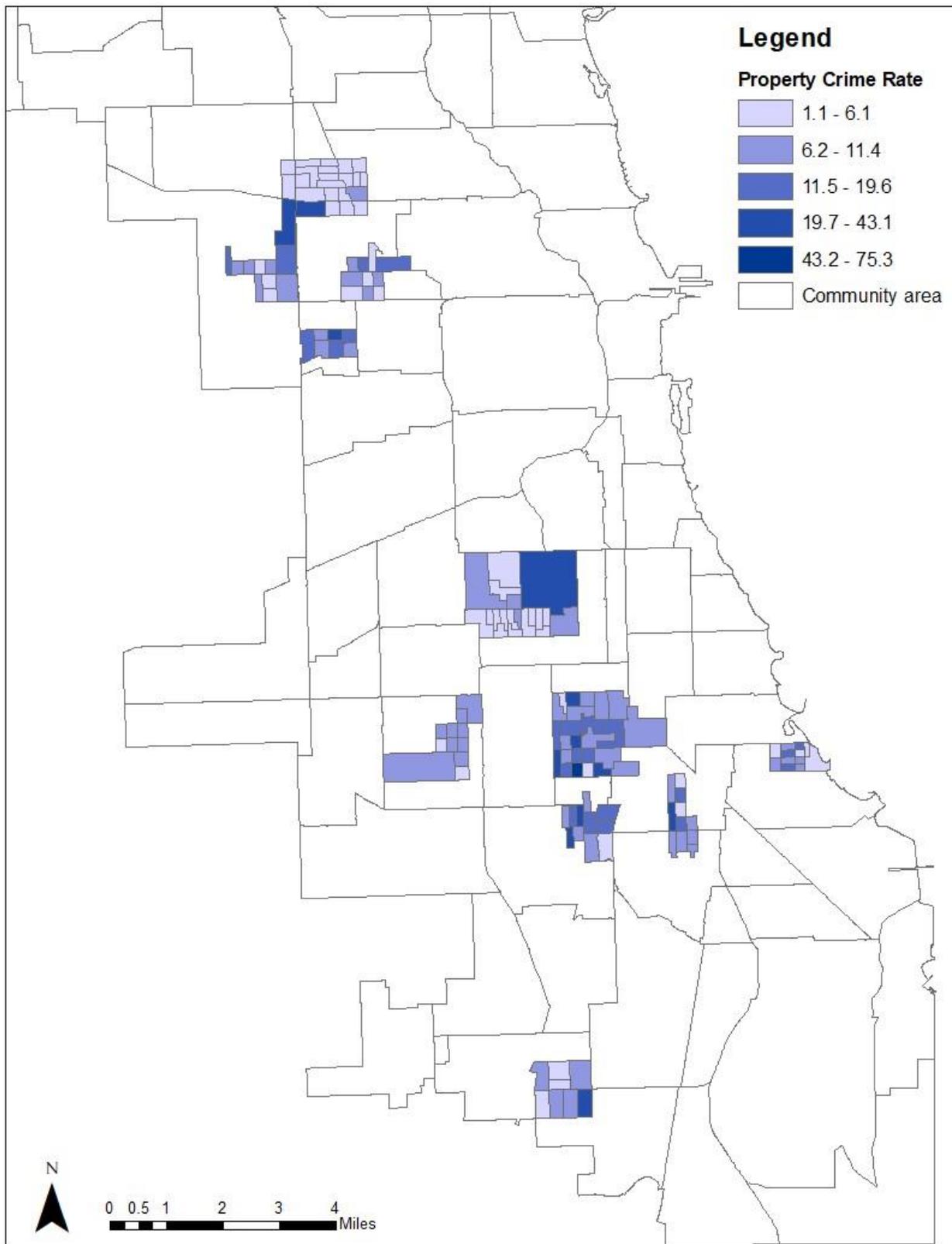


Figure 9. Residential vacancy rate in MMRP census block groups, 2018 – 2021

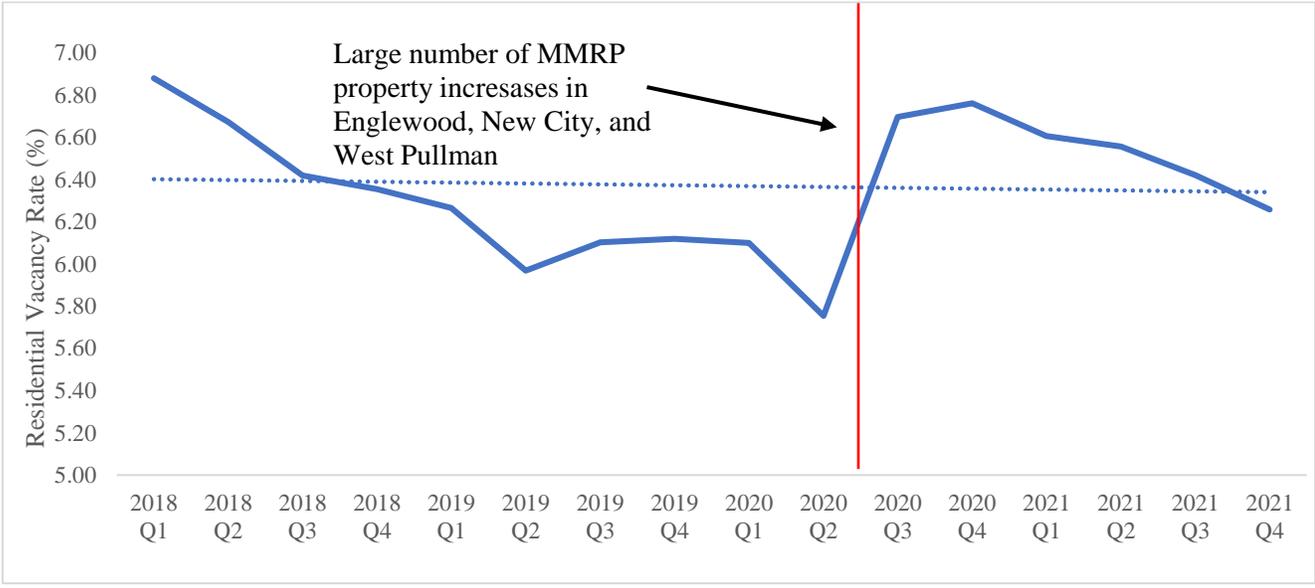


Figure 9 additionally supports the rationale for the inclusion of a categorical study period variable (*SP*) in the aforementioned interaction and spline regression specifications. It is also apparent that when South Shore joined the program in quarter 2, 2021 (increasing overall residential properties by 13.1%), there was minimal fluctuation of residential vacancy rate observed, and thus, there was no necessity for including an additional study period dummy variable. In Figure 10, logarithmic transformations of violent and property rates are plotted against the logarithmic transformation of vacancy rate. For both violent and property crime rates, there appears to be a positive relationship with vacancy rate, suggesting that as residential vacancy in MMRP CBGs increases, crime rates in these spaces also tend to increase. The positive relationship appears to be more pronounced for the violent crime rate than for the property crime rate. A summary of the regression models can be seen in Table 4. In the pooled regression models, increases in vacancy rate were found to be significantly associated with increases in the violent crime rate ($\beta = 0.225$; $p < 0.001$) and property crime rate ($\beta = 0.171$; $p < 0.001$). The inclusion of quarterly and CBG fixed effects did not yield any statistically significant findings. In the interaction model for violent crime rate, there was a significant positive interaction between the study period dummy variable and vacancy rate ($\beta = 0.054$; $p = 0.0362$), indicating that between the first and second study periods, there was a significant positive difference in the association between vacancy rate and violent crime rate. However, findings from the spline regression model indicate that during the second study period, the association between vacancy rate and the violent crime rate was not significant ($\beta = 0.043$; $p = 0.203$). Regarding the property crime rate and the effect of vacancy rate, no significant main effect or interaction was observed. However, in the

spline specification, an increased vacancy rate was found to be associated with a decreased crime rate ($\beta = -0.082$; $p = 0.009$), suggesting that a 10% increase in vacancy rate was associated with a 0.8% decrease in property crime rate.

Figure 10. Log transformations of violent and property crime rates by log transformation of vacancy rate

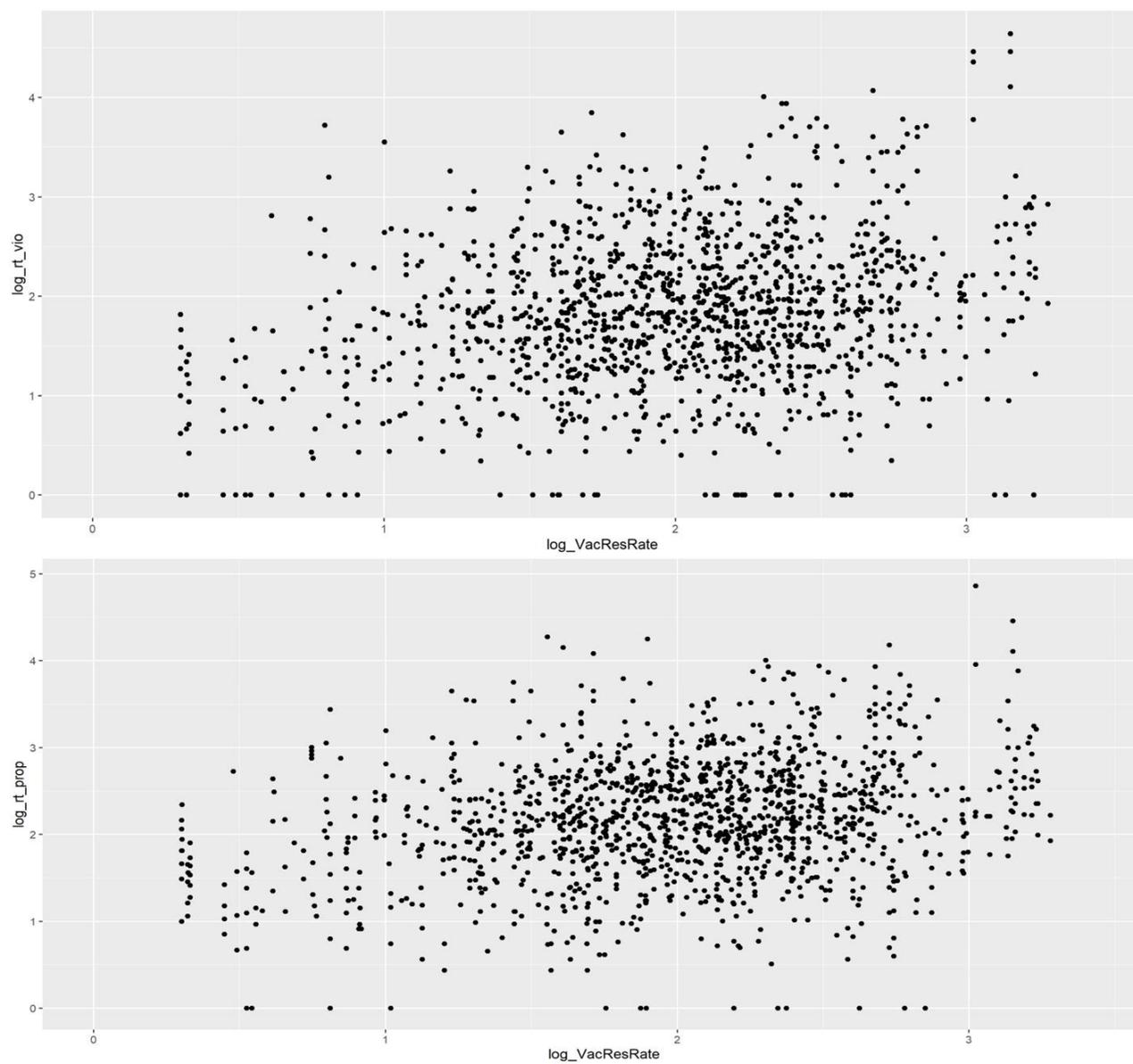


Table 4. Regression model summary

Coefficients ^a	Pooled OLS	Two-way Fixed Effects	Two-way Fixed effects with Interaction	Two-way Fixed effects with Splines
Violent crime rate				
Vacancy rate	0.225***	0.001	-0.011	-
Vacant lot density	0.100***	0.008	0.010	0.010
Vacancy rate*SP	-	-	0.054*	-
Vacancy rate at SP = 0	-	-	-	-0.011
Vacancy rate at SP = 1	-	-	-	0.043
Property crime rate				
Vacancy rate	0.171***	-0.048	-0.038	-
Vacant lot density	0.041***	0.009	0.008	0.008
Vacancy rate*SP	-	-	-0.043	-
Vacancy rate at SP = 0	-	-	-	-0.038
Vacancy rate at SP = 1	-	-	-	-0.082**

Note. OLS = ordinary least squares; SP = study period

a. All variables log transformed.

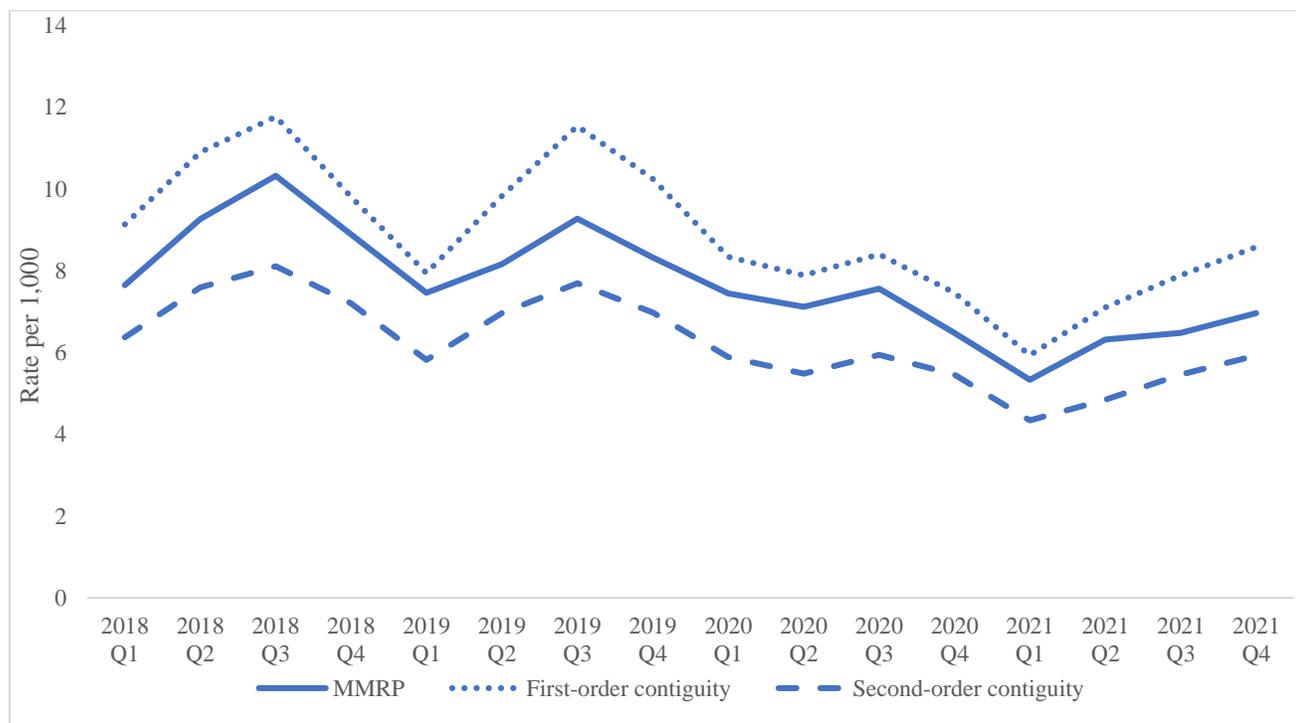
***p < 0.001; **p < 0.01; *p < 0.05.

Figure 11 and Figure 12 display violent and property crime rate trends, respectively, and their crime rates in contiguous CBGs. For both, contiguous rates tended to follow similar patterns and trends compared to MMRP CBGs, and rates in second-order contiguous CBGs were lower than in MMRP areas. For violent crime rates, first-order contiguous CBGs tended to be very close to MMRP violent crime rates, and second-order contiguous CBGs were comparatively lower. For property crime rates, first-order contiguous CBGs had more easily discernable higher rates over time than MMRP areas, though second-order contiguous CBGs more strongly mimicked MMRP areas compared to violent crimes.

Figure 11. Violent crime rates per 1,000 in MMRP and contiguous census block groups, 2018 – 2021



Figure 12. Property crime rates per 1,000 in MMRP and contiguous census block groups, 2018 – 2021



Discussion

Following the housing crisis of the late 2000s, home foreclosures and residential vacancies were abundant in many US cities, particularly concentrated in disadvantaged neighborhoods. There is evidence to suggest that neighborhood spaces characterized by blighted properties and other signs of physical disorder reduce collective efficacy and informal social control, leading to increases in crime (MacDonald 2015; Skogan, 2012). Despite US government efforts to support economic recovery following the housing crisis, interventions were largely not concentrated enough to match spatial patterns of foreclosure and vacancy, and as such, reductions of crime in these areas were not realized (Spader et al., 2016). Recent studies have indicated that governmental housing interventions that are holistic and precisely spatially targeted in areas with supportive infrastructure and investment may lead to significant reductions in neighborhood crime (Kondo et al., 2021; South et al., 2021). In the current study, one such intervention, the Micro Market Recovery Program in Chicago, was evaluated to determine if the reduction of residential vacancy led to decreases in violent and property crimes between 2018 and 2021.

Exploratory analysis indicated that violent and property crime rates and vacancy rate declined in MMRP CBGs between 2018 and 2021, supporting *H1* (Figures 6 and 9, respectively). Additionally, when logarithmically transformed, there was an observed positive relationship between crime rates and vacancy rates (Figure 10), indicating that as vacancy rate increases, crime rates also increase. Adjusting for vacant lot density, pooled regression analysis (Table 4) confirmed these exploratory findings, where it was observed that a 10% increase in residential vacancy rate was associated with a significant 2.25%

and 1.71% increase in violent crime rate and property crime rate, respectively. However, accounting for the heterogeneity of CBGs and study quarters, these findings were no longer significant. Similarly, after adjusting for the study period, interaction and spline models did not indicate a protective effect of vacancy rate against crime rates. In the interaction model, there was a positive significant difference between the effect of vacancy rate on violent crime rate between the first and second study periods, but the spline model indicated that vacancy rate was not significantly associated with violent crime rate during either study period. Based on these regression analyses, *H2* was not supported.

Regarding contiguity, CBGs contiguous to MMRP CBGs followed similar crime patterns, providing evidence in support of *H3*. However, because the effects of the MMRP were largely null in regression analyses, assertions of diffusion of benefits/displacement of crime cannot be made with any degree of certainty, even from a purely exploratory perspective.

The findings from regression analyses of the current study conflict with much of the published literature, which has generally suggested that increasing housing vacancy is associated with increasing crime rates. Studies have indicated that housing vacancy is associated with higher levels of overall crime (Kondo et al., 2016); overall violent and property crimes (Chen & Rafail, 2020); aggravated assaults, including firearm violence (Branas et. al, 2012, Branas et al., 2016; Kondo et al., 2016); homicide (Fox et al., 2021); burglary (Jones & Pridemore, 2016); nuisance crimes (Kondo et al., 2016); and drug crimes (Chen & Rafail, 2020). Though the effect was small, in the current study there was notably a significant *inverse* relationship observed between vacancy rate and

property crime rates during the second study period. The trend of property crimes in MMRP CBGs was decreasing during the study period (Figure 6), which was consistent with city-wide trends; between 2020 and 2021 Chicago had an overall reduction of property crimes by 3.7% (Chicago Police Department, 2022). Despite the decreases in property crime in MMRP CBGs, the findings of an inverse relationship between vacancy rate and property crime rate were novel relative to extant literature. However, in their study of demolitions of abandoned properties in Kansas City, Han and Helm (2023) reported that demolition was not found to be significantly associated with nearby property crimes. Though the authors controlled for several socioeconomic characteristics, they suggest that “lack of effect” could potentially be attributed to the variation of unknown socioeconomic or housing processes (e.g., interventions outside of the focal intervention affected crime rates). In the current study, CBG fixed effects were utilized to account for this potential heterogeneity across space. The dilemma of unknown and unobserved heterogeneity was further compounded by the COVID-19 pandemic and a climate of social unrest, causing erratic crime trends nationwide (Council on Criminal Justice, 2021), and encapsulating about half of the current study’s time period of analysis. Though the inclusion of the study period dummy variable in interaction and spline models to account for the large increase in MMRP properties following quarter 2, 2020 roughly coincided with these social phenomena, it is still challenging to disentangle the complexities of their effects on crime rates.

Beyond fixed effects, several exploratory model specifications were examined beyond those reported herein. Covariates were introduced to all models, specifically population density and neighborhood disadvantage. Neighborhood disadvantage is a

composite score consisting of four attributes: percentage of the civilian population age 16 years or over unemployed, percentage of families with income below the poverty level, percentage of the population age 25 years or over with less than high school education, and percentage of the population in renter-occupied housing. These four variables were standardized and summed to form a composite for each MMRP CBG. The disadvantage index is a metric formulation derived through principal component analysis and is a reliable measure of concentrated socioeconomic disadvantage in urban environments (Hughey et al., 2016). To introduce time variation for population and neighborhood disadvantage, American Community Survey 5-year estimates from two time points were used, 2015 – 2019 and 2017 – 2021. The regression adjustment with these attributes did not remarkably change the magnitude, directionality, or statistical significance of any parameter estimates. An additional specification was examined by including only time fixed effects. Under this specification, the magnitude of the association between vacancy rate and crime rates increased and was positive and statistically significant, analogous to the findings reported from the pooled ordinary least squares model (Table 4). However, excluding CBG fixed effects would likely be methodologically precarious; though MMRP areas were selected, in part, due to commonalities of foreclosure concentration and other characteristics, some degree of heterogeneity across the MMRP target areas was observed (Table 2). As such, discounting this place-based heterogeneity was not a consideration for the primary analysis in this study. Finally, spatial panel models were also explored to adjust regression models for potential spatial dependency and estimate diffusion of benefits/displacement of crime. Unfortunately, due to the missingness of data creating an unbalanced panel, estimation of these models was not possible.

Several factors, including missingness, could have contributed to the largely null findings in the current study. Regarding missingness, the MMRP is complex, including numerous community organizations and partners. The decentralized nature of the program's infrastructure could perhaps contribute to issues concerning data vigilance. As of early 2023, Neighborhood Housing Services is in the process of examining alternate data collection software, which hopefully will remedy data concerns, particularly as they pertain to evaluation, as the program moves forward. Ongoing programmatic development of operations, generally speaking, could perhaps create a "lag of effect," whereby benefits of the MMRP as it pertains to public safety outcomes may not be detectable for some time. Further, the MMRP is holistic, providing a wide range of services for homeowners (Figure 3), with the overarching goal of economically stabilizing neighborhoods. Targeted home remediation only accounted for 7% of all MMRP services offered during the study period. In similar geographically concentrated housing programs (e.g., Kondo et al., 2021; South et al., 2021), home remediation accounts for a larger proportion of programmatic services. It is feasible that the positive crime reduction effects seen in these interventions were a byproduct of the relatively instantaneous change of physical landscape, compared to the more slow-moving, stabilization-oriented programming in the MMRP.

Limitations

The primary limitation in the evaluation of the MMRP was the lack of data concerning intervention dosage. That is, data concerning specific MMRP services received by properties were not available for this analysis. However, there was assuredness from Neighborhood Housing Services that residents in MMRP target areas

were largely aware of the program. This was achieved through community organization members in target areas being embedded in the MMRP target area, presumably facilitating a climate of trust, and reliance on word-of-mouth relaying of the MMRP in these concentrated spaces. This visibility is further enhanced by regular MMRP-sponsored social events in neighborhoods (e.g., block parties, barbecues) and routine informational flyer distribution. Still, dosage data, particularly for residences that underwent remediation to the outside of their properties, could have provided added precision to the current study. Another limitation of the current study involves inferences involving causality. Though panel models allow for the controlling of differences across time and space, the lack of a control group in the current study hindered the ability to make causal inferences. The inability to utilize control group CBGs was an artifact of the MMRP design. As previously noted, the MMRP is a dynamic intervention, with properties/CBGs being added in some time points, and removed in others. Additionally, the program has no specific start or end time. As noted earlier, the data analyzed in the current study reflected the second wave of the study, and it was not known what properties may have been involved with the program's first wave, which lasted between 2014 and 2017. These programmatic characteristics would have made the use of matched or synthetic controls, or methods such as difference-in-differences analysis challenging, if not impossible. Therefore, a true "pre-post" measurement of the programmatic effects of the MMRP were muddled. Finally, pertaining to the regression analyses specifically, the quantity of land area taken up by vacant lots in the MMRP catchment space was unknown. As such, count data was utilized, and standardized to CBG land area. Knowledge of the area absorbed by MMRP land vacancy could have added to the

precision of regression estimates.

Future Directions

There exist several avenues of future inquiry pertaining to the MMRP and public safety outcomes to expand upon the current work. Though a relatively small unit of geographical space, by modern-day criminological standards of the neighborhood, CBGs still represent fairly large areas, particularly as we have understood how crime concentrates around “places” (e.g., individual land parcels) rather than “areas” (e.g., CBGs; Weisburd, 2015). Therefore, the current study could be refined to address crime concentration by joining crime events to smaller units of geography (e.g., blocks, street segments, block-faces). Acknowledgment of crime in these smaller geographies would have the added benefit of helping destigmatize entire neighborhoods. For instance, as we see in choropleth maps for MMRP CBGs (Figures 8 and 9), there are a small number of CBGs in MMRP target areas with crime rates that far exceed adjacent areas. Despite overall crime rates being driven by small pockets of space in some instances, many entire Chicago neighborhoods have city-wide negative reputations, and are labeled as “dangerous.” From a neighborhood researcher's perspective, we can help remedy this stigmatization by adjusting the methodology we employ in our analyses. As a corollary, future analyses could focus on specific target MMRP areas. As seen in Table 2, there does exist some degree of spatial heterogeneity across MMRP target areas, and the use of smaller geographies would increase sample size adequately enough to detect the effects of the program in individual target areas. Additionally, future evaluations of the MMRP could examine various factors which could moderate or mediate the relationship between housing vacancy and crime rates, particular those pertaining to elements of informal

social control and social cohesion in MMRP spaces. Additionally, the current study aggregated violent and property index crimes in analysis, and future work in this area could investigate alternative crime classifications (e.g., drug crimes, nuisance crimes) which could potentially be more sensitive to the MMRP intervention. Finally, beyond crime outcomes, a more robust understanding of the effects of the program would be beneficial. For instance, examining the effects of the MMRP on residential stability, quality of life, and participant satisfaction would help inform program effectiveness and future directions. And, given the City's continuing investment in the program, the potential for future rigorous longitudinal evaluation is within reach.

Conclusion

With increases in recent government funding, the MMRP will be expanding from eleven to eighteen target areas in 2023 – 2024. Though the public safety implications based on this evaluation were not expected based on extant literature, the positive implications in helping distressed homeowners to economically stabilize through housing intervention cannot be disputed, as was the primary intent of the program. Based on a personal communication from Neighborhood Housing Services, as of quarter 1, 2021, the second wave of the MMRP has resulted in 179,895 interventions provided, including 781 reoccupied buildings, 1,535 reoccupied housing units, 338 home improvements, and 557 homeowners advised (A. Reyes, personal communication, June 1, 2021). Over time, it is the hope that these stabilization efforts will have a cumulative effect of increasing informal social control and reducing harmful aggregate processes such as neighborhood crime. From an operational perspective, it will be essential that the MMRP continue to develop, particularly in their vigilance and methodology of data collection and

management. Though the prospect of evaluation may have not been at the forefront during the inception of the program, moving forward, operational growth and ongoing City investment and commitment to evaluation will undoubtedly facilitate the ease and precision of future public safety evaluations for the MMRP.

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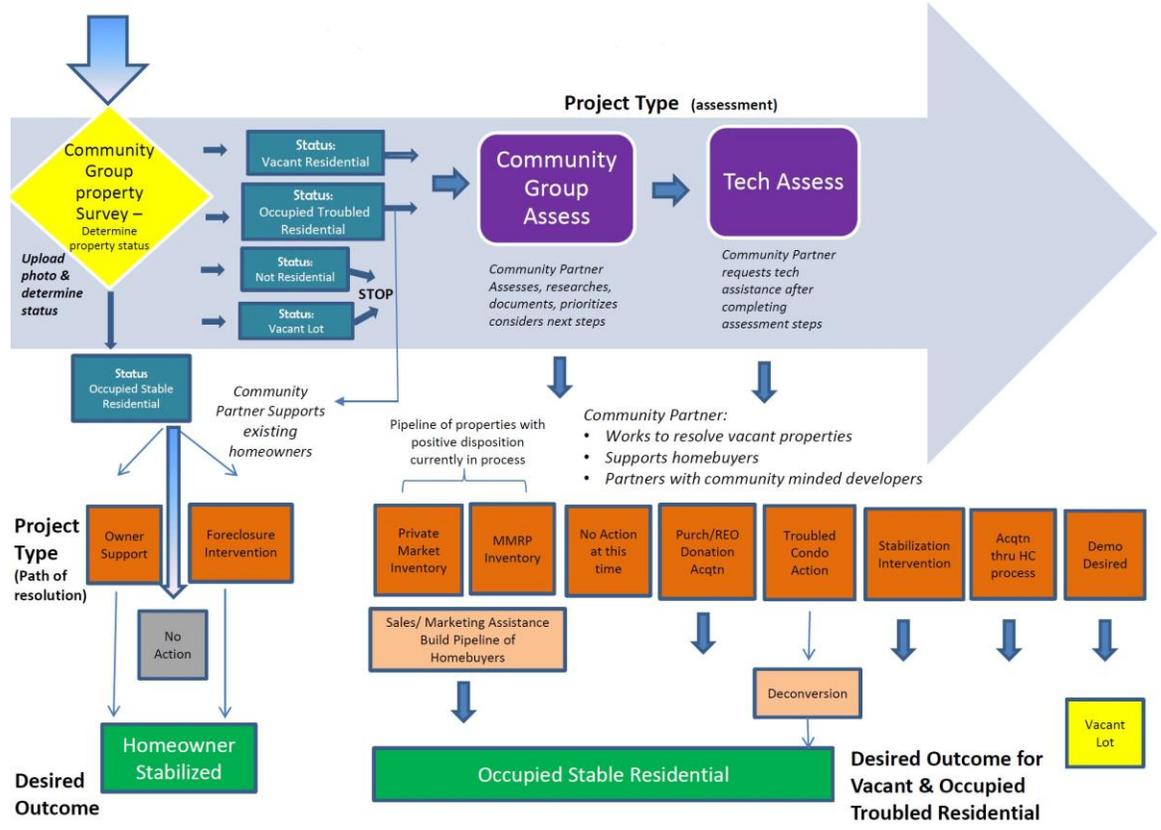
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Appendix A: MMRP Property Statuses and Project Types

Status	Status Definition	Project type	Project type definition
<i>Type of Property</i>		<i>current course of action</i>	
Vacant Residential	Vacant residential or mixed use property that includes vacant residential units	Comm Group Assess	The community group has uploaded a photo, assigned a property status, & is assessing, researching and prioritizing the property and documenting it in the Developer Central database. The goal is to determine and document next steps towards a path of resolution.
		Technical Assess	The community group is requesting technical assessment and feasibility analysis after completing all the Comm Group Assess steps, documenting them in the Developer Central database, prioritizing the property, and considering next steps.
		MMRP Inventory	The property is controlled (being redeveloped, sold/rented, and reoccupied) by an MMRP partner and positive disposition is in process. Part of the pipeline of properties the community group is predicting will be reoccupied soon.
		Private Market Inventory	The property is controlled (being redeveloped, sold/rented, and reoccupied) by a private owner and positive disposition is in process. Part of the pipeline of properties the community group is predicting will be reoccupied soon.
		Acquisition thru HC process	The property on track for acquisition through court proceedings
		Acquisition - Purch, REO or Donation	The property is in the process of Purchase, REO, or donation acquisition
		Stabilization Intervention	The community group and MMRP partners are working to stabilize and occupy the building via municipal action - Housing Court, receivership, TBI, etc. Stabilization intervention project type should be used when municipal intervention other than acquisition is being pursued.
		Troubled Condo Assist	The property is a troubled condo and CIC is providing assistance through the troubled condo program
		Demo Desired	The community group and partners agree that demolition is the desired outcome for this property
		No Action at this time	No action is currently being taken because this property is not the current priority or because action is not warranted at this time
Occupied Stable Residential	Occupied Residential	Foreclosure Intervention	The community group is working with the homeowner of the occupied building to prevent foreclosure
		Homeowner Stabilized	The community group has worked with the homeowner of the occupied building to provide homeowner support or foreclosure intervention, resulting in a stable homeowner
Vacant Lot	Property that is a vacant lot	N/A	N/A
Not Residential	Property that is not residential (commercial, industrial, place of worship, etc.)	N/A	N/A

Appendix B: MMRP Residential Property Process Flowchart



Appendix C: Uniform Crime Reporting Violent and Property Index Crimes

Crime	Description
<i>Violent Crimes^a</i>	
Aggravated battery/assault	An unlawful attack by one person upon another for the purpose of inflicting severe or aggravated bodily injury. This type of assault is usually accompanied by the use of a weapon or by means likely to produce death or great bodily harm, including both aggravated assault and aggravated battery.
Criminal sexual assault	Penetration of the vagina or anus with any body part or object or oral penetration by a sex organ of another person, without the consent of the victim, including attempted offenses.
Homicide	Murder and non-negligent manslaughter: the willful (non-negligent) killing of one human being by another. Death caused by negligence, attempts to kill, assaults to kill, suicides, and accidental deaths, including first- and second-degree murder and excluding justifiable homicide and involuntary manslaughter.
Robbery	The taking or attempting to take anything of value from the care, custody, or control of a person or persons by force or threat of force or violence and/or by putting the victim in fear, including attempted offenses.
<i>Property Crimes</i>	
Arson	Any willful or malicious burning or attempt to burn, with or without intent to defraud, a dwelling house, public building, motor vehicle, aircraft, or personal property of another, including attempted offenses.
Burglary	The unlawful taking, carrying, leading, or riding away of property from the possession or constructive possession of another.
Motor vehicle theft	The theft or attempted theft of a motor vehicle.
Theft	The unlawful taking or attempted taking of property or articles without the use of force, violence, or fraud, including all thefts, regardless of stolen property values, and attempted thefts.

a. Human trafficking also qualifies as a violent index crime, but accounts for < 0.1% of all violent index crimes based on 2021 Chicago Police Department estimates.

Appendix D: MMRP Property Status Frequencies, 2018 – 2021

Property Status	2018 Q1	2018 Q2	2018 Q3	2018 Q4	2019 Q1	2019 Q2	2019 Q3	2019 Q4	2020 Q1	2020 Q2 ^a	2020 Q3	2020 Q4	2021 Q1 ^b	2021 Q2	2021 Q3	2021 Q4
Occupied Stable Residential	13685	14430	14916	14846	14941	14975	14925	14908	14901	14982	20302	19297	19387	19735	19836	19872
Occupied Troubled Residential	135	187	216	215	214	213	217	218	233	201	265	285	277	291	305	292
Vacant Lot	1810	2094	2105	2115	1685	2147	1839	2180	2184	2193	5483	5696	2947	5725	5730	5743
Vacant Residential Total w/ Known Status (vacant lots excluded)	1021	1045	1038	1022	1013	964	984	986	983	927	1476	1420	1391	1405	1382	1346
Vacancy Rate (%; vacant lots excluded)	6.88	6.67	6.42	6.35	6.27	5.97	6.10	6.12	6.10	5.75	6.70	6.76	6.61	6.56	6.42	6.26

a. Large increases in properties in Englewood, New City, and West Pullman between 2020 Q2 and 2020 Q3.

b. South Shore joins program between 2021 Q1 and 2021 Q2.